Abstracts of the 19th Annual NATA Symposium on Patient Blood Management, Haemostasis and Thrombosis

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Abstracts of the 19th Annual NATA Symposium
on Patient Blood Management, Haemostasis and Thrombosis

Speaker Abstracts

Preoperative Anaemia – Is Iron the Best Answer?

S1

What is the best way to classify anaemia?

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Anaemia is identified on the basis of a simple blood count, when the haemoglobin concentration is below the “normal” range for age and sex. However, anaemia is not a diagnosis of itself and is traditionally classified on the basis of underlying cause. The causes of anaemia, both congenital and acquired, will be presented to provide a theoretical background to investigating a patient found to have a low haemoglobin. However, this “classical” approach to diagnosis of anaemia can be unrealistic outside the setting of a formal haematology clinic. I will therefore provide a more pragmatic approach to investigating anaemia, with emphasis on preoperative workup.
S2

Management of preoperative iron deficiency – current evidence

A. Klein

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This talk will discuss anaemia in the context of preoperative optimisation before surgery and discuss the scale of the problem. Up to 40% of patients presenting for surgery may be anaemic, and this is increasingly common as patients are getting older and sicker. We are facing an epidemic of anaemia, but, in many centres, patients are not investigated nor treated. There is marked regional variation in both anaemia and transfusion, with a consistently high incidence of both. Perioperative anaemia, blood loss and allogeneic blood transfusion are associated with increased postoperative morbidity and mortality, and prolonged hospital stay. A multidisciplinary, multimodal, individualised strategy, collectively termed ‘patient blood management’, may reduce or eliminate allogeneic blood transfusion and improve outcomes. This approach has three objectives: the detection and treatment of perioperative anaemia; the reduction of perioperative bleeding and coagulopathy; and harnessing and optimising the physiological tolerance of anaemia.

There are numerous causes of anaemia in surgical patients, the most common is iron deficiency or iron restriction. Preoperative anaemia is associated with increased mortality and worse outcomes, including increased transfusion and complications. Anaemia should be detected before surgery that is likely to cause significant blood loss, preferably at least 30 days before scheduled operations. The cause of preoperative anaemia should be identified and treated if possible. Bleeding from the GI tract and the genito-urinary system should be considered and investigated. Major surgery may have to be rescheduled, whereas minor procedures, without blood loss, can proceed in parallel with the evaluation of anaemia. Different treatment options will be discussed and compared in both elective and urgent surgery. Optimising patients with anaemia before surgery may reduce allogeneic transfusion and improve outcomes as part of a comprehensive blood management programme, and this forms a vital part of perioperative patient care.

REFERENCES

S3

Comparative safety of intravenous iron formulations

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Oral iron has been used to treat iron deficiency since Syndenham first used iron filings in cold wine to treat chlorosis. Oral iron causes significant gastrointestinal perturbation in more than 70% of those to whom it is prescribed. New data suggest oral iron increases hepcidin decreasing subsequent absorption for 48-72 hours. The earliest intravenous formulations were associated with severe infusion reactions due to the release of large amounts of labile free iron. Iron sucrose and ferric gluconate are safe and effective but larger amounts of labile free iron mitigate large replacement doses in a single setting. Newer formulations which bind elemental iron more tightly slowing release of labile free iron are able to be administered as 1000 mg in 15-60 minutes. Misconceptions of the nature and incidence of serious adverse events are due to earlier formulations of high molecular weight iron dextran, which are no longer available. Inappropriate intervention for minor infusion reactions with antihistamines and vasopressors can convert a self-limited reaction which resolves without treatment into a haemodynamically significant serious adverse event. Prospective, observational and intra-institutional retrospective studies support equivalent safety and efficacy among the available intravenous iron formulations. A high-quality meta-analysis comprising more than 10,000 patients who received intravenous iron compared to placebo, oral iron and intramuscular iron concluded that while minor infusion reactions are observed there was no increment in serious adverse events compared to any of the comparators. Intravenous iron is the preferred route of administration after oral iron intolerance and has been shown to be safe in pregnancy, bariatric surgery, inflammatory bowel disease, in the perioperative period and a host of other conditions associated with iron lack. Complete replacement dosing of intravenous iron in one to two short sessions is underutilised.

REFERENCES
Treatment of Anaemia

S4

Anaemia in the elderly – something special?

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Anaemia affects up to forty percent of the elderly population, representing a public health problem that is predicted to further increase in coming years because of the demographic drive. Being typically mild, it is quite often falsely perceived as a minor problem, particularly in the elderly with multimorbidity, resulting in under-investigation of the causes, as well as under-treatment. Nonetheless, a bulk of evidence indicates that anaemia in the elderly is independently associated with disability and other major negative outcomes, including an increased mortality risk. Anaemia in the elderly is generally multifactorial, but initial studies suggested that aetiology remain unexplained in nearly one-third of cases. This high proportion is consistently declining due to recent advances highlighting the role of several conditions including clonal haematopoiesis, “inflammaging”, correctable androgen deficiency in men, and under-recognised iron deficiency. Starting from a real-world case vignette illustrating a paradigmatic example of anaemia in an elderly patient with multimorbidity, I will review current knowledge on definition, epidemiology, clinical, and pathophysiological aspects of anaemia in the elderly, giving some practical insights on how to manage similar cases.
Iron deficiency – it’s not just anaemia

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Iron is vital not just for haemoglobin but for many aspects of cellular function. Whilst blood collects oxygen from the lungs and delivers it to the tissues, it is the utilisation of oxygen through aerobic metabolism to produce energy that is perhaps the most important role for iron. Oxygen is processed by cytochromes in the electron transport chain of the mitochondria to produce ATP. Iron is the key component of the cytochrome and its ability to flip between ferrous and ferric states mediates the metabolism of oxygen.

In iron deficiency, whilst the haemoglobin levels initially remain constant, patients experience fatigue and exhaustion due to reduced cellular iron levels and reduction in aerobic metabolism. Intravenous iron rapidly improves muscle function in days, increasing fitness before an effect on haemoglobin levels are seen.
S6

Anaemia at discharge – what should be done?

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Postoperative anaemia is primarily cause by perioperative bleeding, although it is exacerbated or maintained by the inflammatory response to surgical aggression. The first consequence is the administration of red blood cell transfusion (RBCT). Available evidence shows that a restrictive transfusion threshold does not increase morbidity or mortality, even in elderly patients with cardiovascular risk. Application of restrictive transfusion thresholds has resulted in significant postoperative anaemia that may be accompanied of iron deficiency that could hamper early rehabilitation and return to daily activities. Treatment of postoperative anaemia is part of the first pillar of Patient Blood Management and aims at avoiding RBCT and improving postoperative outcome, although it could also improve physical performance. According to the pathophysiology of postoperative anaemia, perioperative bleeding implies a considerable loss of iron and inflammation-mediated hepcidin increase inhibits intestinal absorption of iron. Thus, postoperative oral iron is not useful and is therefore not recommended (Grade 1B).

Intravenous iron could have an important role in its management, even administered preoperatively, as it has been demonstrated that it improves haemoglobin at discharge.

REFERENCES

Weighing the Evidence for Coagulation Therapies in Cardiac Surgery
(Session organised in collaboration with the European Association of Cardiothoracic Anaesthesiology)

S7

Lessons learned from writing the EACTS/EACTA patient blood management guidelines

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In January 2018, the European Association for Cardio-Thoracic Surgery (EACTS) and the European Association for Cardiothoracic Anaesthesiology (EACTA) published their 2017 Guidelines on Patient Blood Management for Adult Cardiac Surgery. Until recently, patient blood management in cardiac surgery was an unpopular theme in most cardiosurgical journals. However, increased awareness of the multidisciplinary aspect of patient blood management has led to the collaboration of surgeons and anaesthesiologists in the current guideline.

In order to reach consensus for the different topics described in the guideline, surgeons and anaesthesiologists worked in pairs. It was a challenge to integrate the individual views from both sides, and to present a proper definition of the level of evidence for the different recommendations in the guideline.

One challenge was to separate evidence and opinion, and in some cases, this required subsequent discussions. A second challenge was the lack of evidence for many commonly used interventions, such as the use of fibrinogen concentrate to treat coagulopathy after cardiopulmonary bypass. The number and quality of studies available on the effectiveness of fibrinogen is very low, and these recommendations had to be handled very sensitively.

A difficult topic was the definition of a bleeding algorithm in cardiac surgery. While many investigators aim to institute a step-wise protocol for the treatment of bleeding, the guideline task force concluded that the introduction of a bleeding algorithm in an institution might already be beneficial in reducing blood transfusions, without putting emphasis on the cut-off values for coagulation treatment strategies.

The most important lesson learned from writing the guideline is that patient blood management in cardiac surgery can only be successful in case of a multidisciplinary and multifactorial approach. Future updates of the patient blood management guidelines should also involve the European Board of Cardiovascular Perfusion to close the triangular relationship between the surgeon, the anaesthesiologist and the perfusionist.
The story of fibrinogen

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Fibrinogen is the substrate of coagulation and a major constant of clot formation and firmness of the clot. This describes the extraordinary role and function to secure haemostasis by timely clot formation. Timely clot formation is even more important in the setting of perioperative medicine as surgery requires sufficient and quick haemostasis. For decades fibrinogen administration in the perioperative setting relied on therapeutic plasma or cryoprecipitate. A fibrinogen concentrate, however, was mainly indicated for rare coagulation disorders as hypofibrinogenemia or dysfibrinogenemia and not available in all parts of the world.

In recent years more and more presentations and retrospective analyses reported on the successful and effective administration of fibrinogen concentrate in the perioperative setting. Prospective randomised and placebo-controlled trials showed controversial results in reducing blood loss and transfusion requirements in major vascular surgery involving cardiopulmonary bypass. Other controlled data in complex cardiac surgery confirmed inhomogeneous results the efficacy of fibrinogen supplementation. Recent meta-analyses confirm a significant reduction in blood loss and transfusion requirements, but a high risk of bias of the existing studies still prevents further conclusions and asks for more sufficiently powered prospective trials.

This lecture focuses on the evidence from controlled data on fibrinogen supplementation in cardiac surgery with regard to its efficacy and safety in terms of thromboembolic complications. The presentation will conclude with a critical appraisal on the advantages and limitations of fibrinogen concentrate compared to other therapeutical sources for fibrinogen supplementation.

REFERENCES
S9
The story of aprotinin

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Aprotinin is a naturally occurring serine protease inhibitor that has antifibrinolytic properties by directly and non-competitively inhibiting plasmin. It also has anti-inflammatory and organ-protective effects by inhibiting kallikrein and neutrophil activation, and preserving platelet membranes. Aprotinin became widely used to decrease perioperative bleeding and transfusion rate in cardiac and other types of major surgery in the 1980s. These effects, supported by numerous publications, were challenged by observational studies in 2006-2007, which associated aprotinin use in cardiac surgery with an increased risk of renal dysfunction, cerebrovascular accidents and mortality. The subsequent multicentre Blood Conservation Using Antifibrinolytics in a Randomized Trial (BART) included 2331 high-risk cardiac surgical patients and compared the effects of aprotinin, tranexamic acid and epsilon-aminocaproic acid on massive postoperative bleeding and death from any cause at 30 days. The study was terminated early because of a (non-significant) higher mortality in aprotinin-treated patients. This led to the withdrawal of aprotinin from the US market in 2007 and its suspension in Canada and Europe in 2008. However, Health Canada identified several serious methodological problems with the BART study and made aprotinin available again in Canada for isolated coronary artery bypass surgery. In addition, the European Medicines Agency recommended the lifting of the suspension of aprotinin in February 2012. Later studies gave support to aprotinin’s use in complex, high-risk cardiac surgeries. Use of aprotinin is now subject to a 3-year strict safety monitoring under the Nordic Aprotinin Patient Registry (NAPaR). Sixty-five sites in the United Kingdom, Sweden, Denmark, Austria, Germany and the Netherlands have committed to use the NAPaR and as of 22 January 2018, 1321 patients have been recorded.

REFERENCES
14. Meybohm P, Herrmann E, Nierhoff J, Zacharowski K. Aprotinin may increase mortality in low and intermediate risk but not in high risk cardiac surgical patients compared to tranexamic acid and epsilon-aminocaproic acid - a meta-analysis of randomised and observational trials of over 30,000 patients. PLoS One 2013; 8: e58009
Transfusions – The Second Best Option?

S10

Positive influence of transfusion on tissue oxygenation and physical capacity – myth or reality?

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Although adequate tissue oxygenation is one of the most important cornerstones of perioperative medicine, it is seldom measured in the perioperative period. Most of the physicians use parameters like the haemoglobin concentration (Hb), cardiac output, central venous oxygen saturation (ScO₂), lactate concentration, etc. as parameters for tissue oxygenation, however none of these actually describe tissue oxygenation per se, but all of them are just surrogates for adequate global or regional oxygen delivery. It has to be kept in mind that there is even no easily applicable method for direct measurement of regional oxygen delivery (rDO₂), further complicating adequate determination of tissue oxygenation.

Although we do not measure tissue oxygenation on a regular basis, many of our therapeutical strategies aim at improving rDO₂ and tissue oxygenation, without actually measuring the success of these interventions. The therapeutic modalities that are used most often for the improvement of tissue oxygenation are the application of crystalloids or colloids, the transfusion of red blood cells, application of inotropes and an increase of the inspiratory oxygen fraction. Especially the transfusion of red blood cells is believed to improve rDO₂ and by that tissue oxygenation, but the clinical situation is much more complex than the simple rule, “the higher the Hb the better the tissue oxygenation”. An increase of the Hb results in an increase of blood viscosity and by the subsequent reduction of nutritive organ blood flow rDO₂ decreases.

It has been demonstrated by theoretical and clinical studies that the transfusion of red blood cells always improves the haemoglobin concentration, but regularly fails to improve rDO₂ or tissue oxygenation. As a consequence, transfusion of red blood cells has not been demonstrated to be effective in improving postoperative physical capacity.

REFERENCES
Are all platelets the same?

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Even after more than 50 years of platelet concentrate preparation, there is much that is unknown about platelet products. What is the best source of platelets? Could new sources of platelets, e.g. progenitor cells or platelet substitutes, address supply and safety concerns although there are obviously many technical challenges? What are the best methods of collection, processing and storage of platelets? There are several variables including the storage bags, additive solutions and temperature. There is currently a resurgence of interest in ‘cold-stored’ platelets because of their better immediate haemostatic effect.\(^1,2\)

Potential (but not proven) advantages of preparing platelets from single donors by apheresis rather than pooled platelets from whole blood donations include reduced disease transmission, reduced alloimmunisation and improved function.\(^3\) Practical advantages of apheresis platelets are the simpler handling and the convenience of preparing HLA/HPA-matched platelets using a single donor but apheresis platelets are more costly.

Another product of considerable interest is pathogen-reduced platelets, mainly in relation to minimisation of the risk of bacterial growth at 20-24°C but also other pathogens including emerging infections. A recently updated systematic review from our group found 12 trials of standard versus pathogen-reduced platelets.\(^4\) All were in haematology except one small trial. There were no differences in bleeding, mortality or serious adverse events but pathogen-reduced platelets were associated with lower 24-hour post-transfusion corrected count increments, shorter time interval between transfusions, greater number of transfusions and a higher incidence of platelet refractoriness.

Lastly, what are the best clinical and laboratory measures to assess the haemostatic function, safety and efficacy of transfused platelets, remembering there are different clinical scenarios for their use, e.g. prophylaxis in haematology patients and treatment of acute bleeding where immediate haemostasis is required?

REFERENCES
Patient Blood Management – Improved Standards of Care, Patient Safety and Cost-Effectiveness

S14

Patient blood management: the hospital manager’s perspective

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Transfusion of blood or blood products is one of the most frequently applied interventions in the hospital. In general, the largest consumers of blood transfusion services are major surgical procedures (such as major cardiovascular surgery), traumatology, haemato-oncology, and intensive care. However, specialised services such as the haemophilia centre may also be one of the most intense user of blood-related products.

There are several reasons to be involved in a rational patient blood management system in the hospital from a manager’s perspective. In the first place the issue of patient safety has become increasingly more important in recent years, not only for health care professionals but also from the point of view of hospital management. There is mounting awareness that transfusion of blood products may cause avoidable harm to patients, hence, this topic needs major attention. In addition, the issue of standardisation of medical practice throughout the hospital, aiming at improving quality of service and increasing efficiency, may include guidance for blood transfusion and implementation of measures with the intention of maintaining these protocols. Use of electronic prescribing services as part of an electronic health record system may be helpful as well. Thirdly, blood products represent a major item in the hospital’s budget and saving unnecessary transfusion of red cells or other blood components may therefore simultaneously save money and increase quality and safety.

Hospital-wide programmes may include the design and implementation of local transfusion policies, guidance to perioperative coagulation management, registration of transfusion practice and transfusion-related incidents, and regular feedback to prescribing practitioners. In addition, the use of alternatives to blood transfusion, such as preoperative measures to prevent transfusion, iron-infusion clinics, and guidelines for the use of prohaemostatic treatment are useful hospital-wide initiatives.

REFERENCES
5. Yerrabothala S, Desrosiers KP, Szczepiorkowski ZM, Dunbar NM. Significant reduction in red blood cell transfusions in a general hospital after successful implementation of a restrictive transfusion policy supported by prospective computerized order auditing. Transfusion 2014; 54: 2640-5
S15

Medico-legal implications of patient blood management

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A growing body of evidence suggests that effective patient blood management (PBM) minimises the risks of blood transfusion and reduces the costs of treatment. As a consequence, PBM is increasingly recognised as a superior standard of care. The recommendations of the European Commission’s Directorate-General for Health and Food Safety, “Building National Programmes of Patient Blood Management (PBM) in the EU”, and “Supporting Patient Blood Management (PBM) in the EU”, are visible expressions of this fact.

This factual development raises legal questions such as, for example: Is PBM, or will it become, the legally recognised standard of care, either by court decisions or legislation? What does that mean for the rights of patients or for the duties of health service providers such as medical professionals and health care organisations? Will providers be held legally responsible for damage caused by blood transfusion?

In this presentation, some of these questions will be examined based on legal principles of organisational liability, medical malpractice, and informed consent. Although national and local jurisdictions vary in many respects, and although detailed scrutiny will be indispensable, there are common traits that allow to draw some general learnings.

It can be anticipated that once PBM is legally recognised as standard of care, health care organisations might be attributed legal responsibility and be held liable (in criminal and/or civil courts) for adverse medical events that cause injury or loss to a patient due to blood transfusion. Furthermore, medical doctors who do not treat their patients according to the standards of PBM will be held liable for malpractice as soon as these standards are legally established through expert testimony, court decisions, or legislation. In addition, information on the choices of the patient between blood transfusion and other treatments according to PBM standards will be imperative for a legally valid consent.
Supporting patient blood management implementation in Europe – the EU-PBM project

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In recognition of the important role of PBM in promoting patient safety and improving clinical outcomes, the European Union (EU) Public Health Programme called for tenders for a service contract that would support the progress of PBM in the EU. The contract was awarded to a team led by the AIT Austrian Institute of Technology GmbH. Within the frame of this contract, a PBM implementation guide was developed as a supporting tool for hospitals. It has taken inspiration from successfully implemented programmes in different parts of the world. It focuses on how to implement PBM in hospitals in a practical way, building on already recognised best practices.

John Kotter’s eight-step model integrates important elements that are common in change management processes and have been successfully applied to implement the PBM concept at the Western Australia Patient Blood Management Program and the General Hospital in Linz, Austria. This eight-step model serves as a template for the implementation of PBM. Kotter’s organisational change principles are also incorporated in the IHI-improvement model which may be used to take the implementation further into everyday practice. The model is based on the avoidance of eight common errors, which usually account for failure of change efforts. Each error has a specific solution, and together these represent the eight-step change model (Table 1).

Table 1. Eight-step PBM implementation strategy according to the Kotter model

<table>
<thead>
<tr>
<th>Errors</th>
<th>Change Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allowing too much complacency</td>
<td>Create Urgency</td>
</tr>
<tr>
<td>Failing to create a powerful guiding coalition</td>
<td>Form a powerful PBM Group</td>
</tr>
<tr>
<td>Underestimating the power of vision</td>
<td>Create a vision for PBM</td>
</tr>
<tr>
<td>Under-communicating the vision</td>
<td>Communicate the vision</td>
</tr>
<tr>
<td>Permitting obstacles to block the new vision</td>
<td>Empower the PBM group and remove obstacles</td>
</tr>
<tr>
<td>Failing to create short-term wins</td>
<td>Create short-term wins</td>
</tr>
<tr>
<td>Declaring victory too soon</td>
<td>Build on the change</td>
</tr>
<tr>
<td>Neglecting to anchor changes in the corporate culture</td>
<td>Anchor PBM in culture</td>
</tr>
</tbody>
</table>

In this implementation guide, Kotter’s eight steps have been adapted to the implementation of the PBM concept with the ultimate goal of altering physicians’ behaviour and to improve transfusion culture. This overarching concept determines all the clinical and organisational measures to be taken by and adapted to the particular institution. Since this is a step-by-step strategy, skipping or not completing one step leads to a halt or even regression of the process. On the other hand, moving too quickly to the further steps involves the risk of failure.

REFERENCE
**Fluid Therapy**

**S17**

**Crystalloids/colloids – a never-ending debate**

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Although the use of intravenous fluids is one of the most common interventions in perioperative and intensive care, the choice between the different resuscitation solutions remains the subject of an intense controversy. Unfortunately, the debate has sometimes left the pure scientific domain to become a “quarrel of believers”. The crystalloids/colloids debate is, in general, not new but has become more and more complex as there are now discussions among the different crystalloids (isotonic saline versus “balanced” solutions) and among the different colloids (natural versus “synthetic”). Obviously, the ideal resuscitation fluid does not exist, but one can argue that in view of the different clinical situations requiring fluid resuscitation, there should not be one fluid which will fit with all of them. Relative to mortality as the primary outcome, there is no evidence of superiority of any intravascular solution.¹ Whatever the strengths and the weaknesses of the recent 6S and CHEST studies,²,³ they clearly demonstrate that, as fluid resuscitation is part of a complex physiological process, solutions have to be administered with the same caution that is used with any intravenous drug with the aim of maximising efficacy and minimising side effects.⁴

The choice of fluid should be guided by contextual patient-specific factors, taking into account the selection, the volume and the timing of administration. Fluid management during acute illness is a dynamic process occurring in four different phases: rescue, optimisation, stabilisation and de-escalation (mobilisation).¹ In the perioperative context, the objective is, in general, for cardiac output to become preload-independent (i.e. on the plateau of the Frank-Starling curve).³ This requires optimisation of the circulating blood volume. Optimising does not necessarily mean maximising, although frequently interpreted in this way.⁵ Measuring volume responsiveness sometimes referred to as a “goal-directed” approach may be an interesting alternative to directly measuring blood volume.⁶ Although the different techniques developed (i.e. stroke volume or pulse pressure variations, fluid challenges) present some limitations,⁶ there is increased evidence that perioperative goal-directed fluid therapy (GDFT) strategies improve outcome in patients undergoing high-risk surgery.⁷ Systematic implementation of such strategies through predefined algorithms has been associated with changes in fluid administration, associated with improved postoperative patients’ outcome.⁸ Closed-loop assistance has been shown to increase clinicians’ compliance to the GDFT strategy.⁹ Finally, the selection of the intravenous fluid should take into account the liquids that have been loosed, keeping in mind the pharmacokinetic and pharmacodynamics properties of the available solutions, and the importance of the glycocalyx in the regulation of fluid shift from the vascular to the interstitial space.

In the perioperative context, fluid therapy should be divided into two components: 1) replacement of fluid losses from the body via insensible perspiration and urinary output, which is generally best achieved with balanced crystalloids; 2) replacement of plasma losses from the circulation due to fluid shifting or acute bleeding, which could be replaced with iso-oncotic colloids, presuming the vascular barrier to be primarily intact and acknowledging that the volume effect of colloids is context-sensitive.⁶ The basis should be a timely replacement of visible blood losses, supplemented by a goal-directed approach in high-risk surgical patients. Such an approach combining balanced crystalloids and colloids administration has been shown to reduce postoperative complications compared to a pure crystalloid approach in patients undergoing major abdominal surgery.¹⁰

**REFERENCES**

Abstracts of the 19th Annual NATA Symposium
Speaker Abstracts

S18

Albumin – a rising star or a shot in the dark?

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Serum albumin concentration is inversely related to mortality risk in patients with acute and chronic illness. Albumin might have a protective effect as this association remains when corrected for known risk factors for adverse outcome. This is the starting point to consider albumin infusion in critically ill patients. However, literature is conflicting on its positive effect on outcome.

Areas in which albumin infusion may benefit patient outcome are: 1) patients undergoing large-volume paracentesis, 2) patients with spontaneous bacterial peritonitis (SBP). In a meta-analysis of seventeen trials with 1,225 patients, albumin reduced morbidity and mortality among patients with tense ascites undergoing large-volume paracentesis. In another meta-analysis of 4 trials with 288 patients, albumin infusion prevented renal impairment and reduced mortality among patients with SBP.

Half of the extravascular albumin is concentrated close to the skin, which explains the rapid and dramatic protein losses encountered after burns. This makes albumin replacement by albumin infusion a logical approach in burn patients. However, a recent meta-analysis found a neutral effect on mortality in burn patients resuscitated acutely with albumin solutions. It should be noted that only 4 trials involving 140 patients could be used in the meta-analysis.

Furthermore, albumin is the most important driver in colloid osmotic pressure. From this perspective, it seems logical to assume that albumin infusion may be beneficial in critically ill patients which suffer from hypovolaemia. However, larger trials including the SAFE study provided no evidence that albumin reduced mortality in patients with hypovolaemia.

The negative observations in above-mentioned areas may be explained by the lack of power of the trials or the effect of the purification technique on the quality of the albumin. Future directions should be focused on large well-powered randomised trials in the above-mentioned areas using albumin produced with modern purification techniques.

REFERENCES
The Newest Evidence

S20

Transfusion requirements in cardiac surgery: TRICS III

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A restrictive red blood cell transfusion policy in cardiac surgery patients remains for many physicians counterintuitive as physiology-based formulas indicate that tissue oxygenation is dependent on cardiac output, haemoglobin and oxygenation. Cardiac output may be reduced in post-cardiac surgery patients and from this point of view it makes sense to compensate this with an increase in haemoglobin in anaemic patients. However, the potential downside of allogenic blood transfusion is not taken into account by these formulas and this may explain the general finding that a restrictive red blood cell transfusion policy is safe in critically ill patients and may even improve outcome in a subset population.

The Transfusion Requirements in Cardiac Surgery (TRICS) III trial was performed to investigate whether this also holds true for cardiac surgery patients. In this international open-label randomised controlled non-inferiority trial, a restrictive (<7.5 g/dL) and liberal (transfusion if haemoglobin was <9.5 g/dL in the operating room or intensive care unit (ICU) or was <8.5 g/dL in the non-ICU ward) red blood cell transfusion strategy was compared in 5243 adults undergoing cardiac surgery with cardiopulmonary bypass who had a moderate-to-high (4%) predicted risk of death according to the EuroSCORE.

The primary composite outcome was death from any cause, myocardial infarction, stroke or new onset of renal failure with dialysis by hospital discharge or by day 28, whichever came first. The primary outcome occurred in 11.4% of the patients in the restrictive group compared to 12.5% in the liberal group (OR 0.90; 95% CI 0.76 to 1.07). Mortality was 3.0% in the restrictive-threshold group and 3.6% in the liberal-threshold group (OR 0.85; 95% CI 0.62-1.16).

This study shows, in contrast to the results of the MINT study and the results of the TITRe2 trial, that a restrictive red blood cell transfusion policy is non-inferior compared to a liberal strategy with respect to a composite outcome in moderate-to-high risk cardiac surgery patients.

REFERENCES
Randomised controlled trials vs. observational studies – choosing the best evidence to guide clinical practice

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Randomised controlled trials (RCTs) are considered the gold standard for clinical research, thus having a high impact on clinical guidelines and our daily patients care. However, various treatment strategies which we consider ‘evidence based’ have never been subject to a prospective RCT. Benefit and risk associated with allogeneic blood product transfusions have been discussed and debated in a large number of publications. If only a few prospective RCTs compared a liberal with a restrictive transfusion strategy in different medical and surgical populations, a large number of retrospective observational studies have been published leading to sometimes conflicting results.

In a recent publication, Trentino et al. addressed an important question: Should we ignore the results obtained from observational studies when assessing the benefit and the risk of different transfusion strategies? The authors nicely reviewed and summarised the similarities and differences, advantages and limitations, between different study designs frequently used in transfusion medicine. The authors concluded that ‘when comparing the results of observational studies with RCTs assessing transfusion outcomes, it is important that one consider not only the study method, but also the key elements of the study design’.

The strengths of RCTs include the development of a prospective study protocol with strict inclusion and exclusion criteria, a well-defined intervention, and predefined endpoints. All of those being usually absent or defined ‘a posteriori’ in observational studies, which makes the interpretation of the results difficult. However, our daily clinical practice is mainly based on the understanding of the pathophysiology, and how any given interventions may influence that pathophysiology to improve outcomes. In addition, clinical decisions are based on behaviours and treatments which have never been evaluated in clinical trial, considering that some interventions may never be subject to a randomisation.

Although, RCTs are Masterpieces to assess the efficacy of a treatment in a specific population (e.g. can the treatment work under ideal circumstances?), alternatives are required to assess the effectiveness of the same therapy (e.g. will the treatment work in real-world circumstances?). It is important to understand the strengths and limitations of both RCTs (efficacy studies) and observational studies (effectiveness studies), none of the study designs should be considered in isolation since all types of evidence rely primarily on the rigour with which individual studies were conducted (regardless of the methodological approach) and the care with which they are interpreted.

REFERENCES
Iron deficiency anaemia is prevalent across a broad group of cancer diagnoses. Retrospective studies of the use of erythropoiesis-stimulating agents in cancer- and chemotherapy-induced anaemia raised safety concerns but prospective, randomised trials have shown no relevant safety signals with their use. An analysis of patient-reported outcomes correlating haemoglobin concentrations reported maximum improvements in correlates of quality of life across the range of 10 to 12 g/dL. Guidelines for the use of intravenous iron in cancer- and chemotherapy-induced anaemia are inconsistent. ASH/ASCO guidelines state insufficient evidence for its use whereas the National Comprehensive Cancer Network and European Society of Medical Oncology strongly recommend it when clinically indicated, the latter citing the published evidence as Level A. Multiple studies without contradiction have reported optimisation of the response to erythropoiesis-stimulating agents with intravenous iron. A single prospective study reported no difference with the addition of ferric gluconate in the intent-to-treat population. However, a per-protocol analysis of those randomised to intravenous iron who received at least 80% of the planned dose reported similar results as previously published trials. Meta-analyses evaluating the synergy of intravenous iron with erythropoiesis-stimulating agents across all evaluable published evidence report haemoglobin increases, improved survival, decreased transfusions, safety and good tolerance. A meta-analysis of studies of intravenous iron for treatment of chemotherapy-induced anaemia showed a statistically significant benefit in achieving hematopoietic responses for intravenous iron without a negative safety signal. Intravenous iron remains underutilised in the treatment of cancer-associated anaemia. The ASH/ASCO guidelines should be revisited.

REFERENCES
5. Henry DH, Dahl NV, Auerbach M, Tchekmedyian S, Laufman LR. Intravenous ferric gluconate significantly improves response to epoetin alfa versus oral iron or no iron in anemic patients with cancer receiving chemotherapy. *Oncologist* 2007; 12: 231-32


S24

Patient blood management in gastroenterology

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Gastroenterologists are commonly exposed to severe anaemia as a result of GI or liver disease. Certain conditions such as colorectal cancer or inflammatory bowel diseases are specifically prone to anaemia and surgery. For inflammatory bowel disease, only a single uncontrolled trial has been performed regarding patient blood management. The oncological EPO story made cancer surgeons even more sceptical about preoperative intravenous iron therapy despite various clinical trials and molecular investigations on the effect of parenteral or oral iron on cancer cells. This presentation will give an overview on the current evidence on preoperative iron therapy in patients scheduled for colorectal cancer surgery, with a special consideration of the IVICA trial.
Iron deficiency and anaemia in pregnancy is an important risk factor for foetal and maternal morbidity and is considered a global health problem. Pregnancy creates a large demand for iron, which is important for maternal and fetal homeostasis, but also places the woman at risk for developing iron deficiency and anaemia. The consequence of maternal anaemia for the foetus is low birthweight and it may adversely affect the development of the central nervous system with long-term deficits.

Postpartum iron deficiency and anaemia are associated with several clinical consequences including maternal fatigue, impaired quality of life, reduced duration of breastfeeding and postpartum depression. Treatment of iron deficiency and anaemia include oral iron, intravenous iron and blood transfusion. Oral iron, although cheap, is associated with gastrointestinal side effects that reduce patient compliance. The newer intravenous iron preparations enable a ‘total dose’ to be administered rapidly, correcting the iron deficiency in one treatment. Risks and side effects are low with a high degree of patient acceptance. A review of randomised controlled trials on treatment for iron deficiency anaemia in pregnancy found that oral iron improved anaemia and intravenous iron was more effective to improve haematological indices but data are lacking in trials with clinical endpoints.

In a review looking specifically at postpartum iron deficiency anaemia, data on the efficacy of treatments focused on quality of life endpoints, but only few studies reported fatigue. In a later randomised controlled trial comparing intravenous iron to oral iron treatment in women with PPH, intravenous iron was found to be associated with statistical significant improvement in fatigue and depression scores as well as haematological parameters.

Blood transfusion is still often used to treat severe postpartum anaemia. In a randomised controlled trial comparing blood transfusion to non-intervention, non-inferiority could not be demonstrated with a difference found in physical fatigue. A randomised controlled pilot study showed that intravenous iron could be an attractive alternative to blood transfusion in severe postpartum anaemia, and that a larger trial is needed and feasible.

REFERENCES

12. Corwin EJ, Murray-Kolb LE, Beard JL. Low hemoglobin level is a risk factor for postpartum depression. J Nutr 2003; 133:4139-42

Patient blood management as a public health issue – a call for action

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Patient blood management (PBM) is defined as “the timely application of evidence-based medical and surgical concepts designed to maintain haemoglobin concentration, optimise haemostasis and minimise blood loss in an effort to improve patient outcome.”¹ PBM developed as a result of convergence of two pathways.² The first was the quest for transfusion alternatives in a world of emerging pathogens that placed recipients of transfusions at risks of devastating disease and ultimately death.³ The other – long standing but less organised – was the clinicians’ recognition of patients needing care for whom blood transfusion was not an option.⁴ Both these activities were met with not only scepticism but in many encounters, with strong rejection. Those opposing the concepts were either clinicians or ‘blood bankers’ who sole commitment to caring for patients was only through the use of blood components and derivatives and maintaining a system of supply and demand.

To date, advances in “blood management” have resulted in a significant and continued reduction in allogeneic blood transfusion without any negative clinical impact on patients.⁵ The only perceived negative impact seems to have been on the blood centres both in USA and abroad given the reduced demand.⁶,⁷ The reduction of transfusion can be attributed to a combination of increased awareness of the substantial risks and limited benefits of transfusions, the high cost of transfusion especially in light of significant irrational variability of transfusion practices across the board and in response to the now recognised “transfusion overuse” issue.⁸ It is important to emphasize that the reduction in transfusion rates across the globe is not a goal here per se, as PBM advocates a shift away from a “product-centred” approach to a “patient-centred” approach.⁹ Nonetheless, achieving the goals of PBM is expected to result in reduction and elimination of patients’ exposure to allogeneic transfusion as a byproduct.

In the practice of medicine, recognition of an ailment results in the diagnosis of a disease which, in turn, will guide the treatment. It is understood that one must tend to the patient with treatment strategies adjusted and revised as needed throughout the course of the ailment to ensure improved health or cure. This widely recognised and logical approach is at odds with the traditional approach in transfusion medicine, especially within the realm of red cells. Here, transfusion is addressed without identification of the disease to be treated. A plethora of trials to define the threshold for transfusion is continually being published while the disease that can and must be effectively diagnosed and cured is ignored.⁹,¹⁰ This disease is ANAEMIA.

Anaemia affects more than 2 billion people across the globe and has significant disabling and reduced productivity effects on those afflicted. Anaemia is an epidemic that is often ignored by healthcare regulators, clinician and public safety organizations, commonly assumed to be just an “innocent bystander”.¹¹,¹² This is no longer acceptable, given that anaemia is a modifiable risk factor for morbidity and mortality (as well as the leading indication for transfusion) with many effective treatments available.¹¹,¹³ It is time that those in government healthcare agencies, patient safety organisations and healthcare institution no longer obsess over transfusion threshold but address early identification, diagnosis and proper treatment of anaemia before any threshold for transfusion is encountered. PBM provides an evidence-based framework to address this public health emergency, and it should be adopted as the standard of care.¹
Practical and interactive approach to patient blood management – national model

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Blood and blood component utilisation is found to vary substantially across European countries.\(^1\) Patient blood management (PBM) is a multidisciplinary approach that primarily focuses on patient safety by avoiding/treating anaemia and optimising the physiological reserve of anaemia.\(^2\) The European Commission has recently published a new guidance to national health authorities and hospitals recommending the implementation of PBM as the new standard of care across European health systems.\(^3\)

This presentation will focus on the outcomes of implementing nationwide PBM programs in European countries. Departing from red blood cell utilisation countries will be benchmarked for the potential benefits of nationwide PBM implementation in terms of health resource utilisation (blood transfusions, hospital length of stay, in-hospital morbidity and mortality) and public health outcomes (life years gained and disability-adjusted life years).

Attendees will further be stimulated to respond to an online stated preferences questionnaire designed to assess preferences relative to the implementation of PBM policies according to the 3 pillars (red cell mass optimisation; blood loss and bleeding minimisation; physiological reserve of anaemia optimisation) throughout patients perioperative period, including preoperative, intraoperative, postoperative management strategies. Results of nationwide PBM policy implementation in European countries will be available through an interactive mobile phone application in order to stimulate the discussion between the audience and the panel.

REFERENCES
Role of health authorities in the implementation of a patient blood management programme

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Transfusion of blood components has been improving its quality and safety. Although safer than ever before, a residual risk remains associated mainly with immunologic reactions and much less with transmission of infectious agents. Scientific papers link transfusion with morbidities associated increased hospital length of stay and red cell transfusion is still used to treat anaemia that could be treated otherwise.

In many countries, a patient-focused approach named patient blood management (PBM) follows the former product-based approach that was able to increase the quality and safety of blood components. The concept, as stated in the Guide, is “an evidence-based, multidisciplinary, multi-modal therapeutic approach to individually manage and preserve the patient’s own blood in surgical and non-surgical settings”. The WHO Resolution Assembly WHA63.12 and the WHO Global Forum on PBM recommended the National Authorities to support the implementation of PBM.

The European Commission launched a tender in 2013, for a PBM project to support PBM in the EU member states, following other initiatives, like the Optimal Blood Use. PBM Guides were sent to member states Competent Authorities for Blood, to be distributed to Health Authorities and hospitals. This Guide was disseminated by the Portuguese Institute of Blood and Transplantation, throughout the country to each hospital CEO and to its Director of Transfusion Medicine Service. To accomplish PBM consolidation, a guideline in the scope of the General Directorate of Health and a Ministry of Health legal document is current being developed and is about to be published in the Portuguese Official Journal, for a pilot project involving hospitals with and without PBM programmes and a national steering committee to facilitate and evaluate its development. In Portugal, a study that points to the advantages of the PBM has been conducted and there is a medical specialty – Immunohaemotherapy – that facilitates the discussion.

REFERENCES
   Available at: https://ec.europa.eu/health/sites/health/files/blood_tissues_organs/docs/2016_sare_blood_summary_en.pdf
   Available at: http://www.who.int/bloodsafety/events/gfbs_01_pbm_concept_paper.pdf
   Available at: http://apps.who.int/ebwha/pdf_files/WHA63/A63_R12-en.pdf
   Available at: http://www.who.int/bloodsafety/collaboration/who_gfbs_2011_03_priorities_for_action.pdf
    Available at: https://ec.europa.eu/health/sites/health/files/blood_tissues_organs/docs/2017_eupbm_authorities_en.pdf
How to Treat Coagulopathy

**S29**

**Direct oral anticoagulant-induced coagulopathy – how and when to treat**

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Direct oral anticoagulants (DOACs) are now recognized as a major step forward for our patients. However, several issues related to DOACs deserve our attention.\(^1\)\(^2\) Reports on the pharmacokinetics and pharmacodynamics for these agents show a major intra- and inter-individual variability and a high number of drug-drug interactions. In addition, alteration of renal function interferes with most of DOACs. As a result, an unexpectedly high number of major bleeding events have been reported, especially with dabigatran, focusing the attention on these new anticoagulant agents.\(^3\)\(^4\) Furthermore, as new biological tests become more readily available for monitoring,\(^5\) which include the diluted thrombin time for dabigatran (Hemoclot\(^6\)) and specific anti-Xa assays for rivaroxaban, apixaban, and edoxaban, ranges for optimal anticoagulation, and potential thresholds for increased bleeding risks are not well defined.\(^6\)

**Scheduled procedures**

Several groups and major societies, including the European Society of Cardiology (ESC), have recently issued several sets of recommendations focusing on the periprocedural management: when to stop DOACs, whom to bridge and when to restart.\(^1\) The Groupe d’Intérêt en Hémostase Périopératoire (GIHP) has updated its 2011 recommendations which are now on line with the ESC proposals.\(^5\) As a summary, dabigatran has to be stopped (last intake) 4 or 5 days before the procedure, depending of the renal function. The “xabans” (anti-Xa agents: apixaban, edoxaban, rivaroxaban) need a shorter interruption with a last oral intake three days before. No more bridging is requested, whatever the level of thrombotic risk. No biological tests are requested, as far as a scheduled procedure is concerned. Immediately after the invasive procedure, a once daily subcutaneous preventive dose of low molecular weight heparin (LMWH) should be injected (enoxaparin 40mg or dalteparin 5000IU). DOACs are to be restarted only when the surgical haemostasis is secured, i.e. mainly after 72 hours. These proposals are summarized in Table 1.

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<th>Low bleeding risk</th>
<th>Moderate and high bleeding risk</th>
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<td><strong>Cockcroft (\geq 50 \text{ ml/mn})</strong></td>
<td>Last intake at D-4</td>
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<td><strong>Cockcroft 30-49 ml/mn</strong></td>
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<td><strong>Restart oral intake at least 6 hours after the end of the procedure</strong></td>
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<td><strong>Anticoagulant: « prophylactic dose »</strong></td>
<td>At least 6 hours after the procedure, if venous thromboembolism prophylaxis is required</td>
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<td><strong>Anticoagulant: « therapeutic dose »</strong></td>
<td>when surgical haemostasis is completed (between 24 and 72 hours)</td>
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Emergent procedures or bleeding

Prothrombin complex concentrates (PCC) and activated prothrombin complex concentrates (FEIBA®) have been tested with various doses and conflicting results in different animal models, and healthy volunteers, and they are now used by clinicians in bleeding patients on a non-evidence-based basis, and with a variable efficacy. However, several series, especially in neurology/neurosurgery patients show a better outcome in patients treated with PCC. In the GIHP-NACO registry, PCC and aPCC have been shown to partially or totally control bleeding in bleeding patients treated with DOACs.

Specific antidotes are also being developed. Three of them have already performed phase II and/or phase III studies.

- Idarucizumab (Praxbind®) is a fully humanized antibody fragment (Fab) which binds to the thrombin binding site of dabigatran hence inactivating the molecule. In healthy young and older volunteers, idarucizumab was associated with immediate, complete, and sustained reversal of dabigatran-induced anticoagulation. It was well tolerated with no unexpected or clinically relevant safety concerns. The phase III study (REVERSE-AD) has been completed, including bleeding patients who have serious bleeding or patients who require an urgent procedure. The results including 503 patients show a complete reversal of the anticoagulant effect of dabigatran within minutes... and 18% mortality (mainly unrelated to the antibody). Even if the European (EMA) and US (FDA) regulators have granted an approval for this compound, we need further studies and a much larger number of patients to be fully reassured. Nevertheless, this antibody may save lives.

- Andexanet alpha is a recombinant modified human factor Xa protein that binds factor Xa inhibitors. This specific reversal agent is designed to neutralize the anticoagulant effects of both direct and indirect factor Xa inhibitors. Its half-life is short (less than 90 minutes) and the bolus has to be combined with a continuous IV infusion. Up to know, no data are available after a 6hrs administration. Andexanet appears to be effective in healthy volunteers on a biological standpoint, and in a small number of patients (n = 47) treated with apixaban or rivaroxaban. No approval has been given yet, and the FDA has requested additional data in relation with a potential increase in the thrombotic risk.

At the same time, other similar agents are being developed by several research groups.

- PER977 is a small, synthetic, water-soluble, cationic molecule that is designed to bind “specifically” to unfractionated heparin, low-molecular-weight heparin, to the new oral factor Xa inhibitors, and to the oral thrombin inhibitor, dabigatran. Few data are available for the moment.

As DOACs are very effective and increasingly popular, more and more patients are shifting from VKA treatments to DOACs. As a result, the number of DOACs treated patients undergoing an emergency procedure, a trauma or an overdose is increasing steadily and the need for long lasting, safe, user-friendly and cheap antidotes will increase.

Conclusion

No doubt that we stand at the beginning of new complicated but exciting developments, for severely bleeding patients and for DOACs. However, we have to acknowledge that we need some more evidenced-based data to be fully reassured.

REFERENCES

3. Cohen D. Dabigatran: how the drug company withheld important analyses. BMJ 2014; 349: g4670
Abstracts of the 19th Annual NATA Symposium


PI

Contribution of uncertainty sources in the risk of post-transfusion infection by viral agents

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Introduction: The measurement and evaluation of uncertainty have a significant role in the post-transfusion risk assessment. The risk on this scenario could be expressed as the probability of false results. On the current interviews intended for the screening of blood donors the chance of false-negative results in screening laboratory based on the epidemiological prevalence of transmissible diseases/risk of seroconversion window period is already considered. However, uncertainty components in screening tests’ results are commonly misunderstood. This presentation demonstrates the significant sources of uncertainty contributors to the risk of post-transfusion infection.

Methods: Systematic review of literature in blood establishments’ field focused on uncertainty, transfusion-transmitted infections, regulation, and standards. The papers were critically analysed and the conclusions presented in an illustration.

Results: The sources of uncertain results were divided into two groups: (1) biological: window period, mutation of agents, and diagnostic accuracy and (2) analytical: measurement uncertainty, lack of equilibrium in reaction, and interference (see Figure 1). Results into the window period are a false negative (seronegative results). Therefore, it is interpreted as a major component related to the risk of post-transfusion infection. The literature shows cases of the mutation of agents as another critical component of false results principally to the nucleic acid tests results. The confidence intervals of diagnostic sensitivity and specificity measure the risk of false results in a population with the characteristics of the samples type used and could be essential to differentiate two screening tests. Measurement uncertainty represents a chance of the wrong classification of samples with numerical results around the cut-off. The lack of equilibrium could be another source of false results; however, changes in the reaction could be detected with an internal quality control scheme. Sample with interference agents also has a significant chance to be false negatives, and the binary result interpretation should be performed accordingly.

Conclusion: It is strongly suggested that the blood establishments consider not only the epidemiological uncertainty but also other contributors of uncertainty. The computation of the “gray-zone” based on measurement uncertainty is advised for a lower residual risk of false negative results. Blood establishments certified by ISO 9001:2015 are encouraged to consider the presented components in the quality control decisions based on the “risk-based thinking” concept.
P2

Quality control of apheresis collected platelets: plasma versus additive solution

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Introduction: The use of additive solutions in platelet concentrates (PCs) has been proved to reduce platelet transfusions reactions. It is important to assure that apheresis collected platelets (ACP) stored in additive solutions fulfil the same standards of quality of ACP stored in plasma.

Methods: Our aim was to compare the results of the quality control (platelet count, residual leukocyte count and pH) of five months of plasma stored ACP versus five months of platelets stored in InterSol Solution (PAS III) collected with AMICUS. Following the Council of Europe recommendations, the goals of our laboratory, in what concerns quality control parameters, are: platelet count >200x10^9; residual leukocyte count <1.0 x 10^6 and pH >6.4 at 22ºC.

Results: When comparing the mean platelet count (P = 0.057) and residual leukocyte count (p=0.60) there was no statistically significant differences between the two groups. However, when comparing the mean pH at 22ºC of plasma stored ACP versus the mean pH at 22ºC of PAS III stored ACP there was a statistically significant difference (P = 0.03).

Conclusion: We assumed that the statistically significant difference found in the pH parameter is related to the different sizes’ of the samples of the analysed groups. Besides, the mean pH value was within normal values in the two groups, with all ACP’s within quality control parameters, which lead us to assume that if the sample sizes were similar between them, the difference may become not statistically significant. These results reinforce that the quality of platelets stored in PAS III is maintained and that we can use it safely.
Storage-induced aging of packed red blood cells: interrelation between biochemical and biophysical markers

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Introduction: Cold storage of packed red blood cells (PRBC) in the blood bank is reportedly associated with alteration in a wide range of RBC features. Some of these changes take place at an early stage of storage (during the first 7 days), while others occur later. A number of these changes are interrelated and initiate a cascade of biochemical and structural changes which in turn lead to impairment in RBC functionality, specifically alteration in the biophysical/mechanical properties of cells. Thus, release of microvesicles, enriched by lipid raft proteins (specifically, stomatin), from RBC membrane starts at the second week of cold storage. This process lead to decreasing of cell surface-area-to-volume ratio, leading to elevation of cells fragility and rigidity. The present study was undertaken to identify interrelation between stomatin membrane depletion (due to vesiculation) and mechanical properties of stored RBC.

Methods: RBC were isolated from freshly-donated blood or units of packed RBC (PRBC) and suspended in albumin-supplemented PBS. In addition, PRBCs were separated by filtration through a microsphere column into two fractions: enriched with rigid (R-Fraction) and deformable (D-Fraction) cells. The RBC were subjected to determination of their deformability, mechanical and osmotic fragility, as well as stomatin level in isolated RBC membranes.

Results: Depletion of stomatin from cell membrane is characterizing rigid cells and RBC that are destroyed under mechanical/osmotic stress. In the RBC population, the cells that were susceptible to mechanical/osmotic stress were characterized by low deformability. The osmotic/mechanical fragility was higher in the R-Fraction than in the D-Fraction.

Conclusion: This study shows that “mature” erythrocytes are characterized, at the same time, by high fragility, low deformability and stomatin depletion.
Haemostatic profile and safety of pooled cryoprecipitate up to 120 hours after thawing

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Introduction: AABB standards state that cryoprecipitate (CRYO) should be transfused within 4 - 6 hours after thawing. We evaluated coagulation factor levels and sterility of thawed pooled CRYO to assess whether shelf-life can be safely extended.

Methods: Donor CRYO pools (n = 20, 10 group A, 10 group O) were held at ambient temperature and sampled at 0-, 4-, 8-, 24-, 48-, 72-, 96-, and 120- hour post-thawing for fibrinogen, FVIII and vWF levels. Samples were tested at 0- and 120- hours for sterility (BacT/Alert system). Twenty additional CRYO pools were evaluated after 72- hours. Longitudinal differences in component levels were determined from linear fixed-effects models.

Results: Group O CRYO had significantly lower FVIII (P = 0.002) and vWF activity (P = 0.006) compared to group A at 0- hour, but were not statistically different in fibrinogen levels (P = 0.33). Fibrinogen levels were stable over 5 days: 501 ± 81 mg/unit (mean ± standard deviation) at 0- hour to 506 ± 102 mg/unit at 120- hours (P = 0.73). Similarly, there was no decline in vWF activity: 200 ± 53 IU/unit at 0- hour to 209 ± 57 IU/unit at 120- hours (P = 0.084). The FVIII activity significantly declined on average by 9.6 IU (95% confidence interval = 5.5 - 13.8) between 0- hour (111 ± 33 IU/unit) and 120- hours post-thaw (101 ± 33) (P <0.001). No organisms were detected when CRYO pools were cultured at 0- hour, but at 120- hours Staphylococcus epidermidis was identified from one pool, potentially a contaminant introduced during repeated sampling. No cultures were positive among the 20 additional CRYO pools assessed at 72- hours.

Conclusion: Extended CRYO storage at ambient temperature does not affect fibrinogen levels. Sterility of products held at ambient temperature for extended period of time can be assessed by secondary culture.
Pre-transfusion screening for anti-erythrocyte antibodies – clinical importance and security for transfusion therapy

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Purpose of the study: Statistics of the established erythroantibodies in patients with positive pre-transfusion screening in University Hospital “Queen Joanna – ISUL” for the period 2009-2017, which are in need of transfusion therapy. The result of immunohaematological diagnostics in these patients will present in percent erythroantibodies in regard to specificity including auto-and/or alloimmunisation. Main goal of the research is to prove the advantages of pre-transfusion screening, in parallel crossmatch test between donor and recipient, even in conditions of emergency.

Materials and methods: All patients including children with made pre-transfusion screening for anti-erythrocyte antibodies for the shown period of time. Direct, indirect antiglobulin test, enzyme, agglutination method - Dia Med GmbH, Switzerland ID - Micro Typing System.

Results: Percent distribution of the diagnostic specificity of anti-erythrocyte antibodies for the period between 2009 and 2017 year at Queen Joanna – ISUL University Hospital. Advantages like: reduced technical time for the making of the samples, high sensitivity and specificity of the column agglutination gel-technique for the immunohaematological diagnostics in patients and conditions of emergency will be shown in the results of the research. Case report of the alloimmunisation with 4 antibodies will be presented like a risk of the transfusion therapy.

Conclusion: Pre-transfusion screening for anti-erythrocyte antibodies guarantees reliability and safety of the transfusion therapy with erythrocyte concentrate, since the patient can have poorly active clinically significant antibodies, which will not react with the blood unit in the crossmatch test, but the donor has the antigen, to which is directed the antibody/for example antigen in heterozygous condition. Such clinical cases are being observed most often in the presence of antibodies to antigens of MNSs, Rh, Jk, Fy - blood group systems.
FORSCells: a novel reagent for anti-Forssman antibody screening

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Introduction: The Forssman antigen (Ag) was discovered in 1911 by John Forssman but the FORS system was only established in 2012 as the 31st blood group system. There are too little solutions for the study of this blood system (e.g. kodecyte production) and the few solutions that exist are really expensive and time-consuming with several practical limitations. We have identified and proved a source of RBC that express Forssman Ag in their cells. Our aim in this work is demonstrate the quality of a red blood cells (RBC) suspension (FORSCells), which contains the Forssman Ag, and to stablish this suspension as a viable tool for the human anti-Forssman antibody (Ab) screening.

Methods: A 0.8% suspension of RBC containing Forssman Ag was prepared in a stabilizing solution. For assessing the quality and the viability of this RBC solution, mainly three tests were performed for a period of at least 40 days. First, a measurement of supernatant absorbance of the FORSCells was performed every day to check for degradation of the RBC in suspension (naturally occurring haemolysis). Second, an osmotic fragility test was performed, which consists in evaluating the variation of RBC resistance to haemolysis when exposed to the action of hypotonic salt solutions. Third, anti-Forssman Ab titration using plasmas of type A, B, AB and 0 was performed, daily, to verify the FORSCells strength reaction (preservation of the Forssman Ag), evaluating the anti-Forssman Ab titre. FORSCells production, and their respective tests, were performed in three independent experiences.

Results: Our results shown no statistical significant differences on: the measurement of supernatant absorbance of the FORSCells (no haemolysis was detected in the supernatant between the first and the last day of measurement) and on osmotic fragility test from day one to day forty. Regarding anti-Forssman Ab titration with plasmas of type A, B, AB and 0 we start defining the expected titration for each plasma sample and it was 8, 4, 16 and 32, respectively. For the period studied (40 days), we obtained the following results: plasma A with 56% of the measurements obtained the titre 8, plasma B with 82% of the measurements obtained titre 4, plasma AB with 73% of the measurements obtained titre 16 and plasma 0 with 98% of the measurements obtained the titre 32.

Conclusion: Our results suggest that FORSCells RBC solution is ready to use, does not change membrane permeability of RBC and is antigenically stable, meaning that for 40 days it can be securely used for anti-Forssman antibody screening, routinely.
Transfusion safety has evolved significantly over the last years, mainly due to the use of crossmatch tests (CT). In these tests, plasma/serum of a receptor is put into contact with the red blood cells (RBC) of the donor, being the compatibility between both evaluated. Accordingly, the unit of blood is transfused, only when the result of the CT is negative.

Nowadays, the CT is mostly performed using cards that need a centrifuge to obtain the compatibility results. Besides that, current CT require the use of micropipettes, pipette tips, solutions, educated health professionals, laboratory and the performance of a laboratory protocol that takes about 45 to 60 minutes to be completed. To avoid this set of limitations, a new device named Easy Blood Crossmatch (EBC) was, recently, developed by the authors. The EBC device is a medical device, which makes simple, quick and economical, the verification procedure of the blood compatibility for blood transfusion. The constant pressure generated inside the device replaces the need of the centrifugation procedure. This previously mentioned centrifugation procedure, must be performed in a laboratory, require the use of specific and expensive centrifuges, making it expensive and time consuming.

The centrifugation step elimination represents irrefutable advantages, such as the drastic reduction of time and costs of human and material resources for obtaining blood compatibility results. Thus, EBC is versatile and adjusted enough to be used in underdeveloped countries or in crisis scenarios (natural disasters, war, terrorism and/or epidemics) where available resources are scarce. Moreover, the methodology applied to EBC can be useful to other applications in the medical transfusion sector.

Herein the results of a set of pilot tests to validate the EBC medical device characteristics are shown. For that, a double-blind experiment using different blood types of RBC AB0 and plasma/serum CT were performed to validate if the results obtained by the EBC are valid and reliable. In addition, through the use of a selective membrane, it can be observed that the RBC does not cross the membrane if only the gravity force is applied. Furthermore, when the CT is incompatible, agglutination of cells at membrane surface was observed on the top. From these results it can be concluded that the EBC is a very promising device to perform blood CT.
Save a unit; save a life! Reducing donor red blood cell wastage

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National Maternity Hospital (NMH), Dublin, Ireland

Introduction: The Irish National Maternity (NMH) hospital is committed to the optimisation of patient blood management strategies. In 2015 a quality initiative was set to reduce donor red blood cell (RBC) wastage. The aim of the initiative was to ensure the optimum management of this precious resource while offering safe and timely blood provision to our patients.

Method: The NMH keep a low inventory of donor RBCs on site at all times. Previously in the NMH any blood stock that was not transfused before its expiry date was wasted. To combat this, a Service Level Agreement (SLA) was put in place with a neighbouring large tertiary hospital, St. Vincent’s University Hospital (SVUH). The SLA allowed any donor RBCs that were near to expiry to be rerouted to SVUH. Because of the patient population in SVUH there is a far greater likelihood of the rerouted units being transfused. Standard Operating Procedures were drafted to instruct staff on how and when the blood should be rerouted. Staff were then trained on how to carry out the procedure and how to document their actions. The rerouting began at the end of 2015. Statistical data was correlated month on month and these figures were fed back to the heads of department and the Irish Health Service Executive.

Result: The results of the Patient Blood Management strategy are outlined in Figure 1 below.

Figure 1. Reduction in Donor Red Cell Concentrate (RCC) Wastage at the Irish National Maternity Hospital

Conclusion: The NMH continues to commit to this patient blood management strategy. What we have learned is that the initiative has had two key benefits:

1. Dramatic reduction in the wastage of this precious resource
2. More blood is available in the Irish Blood Transfusion Service when our NMH patients need it
Evolution of blood donation and component transfusion in Navarra (North Spain) (2012-2017): possible influence of a preliminary patient blood management programme

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Introduction: Transfusion of blood components is an increasing scarce and costly therapeutic resource. Thus, the availability of epidemiological information regarding appropriate blood component production and usage is of outstanding interest. To this end, we reviewed data from the Comunidad Foral Navarra (Autonomous Region of North Spain) on blood donation and component transfusion from 2012-2017, and the possible influence of a Patient Blood Management (PBM) programme.

Methods: We considered the last 5-year study period. By using BSTN data management programme (eDelphyn version 8.0, Haemasoph®, Valladolid, Spain). We reviewed data of blood donation and blood component supply for all public and private centres and Pharmacy Service.

Results: In 2017 with an increase of hospital activity overall regional numbers of transfused units decreased, increased by 11% for red cells, by 1.1% for FFP, and by 91% for PLT. At second semester the decreased use observed was almost double. Also a donation decreased was need.

<table>
<thead>
<tr>
<th>SUPPLY</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>Diff.</th>
<th>%</th>
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<tbody>
<tr>
<td>Red cells</td>
<td>26391</td>
<td>24571</td>
<td>23141</td>
<td>24277</td>
<td>24341</td>
<td>22294</td>
<td>-2047</td>
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<tr>
<td>Plasma</td>
<td>2462</td>
<td>3167</td>
<td>3334</td>
<td>3308</td>
<td>3487</td>
<td>2379</td>
<td>-1108</td>
<td>-31.78</td>
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<tr>
<td>Platelets dose</td>
<td>3631</td>
<td>2986</td>
<td>2917</td>
<td>3632</td>
<td>4124</td>
<td>3639</td>
<td>-485</td>
<td>-11.76</td>
</tr>
<tr>
<td>Autodonation</td>
<td>548</td>
<td>268</td>
<td>190</td>
<td>127</td>
<td>141</td>
<td>148</td>
<td>7</td>
<td>4.96</td>
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<tr>
<td>Components</td>
<td>32484</td>
<td>30724</td>
<td>29392</td>
<td>31217</td>
<td>31952</td>
<td>28312</td>
<td>-3640</td>
<td>-11.39</td>
</tr>
<tr>
<td>Total</td>
<td>33032</td>
<td>30992</td>
<td>29582</td>
<td>31344</td>
<td>32093</td>
<td>28460</td>
<td>-3633</td>
<td>-11.32</td>
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<table>
<thead>
<tr>
<th>DONATION</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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<tr>
<td>TOTAL</td>
<td>27.874</td>
<td>25.177</td>
<td>24.400</td>
<td>26.265</td>
<td>25.519</td>
<td>24.185</td>
<td>-1.334</td>
<td>-5.23</td>
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<tr>
<td>Apheresis</td>
<td>393</td>
<td>153</td>
<td>282</td>
<td>609</td>
<td>608</td>
<td>818</td>
<td>210</td>
<td>34.54</td>
</tr>
</tbody>
</table>

In the second semester the supply decreased was higher: -13.47 % of red cell concentrates, -40.44% of plasma units and -23.15% of platelets adult doses. The donation need was lower: -14.1%. Albumin supply was decreased by 21990 g (-1.87%).

Conclusion: After the initial step of PBM implementation (medical audit and formative sessions) we have observed an overall decrease in all blood cell components and albumin. The main decrease was observed in the major regional hospital. We must confirmed these preliminary results the next years with a programme of hospital sessions in the main consumer service, medical audit of all components and products.
P10

Rational blood use at General Hospital Celje 2007-2017

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Introduction: General Hospital Celje services a population of 300,000 in the Celje area, with its own transfusion centre collecting round 9,000 units of whole blood annually, with testing, processing and distributing blood components. GH Celje houses surgical, internal and urgency departments. Presented data shows trends for 2007-2017 period of issued erythrocytes, fresh frozen plasma and pooled platelets. With adoption of quality certificate and approval of competent authority, great care was taken on rational and safe blood use with series of lectures and practices since 2008. Hospital transfusion committee meets 4 times yearly, analysing the data and risk events and also setting trends on rational blood use to be implemented in daily practice.

Methods: 2007-2017 data of issued blood products was collected and presented as trends.

Results: Graph presents 11 year trend of issued blood products.

Conclusion: General trend of lowered consumption is evident in fresh frozen plasma (three fold decrease). Great care was taken to lower FFP consumption, following strict rules on FFP usage, enabling more FFP to be contributed to national programme of fractionation (from 50 to 87% of collected plasma). With increasing demands for Ig following broader usage of indications (autoimmune states), the demand for additional plasma exists and is to be addressed with additional collection by apheresis. In erythrocytes the results are not as straight forward as the focus shifted from surgical side (modern techniques and medications in orthopaedic surgery) to internal medicine side (haemat-oncology) with its chronic demands (usage also doubled in pooled platelets ). For further improvements the consumption of blood products per hospitalisation should be measured as is our goal to further implement modern guidelines on blood management.
**P11**

**Platelet transfusions in adult liver transplantation: experience of Coimbra Hospital and University Centre from 2015 to 2017**

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**Introduction:** Platelet transfusions aim to prevent or treat bleeding. Current guidelines for major surgery suggest a platelet count >50000/mm³. This study analyses platelet transfusions in adult liver transplantation at Coimbra Hospital and University Centre CHUC during a 3-year period.

**Methods:** Data from liver transplantations between 1st January 2015 and 31st December 2017 were collected and studied. The parameters analysed were: age, gender, disorder, pre- and postoperative platelet count and platelet transfusions during surgery. All data were treated in Excel system.

**Results:** In 2015, 53 adult liver transplantations were performed. 11 patients (20.75%) received platelet transfusions: 8 men (72.73%), average age 59.1 years, and 3 women (27.27%), average age 51.3 years. Presented disorders: alcoholic cirrhosis (45.46%), retransplantation due to liver failure (27.27%), acute liver failure (18.18%) and hepatocellular carcinoma (HCC) (9.09%). Preoperative platelet count mean was 59000/mm³ (min: 27000, max: 169000) while postoperative mean was 65000/mm³ (min: 24000, max: 89000). The average consumption of platelet concentrates was 1.64 (min: 1, max: 4). In 2016 there were 69 adult liver transplantations. 16 patients (23.19%) received platelet transfusions: 10 men (62.5%), average age 57.7 years, and 6 women (37.5%), average age 55.8 years. Presented disorders: cirrhosis (37.5%; alcoholic, HCV infection and primary biliary cholangitis aetiology), acute liver failure (25%), retransplantation due to liver failure (18.75%), HCC (6.25%), fulminant hepatitis (6.25%) and polycystic liver disease (6.25%). Preoperative platelet count mean was 57000/mm³ (min: 14000, max: 170000) and postoperative platelet count mean was 58000/mm³ (min: 12000, max: 95000). The average consumption of platelet concentrates was 1.5 (min: 1, max: 3). In 2017 70 adult liver transplantations were performed. 11 patients (15.71%) were transfused with platelet concentrates: 7 men (63.64%), average age 55.6 years, and 4 women (36.36%), average age 60 years. Patients disorders were: cirrhosis (54.55%; alcoholic and HCV infection aetiology), acute liver failure (18.18%), retransplantation due to liver failure (18.18%) and HCC (9.09%). Preoperative platelet count mean was 78000/mm³ (min: 13000, max: 294000) and postoperative mean was 45000/mm³ (min: 15000, max: 89000). The average consumption of platelet concentrates was 1.45 (min: 1, max: 3).

**Conclusions:** From 2015 to 2017, there were 192 liver transplantations, 38 (19.8%) with platelet transfusions. Patients with preoperative platelet count <50000/mm³ (44.7%) were transfused with an average of 1.88 platelet concentrates while patients with >100000/mm³ (15.8%) only needed an average of 1.17. It seems to be a linear relationship among these two parameters in major surgery. The increase of study sample in the future may support and allow to enhance statements so far.
P12

The situation analysis on blood product utilization in the cardiac surgery setting in Iran

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Introduction: Despite rapid developments and new insights about transfusion medicines, especially in the context of patient blood management, still there are traditional work flows and blood product utilization pattern in cardiac surgery centres in developing countries. We investigated the blood products utilization manner in a cardiac surgery centre in Iran.

Methods: Retrospectively the records of all blood products which were transfused, during the one year period was studied. The demographic characteristics of patients, type of surgery, triggers of transfusion for packed RBC, background diseases, total transfusion in the operating room, ICU and ward was also reported. The data was reported as frequencies, percentages and was analysed by SPSS version 18. P values less than 0.05 was considered statistically significant.

Results: Among 108 patients underwent to cardiac surgery in a general hospital located in Sanandaj, Kurdistan province of Iran, from March 2015 to March 2016, majority of them 69 (63.9%) were male, the mean age of patients was 62.2±11.3 (range: 29-82 years). Mean age of men was 63.1±10.68 and respective value for female was 62.23±10.49 (p=0.7). The most patients have been operated off pump CABG 91 vs. 17 have gone on pump CABG (84% vs. 15.7%). Mean Hb in female 11.53±1.8 was significantly lower than male patients by respective value as 12.44±2.15 (p=0.004). Surprisingly the mean of Hb for patients have taken packed RBC transfusion was 12.12±2.08, mean of transfused PRBC in the off pump patients was 2.54±1.67 vs. 3.57±2.9.(p=0.0005).

Totally 2.69±1.9 PRBC was transfused to each patients, the distribution of PRBC transfusion were as follow: 27/108 (25%) at the operating room; 68/108 (62.96%) in the ICU and the remaining 13/108 (12.03%) got transfused in the ward.

Conclusion: The present study has declared that the PRBC transfusion in the cardiac surgery setting is too liberal and need urgent interventions like implementing targeted education, standard of care guideline and auditing by hospital transfusion committee with wise feedback. Hence, further studies are required to understand the root causes behind this pattern of PRBC transfusion regardless of world trend toward bloodless surgery.
P13

Transfusion monitoring of cardiothoracic and vascular surgery: Centro Hospitalar Lisboa Central experience

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Introduction: Santa Marta hospital (HSM) of Centro Hospitalar Lisboa Central (CHLC) hosts cardiothoracic (CTS) and vascular (VS) surgical departments. As these surgical practices are related with high blood products consumption, Immunohemotherapy department, incorporated in a quality management programme, has always been concerned in rationalize therapeutic transfusion. Therefore, we have implemented and monitored the average blood consumption by departments and surgical procedures, in order to define: Crossmatch/Transfusion Index (C/T), Average Blood Consumption by Surgical Procedure (ABC) and number of packed red blood cell units used to crossmatch for a surgical procedure. Almost the total amount of thoracic and vascular surgical procedures are included in “Type and Screen” methodology. In a regular basis, the results of this monitoring are shown and discussed with Surgical Departments and Transfusion Commission, in a constant way to optimize the ABC and as a result to minimize the number of returned packed red blood cell units. Our goal is to show the results of blood products consumption monitoring in CTS and VS surgeries, including cardiac and lung transplants.

Methods: We reviewed the number of packed red blood cell units used to crossmatch and used in transfusion and thereafter to calculate the global C/T index by surgical department in year 2014 and 2017. We proceeded then to comparative analysis of ABC in two homologous periods, first trimesters of years 2014 and 2017, by department and by surgical procedure.

Results: The global C/T index in the first trimester of year 2014 was comparatively lower than the homologous period of year 2017. However, in paediatric heart surgeries and in vascular surgeries the C/T index in year 2017 was comparatively lower. In a comparative analysis by departments between first trimester of year 2014 and 2017, we verified less transfused patients and a reduction in the average number of packed red blood cell units used in perioperative transfusions, always below 1 value in year 2017. In regard of the comparative analysis by surgical procedure, we verified also a reduction in the average number of packed red blood cell units used in all perioperative transfusions.

Conclusion: Reduction of ABC by surgical procedure was due to the increased development of the surgical and anaesthetic techniques and the great effort of all health professional involved. Monitoring of ABC and implementation of Type and Screen methodology allows avoiding unnecessary transfusions, more rationalization of the use of blood products, assurance of blood products quality and more safety for the patients.
Risk factors for blood transfusion in paediatric cardiac patients presenting to cardiac catheterization lab

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Emory University and Children’s Healthcare of Atlanta, Atlanta, Georgia, USA

Introduction: Over the past several decades, procedures performed in the cardiac catheterization lab for children and adults with congenital or acquired heart disease are increasing. Previously, most procedures were diagnostic, but more interventional are being performed on younger and smaller patients. A small subset of patients requires blood transfusions during these procedures. Therefore, identifying risk factors that predispose to transfusion will improve care and reduce laboratory costs and blood product waste. As there is little data in the literature, we sought to identify risk factors associated with blood transfusions in the paediatric cardiac catheterization lab at our institution.

Methods: After IRB approval, we queried our institutional database for patients undergoing procedures in the catheterization lab from April 1st, 2016-June 30th, 2017, excluding patients on extracorporeal membrane support (ECMO) and those undergoing an electrophysiology procedure. We identified patients who received a transfusion within 72 hours of the procedure. Using Chi-Square test or Wilcoxon rank-sum tests, we compared risk factors between patients who received a transfusion with those who did not. A multivariate analysis was performed to determine factors predictive of transfusion.

Results: We identified at total of 1063 patients who fit criteria during the study period. Of these, 142 (13.4%) were transfused. Pre-procedure factors significantly associated with blood transfusion included: lower weight; younger age; prematurity; single ventricle physiology; lower preoperative oxygen saturations; preoperative oxygen supplementation; urgent or emergent status; inpatient status. Intraoperative factors that were significant include: length of procedure, systemic arterial saturation; mixed venous saturation. Individual anaesthesiologists or proceduralists were not a significant factor. A multivariate analysis demonstrated weight (OR 1.05; 95% CI 1.03-1.07), preoperative haemoglobin (OR 1.49; 95% CI 1.32-1.68), single ventricle physiology (OR 2.85; 95% CI 1.70-4.79), emergent procedure status (OR 21.45; 95% CI 4.48-102.65), and inpatient status (OR 6.61; 95% CI 1.69-25.85) were risk factors for transfusion in the catheterization lab.

Conclusion: Risk factors for blood transfusion in the cardiac catheterization lab include infants and neonates, history of prematurity, single ventricle physiology, preoperative oxygen supplementation, emergent and urgent procedures, inpatient status, and long procedures. Individual practices of anaesthesiologists and cardiologists are not risk factors for transfusion. These data identify a subset of patients at high risk for a blood transfusion during cardiac catheterization. Measures to ensure blood availability and reduce blood loss during the procedure in predisposed patients should be taken to minimize associated transfusion risks.
Predictors of transfusion in paediatric liver transplant: a retrospective analysis

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**Introduction:** In the adult population, living donor liver transplant (LDLT), in comparison to deceased donor liver transplant (DDLT), has been found to facilitate timely transplantation without increasing blood transfusion requirements, long-term morbidity or mortality. However, these effects remain to be fully investigated in the paediatric population. The effect of LDLT on transfusion is particularly important in paediatrics because blood transfusion in paediatric liver transplant can be substantially higher on a volume per kilogram basis and is associated with decreased patient and graft survival. The aim of the current study was to determine the effect of LDLT on blood transfusion in a paediatric population in comparison to DDLT and to determine modifiable risk factors associated with transfusion so that blood product requirements can be more accurately predicted preoperatively.

**Methods:** Following approval from our local Quality and Risk Management ethics review board, we retrospectively collected perioperative blood loss, transfusion, and outcome data from all paediatric patients (age <18) undergoing isolated liver transplant or combined liver and renal transplant at SickKids Hospital from July 2004 to April 2016. Data were extracted from our institution’s electronic medical record, operating room informatics database and liver transplant program database. 284 patients were evaluated for study inclusion. 11 patients were excluded for incomplete records or if they received a multivisceral transplant and 273 were analysed for perioperative outcomes and transfusion requirements. Linear regression was used to investigate risk factors for transfusion in the paediatric liver transplant population.

**Results:** Data were collected from 153 paediatric DDLT patients (age 6.88 ± 5.71 yrs, 48% male, 29% for biliary atresia, 15.4% retransplant, 43.6% prior laparotomy, transplant year 2010 ± 3.1 yrs, total surgical time 462 ± 140 min, total cross-clamp time 73 ± 25 min) and 120 paediatric LDLT patients (age 3.53 ± 4.73 yrs, 52% male, 53% for biliary atresia, 0% retransplant, 50% prior laparotomy, transplant year 2011 ± 3.3 yrs, total surgical time 527 ± 115 min, total cross-clamp time 78 ± 19 min). DDLT patients received 51.41 cc/kg more packed red blood cells than LDLT when adjusting for age at time of transplant, total cross-clamp time, total surgical time, and year of transplant ($P < 0.001$).

**Conclusion:** The current study indicates that DDLT patients may be at a higher risk of perioperative transfusion due to multiple perioperative risk factors. Identifying these patients early may allow for more efficient blood-bank resource utilization as well as more aggressive perioperative anaesthetic and surgical management of haemostasis.
P16

Perioperative red cell transfusions are associated with postoperative venous thromboembolism in children and neonates: evidence from a large North American multicenter prospective registry

*Weill Cornell Medical College/New York-Presbyterian Hospital, New York, NY, USA

Importance: Molecular/evidence supporting role of red blood cells (RBCs) in pathologic thrombosis is increasing. It has recently been shown that venous thromboembolism (VTE) is associated with RBC transfusion in adults. The incidence of VTE is reportedly rising in hospitalized children. RBC transfusion is commonly performed in the perioperative period in children. Objective of this study was to examine the relationship between perioperative RBC transfusions and post-operative VTE within 30 days of a surgery in children (<18 years).

Methods: Using the pediatric databases of the American College of Surgeons National Surgical Quality Improvement Program (PEDS ACS-NSQIP) database from 2012-2014, risk-adjusted outcomes for venous thromboembolism (deep venous thrombosis or pulmonary embolism) of all pediatric patients (<18 years) undergoing elective and urgent/emergent surgeries were compared. Univariate logistic regression followed by multivariable stepwise logistic regression was performed.

Results: A total of 183,233 children [39,211 infants (≤1 year age); 7,857 neonates (<28 days age)] who underwent surgical procedures from 2012-2014 were evaluated. Of these 73.18% of surgeries were elective, 10.03% were urgent and 16.80% were emergent procedures. About 1.1% (n = 1956) of all children [n = 1129 (2.9%) infants; n = 507 (6.45%) neonates] received pre-operative transfusions (within 48 hours of surgery). Six percent (n = 11,003) of all children [n = 3,462 (8.83%) infants; n = 1,101, (14.01%) neonates] received RBC transfusions intraoperatively from the start of the surgery until 72 hours post-surgery. Of these, 5.9% (n = 10,744) children had a single episode of RBC transfusion and 0.1% (n = 259) had more than one episode (maximum 6 transfusion episodes). A total of 197 children (0.11%) [(n = 74 (0.2%) infants; n = 28 (0.36%) neonates)] had postoperative VTE (including 10 (0.11%) cases of pulmonary embolism (PE)) that warranted a therapeutic intervention. Intra/post-operative RBC transfusions were associated with 1.8-fold higher risk of VTE (adjusted odds ratio [adjOR] = 1.81; 95% CI = 1.25-2.61, P < 0.001) after accounting for various putative risk factors including age, gender, known bleeding/coagulation disorder, sepsis, history of prior cerebrovascular accident (embolic, thrombotic, or haemorrhagic), preoperative labs including haematocrit, platelet counts, partial thromboplastin time and International Normalized Ratio, total operative time, severity of underlying illness and the complexity of surgery (see Table 1). The relationship was stronger in infants [adjOR = 3.2; 95% CI = 1.88-5.43, P < 0.001] and neonates [adjOR = 5.66; 95% CI = 2.30-13.93, P < 0.001].
Abstracts of the 19th Annual NATA Symposium

Poster Abstracts

Table 1. Odds ratio estimates for postoperative venous thromboembolism in children and neonates receiving perioperative red cell transfusions versus not

<table>
<thead>
<tr>
<th>Effect</th>
<th>Point Estimate</th>
<th>95% Wald Confidence Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intra/postop RBC Transfusions (Yes versus No)</td>
<td>1.81</td>
<td>1.25 2.61</td>
</tr>
<tr>
<td>Male vs Female</td>
<td>0.99</td>
<td>0.73 1.34</td>
</tr>
<tr>
<td>Age (every year increase in age)</td>
<td>1.00</td>
<td>1.00 1.00</td>
</tr>
<tr>
<td>SIRS* vs None</td>
<td>1.70</td>
<td>0.85 3.42</td>
</tr>
<tr>
<td>Sepsis vs None</td>
<td>2.07</td>
<td>1.16 3.70</td>
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<td>Septic Shock vs None</td>
<td>6.02</td>
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<td>History of prior cerebrovascular accident (embolic, thrombotic, or hemorrhagic) Yes vs No</td>
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<td>Known Bleeding/Disorder Yes vs No</td>
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<td>Central Line Associated Bloodstream Infection (Yes vs No)</td>
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<td>0.48 2.41</td>
</tr>
<tr>
<td>Preoperative-HCT</td>
<td>0.97</td>
<td>0.94 0.99</td>
</tr>
<tr>
<td>Preoperative-Platelet count</td>
<td>1.00</td>
<td>1.00 1.00</td>
</tr>
<tr>
<td>Preoperative PTT</td>
<td>1.00</td>
<td>1.00 1.01</td>
</tr>
<tr>
<td>Preoperative INR</td>
<td>1.00</td>
<td>1.00 1.01</td>
</tr>
<tr>
<td>ASA** 2- Minor disturbance vs ASA 1(reference)</td>
<td>2.80</td>
<td>0.96 8.15</td>
</tr>
<tr>
<td>ASA 3 - Severe Disturb vs ASA 1</td>
<td>10.05</td>
<td>3.60 28.05</td>
</tr>
<tr>
<td>ASA 4 - Life Threat vs ASA 1 - No Disturb</td>
<td>21.94</td>
<td>7.50 64.14</td>
</tr>
<tr>
<td>ASA 5 - Moribund vs ASA 1 - No Disturb</td>
<td>30.84</td>
<td>8.21 115.94</td>
</tr>
<tr>
<td>Work Related Relative Value Unit of Surgery***</td>
<td>1.01</td>
<td>1.00 1.02</td>
</tr>
<tr>
<td>Total operative time (in minutes)</td>
<td>1.00</td>
<td>1.00 1.00</td>
</tr>
</tbody>
</table>

*SIRS stands for Systemic Inflammatory Response Syndrome.

**American Society of Anesthesiology (ASA) severity class used as surrogate marker of severity of underlying illness.

Conclusions: In this prospective registry study of >180,000 children undergoing surgeries, perioperative RBC transfusions were significantly associated with higher risk adjusted odds of VTE within 30 days post-operatively. The relationship is also seen in subgroup analysis in infants and neonates. Should these findings be validated in a prospective setting, blood sparing alternatives and perioperative paediatric patient blood management strategies need to be explored in these patients to optimize the preoperative haematocrit with an aim to minimize perioperative transfusions in children.
How do we transfuse in postpartum haemorrhage (PPH) – Experience of 5 years in a reference maternity hospital

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Introduction: Postpartum haemorrhage (PPH) is an obstetric emergency and may endanger the pregnant and the fetus, and currently is one of the major causes of morbidity and mortality in maternity hospitals worldwide. Recognizing PPH by an interdisciplinary approach in a timely manner helps to prevent maternal catastrophic bleeding. The aim of this study is to characterize the consumption of blood components and blood products in PPH at Maternity Alfredo da Costa (MAC), a reference maternity hospital in Portugal.

Material and methods: We conducted a retrospective cohort study of patients who received blood transfusion and blood products for PPH during the acute onset and in the first 24 hours post-delivery, at our institution, over a five-year period (2013-2017). The medical records of patients were reviewed to obtain information about the history, pregnancy, delivery characteristics and transfusion data.

Results: Of the 18,005 births recorded in this period, 234 women were transfused by PPH, with a mean age of 32 years. The mean gestational age was 37 weeks and the type of delivery observed was vaginal delivery (24%), forceps and/or vacuum extraction (39%) and caesarean section (37%). The most commonly transfused components were erythrocyte concentrate (70%, median 2), frozen fresh plasma (16.3% median 0) and platelet concentrates (4.1%, median 0). Between 2013 and 2015 the number of PPH had decreased from 54 to 29; however, there has been an increase in the last two years to 61 and 55, respectively. The main causes of PPH observed were isolated uterine atony (13.2%) or associated with placenta retention (4.3%) and perineum laceration (5.1%). The placenta retained alone was also a cause in 6.8%. The cause was unknown in 7.3% of the cases. No maternal death associated with PPH was observed. There were no transfusion related events reported.

Conclusion: PPH is the leading cause of maternal mortality in low-income countries and the primary cause of nearly one-quarter of all maternal deaths globally. It is important that each hospital knows its reality so it can act and prevent this complication. The main causes and the prevalence of PPH identified are consistent with similar studies. At MAC, we observed that transfusion consumption is less than in literature, which reveals that an interdisciplinary approach with Immunohaemotherapy, Obstetrics and Anaesthesia allows a timely diagnosis, resources, and patient blood management according to restrictive policies and rationalization of transfusion and resources.
Abstracts of the 19th Annual NATA Symposium

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Autoimmune haemolytic anaemia: provision of safe and timely blood transfusion

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Introduction: Autoimmune haemolytic anaemia (AIHA) is increased destruction of red blood cells (RBCs) in the presence of autoantibodies with or without the presence of haemolysis. They can be categorised into warm AIHA, caused by IgG autoantibodies or cold AIHA, caused by IgM autoantibodies. Most patients with severe haemolysis will require a blood transfusion. The main concern with patients presenting with autoantibodies is the identification of possible clinically significant underlying alloantibodies. These patients can prove problematic to transfusion laboratories due to their cross reacting autoantibodies. To provide compatible blood for these patients and to prevent haemolytic transfusion reactions, autoantibodies need to be removed by adsorption techniques, allowing for detection of underlying alloantibodies that may be masked by the autoantibody. Alloadsorption is a cumbersome technique, which uses selected allogeneic RBCs. Because of the potentiator effect of Low Ionic Strength Saline (LISS) for antigen-antibody reactivity, its use can increase efficiency of the adsorption of autoantibodies. The addition of LISS during alloadsorptions has been proven to be more effective in removal of auto-antibodies and leads to a shortened completion time.

Materials and methods: Validation of LISS adsorption technique requires pre-enzyme treated RBCs, patient plasma and LISS. The RBCs for enzyme treatment are ABO, Rh, Kell and Kidd matched to the patient. 30 samples were processed in parallel using the alloadsorption and LISS alloadsorption techniques allowing for reduction of the incubation step from 45 minutes to 10 minutes.

Results: LISS adsorptions proved to be a more effective and more sensitive technique for adsorbing autoantibodies from patient plasma. In three of the samples tested additional underlying antibodies were detected. Reduction of adsorption time from 45 minutes to 10 minutes greatly decreased the turn-around time for provision of blood.

Conclusion: Decreased turnaround times for provision of blood for patients presenting with autoantibodies due to the new LISS adsorption technique. Overall cost savings for the hospital reducing unnecessary admissions as blood can now be provided on the same day.
P20

Red blood cell transfusion independence after allogeneic hematopoietic stem cell transplant in patients with acute myeloid leukaemia: a single institution experience

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Introduction: Red blood cell (RBC) transfusion is a standard supportive therapy after allogeneic hematopoietic stem cell transplant (HSCT) for advanced hematologic malignancies. When HLA matched donors are not available, haplo-cord (HC) transplant (umbilical cord blood graft combined with a CD34-selected graft from a haplo-identical donor) is used at our institution. This study compares RBC transfusion independence (TI) and transfusion burden (TB) until TI, between HLA matched related donors (MRD), unrelated donors (MUD) and HC transplant groups.

Methods: Patients undergoing MRD, MUD, and HC HSCT for acute myeloid leukaemia (AML) and Myelodysplastic Syndrome/Myeloproliferative Disease (MDS/MPD), at our institution between 1/2012-12/2017 were included. Time to RBC TI was defined as the day of the last transfusion with no transfusions in the following 30 days. Data were censored on disease relapse or death. Kaplan-Meier failure estimate method, Log rank test for equality of survival function and adjusted Cox proportional hazard regression model were used to compare the time-to-event distribution between the groups. Transfusion burden (TB) until TI was compared by the t-test. Statistical analysis was performed using STATA 14.1 (StataCorp LP, College Station, Texas).

Results: A total of 333 patients with AML (n=241, 72.3%) or MDS/MPD (n=92, 27.7%) received had a MRD (n=96, 28.83%), MUD (n=123, 36.9%), and HC (n=114, 34.2%) HSCT. TI was achieved for RBC transfusion in 90.1%, 80.5%, and 83% of patients, at median time (IQR) of 14 (9, 34), 17 (9,104), and 33 (14, 72) days post-transplant, for MRD, MUD, and HC, respectively. Time until TI was significantly improved in MRD, in comparison to both MUD and HC (log-rank \( P < 0.005 \)) (Fig. 1). Cox regression Hazard Ratio after adjusting for age at transplant, relapse and mortality was 1.5 (95% CI: 1.1, 2.2), and 1.8 (95% CI: 1.2, 2.6) for MUD and HC, respectively (\( p <0.005 \)). TB was also lowest in the MRD group: RBC units per patient (mean ± SD) 4.3 ± 5.4 in comparison to MUD 9.3 ± 13.08 and HC 9.6 ± 11.55 (\( P < 0.005 \)) (Fig. 2). TI and TB were not statistically different between HC and MUD transplants (log-rank \( P = 0.64 \) and t-test \( P = 0.85 \), respectively).

Conclusion: RBC transfusion requirements are approximately doubled in MUD and HC recipients compared to MRD recipients. Time until TI and TB are similar in HC transplant compared to MUD transplant.
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Poster Abstracts

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Predictors of packed red blood cell transfusion in non-emergent cardiac surgery – a single-centre retrospective study

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Introduction: Transfusion remains a negative outcome in cardiac surgery, as it is associated with an excess of morbidity and mortality.

Methods: We performed a retrospective analysis of patients who underwent non-emergent cardiac surgery, in a tertiary care teaching hospital, between 1 January 2016 and 31 December 2016. We collected demographic data, as well as hematologic variables and transfusion needs using electronic and written health records. Data collection and analysis was approved by the institutional ethical committee.

Results: 236 patients were identified. Of these, 25.4% were anaemic (according to WHO criteria) preoperatively (see Table 1), 36.4% underwent complex cardiac surgery and 47% received at least 1 unit of packed red blood cell (PRBCs) perioperatively. Median preoperative haemoglobin was 13.7 g/dL (IQR 12.5-14.4) in the global population; in anaemic patients, it was 11.4 g/dL (IQR 10.4-12.1). Patients received a mean of 1.2 units of PRBCs (SD 2), but those who were anaemic preoperatively received 2.43 (SD 2.02) units, compared to 0.78 (SD 1.81) in the non-anaemic population. Using a multivariate logistic model, we identified independent predictors for perioperative transfusion, and those were preoperative anaemia, according to WHO criteria (OR 15.40, 95% CI 6.66-35.98), patients undergoing complex surgery (OR 2.54, 95% CI 1.47-4.39). We created a predictive model using these two preoperative values and obtained an area under the receiver operating characteristic (ROC) of 0.76 (see Figure 1).

Table 1

<table>
<thead>
<tr>
<th>Variable</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>62  (57-69)</td>
</tr>
<tr>
<td>Preoperative haemoglobin (g/dL)</td>
<td>13.7 (12.5-14.4)</td>
</tr>
<tr>
<td>Preoperative anaemia</td>
<td>25.4% (60/236)</td>
</tr>
<tr>
<td>Complex cardiac surgery</td>
<td>36.4% (86/236)</td>
</tr>
<tr>
<td>EuroSCORE (additive)</td>
<td>4 (3-6)</td>
</tr>
<tr>
<td>Perioperative transfusion</td>
<td>47% (111/125)</td>
</tr>
</tbody>
</table>

Conclusions: Preoperative anaemia, as well as complex planned surgery offer a good prognostic value for perioperative transfusion. There is a strong argument that in such patients, surgery should be postponed until correction of anaemia to avoid preventable postoperative complications.
Reducing crossmatch and transfusion rates through implementation of a Maximum Surgical Blood Order Schedule as a component of Patient Blood Management

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Introduction: Red blood cell (RBC) transfusion is associated with increased morbidity and mortality. Nevertheless, even with restrictive transfusion policies, it remains one of the five most overused procedures in hospitals. Patient Blood Management (PBM) can reduce the need for allogeneic blood transfusions and reduce healthcare costs, while ensuring that blood components are available for the patients who need them and contributes to the accurate and efficient utilisation of RBC units. Preoperative over ordering of blood is common, resulting in waste of blood bank resources (reagents and unnecessary workload). The crossmatch to transfusion (CT) ratio has been used as a tool to evaluate efficient blood utilisation in elective surgery. Maximum Surgical Blood Order Schedule (MSBOS) is a programme to optimise blood ordering in elective surgical cases by reducing the number of RBC units crossmatched preoperatively for patients undergoing elective surgical procedure.

Methods: A list of surgical procedure categories and the corresponding recommended preoperative blood orders was developed with the agreement of surgeons, anaesthesiologists and blood bank medicals. The introduction of type and screen has been standardised, as well as the number of units to be ordered by elective surgical procedures. This program was applied to all patients undergoing elective surgery and with a haemoglobin level ≥11 g/dl. It has been also agreed that a regular monitoring of this ratio should be shared with all participants. This programme was implemented in the 4th trimester of 2017.

Results: We evaluated the 2336 RBC units ordered in 2017. The annual CT ratio was 50.3%. The evolution of this ratio, by trimester, showed an improvement of approximately 2% between the first and fourth trimester.

Conclusion: Implementation of MSBOS reduces unnecessary crossmatching as well as transfusion rates and is an important component of a hospital PBM programme.
Evaluation of perioperative crossmatch-to-transfusion ratio in a Portuguese University Hospital

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Introduction: Crossmatch-to-transfusion (C/T) ratio is a valuable indicator for the quality of an institution’s blood ordering practices. A high C/T ratio indicates failure to accurately anticipate the need of transfusion, also implies that crossmatch are performed unnecessarily. Excessive crossmatching, in addition to being wasteful of resources, has adverse consequences on management of blood inventory and blood quality.

The aim of this report is to evaluate perioperative C/T ratio in our hospital before and after the implementation of Maximum Surgical Blood Order Schedule (MSBOS).

Methods: We made a 7-year overview on the request and intraoperative consumption of packed red blood cells (RBC) between January 2011 and December 2017. All data for preoperative blood orders were obtained from our blood bank database. In 2012, MSBOS was implemented and a numerical maximum blood order was suggested for 77 of the 142 surgeries, a type and screen (T&S) order was applied for 31 and no blood order for 34 procedures. The last update (4th version-2015) of our MSBOS suggested to a total of 141 surgeries, blood order to 52, T&S for 55 and no blood order for 34.

Results: During the period from January 2010 to December 2017, a total of 77 923 crossmatch tests were done and 27 930 RBC were transfused with an overall C/T ratio of 2.8. Looking at the annual C/T ratio, we found that after the implementation of MSBOS there was a reduction from 3.3 in 2011 to 2015 where we reached the lowest C/T ratio of 2.3, though we are aware we didn’t achieve 100% compliance with the Maximum Surgical Blood Order Schedule. The ratio increased in the following years to 2.6. From 2010 to 2017, we observed a 49.5% decrease in preoperative crossmatch in our institution, with a decrease of 35.3% of units transfused.

<table>
<thead>
<tr>
<th>Year</th>
<th>Crossmatch</th>
<th>Transfusion</th>
<th>C/T</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>15 991</td>
<td>4889</td>
<td>3.3</td>
</tr>
<tr>
<td>2012</td>
<td>14 895</td>
<td>4915</td>
<td>3.0</td>
</tr>
<tr>
<td>2013</td>
<td>12 369</td>
<td>4436</td>
<td>2.8</td>
</tr>
<tr>
<td>2014</td>
<td>10 334</td>
<td>3865</td>
<td>2.7</td>
</tr>
<tr>
<td>2015</td>
<td>8187</td>
<td>3521</td>
<td>2.3</td>
</tr>
<tr>
<td>2016</td>
<td>8075</td>
<td>3142</td>
<td>2.6</td>
</tr>
<tr>
<td>2017</td>
<td>8072</td>
<td>3162</td>
<td>2.6</td>
</tr>
</tbody>
</table>

Conclusion: Acceptable value for C/T ratio is ≤2, which means that the physicians transfused the amount of blood they ordered to their patients. Implementing an institution-specific MSBOS results in a substantial reduction in unnecessary orders and costs. Regular audits to assess the C/T ratios with subsequent updating of MSBOS are advantageous.
To bleed or not to bleed – a multidisciplinary approach to improving perioperative transfusion efficiency and safety

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Ninewells Hospital, Dundee, Scotland, UK

Introduction: Current (2012) British Committee for Standards in Haematology guidelines for pre-transfusion compatibility procedures recommend that a second sample should be submitted for confirmation of ABO group in patients who may require transfusion in the next 48 hours. In Ninewells (NWH), a large Scottish teaching hospital, elective patients attend Pre-Assessment Clinic (PAC) where a first Group and Screen (G&S) sample is taken. A second G&S is taken when admitted on the day of surgery. Patients can attend one of three geographically separate PACs prior to attending NWH for surgery. We suspected samples were being taken unnecessarily and incorrectly, leading to delays, possible risk, increased cost and patient discomfort from inappropriate sampling. As Deming notes, “greater than 94% of errors are attributable to the system that underlies them.”1 We conjectured that standardising Multi-Disciplinary Team (MDT) communication would improve our G&S process and patient safety.

Methods: Process mapping the patient journey revealed that PAC G&S first samples were not being taken appropriately or recorded accurately. A questionnaire circulated among 32 junior doctors, nurses and healthcare assistants responsible for admitting surgical patients at NWH revealed unfamiliarity with the indications for a second G&S and variations in recording if a second sample had been taken. Sampling was being duplicated or missed throughout the process, resulting in potential risk from surgery or patient discomfort from oversampling. Surgery was often delayed as documentation of second G&S could not be found.

Results: Multiple PDSA (Plan-Do-Study-Act) cycles focused on improving documentation to facilitate communication between PAC and admitting teams. A sticker enabling standardised G&S documentation was created for PAC forms as a test of change. Process mapping at NWH revealed opportunities to improve patient flow and increase patient satisfaction through reduced unnecessary sampling. Education of PAC nurses and admitting teams ensured familiarity with G&S practice throughout the patient journey. Closer ties with local Blood Transfusion Service (BTS) were invaluable in ensuring recommendations were appropriate, current and had BTS support.

Conclusions: Through an explicit understanding of a system we have developed a simple, standardised process giving us assurance we are avoiding potential inefficiencies and patient harm. Simple improvements have been made to standardise documentation, educate staff and improve patient flow. BTS resources are better employed as fewer unnecessary samples are taken. Delays to surgery are less likely. These small changes have a significant impact resulting in a safer service that is also resource friendly. Future tests of change will continue to improve on the successes we have had with this project, enabling the developed process to adapt to varying service demands.

REFERENCE
Transfusion medicine: good practice, good ideas and a need to change

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Introduction: Good practice in transfusion medicine implies an adequate and effective evaluation of the different applications of transfusion therapeutic. Nowadays, previous analytic evaluation of hemogram values and coagulation status, as effective hemostasis during surgery, allow a rational use of red blood cell units (RBCU). A continuous control of the effectiveness of this process gives an important perspective of the practical application of Patient Blood Management (PBM) concepts. This work intention is to gather, evaluate and compare data from 2015 to 2017 of the Department of Transfusion Medicine of a Portuguese hospital, having in mind the RBCU requested, prepared and transfused, and the use of non-isogrupal units.

Methods: Data of RBCU were obtained from the informatic platform SIBAS® of the hospital, referring from 2015 to 2017.

Results: In 2017, 17,001 RBCU were requested and 7,622 were transfused (44.8% of the total requested). According to a previous study, in 2015, 16,879 RBCU were requested and only 7,670 transfused (45%). In 2016, 16,879 RBCU were requested and 7,529 transfused (44.6%). In each year, 80% of the requested RBCU were prepared for transfusion. The percentage of non-isogrupal units was 2%, the very same as in 2016.

Conclusion: The continuous control and evaluation of the RBCU use in a Portuguese hospital, shows that in three consecutive years, there was no alteration in the high number of RBCU requests and prepared units. Besides that, the RBCU transfused remains approximately 45% of the total units requested in these three years. Less than half of the requested RBCU was transfused, which may indicate that the correct measures to maintain an effective haemostasis have been applied. However, twice of the RBCU actually transfused were prepared, implying a waste of time and resources. It is urgent to define a method that guides the decision of the number of RBCU to request and to prepare. It has to be effective in maintaining the quality of the response and the resources. The method has to be simple to apply and regularly updated, according to the modern techniques used in surgeries. The use of old algorithms is not sufficient to decrease the number of requested and prepared units. It is important to implement a global strategy regarding PBM that includes the hospital’s administration.
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Reduction of red blood cell average daily consumption in a Portuguese University Hospital over a 7-year period

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Introduction: Strategies have been developed over the years to optimise blood usage, avoiding patient over-transfusion, in order to improve patients’ outcome. As many Hospitals, Centro Hospitalar de São João, EPE, is facing a reduction in red blood cell (RBC) transfusions. This seems to be associated with a series of strategies implemented by our local Transfusion Committee since 2012. Our aim was to evaluate the impact of these policies, such as the Maximum Surgical Blood Ordering Schedule (MSBOS), Transfusion Manual, Medical Education in Transfusion Medicine and single-unit transfusion in the drop of average daily RBC consumption at our institution.

Methods: We collected data from January 2010 to December 2017 from the blood bank database. We determined the average daily consumption of RBC along this period, the absolute number of RBC units transfused and the number of recipients per year.

Results: We observed a reduction of 32.2% in RBC consumption from 2010 to 2017 with the biggest decrease between the years 2012 and 2013 (-9.2%) (Table 1). The index units of RBC per recipient was similar along this period. There was a decrease in both the number of recipients (from 5272 to 3970) and blood units used (from 24055 to 16310).

Table 1

<table>
<thead>
<tr>
<th>Year</th>
<th>RBC consumption</th>
<th>Daily consumption of RCB units</th>
<th>Δ between years</th>
<th>Recipients</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>24055</td>
<td>65.9</td>
<td>-6.7%</td>
<td>5272</td>
</tr>
<tr>
<td>2011</td>
<td>22474</td>
<td>61.5</td>
<td>-8.3%</td>
<td>5297</td>
</tr>
<tr>
<td>2012</td>
<td>20600</td>
<td>56.4</td>
<td>-9.2%</td>
<td>4944</td>
</tr>
<tr>
<td>2013</td>
<td>18705</td>
<td>51.2</td>
<td>-8.2%</td>
<td>4595</td>
</tr>
<tr>
<td>2014</td>
<td>17162</td>
<td>47.0</td>
<td>-6.4%</td>
<td>4185</td>
</tr>
<tr>
<td>2015</td>
<td>16273</td>
<td>44.6</td>
<td>+4.2%</td>
<td>3968</td>
</tr>
<tr>
<td>2016</td>
<td>16990</td>
<td>46.5</td>
<td>-4.3%</td>
<td>3941</td>
</tr>
<tr>
<td>2017</td>
<td>16310</td>
<td>44.7</td>
<td></td>
<td>3970</td>
</tr>
</tbody>
</table>

Conclusions: The promotion of transfusions best practices through the enhancement of awareness and education by our Transfusion Committee had a strong influence in the change of clinical practices, with a reduction in the RBC units transfused. Though the number of units of RBC per receptor had little variation, there was a decrease in both the number of recipients and blood units used. All together, we can assert that the measures implemented were effective and contributed to a better and more conscious use of RBC units.
Patient blood management allows direct savings from reduced blood product ordering: evaluation of an educational intervention in blood ordering policy

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University Hospital Centre Zagreb, Croatia

Introduction: Patient blood management (PBM) is a multimodal approach to optimize utilization of blood products transfusion. Since transfusion ordering practice was influenced more by old habits than by evidence-based guidelines, in March 2015 we implemented PBM in University Clinical Hospital Center Zagreb and in December 2016 we published local guidelines for preoperative red blood cell (RBC) orders for all kind of general surgical procedures (with modernization of the maximal surgical blood ordering schedule - MSBOS), and provided continuous clinical education for our clinicians. We examined RBC utilization trends in the perioperative period in our centre, suspecting that RBC products are being over-requested and to find out if our educational efforts succeeded in implementing new MSBOS guidelines.

Methods: All surgeries conducted in our centre between January 2012 and June 2017 were retrospectively reviewed. Preoperative RBC unit ordering and transfusion events were extracted from the electronic medical records and a paper blood bank database, and cross-match-to-transfusion ratio (C/T ratio) calculated for every surgical ward before and after PBM and guidelines introduction. Based on our analysis, many surgical procedures were identified as “no routine order” (NRO), some procedures were downgraded to “type and screen only” (TSO) and for those with a risk of intraoperative bleeding ≥50% we ordered “type and crossmatch” (TC) blood. We aimed to achieve a crossmatch-to-transfusion (C/T) ratio of <2.0. Expenses regarding blood testing were calculated and compared.

Results: A trend is evident in reduction in number of ordered RBC units, from approximately 1972 units during pre-induction of PBM, to 1108 after intervention, as well as reduction in C/T ratio (Graph 1 and 2). Before PBM, there were wards with unacceptable high C/T ratio of 6.0 (Graph 3). All surgery wards show C/T ratios of 2.0 in first 6 months of 2017, indicating rationale preoperative blood ordering. We noticed decrease in spending for pre-transfusion testing, with costs cut in half after PBM (Graph 4).

Conclusions: We made 100% success in reducing unnecessary blood ordering and considerable cost savings with avoiding unnecessary blood testing. Intensive education and decision support led to a change in transfusion practice: clinicians have moved towards more restrictive transfusion triggers and targets. This results demonstrate that improvement of transfusion practice is feasible and has significant potential to reduce RBC usage and hospital costs.
Educational change programme in patient blood management

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¹University College London, London, UK

Introduction: Patient blood management (PBM) is a patient-centred, multidisciplinary, multimodal evidence-based approach to optimise the use of blood products. Educational change is pivotal to implementation. The aim of this study was to assess implementation of PBM through a programme of awareness in vascular surgery.

Methods: Audit of process in vascular surgery.
- Initial audit of transfusion practice in a regional vascular service (October 2014-March 2015).
- Intervention: An educational change programme including educational sessions to hospital staff, development of a PBM checklist and attendance on ward rounds, which was led by an undergraduate student.
- Re-audit (November 2015-February 2016)
- Outcomes of interest were: 1) proportion of patients receiving transfusion, 2) single-unit transfusion, 3) length of stay (LOS).

Results: Overall, there were 127 patients for Audit 1 and 84 for Audit 2. There was no change in patient demographics or the type of intervention the patients received. Proportion of patients receiving blood transfusion was reduced between Audit 1 & 2 (n = 47 (37.0%) vs. n = 17 (20.2%) (P = 0.010). Similarly, proportion of single-unit transfusion reduced between Audit 1 & 2 (n = 34 (32.7%) vs. n = 12 (30.8%)), however this was not significant (P = 0.826). Median LOS observed from Audit 1 of 17 days reduced to 8 days in Audit 2 (P = 0.001).

Conclusion: Intervention of a PBM programme led by a student reduced doctors’ transfusion rates.
Patient blood management in oncological surgery

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Introduction: The application of patient blood management (PBM) principles in cancer patients might have diverse beneficial effects and their application is strictly recommended. Indeed, it is known that perioperative blood transfusions may negatively influence the recurrence of the disease and the overall survival of this subset of patients, probably because of an immunosuppressive effect of transfusions.1,2 The aim of our study was to verify whether the implementation of a PBM policy could impact on the appropriateness of the post-operative transfusion therapy in cancer patients submitted to elective major surgery.

Methods: We evaluated the impact of the PBM policy at the AUSL-IRCCS Reggio Emilia in a two-phase retrospective study:
- Phase 1 (2014): baseline, before PBM implementation, without any intervention;
- Phase 2 (2015): PBM policy implementation, comprising i) systematic education and training of physicians and nurses of the surgical wards ii) medical consultation by the transfusion medicine doctors.

The medical and transfusion records of 400 patients who underwent elective major surgery were reviewed: 300 for phase 1 and 100 for phase 2. Transfusion therapy appropriateness, in accordance to Italian Society of Transfusion Medicine recommendations, was assessed taking into account pre-operative haemoglobin level, type of surgery and patients’ comorbidities.

Results: The patients of the two groups (Phase 1 and Phase 2) are homogenous for age, sex, type of surgery and comorbidities. Our data show that after PBM implementation: the percentage of RBCs appropriately transfused in the postoperative period increased of 20%; the number of the transfused RBCs units per patient decreased from 2.1 to 1.7.

Conclusion: In conclusion, the starting of a PBM programme specifically dedicated to cancer patients, showed a remarkable increase of RBC transfusion appropriateness and the reduction of the number of RBC units transfused in the postoperative period. Actually, developing a third phase with the aim to evaluate and cure anaemia in the preoperative period.

REFERENCES
Patient blood management: transfusion appropriateness in the postoperative period

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Introduction: Within the context of a patient blood management (PBM) policy for the perioperative period, the Transfusion Medicine Unit of the AUSL-IRCCS of Reggio Emilia adopted series of strategies to support and enhance red blood cell (RBC) transfusion best practice. The purpose of our study was to evaluate the appropriateness of RBC transfusion, focusing in the postoperative period, before and after the implementation of a PBM policy during a three-year period (2013-2015).

Methods: An observational study was conducted on adult patients underwent major surgical (orthopaedic, abdominal, thoracic, urologic, vascular) interventions. The study was designed as follows:
- preliminary audit (3 months);
- PBM policy, consisting of 3 months of PBM training (i.e. seminars, lectures, consultation with prescribers) followed by the introduction of point-of-care (POC) testing for the continuous monitoring of haemoglobin levels (12 months);
- final audit on patients monitored with POCs.

The adherence to SIMTI guidelines for RBC transfusion was assessed in both audit.

Results: The preliminary audit, performed on 168 patients, showed that 37.7% were appropriately transfused with RBCs. On the other hand, the final audit, performed on 205 patients, showed a significant increase of RBC transfusion appropriateness (65.4%).

Conclusion: In our experience, the PBM strategies introduced improved RBC transfusion appropriateness in the postoperative period. We believe that our PBM policy and introduction of POC testing are a valuable support for the healthcare workers in the transfusion decision-making process. This enhancement of transfusion appropriateness implies clinical and managerial advantages, such as reduced transfusion-related risks, optimization of the health care resources and reduction of the costs.
Blood Conservation Strategies / Autologous Transfusion

Use of cell salvage in the UK

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Introduction: Intraoperative cell salvage (ICS) is a recognised blood conservation strategy forming a standard part of patient blood management (PBM) for surgical patients. There is however no central register or database that records the usage of ICS in the UK. This study set out to support improvements in the understanding of where, how and why ICS is currently being used. The aim of these improvements is to inform clinical developments and PBM decision making.

Methods: NHS Trusts/hospitals were asked to provide information on: the number of ICS machines in use; what surgical specialties utilised cell salvage; surgical procedures in which cell salvage was routinely used; the number and cost of consumables purchased for cell salvage machines; the number of operating theatres within each organisation. Data was collected by Accelerate Associates, Stafford, UK, by means of Freedom of Information requests and interviews with key stakeholders. All data relates to the financial year 2015/16.

Results: Fifty eight NHS Trusts were approached and 32 (55%) responded. Four Trusts (5 hospitals) did not currently use cell salvage. In the remaining organisations, there were 159 cell salvage machines covering 677 operating theatres. The majority of Trusts (52%) had 4 or less cell salvage devices, 3 organisations had more than 10. The annual usage per cell salvage device was highly variable and ranged from 8 to 282 per device. Twenty seven organisations provided data on specialty use: 77% of Trusts (n = 21) were cited as using ICS for orthopaedic surgery. 74% of Trusts (n = 20) were using cell salvage for vascular surgery. 59% of Trusts (n = 16) were using ICS for obstetric and gynaecological surgery and a further 44% were using it for cardiothoracic surgical procedures. Other surgical specialties mentioned included: trauma (30%), spinal surgery (26%) liver and general surgery (22%) urology (19%) neuro surgery (15%) and patients refusing donated blood (7%). Most commonly cited procedures were open aortic surgery (70%, n = 19), revision hip replacement (70%, n = 19), ‘other’ vascular procedures (59%, n = 16), orthopaedic procedures (59%, n = 16) and caesarean section (55%, n = 15). Eight organisations supplied information on consumable costs. The mean consumable cost (range) for providing cell salvage per patient was £107 (£34-252), however this rose to £157 (£87-299) per full processing kit, reflecting that not all blood collected is reinfused. The highest level of activity was in organisations with cardiothoracic centres where cell salvage was used in over 1000 cases per annum with a highest reported individual annual expenditure on consumables in the region of £93,000.

Conclusion: Data on the use of cell salvage in the UK is not readily available. Within our survey some hospitals were not able to provide information as it was not held in an easily accessible form. The cost of cell salvage consumables can be highly variable and may reflect different purchasing options for organisations with high and low activities. A national registry recording usage would be of great benefit in benchmarking an important strategy within the broader concept of PBM.
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5-year review of the autotransfusion programme at Madeira Island Hospital

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Introduction: Dr. Nélio Mendonça Hospital is the only one in the Madeira Archipelago, located 1000 km and 90 minutes by commercial flight from the nearest Hospital. The geographical isolation of the Hospital obliges the blood bank to take all measures to guarantee the self-sufficiency of all the components to be transfused in the region. One of the strategies adopted in the context of a Patient Blood Management programme still to be implemented was the creation of an autologous transfusion protocol, open to all users of the Health System and with scheduled surgery. This review seeks to identify trends and profiles of patients and the specialties that refer them to this programme.

Methods: We performed a survey of all autologous blood units collected between January 1, 2012 and December 31, 2016, obtaining a total of 259 patients who were collected 437 units for transfusion of erythrocyte concentrate.

Results: The average unit taken per patient was 1.6, with a minimum of 1 and a maximum of 4. The mean age of the patients was 61 years, with a minimum of 13 years and a maximum of 85. The majority of the patients were male. The specialty that most referred patients was orthopaedic surgery (predominantly for prosthetic surgery), followed by urology (prostate surgery) and gynaecology (uterine surgery).

Conclusion: The use of these autologous blood units allowed, in addition to minimizing the medical consequences of the transfusion, an effective saving of heterologous components of the blood bank, and an added value for the self-sufficiency of the service.
Intraoperative blood salvage: a retrospective study

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Introduction: Intraoperative blood salvage is considered an essential procedure strategy in order to prevent or reduce blood transfusion in patients undergoing major surgery. Traditionally, orthopaedics and vascular surgery are one of the surgical procedures that often need the administration of large volumes of homologous blood components. The development of effective salvage techniques have played a major role in reducing and frequently eliminating the need for postoperative transfusion, and hence reducing the risks of administering an homologous transfusion, and increasing the cost effectiveness. Cell salvage has been used in a variety of surgical procedures namely vascular, trauma, and orthopaedic surgery. We present a successful approach in our institution’s comprehensive blood conservation programme.

Methods: A retrospective study was performed in our institution during a two year period, 2016 to 2017, and concerning 114 patients that were submitted to intraoperative cell salvage during elective vascular and orthopaedic surgery. Statistical analysis was performed using SPSS 22.0.

Results: In a total 113 patients were submitted to intraoperative blood salvage during 2016 and 2017. Surgeries consisted of 105 orthopaedic procedures (hip/knee replacement, spinal laminoforectomy/fixation), 6 AAA, 1 pituitary adenoma, 1 hepatic hemangioma and 1 thoracic aortic dissection. A total of 6 patients were suspended for presenting contraindication for the procedure. In the analysed data the mean Hb and Hct presurgery were 13.18 g/dl; 39.7% and post-surgery were 10.68 g/dl; 31.72% respectively. The mean volume collected during the surgery was 812.92 ml and the mean volume transfused during surgery was 403.23 ml. A total of 17 (15%) patients needed homologous blood transfusion, 27 units of packed red blood cells, in the first 24 hours after surgery.

Conclusion: Despite a limited sample size, the results of this study show that intraoperative blood salvage is a valuable asset in reducing the risks of homologous blood transfusion. Intraoperative red blood cell salvage is cost-effective in high-demanding surgeries with clinically important perioperative blood loss.
Cracked circuit in autologous blood salvage device for total hip arthroplasty

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Background and purpose: Intraoperative and postoperative autologous blood transfusions are performed for orthopaedic surgery at our hospital, primarily in total hip arthroplasty (THA) operations. We report an incidence of a cracked bowl in the circuit during the use of an autologous blood salvage device.

Observation: In a case that utilised the Cell Saver® 5+ (hereafter referred as 5+) autologous blood recovery system during a THA operation, a crack was observed in the base of the inner core within the bowl, allowing an influx of blood inside the inner core. Because there were no related reports at other institutions, the manufacturer tested the device and its procedural technique; however, no problems were found. As the Ministry of Health, Labour and Welfare had previously alerted that “contact with oils and fats with the polycarbonate material may induce cracks when a physical load is applied”, we reasoned that the cause of cracking is a result of fat originating in the bone marrow aspirate of the intraoperative blood during THA. As a result of conducting a verification test at the manufacturer with swine blood and soybean oil, 100% reproducibility was obtained. Therefore, we substituted a new procedure at the recommendation of the manufacturer in order to reduce the fat retention time within the bowl, and performed autologous blood salvage with the 5+ to perform unilateral THA, bilateral THA, and other operations (surgeries that do not require treatment of femoral bone marrow).

Discussion: Although the incidence of cracks in the inner core was reduced by using the newly recommended procedure, bilateral THA demonstrated a higher incidence rate compared to other surgical operations. This is due to the fact that, when compared with unilateral THA, bilateral THA produces a greater amount of fat with salvaged blood during the medullary reaming or rasping procedure of the femur, in effect doubling the fat retention time in the bowl due to increased operation time. At present, for bilateral THA our hospital is using the LivaNova autotransfusion device XTRA, which has never shown similar issues.

Conclusion: In operations that produce a mixture of fat and salvaged blood, the polycarbonate circuit in 5+ requires a technique to reduce the fat retention time within the bowl while XTRA does not require any specific technique in addition to its factory protocols. In the future, we hope the product will be improved by Haemonetics.
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Platelet-rich plasma sequestration in cardiac surgery – prospective controlled study

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Introduction: Contemporary cell-salvage technology can preserve platelets in platelet-rich plasma (PRP) sequestration. In pilot study in 2017 we tested the preservation of platelet functions during and after PRP sequestration. We have now conducted a prospective controlled study.

Methods: In this prospective non-randomised study, we enrolled 33 adult patients scheduled for complex cardiac surgery (aortic, redo, combined) with estimated cardiopulmonary bypass (CPB) duration >2 hours. (roller pump, X-coated circuit, UFH 3 + 1 mg/kg, crystalloid-colloid priming volume, ACT-kaolin >400 s, TXA 30 + 15 mg/kg in all the patients). We performed RBC sequestration and in intervention group also PRP sequestration preoperatively. 800 mL of whole blood was processed in cell saver (Sorin Xtra, 250 mL Latham bowl, CPDA bags, EDTA vacutainer, and manufacturer protocol). PRP was retransfused always at the end of surgery, autologous RBC according to clinical situation. TEG guided transfusion algorithm was used. Platelet count and platelet aggregometry (collagen, ADP, ristocetin, and epinephrine-induced aggregation) were measured at the beginning and at the end of surgery in control group, before PRP sequestration, in PRP, after retransfusion of PRP and at the end of surgery in PRP group. SPSS version 22 software (Fisher exact test for qualitative, Student and Mann-Whitney test for quantitative parameters) was used for comparison of groups.

Results: Sequestration group: 21 patients (94% male), control 12 patients (80% male). Both groups were comparable by age (67 both), EuroSCORE (3.37 vs. 3.62%), aortic (61 vs. 49%), redo surgery (22 vs. 14%). Antiplatelet medication was withdrawn before surgery. No difference in perioperative (605 vs. 564 mL) postoperative (711 vs. 652 mL) blood loss, transfusion of RBC (1.6 vs. 2.4 TU mean), FFP (1.7 vs. 1.7 TU mean), PLT (1 vs. 0 TU mean), fibrinogen concentrate, prothrombin-complex concentrate, additional TXA dose (18 vs. 14%), reexploration because of bleeding (16 vs. 14%), ICU LOS (4 vs. 3.5 days), HLOS (11.5 vs. 10.5 days), 30 day mortality (1 vs. 0) was recorded. No difference in major postoperative complications (recent myocardial ischaemia, stroke, AKI, ALI, pneumonia, delirium and new onset of atrial fibrillation) was assessed. No difference in haematocrit (40 vs. 42 initial, 30.1 vs. 30 at the end), perioperative peak of lactate and ionized calcium was measured. Platelet count decreased (185 to 136 vs. 230 to 136 G/L) in both groups. Platelet count after CPB was lower in PRP group (105 vs. 196; P = 0.001) but not at the end (136 both). Significant decrease of collagen, (43 vs. 5.3%), ADP (79 vs. 4%) and epinephrine (97 vs. 5%) mediated aggregation but preserved ristocetin (97 vs. 99%) mediated aggregation was detected in platelet-rich plasma.

Conclusions: The using of PRP sequestration have no impact on bleeding, transfusion therapy and clinical outcome in complex cardiac surgery. It preserves platelet count and ristocetin, but no other receptor mediated platelet aggregation.

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Intraoperative cell salvage: the cost of missed opportunity

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Introduction: Intraoperative cell salvage (ICS) is part of the standard Patient Blood Management care at our hospital. Intraoperative cell salvage is a cost-effective and safe alternative to allogeneic (donated) blood transfusion where a patient’s own blood, lost during surgical procedures, can be collected, processed and reinfused. After 25 years of successful conduct we have now identified a significant number of cases where patients received allogeneic blood transfusion (ABT) without the benefit or option to receive intraoperative cell salvage instead.

Methods: We therefore conducted a detailed retrospective audit, including all surgical patient transfusion episodes over 6 months, to evaluate potential solutions and increase the usage of ICS. The RBWH provide surgical care for ≈33,000 patients per year. As a result of surgery, many patients experience significant blood loss and require allogeneic (donated) blood transfusion. Allogeneic blood transfusion is associated with the potential for adverse outcome and significant cost. According to the National Blood Authority, the estimated cost associated with blood transfusion is over $1 billion per year in Australia. This figure still does not include the full cost of blood transfusion associated with overhead costs and adverse outcomes.

Results: During January to June 2016, 428 ABT transfusion episodes occurred. 249 patients received 896 units of allogeneic red blood cells. One transfusion episode was defined as any number of units ABT received on the same day, by the same patient. We identified 3 groups; 1) those who received only ABT, 2) only ICS or 3) ICS and ABT. Database information was used to evaluate each case and examine the reasons for allogeneic blood transfusion instead of intraoperative cell salvage transfusion. For each case we evaluated demographic information, type of procedure, surgical specialty, time of procedure, unexpected blood loss, in hours/after hours, urgency and volume of allogeneic blood transfusion received (as per clinical indication).

Conclusions: During this 428 ABT transfusion episodes, 103 patients received ICS. There were 318 ABT transfusion episodes where the patients received ABT and no ICS. When a detailed evaluation was done per speciality, urgency and clinical appropriateness we found at least 182 additional cases where ICS could have been used.
Exploring the availability and acceptability of cell salvage after vaginal birth in the UK: the SalVage study

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Introduction: The availability of cell salvage in obstetrics has been increasing in the last decade and obstetrics is now the main user of cell salvage in the UK.1 The use of cell salvage has been restricted to caesarean section, however, two thirds of women with major postpartum haemorrhage will have a vaginal birth. Following supporting evidence for the use of cell salvage after vaginal birth,2 the aim of this project was to determine the current availability of cell salvage in obstetrics in the UK and to explore the acceptability of cell salvage after vaginal birth.

Methods: A telephone survey was conducted in England, Scotland, and Wales from December 2016 to August 2017 to determine the current availability of cell salvage in obstetrics. An electronic survey to explore staff acceptability of obstetric cell salvage in general, and specifically after vaginal birth, was sent out to all obstetric staff of three obstetric units in the UK. The survey was also e-mailed to all lead consultant obstetricians, all lead consultant obstetric anaesthetists (through the Obstetric Anaesthetists Association (OAA) network) in the UK, and all blood transfusion medicine consultants in England.

Results: All 184 consultant led units in England, Scotland, and Wales responded. Cell salvage was available in 84% of all maternity units (154/184). Twenty-four-hour access was available in 50% of the units (92/184). Cell salvage was mostly used for caesarean sections with high risk of haemorrhage (89%) and women refusing blood transfusion (99%). Seven units collected blood for cell salvage for all their caesarean sections (5%). None of the units used cell salvage after vaginal birth routinely. Thematic analysis of the staff survey showed that there was support for the concept of cell salvage after vaginal birth. The majority of staff had no or only mild concerns about the use of cell salvage after vaginal birth. Staff were most concerned about the perceived risk of infection, the availability of trained staff, and the availability of equipment. Four themes emerged from the thematic analysis: location (‘where will cell salvage be done, in labour ward or in theatre?’), staff (‘who is going to perform cell salvage?’), intervention (‘is it safe?’), and patient (‘who is suitable for cell salvage after vaginal birth?’).

Conclusion: The availability of cell salvage in obstetrics is the highest it has ever been in the UK, although further improvement in the 24-hour accessibility of cell salvage is needed. The current lack of cell salvage following vaginal birth highlights an important area of further development.

REFERENCES
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Using intraoperative cell salvage for all obstetric caesarean sections. Data report of >1000 women receiving reinfusions at the Royal Cornwall Hospital

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Introduction: Despite the endorsement of the AAGBI, OAA and NICE, cell salvage is still not routinely offered in obstetrics. Increased use targets women perceived at risk of bleeding with many centres unable to offer 24-hour availability. This limited availability may be due to the perceived risks of amniotic fluid embolus and fetal red cell sensitisation however concerns relate to resources, staffing, training and financial predominate. The issues of amniotic fluid contamination and fetal red cell contamination have been considered. Since 2012 blood is collected during >98% of Caesarean Section deliveries and is available 24/7. Each year the percentage of collections processed and the number of reinfusions increases. Initially re-infusions were all given with a leucodepletion filter (LDF) however most have not. We have not encountered any clinically significant problems re-infusing cell salvaged blood. Currently any blood processed from a partial first bowl is discarded. To assess the risk of alloimmunisation, all women who receive a re-infusion are asked 3-4 months later for a blood sample for antibody screening. We present an update of the routine use of ICS in obstetrics where we have now reinfused to greater than 1100 woman over a seven-year period. We present alloimmunisation rates, quality of blood being returned, and quality of partial bowls.

Methods: During surgery, any blood lost (blood with amniotic fluid) is collected with a single specific wide-bore suction device to a reservoir in a Haemonetics Cell Saver® system (Haemonetics Corp., Braintree, MA, USA). We collect routinely and do not target women considered at risk of bleeding. The cell salvage machine is available 24/7. Women receiving cell salvaged blood are invited 3-4 months post-surgery to have a blood sample to screen for maternal antibodies (alloimmunisation rates).

Results: There has been a year on year reduction in donor blood consumption with the increase in number of re-infusions. The percentage of women who deliver at RCH and require a blood transfusion has dropped to <1% (0.6% 2017). Partial bowl quality is no worse than that of full bowls, with plasma free Hb, albumin, potassium and lactose dehydrogenase concentrations and doses similar or lower in partial bowls.

Conclusion: We have shown that ICS can be effectively employed routinely into maternity theatre and reduces the consumption of allogeneic blood used by the obstetric population. A feasibility study demonstrated it is also possible to collect blood from vaginal blood loss. Although no women were re-infused blood in this study2 we support further investigation of the use of cell salvage in vaginal blood loss. We have not noted an increase in alloimmunisation rates when compared to allogeneic transfusion (allogeneic risk 0.35%). Using blood processed from partial bowls should be considered, which could potentially reduce the rate of post-natal transfusions further. The role of the leucodepletion filter requires further investigation.

REFERENCES
Obstetric intraoperative cell salvage and maternal fetal red cell contamination

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**Introduction:** Fetal red blood cells (RBCs) are present in the maternal circulation throughout the antenatal and perinatal periods. However, the available published data to define the range of circulating fetal RBCs is limited to small case numbers and outdated.¹ Our previous projects on the use of cell salvage in obstetrics, both in caesarean sections and vaginal deliveries showed that fetal RBCs are collected during the cell salvage process.²⁻³ During the use of obstetric cell salvage (ICS) during caesarean section there is a need to be aware of the risk of formation of other antibodies other than anti-D. This fact is not widely appreciated and many investigators involved in obstetric ICS are still only concerned with the risk of anti-D. If ICS is to be routinely employed in obstetrics, formation of other clinically significant antibodies that could impact on future pregnancies must be considered and potential risks addressed by multidisciplinary teams. Our evidence suggests that fetal RBC contamination is potentially the only barrier to the routine use of this alternative to allogeneic blood transfusion and should be offered to all parturients. The aim of this study was to measure the level of fetal RBC contamination in the maternal circulation prior to delivery and during the delivery process, and to compare the levels of contamination to those found in processed, cell-salvaged blood.

**Methods:** We quantified the levels of fetal cells in 100 women immediately prior to delivery using a visual microscopic counting method (Kleihauer-Betke Technique). To improve the accuracy and precision of these measurements, we repeated this experiment in a further 100 women pre- and post-delivery, measuring the RhD antigen by indirect immunofluorescence and flow cytometry.

**Results:** This current study has confirmed previous reports that fetal RBCs are present in the maternal circulation with up to 37% of woman having fetal cells present in their circulation pre-delivery, increasing to 53% post-delivery with a maximum of 21.2 mL detected.

**Conclusion:** Fetal red blood cells are present in the maternal circulation throughout pregnancy and the volumes are comparable to that obtained from intra-operative salvage with contamination amounts up to 19 mL. Since 2012 we have established a 24/7 routine use of ICS in the obstetric operating theatre, reinfusing to over 1000 women. All those women who receive a re-infusion are asked 3-4 months post re-infusion to have a sample taken for antibody screening. Follow-up samples have been obtained from approximately 600 women, of which two have produced an antibody (both anti-E). Exact cause of formation is unclear. The first case was an abruption with an EBL of 600 mL, receiving 237 mL ICS blood and one unit allogeneic transfusion. In the subsequent pregnancy, the anti-E was only detectable by enzyme technique, and so the anti-E may have been present in first pregnancy, but at too low a level to detect in routine screening. The second case was a twin vaginal delivery requiring urgent surgical intervention due to complications and bleeding with the second baby being born by caesarean section an hour later. 400 mL ICS blood was reinfused. From the data obtained, we therefore suggest that this does not put women at any higher risk of antibody formation compared to women who receive an allogeneic transfusion (allogeneic risk 0.35%). We strongly recommend that other institutions using ICS in obstetrics adopt this method of following up women three to four months post re-infusion in order to collect data on alloimmunisation rates.

**REFERENCES**
The use of intraoperative cell salvage during obstetric anaesthesia at the Royal Brisbane and Women’s Hospital: an interdisciplinary survey

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Introduction: Obstetric haemorrhage is a leading cause of maternal morbidity and mortality in Australia. Intraoperative cell salvage (ICS) is a valuable method of blood conservation used when significant blood loss is anticipated. During ICS, the patient’s blood is collected, cleaned and reinfused, thus reducing the need for allogenic transfusions and associated complications. Evidence suggests ICS is safe, cost-effective, reduces hospital stay, and mortality. ICS is employed at the Royal Brisbane and Women’s Hospital (RBWH) and used in obstetric surgery since 2009. Despite proven ICS benefits, there continues to be obstetric cases where unnecessary allogenic transfusions are used. In this study, we explore experiences, conceptions and perceived barriers to ICS use at RBWH. Data from this study could be used to optimize patient outcomes.

Methods: A voluntary paper-based survey was conducted over a 1-month period. Surveys were offered to obstetric consultants/registrars, anaesthetic consultants/registrars, anaesthetic technicians, nurses, and residents. The survey explored experiences, concerns and barriers surrounding ICS use. Hardcopies of the surveys were collected via a return box. The anonymous data was uploaded to Microsoft Excel spreadsheet for analysis. Electronic data will be kept securely on a password protected hard-drive destroyed after a 10-year period. Findings will be presented locally in anaesthetic/obstetric department meetings and other national symposiums.

Results: The study collected data from 81 participants. Anaesthetic department made up 56%, obstetric department 28%, and the remaining 16% included nurses and residents. Of those involved, 81% had previously used ICS. 20 valid obstetrical indications for ICS were surveyed. 78% of responses stated ICS was never, rarely, or sometimes used. Inadequate suction (17%), amniotic fluid embolism (13%), and bacterial contamination (12%) were the most commonly perceived concerns which precluded the use of ICS in practice. Many also cited concerns regarding lack of training (20%), lack of staff allocation/availability (20%). In addition, 20% of respondents stated that they would sometimes, often or always not know how to arrange ICS for their patients.

Conclusions: Despite known benefits of ICS and endorsement by several key national bodies, a large portion of those surveyed stated that ICS is never, rarely or only sometimes employed. Specific reasons can be explored in future studies. A large portion of those surveyed cite lack of training, availability of staffing, and not knowing how to arrange ICS. This data can be used to develop further education and training strategies to enhance ICS uptake. With new strategies in place, we hope that an annual re-audit can occur as part of quality assurance at RBWH.
Patient blood management in surgery – results of a repeat UK national comparative audit with improvement in practice

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Introduction: Patient Blood Management (PBM) is an evidence-based patient-centred approach to transfusion practice with emphasis on active anaemia management, minimisation of blood loss and appropriate blood use. We repeated a large national comparative audit in 2016 to assess improvements in PBM practice from a previous audit in 2015.

Methods: The initial audit was undertaken between Feb and Apr 2015 assessing practice in the application of preoperative, intraoperative and postoperative PBM measures in a range of surgical patients likely to need transfusion. Following feedback of results to all participating hospitals a repeat audit was undertaken between Sep and Nov 2016.

Results: Data on 3266 cases were available for analysis, submitted by 156 sites across the UK. 138 of these sites also took part in the 2015 audit. The commonest type of surgery in both audits was elective orthopaedic surgery followed by surgery for fractured neck of femur and then cardiac surgery. Overall, there has been an improvement in PBM practice since 2015. This is particularly evident in areas where change in practice can be achieved more readily. When comparing practice for the 138 sites participating in both rounds, there has been an improvement in the use of a restrictive approach to postoperative transfusion from 23% to 34% (P < 0.001) and an increase in the use of a single-unit transfusion approach postoperatively from 37% to 50% (P < 0.001). Tranexamic acid use has increased from 32% to 42% (P < 0.001). In contrast, there has been a smaller, although still significant (P=0.01), improvement in the management of preoperative anaemia with the relative proportion managed appropriately improving to 50% in 2016 compared to 46% in 2015. Overall, only 11% of patients receiving a postoperative transfusion were found to have had all appropriate PBM measures attempted in 2016, compared to 7.5% in 2015 (P = 0.002).

Conclusions: Key barriers that need to be overcome include adequate resources to support the infrastructure to deliver effective management and a restructuring of the preoperative pathway to allow for timely investigation and management. It is encouraging to see that there has been progress in the implementation of PBM since 2015, particularly in areas highlighted in NICE Clinical Transfusion Guidelines and Quality Standards. Further work is required to deliver timely preoperative anaemia management in particular and to ensure consistent implementation of all appropriate PBM measures.
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Patient blood management at Curry Cabral Hospital

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Introduction: The implementation of patient blood management (PBM) programmes in surgical patients has shown a decrease of perioperative blood consumption and morbimortality. In 2016, we began a PBM program directed to orthopaedic surgery patients undergoing elective hip and knee arthroplasty. It include preoperative screening for anaemia and/or sideropenia and correction with oral or intravenous iron, intraoperative infusion of tranexamic acid and restrictive transfusion strategy.

Methods: The aim of this study was to determine the impact of PBM programme in this patient population comparing the first trimester 2014, before PBM, with the first trimester of 2017, after PBM implementation. We did a retrospective analysis of transfusion requests sent to our service in 2014 (n = 176) and 2017 (n = 141). We evaluated preoperative haemoglobin (Hb) levels and packed red blood cell (RBC) transfusion within 7 days of surgery.

Results:
We observed a decrease in the mean RBC transfusion from 0.9 to 0.4 in knee arthroplasty and from 0.7 to 0.6 in hip arthroplasty. Results can be seen in Table 1.

<table>
<thead>
<tr>
<th>Knee Arthroplasty</th>
<th>2014 (n = 94)</th>
<th>2017 (n = 69)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preoperative Hb (g/dL; mean)</td>
<td>10.9</td>
<td>12</td>
</tr>
<tr>
<td>RBCs transfused perioperatively (mean)</td>
<td>0.9</td>
<td>0.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hip Arthroplasty</th>
<th>2014 (n = 82)</th>
<th>2017 (n = 72)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preoperative Hb (g/dL; mean)</td>
<td>11.1</td>
<td>11.8</td>
</tr>
<tr>
<td>RBCs transfused perioperatively (mean)</td>
<td>0.7</td>
<td>0.6</td>
</tr>
</tbody>
</table>

After PBM the rate of orthopaedic surgery patients transfused was reduced from 47% (n = 82) to 33% (n = 47). We also observed a significant decrease of 48% in total RBC consumed in 2017 (n = 76) comparing with 2014 (n = 142).

Conclusion: After implementation of PBM in elective hip and knee arthroplasty, there was an increase in patient preoperative Hb levels and a significant reduction in mean RBC administration. These results incite us to extend the PBM programme to other elective surgical procedures.
Paediatric patient blood management programme in scoliosis surgery: net clinical benefits

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Introduction: Patient blood management (PBM) programmes have been introduced during the last 10 years to minimize the use of blood transfusion. Paediatric scoliosis surgery (SS) is associated with high rates of packed red blood cells (RBC) transfusion. At our institution, between 2013 and 2015, there was a median consumption of 2 RBCs per SS. In January 2016, a PBM programme was adopted. The aim of this work is to evaluate its efficiency.

Methods: The PBM programme was introduced by a multidisciplinary team since January 2016. It included a restrictive transfusion strategy (transfuse only if haemoglobin [Hb] <7 g/dL) and other specific elements (Table 1). Retrospective data evaluation allowed us to compare the patients submitted to SS before and after the implementation of the PBM programme (Table 2).

Results:

<table>
<thead>
<tr>
<th>Preoperative (≈1 month before surgery)</th>
<th>Intraoperative</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Screening for anaemia and/or sideropenia + optimisation of Hb when necessary;</td>
<td>1. Infusion of tranexamic acid in all patients;</td>
</tr>
<tr>
<td>2. Evaluate bleeding/thrombotic risk;</td>
<td>2. Prophylaxis/treatment of haemorrhagic diatheses:</td>
</tr>
<tr>
<td>3. Haemostasis screening (aPTT, PT, fibrinogen and platelet function).</td>
<td>desmopressin (DDAVP), fibrinogen concentrates, other procoagulant drugs;</td>
</tr>
<tr>
<td></td>
<td>3. Thromboelastometry if necessary.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variables</th>
<th>2013-2015 (n = 59)</th>
<th>2016-2017 (n = 52)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years; mean)</td>
<td>13.5</td>
<td>12.8</td>
</tr>
<tr>
<td>Idiopathic Scoliosis / Neuromuscular Scoliosis (%)</td>
<td>66.7 / 33.3</td>
<td>47 / 11.7</td>
</tr>
<tr>
<td>Preoperative / Postoperative Hb (g/dL; median)</td>
<td>13.2 / 9.3</td>
<td>13.4 / 10</td>
</tr>
<tr>
<td>No. of packed RBCs transfused perioperatively (median)</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

*Eight patients had platelet function impairment and needed treatment with DDAVP. One patient with congenital FVII deficit received recombinant FVII during surgery. The median of packed RBCs consumed decreased from two (2013-2015) to zero (2016-2017).

Conclusion: The implementation of the PBM programme in paediatric SS allowed for a substantial decrease of packed RBC transfusion.
P44

Patient blood management in internal medicine: our recent experience

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Introduction: Internal medicine is essential in coordinating and treating patient blood management (PBM) patients. We present our recent experience with PBM as an Internal Medicine Department in Athens Medical Center, a Greek tertiary private hospital.

Methods: We took care of a total of 181 cases which were treated without the use of allogeneic blood products with a variety of medical and surgical conditions during the years 2016-2017. We followed the PBM principles by optimizing haematopoiesis, successfully managing anaemia, minimizing bleeding and blood loss (including iatrogenic one) and by optimizing physiological tolerance to anaemia.

Results: In analysis we have involved in the treatment of 95 internal medicine, 30 general surgery, 15 gastroenterology, 11 urology, 11 oncology, 6 orthopaedic, 5 haematology, 3 neurosurgical, 3 cardiology and 3 gynaecology/obstetrics cases. The thirty-day mortality rate was 2.2%.

Conclusions: Being an internist at a PBM environment is both fascinating and challenging. From the ethical point of view, providing advanced medical care to patients who refuse blood transfusions but accept alternative medical and surgical procedures is proper and appropriate according to Hippocrates principles of patient respect and autonomy. From the medical point of view, coronary heart disease remains the major negative prognostic factor to a favourable PBM outcome. Nevertheless, the overall successful response to the management urges us to provide the same quality medicine to all of our patients and to inform them about this medical strategy. We strongly believe that PBM will be the standard of care in medicine practice in the near future.
Anaemia Effects and Management

P45

A 5-year retrospective cohort study of the impact of anaemia in a tertiary hospital setting


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Introduction: The aim of this study is to investigate the association between nadir haemoglobin, mortality and length of stay in all hospitalised patients within a single tertiary centre.

Methods: A retrospective observational cohort study of all patients admitted for at least 48 hours to a tertiary centre between July 2010 and June 2015. Anaemia status was measured using nadir haemoglobin results and was grouped into 3 categories: moderate to severe (<100 g/L), mild (between 100‒119 g/L for females and 100‒129 g/L for males), or not anaemic (>120 g/L for females, >130 g/L for males).

Results: In our sample, 56.6% (45 675/80 765) of inpatients were anaemic at some point during their hospital stay. After adjusting for potential confounders, anaemia was independently associated with higher odds of in-hospital mortality, even when the anaemia was mild (odds ratio 1.59, 95% CI 1.36 to 1.86, P = 0.001). Anaemia was also associated with increased length of stay in both emergency and elective patients, however the increase was significantly longer in emergency admissions (mild anaemia: incident rate ratio, 1.52, 95% CI 1.48 to 1.56, P < 0.001; moderate to severe anaemia: incidence rate ratio 2.18, 95% CI 2.11 to 2.26, P < 0.001) compared to elective admissions (mild anaemia: incidence rate ratio 1.30, 95% CI 1.21 to 1.41, P < 0.001; moderate/severe anaemia incidence rate ratio 1.69, 95% CI 1.55 to 1.83, P < 0.001). Independent of anaemia, red blood cell transfusion was associated with 2.23 times higher odds of in-hospital mortality (95% CI 1.89-2.64, P < 0.001) and 1.31 times longer length of stay (95% CI 1.25-1.37, P < 0.001).

Conclusion: In our hospital sample, the majority of patients were anaemic during admission. Over one-third of patients not anaemic on admission developed anaemia during their hospital stay. Anaemia, even if mild, is independently associated with increased mortality and hospital length of stay; however, transfusion to treat anaemia is an independent and additive risk factor. These findings, if replicated in other jurisdictions, have significant medical and economic implications for health systems.
Reducing phlebotomy loss in Belfast Trust intensive care units

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Introduction: Due to the intensive and frequent monitoring of the Intensive care unit (ICU) patient, between 350-500 mL can routinely be drawn from a patient in a week. Those in longer term stay often require blood transfusion for this reason alone. We achieved a reduction of 52% in sample volume for the three most frequent test in our Regional ICU (RICU). Two other Trust ICUs showed similar reduction when the practice was shared.

Methods: From October 2016 in Belfast Trust RICU, staff questionnaires, Lab and ICU data were used to determine baselines and to identify the most 3 frequent blood tests and variation in practice. We introduced a minimum volume waste and sampling protocol for Arterial Blood Gas Analysis (ABGA) and identified smaller volume sample bottles for full blood count (FBC) and biochemistry tests. This practice was shared with two other Trusts ICUs. This quality improvement project was led by Haemovigilance using local ICU teams.

Results: There was a reduction of phlebotomy volume for the three most frequent blood samples by over 50% in each ICU. None of the changes had any adverse effect on the clinical or laboratory practices nor any additional costing – in fact sampling time reduced and overall cost saving resulted. Variation in practice that was identified within and between each ICU was removed. Identified risks (e.g. using non-heparinised syringes for ABGA in one ICU) were removed.

Conclusion: Ownership of the project and dedication to maintaining phlebotomy volume loss was left with the local teams, ensuring sustainability and further improvements, with some of their work being presented to Critical Care symposiums. Implementation of the project was very easily done and welcomed by all staff. The ABGA protocol was shared with all relevant Trust departments and plans to explore the smaller volume FBC/Biochemistry to Trusts areas with non-arterial line sampling is being planned. Plans to assess annual impact on ICU RBC transfusion figures are in place. Where we did standardise and reduced pre-sample waste, we continue to explore elimination of this waste, e.g. trialling the VAMP system.
P47

Therapeutic phlebotomies: five-year experience at a Portuguese university centre day hospital

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Introduction: Therapeutic phlebotomy has several physiological mechanisms and also is the preferred treatment for blood disorders in which the removal of red blood cells or serum iron is the most efficient method for managing the symptoms and complications. The Day Hospital (DH) of Blood and Transfusion Medicine Department of CHUC aims to perform therapeutic phlebotomies with the purpose of removing the cellular or metabolic product, present in excess in circulating blood, or stored in vital organs.

Methods: Retrospective analysis of the activity of the DH University Center university central hospital over a period of 5 years (2012 to 2016); Use of the casuistry and graphical interpretation of the results analyzed using Microsoft Excel®.

Results: During 5 years (2012 to 2016), 3344 phlebotomies were performed. The total number of patients admitted to DH was 521. The majority of patients were men (81%) with an average age of 60-years-old. 49% of the total patients were older than 61-years-old. Secondary polyglobulia (n = 237) and hemochromatosis (n = 161) were the two most frequent causes in 398 patients. The other diagnosis were secondary hyperferritinemia (n = 12), polycythemia vera (n = 41), porphyria cutanea tarda (n = 18), and diagnosis of idiopathic polyglobulia (n= 50). External consultant’s patient visits have the following dispersion: General hematology and internal medicine have the highest frequency of referrals: 165 and 109 patients, respectively. The outpatient post-transplant renal referral was 96 patients, 72 patients referred by the consultation on hematology-oncology, 20 patients from the gastroenterology consultation, 17 referred by dermatology and 42 patients were referred by miscellany of external consultations of the CHUC. It was possible to verify that 151 patients performed 1 phlebotomy session in the DH, 262 patients: 2 to 10 sessions, 75 patients: 11 to 20 sessions and 33 patients: 21 or more sessions. The middle number of sessions per patient was 6.4. In the 5 years studied (2012 to 2016), 3344 phlebotomies were performed, corresponding to an average of 669 sessions each year. However, according to this study, there was an annual increase in the number of phlebotomies from the beginning of 2012 until the end of 2015 (451 phlebotomies in 2012, 619 in 2013, 654 in 2014 and 858 phlebotomies during the year 2015), with a subsequent decrease in 2016 (762 phlebotomies).

Conclusion: During the 5 years studied, 521 patients were treated with therapeutic phlebotomy in a total of 3344 phlebotomies. Haematology was responsible for sending more patients. The most frequent underlying pathologies responsible for therapeutic phlebotomy were secondary polyglobulia and hemochromatosis. The decrease in the number of treatments in 2016, compared to the increase of sessions in the previous four years, can be a consequence of the treatments efficacy results corresponded to a decrease in the number of patients in DH. Therapeutic phlebotomy is safe and provides good clinical efficacy with relatively low costs.
Donor blood management: iron and apheresis donors

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Introduction: In a previous study we identified a high prevalence of iron deficiency in our apheresis donor population (38%). To overcome this, the following measures were taken: we informed the donors about their ferritin level and those who had ferritin <30 ng/mL were instructed to increase the iron intake through diet, increase the time between donations, and suspend erythrocyte donation. For those with ferritin <15 ng/mL we also proposed oral iron supplementation. These instructions were resumed in a flyer that was given to donors. In this study we evaluated the efficacy of these measures by monitoring the ferritin levels in the subsequent donations.

Methods: The study underwent from October 2016 to December 2017 and analyzed 222 regular apheresis blood donors, that is, those who have donated blood twice or more by apheresis. In each time, we determined the ferritin level and performed a full blood count.

Results: 222 apheresis blood donors were evaluated: 27% were females and 73% were males. 76 donors had ferritin <30 ng/mL (36% females; 64% males) and 27 of these had ferritin <15 ng/mL (56% females; 44% males). Only 21 of the 76 donors received oral iron supplementation. The measures were evaluated in 51 of the 76 donor with iron deficiency, which were the ones who returned to donate during the time established for this study, yet to be continued. The ferritin level mean increase was 47%.

Conclusion: Iron deficiency is highly prevalent in the Portuguese population, according to the EMPIRE study, and so it is also prevalent in our blood donor population: 66% in female donors and 49% in male donors. Even donors who only donate platelets by apheresis, lose 40 mL of erythrocytes per donation included in blood samples and apheresis system priming. With the implementation of this blood donor management programme we aimed to maintain a healthy blood donor population in order to optimize their physical condition and decrease the donation suspension rate. Further so, we hope to retain more donors, as they usually appreciate the concern about their health status, raise individual awareness about their dietary needs and about their role in maintaining a healthy lifestyle.
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Dr Facebook and the fog of iron deficiency

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1University College London, Division for Surgery and Interventional Science, London, UK; 2The Iron Clinic, London, UK; 3Anaesthetic Department, Papworth Hospital, Cambridge, UK; 4Anaesthetic Department, Royal Marsden Hospital, London, UK

Introduction: Anaemia and iron deficiency (ID) are common. Indeed, the symptoms may often be overlooked as non-specific, and many patients are not diagnosed. Social media is increasingly used by patients to source medical advice. We wished to assess the symptoms and impact of ID in the patients’ own words.

Methods: Two Facebook (FB) pages were developed. One is factual: https://www.facebook.com/theironclinic/?ref=settings
The second is a patient forum: https://www.facebook.com/groups/782812378530009/?ref=nf_target&fref=nf
A contributor to the forum asked patients to list ‘in their own words’ their symptoms of iron deficiency and anaemia. From this we developed an online questionnaire (survey monkey) that was posted on both forums. Of 13 questions, patients were asked to list their symptoms in order, duration of ID, treatment, haemoglobin (Hb) and ferritin levels.

Results: Over 11,000 people joined the patient and >1000 the factual FB forum. 10,521 responses were given initially. In an online questionnaire, 470 responded, with an average ferritin of 12. After ‘fatigue’ and ‘exhaustion’, ‘brain fog’ was the most specific symptom, reported by 372 people (79%), and cardiac symptoms (SOB, palpitations & dizziness) were the most common reasons for seeking help. Pica was present in 28% and indicated a ferritin <8. Most (92%) took iron supplements, many had side effects (72%) and 45% stopped taking oral iron. Patients took an average of 10 months to feel better and carried on supplements for an average of 16 months. 179 had an iron infusion, feeling better after one month. 80% would prefer an iron infusion as a treatment option.

Conclusion: Patient opinions on their symptoms and preferred treatment options should inform medical practice.
A multilevel and propensity score exploratory analysis of the World Health Organization Multicountry Survey on Maternal and Newborn Health on severe anaemia and maternal death

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Women’s health Research Unit, Barts and the London School of Medicine and Dentistry, London, UK

Background: Anaemia affects up to half of all pregnant women in low and middle-income countries. The burden of anaemia and associated maternal mortality rates are not robustly quantified. The objective of this work was to assess the association between severe anaemia and maternal death using the data from the World Health Organization Multicountry Survey (WHO MCS) on Maternal and Newborn Health.

Methods: We used multilevel and propensity score regression analyses to determine the relationship between severe anaemia and maternal death in 357 health facilities in 29 countries across Latin America, Africa, Western Pacific, Eastern Mediterranean and South East Asia. Severe anaemia was defined as antenatal or postnatal anaemia with a haemoglobin <7 g/dL in a blood sample obtained before death. Maternal death was defined as death up to the seventh day postpartum. The regression analyses made adjustments for the following confounding variables: postpartum haemorrhage, general anaesthesia, admission to intensive care, sepsis, pre-eclampsia/eclampsia, thrombocytopenia, shock, massive transfusion and severe acidosis. These variables were used to develop the propensity score.

Results: There were 312,281 women admitted for labour/delivery or ectopic pregnancy were included in the adjusted multilevel logistic analysis. Of these, 12,470 were included in the propensity score regression analysis. The odds of maternal death was doubled in mothers with severe anaemia overall (adjusted odds ratio (aOR) 2.36, 95% CI: 1.60-3.48). In the propensity score analysis, severe anaemia was also associated with maternal death (aOR 1.86, 95% CI 1.39-2.49).

Conclusion: Prevention and treatment of anaemia during pregnancy and postpartum should remain a global public health and research priority.
Preoperative anaemia, it’s a bleeding problem

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Aintree University Hospital, Liverpool, UK

Introduction: Preoperative anaemia is prevalent problem. Most commonly it is due to absolute or functional iron deficiency (1). It is associated with increased postoperative morbidity and mortality and is a powerful predictor of the need for postoperative blood transfusion (2). International consensus is that preoperative anaemia; haemoglobin (Hb) less than 130 g.l\(^{-1}\) should be investigated, diagnosed and if appropriate, treated with iron prior to surgery (3). The purpose of this project was to establish a baseline in current practice and to use this to develop a preoperative anaemia service. The aim is to standardise practice and improve patient care.

Methods: A retrospective analysis of 343 elective surgical patients from 8 specialities admitted to intensive care (ICU) post operatively in 2016. Several parameters were examined including pre and postoperative anaemia investigations, postoperative transfusion and length of stay in hospital and ICU.

Results: Of 343 patients, 181 (53%) were anaemic preoperatively. 20 (11%) of these patients had full haematinic studies measured and an additional 17 (9.4%) had partial studies. The number of days between preoperative investigation and surgery was variable between surgical specialties (range 1 to 148) but the mean was 15. The mean length of hospital stay for anaemic patients was 2 days longer with no difference in mean length of stay in intensive care. The mean number of postoperative transfused red cells in patients with preoperative anaemia was 1.05 versus 0.37 units in non-anaemic patients. An evidence based, multidisciplinary service to manage preoperative anaemia is being developed. This will include guidelines for primary and secondary care, investigation and management algorithms, novel point-of-care testing of Hb (Masimo\textsuperscript{®}) and a nurse-led preoperative anaemia clinic.

Conclusion: Preoperative anaemia is common, associated with a higher transfusion requirement postoperatively and longer mean length of hospital stay. Appropriate investigation is rarely undertaken. We hope that the new preoperative anaemia service will reduce transfusion requirements, length of hospital stay and ultimately improve patient care.

REFERENCES
Intraoperative transfusion – preoperative illusion

K. Wyssusek, M. Roets, H. Raniga & C. Town
Royal Brisbane and Women’s Hospital (RBWH), Brisbane, Queensland, Australia

Introduction: Patient Blood Management (PBM) is defined as an evidence-based bundle of care to optimise medical and surgical patient outcomes by clinically managing and preserving a patient’s own blood. Our institution has introduced several PBM strategies including haemovigilance, intraoperative cell salvage and point-of-care coagulation management. However, the RBWH currently has no formal anaemia management process in place. There is substantial evidence that preoperative anaemia increases the need for blood transfusion, hospital associated costs and the risk of postoperative adverse events.1,2,3 The aim of our study was to evaluate the preoperative anaemia incidence in our surgical patients.

Methods: We conducted a retrospective audit, including all surgical patient transfusion episodes over a 6-month period. Preoperative haemoglobin (Hb) was retrospectively identified for all patients transfused. Database information was used to evaluate each case and examine number and reasons for allogenic blood transfusion. For each case we evaluated demographic information, type of procedure, surgical specialty, time of procedure, unexpected blood loss, in hours/after hours, urgency and volume of allogenic blood transfusion received (as per clinical indication).

Results: During January to June 2016, 428 patients received allogenic blood transfusions (ABT) on the day of surgery. 896 units of red blood cells were transfused. 184 patients (43%) were severely anaemic preoperatively with a Hb <100g/L. 59 patients (14%) did not have a known Hb value.

Conclusions: The implementation of an anaemia management programme in our institution is imperative. By diagnosing and treating anaemia prior to surgical admission we endeavour to enhance patient safety. This intervention will improve patient capacity to deal with the haemostatic challenge of surgery, and reduce anaemia-related adverse events as well as additional transfusion requirements and costs.

REFERENCES
Preoperative anaemia and iron deficiency in scheduled surgical procedures with potential bleeding

S. García, R. Velasco, A. Alfonso, L. E. Gutiérrez Cantero, J. Mazaira & F. Ruiz Izquierdo
Hospital Sierra Llanas, Torrelavega, Spain

Introduction: Based on PBM evidence we started a diagnostic and treatment programme of preoperative anaemia and iron deficiency to get better tolerance to blood loss and decrease postoperative anaemia in scheduled surgical procedures. In agreement with surgical services we included: mastectomy, hysterectomy, nephrectomy, cystectomy, prostatectomy, bladder or prostatic transurethral resection, colectomy, gastrectomy, inflammatory bowel disease, hip or knee primary prosthesis and prosthesis revisions.

Methods: Laboratory anaesthesia preoperative analysis with iron study and on admission for surgery haemoglobin of the day before and day after were obtained. Time between diagnostic/treatment and surgery should be preferably 2–4 weeks. We included those with haemoglobin ≤13 g/dL (hip or knee prosthesis replacement ≤14 g/dL). If TSI (transferrin saturation index) <20% and ferritin <100 ng/mL were considered iron deficient patients. Treatment consisted on intravenous iron and haematinics. We treated TSI <20% and or ferritin <300 ng/mL; except TSI >40% and or ferritin >300 ng/mL.

Results: 150 patients received treatment, 78.3% had iron deficiency. Day before surgery HB had increased over 0.5 g/dL in 40% of these patients. Only 30.5% had a time between treatment and surgery of 2–4 weeks. 71.9% day after surgery HB figures were >10 g/dL. We show the values of these statistical variables of the different procedures included; the results differed due to pathologies and surgery. (See graphics below).

Conclusions: Intravenous iron administration improves degree of anaemia the day of surgery. We observe a reduction in postoperative percent of patients who reach transfusion threshold. Detected preoperative iron deficiency should be treated with intravenous iron in scheduled surgical procedures with potential bleeding.
**P54**

**The UK cardiac and vascular surgery interventional anaemia response (CAVIAR) study: preliminary results of the cardiac population**

M. Chau1, T. Richards1, C. Evans2, S. Abeysiri1 & A. Klein3

1University College London, London, UK; 2Cardiff & Vale University Health Board, Cardiff, UK; 3Papworth Hospital, Cambridge, UK

**Introduction:** Preoperative anaemia is linked to poor post-surgical outcome, longer hospital stays, and greater risk of complications and mortality. There is a need to assess feasibility of a ‘Pillar 1’ preoperative anaemia management pathway. The aim of this study was to develop a platform to assess anaemia and the effect of IV iron in this setting.

**Methods:** Multicentre, stepped, prospective, observational platform was developed in adult patients awaiting major cardiac surgery.

*Cohort 1:* Examined the impact of anaemia on patient outcomes:
- Step 1 assessed if centres could identify and consent patients on the day of surgery.
- Step 2 was whether step 1 could be done at least 10 days before operation.

*Cohort 2:* Examined the effect of intravenous iron isomaltoside (full treatment dose) before operation in patients where centres had completed step 2.

Primary outcome was change in haemoglobin (Hb) levels in Cohort 2. Secondary outcome was proportion of patients who were transfused.

**Results:** Baseline characteristics

<table>
<thead>
<tr>
<th>Cohort 1</th>
<th>Cohort 2 (n=58)*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Anaemic (n=133)</strong></td>
<td><strong>Non-anaemic (n=95)</strong></td>
</tr>
<tr>
<td>Males (n, %)</td>
<td>98 (73.7)</td>
</tr>
<tr>
<td>Mean (SD) age</td>
<td>68.9 (12.2)</td>
</tr>
<tr>
<td>Step 1 (n, %)</td>
<td>56 (42.1)</td>
</tr>
<tr>
<td>Step 2 (n, %)</td>
<td>77 (57.9)</td>
</tr>
</tbody>
</table>

* subgroup of cohort 1 anaemic group

Comparing Cohort 1 & 2, untreated patients had little change in Hb levels (mean -0.02, SD 0.3) preoperatively whereas treatment increased in Hb by 1.6 g/dL (1.2), range -0.4 to 4.0 (P < 0.0001). There was no statistical difference in the proportion of patients transfused during operation in Cohort 1 anaemic compared to non-anaemic patients (34.6% vs. 22.8%, OR 1.45 (CI 0.70-2.97); P=0.315). However, this was statistically significant in patients who were treated compared to those who was not treated (48.5% vs. 25.2%, OR 2.51 (CI 1.06, 5.99); P=0.037).

**Conclusion:** Preoperative anaemia management is feasible in an appropriate timescale and can result in a significant increase in patient Hb levels.
Prevalence and consequences of preoperative iron deficiency in total hip arthroplasty: a single-centre, preliminary retrospective study

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Introduction: Iron deficiency (ID) and iron sequestration or functional ID (FID), with or without anaemia, are frequent among patients undergoing major elective orthopaedic surgery.\textsuperscript{1} This preliminary retrospective study was aimed at assessing the prevalence and consequences of ID/FID in patients scheduled for primary total hip arthroplasty (THA) in a single centre.

Methods: Demographic, medical and laboratory data from consecutive patients undergoing elective THA (2013-2014; \(n = 165\)) were retrieved. Anaemia was defined by Hb <13 g/dL for both genders; ID by ferritin <30 ng/mL or ferritin 30-100 ng/mL and TSAT <20%; and FID by ferritin >100 ng/mL and TSAT <20%.\textsuperscript{2} Patients without ID/FID were the control group. The main outcome variables were allogeneic blood transfusion (ABT), postoperative infections, and length of hospital stay (LOS). Data are presented as mean ± SD or number (n) and percentage (%).

Results: Iron data were available for 115 patients (70%). Compared to control group, patients with ID/FID (\(n = 54\); 45 ID, 9 FID) have lower perioperative Hb, higher prevalence of preoperative anaemia, higher ABT rate without differences in pretransfusion Hb, and a trend to longer LOS. No difference in infection rate was observed (1 surgical wound infection in the control group) (Table 1). Interestingly, only 8 out of 15 patients receiving ABT presented with preoperative anaemia.

<table>
<thead>
<tr>
<th></th>
<th>Control ((n=61))</th>
<th>ID/FID ((n=54))</th>
<th>(P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender (M/F)</td>
<td>43/18</td>
<td>24/30</td>
<td>0.009</td>
</tr>
<tr>
<td>Age (years)</td>
<td>62 ± 11</td>
<td>64 ± 11</td>
<td>0.195</td>
</tr>
<tr>
<td>Preoperative anaemia, n (%)</td>
<td>6 (10)</td>
<td>14 (26)</td>
<td>0.028</td>
</tr>
<tr>
<td>Preoperative Hb (g/dL)</td>
<td>14.9 ± 1.4</td>
<td>13.8 ± 1.5</td>
<td>0.001</td>
</tr>
<tr>
<td>Postoperative Hb (g/dL)</td>
<td>10.7 ± 1.2</td>
<td>9.9 ± 2.1</td>
<td>0.010</td>
</tr>
<tr>
<td>ABT rate, n (%)</td>
<td>1 (1.6)</td>
<td>14 (26)</td>
<td>0.001</td>
</tr>
<tr>
<td>Pretransfusion Hb</td>
<td>7.5</td>
<td>7.5 ± 0.8</td>
<td>---</td>
</tr>
<tr>
<td>Postoperative infection, n (%)</td>
<td>1 (1.6)</td>
<td>0 (0)</td>
<td>0.541</td>
</tr>
<tr>
<td>LOS (days)</td>
<td>5.9 ± 1.7</td>
<td>6.5 ± 2.3</td>
<td>0.107</td>
</tr>
</tbody>
</table>

Conclusion: ID-FID, with or without anaemia, is highly prevalent among elective THA patients (47%) and may result in poorer outcomes. Though a large confirmatory study is needed, our data suggest a benefit for preoperative ID-FID correction in patients scheduled for elective THA.

References
Study of the incidence of iron deficiency in abdominal aortic aneurysm surgery

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Introduction: Iron deficiency is a common cause of preoperative anaemia. Management of perioperative anaemia management is a major concern for anaesthesia and surgery teams because of its impact on patient morbidity and patient mortality.1 In major orthopaedic surgery, the prevalence or iron deficiency is around 20%. In line with the recommendations of the national health authority, a blood saving policy is applied in patient undergoing major surgery. Before the surgery, iron therapy could be introduced in abdominal aortic surgery. The objective of our work was to determine the incidence of iron deficiency in abdominal aortic surgery and its association with perioperative anaemia.

Material and methods: It is an observational, prospective and single-centre study. This study was conducted from December 2016 to March 2017. This study was approved by the Comité de Protection des Personnes Nord-Ouest in June 2016. All consecutive patients requiring aortic abdominal surgery were included. A preoperative haemoglobin level of less than 13 g/dL defined anaemia. Iron deficiency was defined as a serum ferritin less than 100 µg/mL and/or a transferrin saturation less than 20%. A monitoring of the haemoglobin level was performed the day before the surgery (D-1) and postoperatively on D0, D1 and D3.

Results: Twenty patients were included. Iron deficiency involved 12 (60%) patients preoperatively. The presence or absence of iron deficiency was our 2 study groups. Populations in each group were comparable in terms of age (74 vs. 67, P = 0.13), duration of surgery (176 minutes vs. 196 minutes, P = 0.63). The blood recovery by cell saver was similar (632 mL vs. 525 mL, P = 0.67). Iron deficiency was not associated with preoperative anaemia (P = 0.49). Postoperative anaemia on D1 was not associated with iron deficiency (P = 0.62). Postoperatively on D3, all patients had haemoglobin levels below 13 g/dL.

Conclusion: In abdominal aortic surgery, the incidence of preoperative iron deficiency is high. However, it is not associated with perioperative anaemia. This observation does allow to better target the causes and treatments of anaemia in this context.

REFERENCE
Impact of preoperative anaemia on health care resource utilization in patients undergoing secondary hip arthroplasty

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Introduction: Secondary hip revision is associated with high costs and health resource utilization than primary hip arthroplasty. Anaemia has been shown to be independently associated with higher rates of complications and longer hospital stay in this patient cohort. Aim of this study was to investigate the impact of preoperative anaemia on surrogate parameters of health care resources.

Methods: Single-centre, retrospective cohort study at a tertiary university hospital in Germany. After clearance from the Federal Data Protection officer and IRB approval (EA1/343/16), data of all patients undergoing secondary hip arthroplasty between 2011 and 2016 were extracted from electronic medical records and included in the analyses. Patients were categorized as positive or negative for preoperative anaemia according to WHO criteria (Hb <13 g/dL for men and Hb <12 g/dL for woman). Propensity score (PS) matching was performed based on age, gender, ASA and pre-existing medical conditions including diabetes, obesity, hypertension, left heart failure, chronic pulmonary obstructive disease (COPD) and chronic renal insufficiency.

Results: Out of 1,161 patients, 411 (35.4%) were identified with preoperative anaemia. After PS matching, surrogate parameters of health care resource utilization were significantly increased in this group (see Table 1). In addition, significantly more patients with preoperative anaemia received packed red blood cell transfusion (84.4% vs. 46.5%, P < 0.001).

Table 1. Outcome after PS matching

<table>
<thead>
<tr>
<th></th>
<th>All Patients N=822</th>
<th>Without Preop. Anaemia N=411</th>
<th>With Preop. Anaemia N=411</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICU LOS &gt;24 h</td>
<td>93 (11.3%)</td>
<td>27 (6.57%)</td>
<td>66 (16.1%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Hospital LOS</td>
<td>12.0 [10.0;16.0]</td>
<td>10.0 [9.00;13.0]</td>
<td>14.0 [10.0;21.0]</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>LOS &gt; upper DRG limit</td>
<td>35 (4.26%)</td>
<td>4 (0.97%)</td>
<td>31 (7.54%)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Results are given as number of patients with percent or median with interquartile range. LOS, length of stay, DRG, diagnosis related groups.

Conclusions: Preoperative anemia impacts health resource utilization in patients undergoing revision hip arthroplasty. Preoperative identification and effective treatment of anemia may not only improve patient outcome but could also reduce the financial burden of the hospital.
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Preoperative haemoglobin profile and RBC transfusion in elective surgery

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Introduction: Anaemia is a public health problem that affects about 30% of surgical patients. Preoperative anaemia has a negative predictive value of postoperative results. It is associated with an increased risk of mortality (42%) and morbidity (35%) at 30 days, as well as a decrease in quality of life. Identification of surgeries with moderate to high risk of haemorrhage and the treatment of preoperative anaemia minimizes the number of allogeic blood transfusions and contributes to a better postoperative evolution.

Methods: Over a six-month period, data from preoperative haemograms and red blood cell (RBC) transfusions in elective surgeries were collected and studied. 2,702 patients were studied, all aged over 18 years and referred to the Blood and Transfusion Medicine Department of Coimbra University Hospital Center in the context of preoperative blood reserves. The study was carried out by the analysis of the clinical process, the haemogram and the registry of allogeic RBC transfusion during the surgery and in the following 24 hours. All data were treated in Excel system and SPSS software version 24.0.

Results: During the six-month period studied, there were 2,702 patients subjected to elective surgery with preoperative blood reserves, 1,434 men and 1,268 women. The average age of patients was 62.8 years old (min.: 18; max.: 99). The prevalence of preoperative anaemia in patients (n = 2,702) in this study was 31%. Their gender distribution showed that it was higher in men (34.3%) than in women (27.2%). Of all the patients (n = 2,702), 14.7% needed to receive a RBC transfusion during the surgery or in the next 24 hours. Of the patients with preoperative anaemia (n = 838) who underwent elective surgery, 30.9% needed to receive transfusion support during surgery or within the following 24 hours. Of the patients who did not have anaemia (n = 1,864) only 7.4% were transfused. A statistically significant relationship between the presence of preoperative anaemia and the need for RBC transfusion during the surgery and in the following 24 hours was verified (P < 0.001).

Conclusion: In the study sample, the prevalence of preoperative anaemia was higher in males and patients with preoperative anaemia were transfused 4 more times than non-anaemic patients. Given that preoperative anaemia is associated with an increased need for blood transfusion, which, while playing a key role in clinical practice, is not without risk, we must join efforts to prevent, identify, characterize and treat anaemia before surgery in order to reduce the number of blood transfusions.
Preoperative anaemia in major colorectal surgery patients: length of stay and blood transfusion

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Introduction: Preoperative anaemia has been shown to increase the risk of requiring perioperative allogenic blood transfusion and increase the length of postoperative stay. If identified in advance, administration of intravenous iron can be used to treat preoperative anaemia and avoid the need for blood transfusion. Our objective was to demonstrate the burden of preoperative anaemia to support a business case for a preoperative intravenous iron service.

Methods: All patients who underwent major colorectal surgery in our hospital during the first six months of 2017 were retrospectively reviewed. Data was obtained from the electronic patient record, we used descriptive and simple statistical calculations. Cost savings were calculated using figures from data.gov.uk and the National Institute for Health and Care Excellence. Anaemia was defined according to the World Health Organization classification.

Results: 102 major colorectal surgeries were performed, 28% were completed laparoscopically. The mean haemoglobin value was 110 g/L (SD ± 12) in the 33% (n = 33) of anaemic patients. Median length of stay was 4 days longer for anaemic patients (11 days [IQR 9-15]) than non-anaemic patients (7 days [IQR 5-9]) (P = 0.0001). Blood transfusion was received by 57% of anaemic patients compared to 13% of non-anaemic patients giving a relative risk of blood transfusion with preoperative anaemia of 4.43 (95% CI 2.21-8.65). Patients who received allogenic blood transfusion received between 1 and 7 units, median of 2 units [IQR 2–4], there was no difference between the groups. Over one year, the anaemic patients stay an additional 264 days in hospital and receive 58 more units of blood. This equates to an additional £105 000 (€118 142) in bed days and £9860 (€11 904) in blood administration costs.

Conclusion: The incidence of preoperative anaemia for colorectal surgical patients is similar to that found in previous studies. We found an association between preoperative anaemia and increased length of stay. Preoperative anaemia was also associated with a fourfold increased relative risk of allogenic blood transfusion in the perioperative period. Addressing preoperative anaemia has the potential to save significant resources as well as reduce the risks associated with allogenic blood transfusion.
Preoperative anaemia is associated with inferior outcomes and increased use of red cell transfusion in patients undergoing hysterectomy

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Introduction: Preoperative anaemia has been established as a risk factor for morbidity, increased length of stay and mortality across a variety of surgical contexts and recent national quality standards in the UK require that patients with iron-deficiency anaemia undergoing elective surgery are offered iron supplementation before and after surgery. Patients undergoing gynaecological surgery are at risk due to the frequency of bleeding pathologies in this group, but there is little published data describing the prevalence of anaemia and association with outcomes. This service evaluation was performed to establish the prevalence of anaemia and association with 30 day mortality, length of stay and red cell transfusion in 1544 consecutive patients undergoing hysterectomy in a single tertiary centre over a 5-year period.

Methods: Anonymised data were collected from electronic patient records for all patients with the Office of Population Censuses and Surveys Classification of Interventions and Procedures version 4 code Q074 “Hysterectomy” from August 2012 to July 2017, including last preoperative haemoglobin (Hb), date from preoperative Hb result to procedure, length of stay, whether blood products were transfused and mortality. Anaemia was defined according to current WHO definitions. Prolonged length of stay was defined as greater than the 75th centile (4 days).

Results: Amongst the 1544 patients there were 333 (21.6%) with mild anaemia (Hb 110-119 g/L), 143 (9.3%) with moderate anaemia (Hb 100-109 g/L), and only 3 (0.2%) with severe anaemia (Hb <80 g/L). The median time from Hb result to procedure was 8 days with interquartile range 4–15 days. Length of stay ranged from 0 to 56 days with median 2 days. Preoperative anaemia was associated with increased length of stay. Patients with mild anaemia had median length of stay 3 days and patients with moderate or severe anaemia median length of stay 5 days. Patients with moderate or severe anaemia were significantly more likely to have a prolonged stay (56%) than patients without anaemia (14.0%), (Odds ratio (OR) 7.7, 95% confidence interval (CI) 5.3–11.1. 30 day mortality was 2.05% in the group with moderate or severe anaemia and there were no deaths within 30 days in the group with mild or no anaemia (P=0.0001, Chi-Square Test with Yates correction). Transfusion of red cells was significantly more frequent in the group with moderate or severe anaemia (15.0%), than in the group without anaemia (4.68%), (OR 13.8, 95% CI 5.53–34.31). The group with mild anaemia also received more transfusion (10.7%), but this did not reach statistical significance (OR 2.75, CI 0.95–8.0).

Conclusion: Moderate or severe preoperative anaemia was associated with significantly increased length of stay, 30-day mortality and use of red cell transfusion in these 1544 consecutive patients undergoing hysterectomy in a large UK tertiary centre anaemia, supporting the implementation of measures such as treatment of iron deficiency to improve operative outcomes.
P61

Evaluation of a non-invasive method for the early preoperative detection of anaemia in a large teaching hospital

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Introduction: Preoperative anaemia management is one of the pillars of patient blood management. The advantages of preoperative anaemia management are well documented and go beyond avoidance of unnecessary blood transfusions. University Hospital Aintree is a tertiary referral centre for various surgical specialties. In line with NHSBT and AAGBI recommendations, we are developing a preoperative anaemia pathway for all specialities. The use of a pulse co-oximeter such as the Masimo Rad-67™ is being considered as a triage tool in our surgical outpatient clinics to facilitate early anaemia detection. Patients with a low haemoglobin will have haematinics added to their routine preoperative bloods and a referral made to the preoperative anaemia service.

Method: The Masimo Rad-67™ was assessed over a two-week period in our pre-op clinic. Staff were trained and asked to measure and record the pulse co-oximetry haemoglobin concentration whilst recording the routine observations for the patient. The Rad-67™ gives an estimate of the perfusion index, PI, a measure of signal quality, which was also recorded. The patients subsequently had preoperative bloods as part of their routine work-up. A retrospective analysis of the laboratory haemoglobin concentration was compared with the pulse co-oximetry haemoglobin that was recorded.

Results: Data was collected from 34 patients. 18 were found to be anaemic. The positive predictive value was calculated at 75%, and negative predictive value of 66.67%, with overall accuracy of 70%. When the PI was taken into consideration, it was found that a PI <4 was associated with a poor correlation of the pulse haemoglobin and laboratory haemoglobin. Accuracy was improved when the PI was above 4.

Conclusion: The Masimo Rad-67™ is easy to use and non-invasive. Its accuracy is improved when the PI is greater than 4. The utility of this device as a screening tool in surgical and preoperative assessment clinics is possible, with the addition of advice regarding patients with a poor perfusion index, where laboratory testing including haematinics will be advised regardless of the measured pulse co-oximetry haemoglobin.

REFERENCE
P62

Evaluation of non-invasive haemoglobin monitoring in postpartum haemorrhage patients with low haemoglobin levels

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Introduction: Postpartum bleeding or postpartum haemorrhage (PPH) is defined as the loss of more than 500 ml or 1,000 ml of blood within the first 24 hours following childbirth. Some have added the requirement that there also be signs or symptoms of low blood volume for the condition to exist. Signs and symptoms may initially include: an increased heart rate, feeling faint upon standing, and an increased breath rate. The condition can occur up to six weeks following delivery. In the developing world about 1.2% of deliveries are associated with PPH and when PPH occurred about 3% of women died. Last year, we implemented a collaboration between two departments in accordance to patient blood management programme and we introduced the use of radical 7-Masimo device for monitoring some oxyphoretic parameters during active bleeding. Evaluation of non-invasive haemoglobin is very important for the appropriate management of a targeted transfusion therapy.

Methods: The aim of this study was the evaluation of haemoglobin level (SpHb) using radical-7 Masimo device in PPH patients for improving the transfusion triggers. From July to December 2017 we evaluated SpHb monitoring in 4 PPH patients (36-42 years). All the methods and pharmacological devices have been used for all patients for the bleeding management. SpHb monitoring started after the hemodynamic stabilization of the patients. The transfusion thresholds we observed was less than 8 gr/dl with active bleeding.

Results: This fearful complication was well managed in all four patients. All the patients were treated without clinical complications and the monitoring of haemoglobin allowed to carry out a targeted transfusion therapy.

Conclusion: SpHb monitoring is one of the methods recommended by the guideline on the PBM for the correct management of patients with active bleeding. Our experience shows that SpHb monitoring is very useful in this setting. An increase in treated patients will allow the construction of a diagnostic algorithm for the correct management of transfusion support in PPH patients.
Evaluation of the Easy Reader + spectrophotometer for quantitative point-of-care assessment of ferritin levels in capillary, venous and plasma samples

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Introduction: Anaemia is frequent among surgical patients and iron deficiency (ID) is its most common cause. Ferritin assessment is essential for ID diagnosis and it is usually performed at central lab. The Easy Reader + spectrophotometer (ER+; Veda Lab, France) allows for point-of-care ferritin measurement in 15 min in a variety of samples, using monoclonal-dye conjugate and polyclonal solid phase antibodies, with a lower limit of detection of 10 ng/mL. We performed a comparative analysis of ferritin data provided by ER+ and Dimension Vista 1500 (DV; Siemens Healthineers, USA) in capillary, venous and plasma samples.

Methods: Capillary (n = 50), venous (n = 52) and plasma (n = 50) samples (50 μL) were analysed in the ER+. In most cases the three samples were obtained from the same individual. Capillary samples were obtained from a finger prick using the Pasteur micropipettes provided by the manufacturer. Venous and plasma samples obtained from blood drawn in lithium heparin and dispensed using precision automatic pipettes, fitted with disposable tips. For each ER+ sample, a plasma sample was processed in the DV (Accuracy). 4 venous and 4 plasma samples with low normal (33 ng/mL), middle normal (133 ng/mL), high normal (291 ng/mL), and high abnormal (558 ng/mL) ferritin levels were analysed (5 times each) in ER+ and DV (Precision). The effect of venous sample volume (30, 35, 40, 45, 50, 55 and 60 μL) on ferritin values measured in the ER+ was also assessed.

Results: Overall, there was a systematic underestimation in ER+ ferritin values in all sample types with respect to those offered by DV in plasma. From linear regression analysis, forcing to x = 0 and y = 0, correction factors were 2.25 for capillary samples (r² = 0.709), 1.94 for venous samples (r² = 0.843), and 1.25 for plasma samples (r² = 0.944). In the precision evaluation, variation coefficients (CV) were 9.2%, 9.2% and 0.9%, for low normal in ER+ venous, ER+ plasma and DV plasma, respectively; 16.4%, 13.3% and 0.1%, for middle normal, respectively; 19.3%, 8.8% and 0.9%, for high normal, respectively; and 12.7%, 4.3% and 0.9%, for high abnormal, respectively. Low sample volumes greatly affected ferritin values offered by ER+ in venous blood.

Conclusion: Ferritin assessments by ER+ in venous and plasma samples have an acceptable precision and accuracy compared to DV measurements. This was not observed for capillary samples probably due to variations in sample volume, although confirmatory data are needed.
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Patient blood management in colorectal cancer patients: a survey among Dutch gastroenterologists, surgeons and anaesthesiologists

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Introduction: There is an increasing awareness of the need to integrate patient blood management (PBM) within routine surgical care to improve patient outcome. However, to date, and despite the high prevalence of preoperative anaemia associated with increased morbidity and mortality, virtually nothing is known about the use and implementation of PBM strategies in colorectal cancer surgery. Present study aimed to assess the current preoperative blood management strategies in the Netherlands, and to identify preferences of physicians in the treatment of preoperative anaemia.

Methods: An online electronic survey was developed and was sent to all surgeons of the Dutch Taskforce Coloproctology (i.e. 177 in total). In addition, for each hospital in which surgery for colorectal cancer surgery is performed (i.e. 75 in total), the survey was sent to one gastroenterologist and one anaesthesiologist. Analyses were performed using descriptive statistics.

Results: A total of 192 physicians responded to the survey (response rate 58.7%). In 73 hospitals (97.3%) the survey was conducted by at least one physician, while in 21 hospitals (28.0%) the survey was conducted by both surgeon, anaesthesiologist and gastroenterologist. Regarding the management of preoperative anaemia, there is no clear policy in the vast majority of hospitals (49.3%). In 14.7%, 20.0%, 5.3%, 2.7%, 2.7%, preoperative anaemia was indicated to be first treated by the gastroenterologist, surgeon, colon care nurse, haematologist, and anaesthesiologist, respectively. 45.3% and 17.8% of responding hospitals indicated that iron status was measured during screening for colorectal cancer and during preoperative assessment, respectively. Most physicians (98.0%) considered severity of anaemia as variable in their decision-making to treat anaemia.

Conclusion: The present study shows a distinct variability in preoperative blood management practices in colorectal cancer care, indicated by varied responses from gastroenterologists, surgeons and anaesthesiologists. Strikingly, this variability was not only seen between, but also within Dutch hospitals. As a result, the present study clearly demonstrates the lack of consensus between gastroenterologists, surgeons and anaesthesiologists, resulting in a suboptimal preoperative blood management strategy.
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Why are guidelines for intravenous iron administration so necessary in hospitals?

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**Introduction:** The introduction of a PBM programme in hip fracture has led to significant reductions in transfusion and length of stay in hospitals. In order to reduce the number of time required to administer the full dose of intravenous iron, and to improve elderly patient outcome, permission to change iron formulation was sought from Pharmacy and Therapeutics (P&T) committee. The Anaesthesia and Traumatology Services asked for the inclusion of ferric carboxymaltose (FCM) in the PBM programme instead of iron sucrose (IS). To evaluate and justify the inclusion of FCM, the P&T committee asked us to analyse the use of intravenous iron therapy in our hospital.

**Methods:** To analyse the use and administration of intravenous iron to 200 patients during first 3 months of 2017, we used our computerized physician order entry programme.

**Results:** Most of the patients treated with intravenous iron had a FCM prescription (59.2%). The exception was Traumatology and Gynaecology where their protocols included IS. We found different doses and frequencies of administration of specific intravenous iron preparations. Before the treatment figures such as haemoglobin (Hb), transferrin saturation index (TSI) or serum ferritin levels (SFL) were not recorded in 42.29%. In 33.83% patients who received intravenous iron the posology differed from the included in the summary of product characteristics. Some results of the study are shown in the graphics below:

**Conclusions:** These results were presented in the P&T committee and the inclusion of FCM in PBM programme in hip fracture was approved. In this programme the posology follows a determination of the individual iron need according to previous figures (Hb, TSI, SFL). We introduced in the computerized physician order entry program alerts with maximum doses and frequencies of intravenous iron and the need to have a previous iron study. We recommend the utilization of intravenous iron guidelines in medical services.
P66

**Intravenous iron service in a tertiary cancer hospital: patient follow up and audit of clinical efficacy**

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**Introduction:** Anaemia is common, especially in cancer patients. It is an independent risk factor for increased mortality post-operatively. The leading cause in the developed world is Iron Deficiency Anaemia (IDA). Diagnosis and Treatment of anaemia should form a part of the routine perioperative care of patients. The Royal Marsden hospital (RMH) has had an intravenous (IV) iron service for more than ten years. We set about to audit the use of the service and follow up the patients who received intravenous iron.

**Methods:** In October 2017 pharmacy records were analysed to identify patients who had received a dose of IV iron. All patients from a 2 year period (January 2014 to October 2016) were included in the study. Electronic patient notes were then accessed and demographics, surgical status and laboratory results were analysed. We aimed to assess the increment in haemoglobin (Hb) by analysing the pre-infusion Hb and monitoring the changes post-op, at 1-2 weeks, 3 weeks, 4 weeks, 6-8 weeks, 10 weeks and 16 weeks. Data collection was stopped if any blood was transfused.

**Results:** During the study period 174 patients received iron infusions. 71.8% (125) were female and 28.2% (49) were male. 9 surgical specialities were represented with the majority of patients being cared for by lower gastro-intestinal (31.3%), gynaecology (23.7%) and upper gastro-intestinal (13.0%) teams. The average age of patients was 60.8 years with a range of 25 to 92 years old. 75.3% of patients received IV iron in the perioperative setting and 24.7% received a dose in a non-surgical setting. The doses were given to patients both pre and post op, in a timeframe that ranged from 380 days pre-op to 70 days post op. 59.8% of patients who received IV iron did not require a blood transfusion within 4 months at the RMH. The average Hb was 103.9 g/L at the time IV iron was administered with a range from 64 to 151 g/L. The average rise in Hb was 6 g/L at 1-2 weeks, 12 g/L at 3 weeks, 12.1 g/L at 4 weeks, 24 g/L at 6-8 weeks, 35 g/L at 10 weeks and 23.7 g/L at 16 weeks.

At time of follow-up in 2017 31.6% of the patients had died.

**Conclusion:** We were able to show that the iron service is widely used at the RMH across multiple surgical specialities and it provides a valuable alternative to blood transfusion in appropriate clinical scenarios. When IV iron is used, anaemia is often corrected and blood transfusions are seldom required. This study showed that a significant increment in Hb is seen when IV iron is administered and this was most notable at 10 weeks post infusion. There were several limitations in the follow-up as we required patients to have had blood tests at specific intervals. Numerous patients had their surgery and IV iron at the RMH and were then transferred back to their base hospital so we were unable to fully assess the efficacy of the IV iron. With the increasing uptake of patient blood management (PBM) strategies and the understanding of the deleterious effects of blood transfusions, we believe that the popularity of IV iron will continue to grow.
Evaluation of a new preoperative anaemia optimisation pathway 6 months post implementation

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Introduction: Both preoperative anaemia and perioperative blood transfusion are associated with excess morbidity and mortality. NICE have introduced a “Quality Standard” that patients undergoing major surgery with iron deficiency anaemia (IDA) are offered preoperative supplementation in order to replenish stores and promote haemoglobin (Hb) incrementation. In response to NICE guidance, a Preoperative Anaemia Optimisation Pathway was introduced in March 2017.

Methods: 6 months following implementation of the new pathway, its need, utility and impact was assessed by review of electronic patient pre, intra and postoperative records. Data were analysed using Excel. Non parametric data were described as median [interquartile range].

Results: 72 anaemic patients were identified in preoperative assessment (POA) over a 6 month timeframe. Median Hb was 99.5 g/L [88.5-106]. 43 patients were on a cancer pathway and 59 were awaiting major surgery according to NICE classification. 9 failed to have further diagnostics, while 63 (88%) went on to have haematinics (62% absolute IDA, 25% functional IDA, 13% undefined aetiology). 50/72 (69%) received preoperative IV iron (Monofer 1500 mg [1000-1500]) with no reported adverse events. 17/50 (34%) had a repeat Hb check preoperatively. Of these, median Hb increase was 9 g/L [3-17]; 50% demonstrated Hb rise >10 g/L, 6% failed to respond and only 6% achieved an optimal Hb (>130 g/L), while 37.5% incremented to Hb >120 g/L. 8/72 received oral iron with no follow up. 1 preoperative transfusion was administered for a patient with symptomatic non-IDA (Hb 77). 12 patients were referred back to their GP, 1 to renal and 1 to haematology. Median time from anaemia diagnosis at POA to IV iron was 11 days [5-17.5] while median time from POA to surgery was 27 days [16-47]. 7 patients who received IV iron never underwent surgery.

Conclusion: We have demonstrated a genuine need for this pathway to preoperatively optimise patients awaiting major, often cancer surgery. Moving forward, the evaluation highlights several shortfalls and areas for improvement. Haematinics were not performed in all anaemic patients, which may be reconciled through implementation of reflex testing where anaemia is identified. Patients were entered on to the pathway despite not being planned for major surgery and some treated with IV iron who did not go on to have their surgery, representing potential wastage of resources. The time interval from detection of anaemia at POA to iron infusion may contribute to the failure to adequately increment in some patients, prompting plans to develop capacity for same day infusions within POA. In order to better evaluate the impact of iron treatment, Hb recheck must be incorporated robustly within the pathway, enabling re-dosing or referral for specialist review where Hb fails to respond.
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Preoperative anaemia and perioperative transfusion 6 months post implementation of a new clinical pathway

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Introduction: The adverse effect of the triad of risks (conveyed by preoperative anaemia, intraoperative haemorrhage and perioperative transfusion) on morbidity and mortality is well described. Preoperative anaemia therefore represents an important modifiable risk factor for patients undergoing major surgery, prompting recent NICE recommendations that anaemia should be identified and optimised preoperatively to enhance patient outcomes.

Methods: Following implementation of a new preoperative anaemia optimization pathway, its impact on haemoglobin levels and perioperative transfusion was evaluated through review of electronic patient records. Non-parametric data were described by median [interquartile range] and data analysed with Mann-Whitney U and Chi-square tests using Excel and SPSS. $P < 0.05$ denoted statistical significance.

Results: 72 anaemic patients were identified in preoperative assessment (POA) over a 6-month time period. Median haemoglobin (Hb) was 99.5g/L [88.5-106]. Of the 63 patients who had haematinics checked, 62% had absolute iron deficiency anaemia (IDA), 25% functional IDA and 13% anaemia of undefined aetiology. 50/72 (69%) received preoperative IV iron (Monofer median dose 1500mg [1000-1500]) with no reported adverse events. Perioperative transfusion rate amongst the anaemic patients undergoing major surgery was 33% (16/48). 7 transfusions were administered intraoperatively, mainly for significant haemorrhage (median RBC 4 units [2.5-6]). 14 patients received postoperative transfusion(s) (median RBC 1.5 units [1-2]).

<table>
<thead>
<tr>
<th>Table 1. Comparison of transfused and non-transfused patients</th>
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</thead>
<tbody>
<tr>
<td>Anaemic transfused n=16</td>
</tr>
<tr>
<td>Median baseline Hb at POA g/L [IQR]</td>
</tr>
<tr>
<td>% patients with Hb rechecked post IV iron</td>
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<tr>
<td>Median post IV iron incremental Hb g/L [IQR]</td>
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<tr>
<td>Median Hb increment g/L [IQR]</td>
</tr>
<tr>
<td>% optimised (Hb &gt;120g/L)</td>
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<tr>
<td>Median time to Hb check (days) [IQR]</td>
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</table>

Conclusions: Following implementation of a pathway to detect and optimize anaemic patients undergoing major surgery, 50 patients were given IV iron during a 6 month time period. Despite enrolment on the pathway, one third of patients required perioperative transfusion, with almost half transfused intraoperatively in response to significant haemorrhage. In patients who did not require perioperative transfusion there was a trend towards greater Hb rise following IV iron and longer time frames prior to repeat Hb and date of surgery when compared to those that did need transfusion. Successful optimization and adequate time for incrementation may contribute to reduced transfusion burden, though haemorrhage remains the principal determinant of acute transfusion. Data is limited by low rates of routine post iron Hb check, which will be addressed in the subsequent of data collection.


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**Experience of running an IV iron service for preoperative anaemia**

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**Introduction:** We present our experience of setting up an intravenous (IV) iron service for the management of preoperative anaemia in a major cancer centre receiving tertiary surgical referrals for hepatobiliary, gynaecology and robotic cystectomy.

**Methods:** We developed a pathway for the identification and referral of anaemic patients on enhanced recovery pathways for major surgery (cancer, benign disease and orthopaedic joint replacement) using WHO criteria. This pathway was introduced to preoperative assessment clinic, where nurses identified and referred patients for consideration of pre-operative intravenous iron infusion. We audited this referral data between 14/6/2017 and 17/10/2017. Patients who were not anaemic, or who did not have iron deficiency anaemia, were excluded. Lead time was calculated as the time between date of referral for IV iron and date of planned surgery.

**Results:** 70 patients were referred. 50 patients met the inclusion criteria; of these, 19 had low plasma ferritin. Of these eligible patients, 7 (37%) were offered IV iron preoperatively, with 6 consenting to treatment. The mean lead time was 7 days. The mean time from IV iron infusion to day of admission was 3.5 days.

**Conclusion:** Challenges of running an IV iron service currently include a short lead time, and an even shorter period of time between IV iron infusion and planned surgery date. Some referrals do not meet the criteria for iron deficiency anaemia.

**Discussion:** There is a delay between IV iron infusion and improvement of anaemia. Deferral of time-sensitive major surgery is rarely an option. Hence to create a longer lead time the referral must be brought forward. In order to maximise this time between referral and date of surgery we will identify key points where the surgical teams could assess for anaemia (such as at endoscopy). This may involve anaemia champions to raise awareness. Tertiary oncology referrals will now require Hb and ferritin from the referring hospital. Another difficulty as a tertiary referral centre is that some patients may have to travel long distances for treatment. Therefore, we aim to form a collaborative with local hospitals to permit IV iron therapy closer to home to improve convenience and access.
Impact of patient blood management on length of stay in elective surgery

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Introduction: Anaemia in surgery is classified as a haemoglobin concentration of less than 130 g/L in both men and women. Anaemia compounds the stress of surgery and is associated with increased morbidity and mortality. Anaemic patients are more likely to receive a blood transfusion and transfusion is an independent predictor of poor outcome. Therefore the combination of anaemia and blood transfusion together puts the patient at significant risk of postoperative complications. Based on PBM guidance, in 2013, the Pre-assessment Team began to identify patients with iron deficiency anaemia (IDA) whose surgery could not be delayed. These patients were referred for treatment with intravenous iron and received 1000 mg of iron isomaltoside (MonoFer™).

Methods: Taking an Hb of <130 g/L as indicative of anaemia, the Transfusion Team retrospectively analysed a cohort of 87 surgical patients between 2013 and 2017:

- Group 1: 37 non-anaemic patients
- Group 2: 30 anaemic patients who did not receive IV iron due to imminent surgery prior to iron isomaltoside availability.
- Group 3: 20 anaemic patients who received IV iron (iron isomaltoside) before surgery

Results: Of the patients audited, the patients who were not anaemic at the time of surgery had the lowest transfusion rate and the shortest length of stay in hospital. The patients who received iron therapy preoperatively were transfused less blood and left hospital 3.1 days earlier than the anaemic patients who did not receive iron.

Conclusion: This small, unpublished audit reflects the findings of research in this field. Whilst scientific conclusions cannot be drawn, the results validate the work of the Pre-assessment Team. Identifying and treating IDA early is likely to benefit the patient most. Testing for anaemia at the point of referral in primary care or when undergoing investigations (e.g. colonoscopy) would buy critical time to allow the Hb level to rise. However, there may also be merit in replenishing the patients’ iron stores even when the pre-operative interval is short. The scope of this work could be extended to encompass urgent surgery and treatment with IV iron (iron isomaltoside) could be considered in the recovery room or postoperatively.
Clinical and economic impact of a perioperative intravenous iron support protocol in patients undergoing femur fracture surgery

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Introduction: The aim of the study was to evaluate if the introduction of a PBM program based on a patient-tailored management of perioperative anaemia is effective in reducing patients’ exposure to allogeneic blood without increasing the direct cost correlated with anaemia treatment in patients undergoing orthopaedic surgery for femur fracture.

Methods: From May 17, all the patients admitted at the Emergency Department (ED) because of a femur fracture (FF) enter the PBM femur fracture protocol (PBM-FFP) set up and managed by the hospital Blood Bank (BB). According to the PBM-FFP, patients are referred to the BB staff by the doctors in charge at the ED or captured through a daily check of the Hospital Information System by the PBM Nurse coordinator. The Nurse coordinator fills in a dedicated clinical chart, notify the BB doctor for clinical evaluation and monitors the patients’ haematological parameters. If at any time before surgery, an Hb value <13 g/dL is recorded, iron metabolism parameters are measured and if serum iron <60 µg/dL and/or serum ferritin <60 ng/mL, 500 mg of ferric carboxymaltose (Ferrinject, Vifor) are administered intravenously. Moreover, during the postoperative period, patients with Hb <9.5 g/dL are referred to the BB doctor for evaluation of possible measures. Blood transfusions are usually not performed if Hb >8.0 g/dL except for patients with coronary artery diseases or who are symptomatic. Obtained results have been compared with those observed in a control group of 70 patients operated by the same team from Aug 16 to Jan 17. Evaluated end points were: number and % of transfused (Tx) patients, mean number of Tx RBC units/transfused patient.

Results: Up to Oct 17, 54 patients have completed the study protocol. No difference has been observed between PBM and control group in term of age (82 ± 12 vs. 81 ± 11) sex (female 70% vs. 69%) and Hb at admission (12.3 ± 1.7 vs. 12.7 ± 1.3). The PBM-FFP allowed to significantly decrease the % of patients requiring RBC transfusion (37% vs. 50%), the mean number of RBC units/transfused patients (1.8 ± 0.8 vs. 2.5 ± 1.8) and to reduce the mean needs of RBC units per operated patient (0.67 vs. 1.23 RBC units transfused per operated patient, for PBM and control group respectively). In the PBM-FFP group, 39 patients had additional lab tests for anaemia evaluation and 16 received intravenous iron support (total cost 1517 €). Considering also the cost of the RBC units, the direct costs for the management of perioperative anaemia, per operated patients, were 149.8€ for the PBM-FFP group and 222.4€ in the control group.

Conclusion: The study demonstrates that a patient-tailored management of anaemia and iron deficiency is effective, also in non-elective surgery, in reducing RBC transfusions and related direct costs.
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Improving the efficacy of the perioperative iron infusion service during major cancer surgery – a quality improvement project

The Royal Marsden Hospital, London, UK

Introduction: Anaemia is common, especially in cancer patients. It is known to be an independent risk factor for increased post-operative mortality. The leading cause of anaemia in the developed world is iron deficiency. Diagnosis and treatment of anaemia should form a part of routine perioperative care of the patient. The Royal Marsden has had an intravenous iron service for several years. In 2017, an international consensus statement was published that stated clinicians should aim for a perioperative haemoglobin (Hb) of 130 g/L in both men and women. This change in thinking required us to update our anaemia guidelines. In the process of updating our guidelines we designed a quality improvement (QI) initiative to systematically improve the efficacy of the iron service and to educate the multi-disciplinary team involved in the perioperative anaemia management of patients.

Methods: Having gained local approval for the QI project we set about updating the clinical guidelines and disseminated them to the relevant teams. We planned a QI initiative which comprised of a pilot period followed by a 10 week timeframe to improve the iron service with different weekly activities and aims. These included teaching and troubleshooting sessions, creating clinical flowcharts and regular contact with pre-assessment nurses. Throughout the project we collected data and provided live feedback to the teams involved in an attempt to maximise efficacy and improvement. Every week we aimed to monitor the number of anaemic patients, the number of patients who were having iron studies requested, the amount of patients where the cause of anaemia was unidentified and the proportion of patients who were successfully receiving pre-operative iron therapy.

Results: During the QI project, data was collected from 501 patients. The average Hb of the patients was 130.8 g/L and 42.8% of patients were anaemic. Initially only 19.6% of patient were having iron studies completed and by the end of the initiative this had risen to 35.6% of patients. Initially 72% of patients were found to be anaemic with no cause identified, this improved to a value of 58.6% of patients at the end of the period. Intravenous iron was only being administered 21.4% of patients who required it at the beginning of the QI project and this improved to 27.6% of patients at the end of the project.

Conclusion: As expected there was a high proportion of anaemic patients in our pre-operative oncology patient population. The initial levels of anaemia investigation and treatment were low and we were able to show an improvement in the service across the study timeline. There was not always time to treat patients pre-operatively due to late referrals and therefore some patients were treated postoperatively. The QI project allowed us to scrutinise the patient pathway and we realised that the surgical outpatient appointment would be the optimal time to initiate anaemia investigations as it would allow additional time for treatment preoperatively. The project helped to raise awareness of perioperative anaemia management and we managed to successfully educate the pre-assessment nurses, surgeons and anaesthetists in the process of completing the QI project.
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Cost-effectiveness analysis of ferric carboxymaltose for preoperative haemoglobin optimization in patients undergoing primary knee arthroplasty

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Introduction: The aim of this study is evaluating the cost of ferric carboxymaltose (FCM) treatment protocol comparing no intervention and this effectiveness avoiding red blood cell transfusion (RBCT) in patients under knee arthroplasty.

Methods: This was a cost-effectiveness analysis of intravenous FCM for preoperative Hb optimization in iron-deficient patients in knee arthroplasty compared to no treatment. The analysis was performed from the perspective of the health care centre. The study was approved by the Ethics Committee. We simulated 20 000 patients with either real or functional iron deficiency anaemia submitted to primary knee arthroplasty who were randomly assigned to the Hb optimization arm or the control, non-optimization arm, in a strict 1:1 ratio. The simulation model was built in Excel spreadsheets and analysed with the @Risk add-in (www.palisade.com).

Results: The main results for the reference case scenario are summarized in table 1. The simulated preoperative Hb optimization protocol led to less patients exposed to allogeneic RBC transfusion (2 212 vs. 6 595 out 10 000 patients) and a relevant decrease in the number of transfused RBC units (4 342 vs. 13 336). Increased costs in the optimization arm were mostly associated with the outpatient day-hospital visit (54%) and the FCM treatment (40%).

<table>
<thead>
<tr>
<th></th>
<th>Control Arm</th>
<th>Optimization Arm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients transfused</td>
<td>6595</td>
<td>2212</td>
</tr>
<tr>
<td>pRBC units transfused</td>
<td>13 336</td>
<td>4341</td>
</tr>
<tr>
<td>Cost</td>
<td>-</td>
<td>3 641 421 €</td>
</tr>
<tr>
<td>Laboratory</td>
<td>-</td>
<td>210 000 €</td>
</tr>
<tr>
<td>Hospital outpatient clinic</td>
<td>-</td>
<td>1 966 500 €</td>
</tr>
<tr>
<td>IV iron (FCM)</td>
<td>-</td>
<td>1 464 921 €</td>
</tr>
<tr>
<td>Cost per patient transfused avoided</td>
<td>831 €</td>
<td></td>
</tr>
<tr>
<td>Cost per pRBC avoided</td>
<td>405 €</td>
<td></td>
</tr>
</tbody>
</table>

Conclusion: Hb optimization in iron deficient patients under knee arthroplasty with intravenous ferric carboxymaltose is cost-effective.
Results following the setting up of a protocol for timely correction of preoperative anaemia in patients suffering from colorectal cancer by using ferric carboxymaltose

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Introduction: From 2015 is established, in our Hospital (Group 3), a protocol to treat anaemia preoperatively in those patients suffering from colorectal cancer (CCR) by using ferric carboxymaltose. By reference to the data entered during 2014, when no protocol did exist, and no measures were taken to correct anaemia before surgery but transfusion in those cases with haemoglobin levels low enough to underwent surgery, we aim to determine the advantages and disadvantages of the preoperative treatment of anaemia in patients with CRC.

Methods: A retrospective study was conducted in all those patients suffering from CRC who were treated surgically both scheduled and of urgency, during 2014, when no protocol of preoperative treatment of anaemia was established. We collected also data from 2015, once the protocol of preoperative treatment of anaemia was started, in which, according to the levels of haemoglobin, ferritin, iron and transferring saturation index of the patients, they were treated by using ferric carboxymaltose. We compared data from these two groups.

Results: During 2014, before the setting up of the protocol, 74 patients underwent surgery because of colorectal cancer, 44 (59%) men, and 30 (41%) women. The average hospital stay was 14.5 ± 9.5 days. 5 patients died during the stay. There was need of transfusion in 21 patients (28%) being used 35 blood bags. There were 32 patients with postoperative complications associated (43%), spotlighting the presence of anastomotic dehiscence (11%), bleeding (8%), and infection (18%). We have analysed data from the first 100 patients operated since 2015 because of colorectal cancer, once the protocol of management of anaemia preoperatively was established; 57 men and 43 women. The average hospital stay was 14.8 ± 12.43 days, it was registered 3 exitus during the stay. Transfusion was required in 18 patients (18%), using 24 blood bags. 30 patients were treated by using ferric carboxymaltose in order to correct anaemia preoperatively. 29% of patients suffered from postoperative complications: 14% anastomotic dehiscence, 8% bleeding and 18% infections.

Conclusion: Despite further research is needed, in the light of the outcomes of these analyses, we can state that by treating preoperatively anaemia in patients suffering CRC we have reduced the use of blood bags and the need of transfusions. And not only that, but the complications rate has also decreased since 2015.
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Assessing the impact of treating iron deficiency anaemia in patients undergoing surgery for colorectal cancer

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Introduction: The objective of this audit was to assess the burden of anaemia in surgical patients and the effectiveness of treating anaemic patients with colorectal cancer with intravenous (IV) iron isomaltoside pre-surgery. Three groups were retrospectively audited. Group 1: patients who underwent surgery with an Hb of <130 g/L (n = 49). Group 2: patients who underwent surgery with haemoglobin (Hb) levels of ≥130 g/L (n = 44). Group 3: patients with an Hb of <130 g/L and were given IV iron before surgery (n = 9/30 audited to date).

Method: Patients in groups 1 and 2 were treated consecutively from Jun and Dec 2016. Patients with underlying haematological malignancies and patients admitted for emergency surgery were excluded. Patients in group 3 were anaemic patients treated with IV iron and treated consecutively from Jun 2016 to Feb 2018. Data was gathered using available IT systems and patients’ clinical record. The groups were compared in terms of length of stay in hospital, post-operative infection rates and red cell transfusion rates.

Results:

<table>
<thead>
<tr>
<th>Group (n)</th>
<th>Hb level (g/L)</th>
<th>Average Hb at referral (g/L)</th>
<th>Average preoperative Hb (g/L)</th>
<th>Length of stay (days)</th>
<th>Post-operative infection (%)</th>
<th>Patients received a red cell transfusion (%)</th>
<th>Average number of red cells units/patient (units)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (49)</td>
<td>&lt;130</td>
<td>103</td>
<td>116*</td>
<td>10.5</td>
<td>53</td>
<td>31</td>
<td>0.81</td>
</tr>
<tr>
<td>2 (44)</td>
<td>≥130</td>
<td>142</td>
<td>142</td>
<td>8.8</td>
<td>39</td>
<td>2</td>
<td>0.05</td>
</tr>
<tr>
<td>3 (9)</td>
<td>&lt;129 (IV iron pre-surgery)</td>
<td>90</td>
<td>115</td>
<td>6.3</td>
<td>11</td>
<td>11</td>
<td>0.22</td>
</tr>
</tbody>
</table>

* Rise in Hb due to red cell transfusion

Conclusion: Anaemia bears a significant burden of disease for surgical patients with colorectal cancer. Comparing groups 1 and 2, show that there was a shorter length of stay, there were less infections and a lower transfusion rate in non-anaemic patients vs. anaemic patients, although a statistical analysis did not take place. Preliminary findings from group 3 indicate that preoperative treatment of iron deficient anaemia with IV iron could have a positive impact in improving patient outcomes.
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The effect of intravenous iron therapy on long-term survival in anaemic colorectal cancer patients: results from a matched cohort study

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Introduction: Intravenous iron therapy has been shown to be advantageous in treating anaemia and reducing the need for red blood cell transfusions in colorectal cancer patients. Iron treatment, however, may also be hazardous by inducing cancer development and supporting cancer growth. The present clinical study explores, for the first time, the effect of preoperative intravenous iron therapy on tumour prognosis in anaemic colorectal cancer patients.

Methods: A retrospective cohort study was performed on consecutive patients who underwent surgery for colorectal cancer between 2010 and 2016 in a single teaching hospital. The primary outcomes were 5-year overall survival (OS) and disease-free survival (DFS). Survival estimates were calculated using the Kaplan-Meier method and in the intravenous iron and non-intravenous iron group patients were matched based on propensity score.

Results: 320 (41.0%) of all eligible patients were anaemic, of whom 102 patients received preoperative intravenous iron treatment (31.9%). After propensity score matching 83 patients were included in both intravenous and non-intravenous iron group. The estimated 1-, 3-, and 5-year OS (91.6%, 73.1%, 64.3%, respectively) and DFS (94.5%, 86.7%, 83.4%, respectively) in the intravenous iron group were comparable with the non-intravenous iron group (P = 0.456 and P = 0.240, respectively). No significant difference was observed in the time to recurrence (P = 0.275). In comparing patients with an event (i.e. death or recurrence) and no event in the intravenous iron group, age was significantly increased (P = 0.009), and with regard to iron status, a distinct trend was found for decreased transferrin in the event group (median 2.53 g/L vs. 2.83 g/L, P = 0.052).

Conclusion: The present study illustrates that a dose of 1 000 – 2 000 mg preoperative intravenous iron therapy does not have a profound effect on long-term overall and disease-free survival in anaemic colorectal cancer patients. Future randomized trials with sufficient power are required to draw definite conclusions on the long-term safety of intravenous iron therapy.
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Transfusion and alternative therapy in oncologic associated anaemia, retrospective randomised aleatory observational evaluation: pilot study

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Introduction: The most common components transfused, in acute care or long-term support, are red blood cells (RBC) and platelets, for treatment of patients with cancer-associated anaemia, chemotherapy-induced anaemia or undergoing intensive radiation therapy. This anaemia is multifactorial and iron deficiency is the predominant mechanism. Transferrin saturation <20% is more reliable for diagnosis than ferritin level because inflammatory processes causes iron trapping in macrophages and enterocytes. Treatment can use different haemoglobin (Hb) cut-off values, based on restrictive transfusion policy, patient symptoms and characteristics. RBC transfusion is associated to an increased risk of infection, among others adverse effects. Intravenous (IV) iron and darbepoetin alfa, an erythropoiesis-stimulating agent (ESA), can be used in addition or alternatively to the transfusion to improve the Hb level. However, as ESA is associated with increased risk of venous thromboembolic events, cancer recurrence and shortened disease-free survival, should be used carefully.

Methods: A retrospective randomised aleatory observational study, at the Immuno-Haemotherapy outpatient-day Hospital (CHLN-HSM) was made during a 2-month period (Sept/Oct, 2017), on a sample of 178 outpatients attendances, from 18 patients with a malignant disease [11 haematological malignancy cancer (61%) and 7 solid tumours (39%)]. Patients: 7 males (39%) and 11 females (61%), mean age of 68.8 years. Data collected: number (nº) and type of transfusions, ESA and IV iron therapy. Outcome measurements: primary – number of RBC units transfused per outpatient episode; secondary - proportion of outpatients who were transfused RBC, administered ESA and IV iron. Patient evaluated: current state of stability, clinical course and availability.

Results: Most common malignancies (44%) were digestive adenocarcinoma and acute lymphoblastic leukaemia. From a total of 178 episodes, 103 (58%) corresponded to RBC transfusions, 69 (39%) to ESA and 5 (3%) to IV iron. The mean of RBC units per patient was 6.2.

Conclusions: Cancer associated anaemia is associated to a high rate of transfusion. Responsible strategies to minimize transfusion exposure include an early identification of anaemia, evaluation for suboptimal iron stores followed by an adequate treatment and restrictive transfusion threshold with emphasis on single-unit transfusion. Although significant controversy exists regarding the impact of ESA on cancer patients survival, their use in our sample minimized blood transfusion exposure.
Bloodless treatment of acute lymphoblastic leukaemia with severe anaemia

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Introduction: Treatment of Jehovah’s Witness (JW) patients with acute leukaemia is very challenging. It is inevitable for most patients to run a risk of severe anaemia as well as severe thrombocytopenia. However, some drugs are effective for lymphoid malignant cells without bone marrow suppression.

Methods: A 23-year-old male patient was admitted for exertional dyspnoea. His haemoglobin concentration was 3.7 g/dL. Peripheral blood smear and bone marrow aspiration revealed that most haematopoietic cells were replaced by leukemic blast cells. The origin of his leukemic cells was proved to lymphoid malignancy by flow cytometry. Philadelphia chromosomes were detected in bone marrow cells. Non-myelosuppressive therapy with vincristine, prednisolone and imatinib was administrated. Erythropoietin and iron were administrated concurrently.

Results: Haemoglobin concentration gradually decreased to a nadir of 2.6 g/dL 12 days after initiation of chemotherapy. At chemotherapy day 17, haemoglobin concentration started to improved. Haemoglobin concentration improved to 8.9 g/dL at chemotherapy 24 days. The symptoms of the patient including exertional dyspnoea were improved at the same time. Follow-up bone marrow study showed the achievement of complete remission. After further recovery of anaemia, consolidation chemotherapy with Hyper-CVAD was successfully administered.

Conclusion: A JW patient with acute lymphoblastic leukaemia was able to achieve complete remission by using bloodless chemotherapy combined with non-myelosuppressive agents.
Efficacy of intravenous iron isomaltoside to improve anaemia and quality of life during palliative chemotherapy for oesophagogastric adenocarcinoma

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Introduction: Anaemia is common in oesophagogastric (OG) adenocarcinoma, increasing mortality, blood transfusions and reducing quality of life. No clear evidence exists for safe and effective treatment, especially for mild to moderate anaemia. This study assessed the efficacy of intravenous iron isomaltoside to improve anaemia, quality of life and prevent blood transfusions in OG adenocarcinoma.

Methods: Anaemic patients with histologically proven OG adenocarcinoma were recruited before initiation of palliative chemotherapy. Patients were randomised to receive standard care or intravenous iron isomaltoside. Post-chemotherapy changes in haemoglobin, ferritin, transferrin saturations, blood transfusions and quality of life were recorded for 3 cycles of chemotherapy.

Results: 27 patients were randomised to standard care (n = 13) or intravenous iron (n = 14). A non-significant decrease in haemoglobin was seen in the standard care group over three cycles of chemotherapy (mean difference -0.6 g/dL 95% CI -0.1 to -1.1 g/dL, P = 0.336) compared to an increase in the intravenous iron group (mean difference 0.5 g/dL 95% CI -0.1 g/dL to 1.1 g/dL, P = 0.903). An increase in ferritin and transferrin saturations above 20% was seen in the intravenous iron group by cycle one of chemotherapy with a greater and statistically significant increase in ferritin in the intravenous iron group (standard care 116 ng/mL versus intravenous iron group 770 ng/mL, P < 0.05). Blood transfusions were received by 7 patients (standard care n = 4, intravenous iron n = 3). No significant difference in the number and amount of blood transfused were seen (P = 0.851). No patient received a blood transfusion after cycle one of chemotherapy in the intravenous iron group. Quality of life improved in the intravenous iron group with physical well-being, emotional well-being, anaemia-specific quality of life, trial outcome index and total scores all exceeding the minimum clinically important difference. No improvement was seen with standard care.

Conclusion: Data from this pilot study suggest intravenous iron improves quality of life, ferritin and transferrin saturations. It may also increase or maintain haemoglobin, thus preventing transfusions after the first cycle of chemotherapy. However, larger adequately powered studies are required to definitively conclude this.
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Patient blood management in oncology

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Introduction: Patient blood management (PBM) is a multidisciplinary, evidence-based approach to optimize the care of patients who may need transfusion. Its primary objective is patient safety by avoiding and/or treating anaemia, minimizing blood loss and optimizing tolerance to anaemia. This multidisciplinary strategy decreases the use of blood components, thereby reducing the adverse effects of transfusion, and has been shown to be cost-effective for health systems. The causes of anaemia in cancer patients are multifactorial and often concomitant, making their evaluation complex. It is often underdiagnosed and undertreated. The main implications of anaemia in cancer patients are fatigue, reduced quality of life and negative predictive factor. Iron deficiency anaemia is common, and it is estimated that 32-60% of cancer patients have iron deficiency. Usually, the iron deficit is functional. Screening for the absolute or functional iron deficiency should be done, even if the patient does not have anaemia. Studies have shown that iron intravenous iron increases haemoglobin levels and reduces the need for transfusion. There are some national and international guidelines that already include intravenous iron treatment in this setting. According to the Portuguese EMPIRE study, the absolute iron deficit has a prevalence of 20% in the Portuguese population. Thus, it is urgent to implement PBM strategies in oncology in our country.

Methods: We report the experience of 9 months of attempted implementation of PBM strategies in oncology at our centre.

Results: There was an interdisciplinary meeting between haemotherapy and oncology in April 2017 for the PBM approach. After this meeting, no patients were referred to the haemotherapy consultation for PBM. All patients were only referred for transfusion. We identified 5 iron deficiency patients who were successfully treated with intravenous iron and did not require transfusion. There were no adverse events related to iron treatment.

Conclusion: PBM is centred on evidence-based guidelines for the use of blood with the implementation of restrictive transfusion strategies; in the education of health professionals in the best practice in transfusion medicine; in the use of pharmacological, surgical and medical therapeutic modalities in combination; and in the emphasis and centring on the patient. Unsurprisingly, the implementation of PBM protocol in oncology at our centre has been difficult, evidencing the continuing need for interdisciplinary medical training.
P81

Intravenous iron improves haemoglobin and iron stores in female iron-deficient blood donors – a randomised double-blind placebo-controlled clinical trial

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Introduction: The present trial evaluates the efficacy and safety of intravenous iron isomaltoside (Monofer®) in comparison with placebo in first-time non-anaemic female blood donors.

Methods: The trial is a prospective, double blind, placebo-controlled, randomised, comparative, single-centre trial of 85 first-time female blood donors with non-anaemic iron deficiency. The subjects were randomized 1:1 to either 1 000 mg intravenous iron isomaltoside infusion or placebo. The primary endpoint of the trial was change in haemoglobin from baseline to right before the third blood donation.

Results: The increase in haemoglobin was significantly higher for iron isomaltoside compared with placebo. Improvements in other iron related parameters (p-iron, p-ferritin, transferrin saturation, and reticulocyte count) in favour of iron isomaltoside were also observed. There were no differences in side effects.

Conclusion: In non-anaemic iron deficient female blood donors a single intravenous iron isomaltoside administration resulted in an improvement in haemoglobin concentration and iron stores and demonstrated a favourable safety profile compared to placebo.
Intravenous iron isomaltoside treatment of women suffering from severe fatigue after postpartum haemorrhage

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Introduction: The objective of this study is to explore if intravenous iron isomaltoside (Monofer®) leads to a better relief of fatigue than current treatment practice with oral iron in women suffering from severe fatigue after postpartum haemorrhage.

Methods: This is a sub-analysis of a single-centre, open-label, randomized controlled 12 weeks trial conducted in women suffering from postpartum haemorrhage. Participants were randomized 1:1 to infusion of 1200 mg iron isomaltoside over at least 15 minutes or current treatment practice with oral iron. We measured fatigue by the Multidimensional Fatigue Inventory (MFI) and Edinburgh Postnatal Depression Scale, and determined haematological and iron parameters. The sub-analysis includes participants with a high fatigue score (MFI physical fatigue score >15) at inclusion. The primary endpoint was aggregated change in physical fatigue score from inclusion to 12 weeks postpartum.

Results: A total of 85 women had a high fatigue score at inclusion. The difference in physical fatigue score from baseline to week 12 was -2.3 (confidence interval 95 %: -3.3; -1.3) (P < 0.0001) in favour of iron isomaltoside, i.e. iron isomaltoside reduced fatigue significantly more than current treatment practice with oral iron. The pre-defined minimum clinically relevant difference in aggregated physical fatigue was 1.8, and therefor superiority could be claimed. Other fatigue and depression scores also improved significantly with iron isomaltoside compared with current treatment practice with oral iron. Significant differences in haematological and iron parameters were observed and all in favour of iron isomaltoside. There were no differences in side effects between the groups.

Conclusion: In women with a high fatigue score after postpartum haemorrhage, a single dose of 1200 mg intravenous iron isomaltoside is associated with a statistically significant and clinically relevant reduction in aggregated physical fatigue within 12 weeks after delivery, when compared to current treatment practice with oral iron.
Collaboration in bloodless care of major obstetric haemorrhage with acute extreme anaemia – a case report


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Introduction: Acute extreme anaemia poses a serious challenge in surgery due to issues of haemodynamic instability complicated by tissue hypoxia and possibility of coagulopathy. This case report of bloodless surgery in major obstetric haemorrhage with acute extreme anaemia illustrates how collaboration in bloodless care can be life-saving.

Case report: A 32-year old female Jehovah’s Witness with twin pregnancy had miscarriage at 23 weeks gestation with massive obstetric haemorrhage. All attempts to control haemorrhage conservatively failed. Patient had emergency hysterectomy. Preoperative haemoglobin was 3.3 g/dl, and immediate post-op haemoglobin was 1.8 g/dl, but fell to 1.3 g/dl on 1st day postop. Patient woke up from surgery, and remained on oxygen therapy in ICU, but consciousness deteriorated subsequently to GCS 6/15 on 1st day post op. Chemical pathologist invited assayed blood & urine osmolality and electrolytes and diagnosed fluid overload and severe acidosis, which were successfully managed with intravenous mannitol and sodium bicarbonate. Haematologist invited placed patient on intravenous iron and subcutaneous erythropoietin. Microbiologist was invited due to postop pyrexia, and patient was placed on antimalarial medication. Patient regained consciousness fully by 5th day post op and was moved from ICU to the ward on 8th day post op with Hb of 3.5 g/dl. She was discharged on 18th day post op with Hb 6.9 g/dl in good condition. Last visit was at 4 months post op, Hb was 12.5 g/dl, and patient was in excellent condition.

Conclusion: Tolerance of anaemia without blood transfusion is one of the pillars of patient blood management adopted by the World Health Assembly in 2010. Acute extreme anaemia can be successfully managed in bloodless surgery through appropriate collaboration and prompt intervention in respect of haemodynamic and metabolic complications.
**Abstracts of the 19th Annual NATA Symposium**  
**Poster Abstracts**

**Fluid Therapy / Oxygen Carriers**

**P84**

**BALBUMIN: Survey on the use of albumin in resuscitation of major burn patients**

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**Introduction:** Despite the studies and reviews published on the initial resuscitation of major burn patients (MBP), certain points continue to generate conflict among professionals, such as different types of monitoring, fluids and the use of albumin, especially in those professionals who are not used to treat this type of patients. We consider that knowing the usual practice of the Spanish reference units (CSUR) could be useful in these cases, so we decided to conduct a survey.

**Objective:** To know how the CSUR perform the initial resuscitation of MBP and the use of albumin.

**Methods:** A questionnaire of 20 questions was distributed via e-mail to the CSUR’s heads about the epidemiology, initial resuscitation and use of albumin.

**Results:** 86% of the hospitals have a specific team and protocol to carry on the initial resuscitation of MBP. In 47% of the units, the resuscitation protocol is still based on the Parkland formula, the rest combine Parkland formula and goal guided therapy resuscitation for therapeutic purposes through haemodynamic monitoring. The fluid of choice in 71% of the units is still the Ringer’s Lactate, while in 29% the Ringer’s Acetate has been introduced. 86% of the units use albumin according to their protocols as a resuscitation colloid in the first 24 hours.

**Conclusions:** The correct initial resuscitation is very important for the progression of the lesions in MBP. Knowing the usual practice of reference units allows us to see where the trends are going and to identify points of conflict, such as the type of monitoring, and the crystalloids and colloids of choice for these patients.

**REFERENCE**

Haemostasis & Thrombosis

P85

Tranexamic acid administration time to prevent bleeding in total knee arthroplasty: preliminary data

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Background and goal of study: Tranexamic acid (TXA) has proven effective in reducing blood loss and transfusion requirements in arthroplasty. However, the ideal timing of its administration is not well established in total knee prosthesis surgery with tourniquet as the need of a second dose. The aim of this study is to know if the moment of the tranexamic acid administration (at induction or before relieving the tourniquet) influences the perioperative bleeding on knee arthroplasty and to evaluate the utility of adding a second TXA dose.

Materials and methods: A prospective, double-blind clinical trial (EudraCT 2016-000071-24) of the first 99 primary knee arthroplasty patients operated with tourniquet who were randomized into 4 groups as follows:

<table>
<thead>
<tr>
<th>INDUCTION</th>
<th>ISCHAEMIA</th>
<th>POSTOPERATIVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 TXA (15 mg/kg)</td>
<td>Saline Solution</td>
<td>Saline Solution</td>
</tr>
<tr>
<td>2 TXA (15 mg/kg)</td>
<td>Saline Solution</td>
<td>TXA (10 mg/kg)</td>
</tr>
<tr>
<td>3 Saline Solution</td>
<td>TXA (15 mg/kg)</td>
<td>Saline Solution</td>
</tr>
<tr>
<td>4 Saline Solution</td>
<td>TXA (15 mg/kg)</td>
<td>TXA (10 mg/kg)</td>
</tr>
</tbody>
</table>

The groups are compared using the Student’s t-test for qualitative variables and Chi square test for the quantitative variables. We consider statistically significant at $P < 0.05$.

Results and discussion: The four groups were comparable in sex, age, ASA, preoperative haemoglobin (Hb) and duration of surgery. Patients that received TXA at the induction (1-2 groups), the visible bleeding in the drainage was lower than in the groups that received before release ischemia (3-4 groups) (145 ml versus 214 ml, $P < 0.005$). We found no significant differences between Hb at 24h and at discharge, neither in calculated total bleeding (1568 ml vs. 1595 ml, respectively). The administration of a second dose of TXA after surgery showed a reduction in blood loss, but our findings only showed a significantly higher Hb at discharge (Hb 10.32 ± 1.20 vs. 10.92 ± 1.06). However, the clinical relevance was low since there was no impact on the number of transfusions or outcomes.

Conclusion: the administration of TXA before the induction significantly reduced visible bleeding in the total knee arthroplasty. The patient who received a second dose of TXA after surgery showed a higher Hb at discharge.
The use of tranexamic acid in hip fracture patients

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Introduction: It has long been observed that tranexamic acid (TXA) use is associated with reduced blood loss in trauma. This has increasingly led to the review of outcomes of TXA use in various emergency surgical procedures. Emerging evidence suggests the use of TXA may reduce bleeding and transfusion rates postoperatively in hip fracture patients. There is also growing evidence that suggests there is no increase in the risk of deep vein thrombosis or pulmonary embolism with TXA use, with the same risk applying with any anticoagulant taken postoperatively. There is also emerging evidence that correlates the use of TXA with reduced length of stay and subsequently a significant cost benefit to the health service.

Aim: To determine correlation between TXA use and postoperative haemoglobin (Hb) levels, the need for transfusion, its use and the effect on length of stay and associated mortality rates at 30 days and 1 year for patients that undergo hip fracture surgery.

Method: The use of TXA and its effects on outcomes was examined using retrospective data of patients managed surgically for neck of femur fractures at the Manchester Royal Infirmary, England, between January 2015 and December 2016. Patients were divided into two groups: those who had received TXA and those who had not. Within these categories the postoperative Hb, length of stay, and 30 day and 1 year mortality rates were examined and compared. Data was tabulated and analysed using Microsoft Excel software.

Results: Of the 414 patients who underwent surgery for hip fractures, 145 patients received TXA. An average Hb drop of 31.7 g/L was seen in the TXA group, compared to 33.8 g/L in the group without TXA. Transfusion rate was similar at 2.6 units for TXA patients vs. 2.5 units without. There was no significant difference in median length of stay between the groups: 20 days (IQR 12-36 days) in patients with TXA vs. 19 days (IQR 10-36 days) in those without. Although 30-day mortality was higher with TXA at 5.52% (vs. 4.4% without), the overall 1-year mortality was significantly lower at 18% compared to 25% without TXA.

Conclusions: Patients with hip fractures are often critically unwell. This might explain the minimal difference in transfusion rates and 30-day mortality. However, the overall reduced fall in Hb and significantly lower 1-year mortality supports the use of TXA in hip fracture patients. This highlights the need to treat all hip fractures as high level trauma cases and manage them as such.
Tranexamic acid in patients undergoing elective abdominal aortic aneurysm repair treatment (surgical and endovascular): one-centre experience

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Introduction: Reduction of perioperative blood loss is one of the fundamental pillars of patient blood management (PBM). In recent years, Tranexamic acid (TA) is accepted therapy to reduce bleeding and the need for red blood cells (RBC) transfusion in certain traumatic bleeding, GIT, postpartum haemorrhage, as well as elective cardiovascular and spinal surgery. Its use in elective surgery for abdominal aortic aneurysm (AAA) repair surgery in terms of reducing blood loss and possible postoperative neurologic and cardiovascular complications is unclear.

Methods: A retrospective study of 121 patients undergoing elective surgical (n = 112) and endovascular (n = 9) repair of AAA between January 2013 and November 2017 was conducted. Number of patients who received intraoperative RBCs transfusion, average intraoperative blood loss and early postoperative complications was correlated with introduction of PBM algorithm and, in the PBM group (n = 69), those who were (n = 51) vs. who were not (n = 70) treated preoperatively with TA.

Results: Out of 121 examined patients, 96% were male. They were, in average 68 years of age (48-83 years), on average ASA status 3. The surgery lasted on average 342 min. All patients were under general anaesthesia and 30% of them had epidural catheters with continuous analgesia. 56% of all patients did not receive any RBCs. Before the introduction of PBM algorithm, 73.03% of patients received intraoperative RBC transfusion, in contrast with 21.73% after PBM introduction (P < 0.001). TA was given prior to the incision to 42.2% patients (which constitutes 73.91% of post-PBM group). Estimated blood loss was on average 575 mL (median 495 mL) in TA group, in contrast with 1313 mL (median 1200 mL) in non-TA group (P < 0.001). In the TA group, 11.76% received RBC transfusion in contrast with 67.14% RBC transfused patients who did not receive TA (P < 0.001). In non-TA group, average length of hospitalization was 16.22 (median 13) days, while in TA group 19.37 (median 15). Out of our 121 patients, 36.36% (n = 44) of patients developed postoperative complications and 3 patients died within early postoperative period. All of patient deaths occurred in non-TA group. Those complications were: 9.09% cardiovascular (5.88% in TA and 11.42% in non-TA group), 19% infection (19.6% in TA and 18.57% in non-TA group), 1.65% neurological complications (0% in TA and 2.85% in non-TA group) and 14.88% other (19.6% in TA and 11.42% in non-TA group).

Conclusion: Our results suggest that implementation of PBM and preoperative application of TA reduces the need for transfusion in patients undergoing elective AAA repair procedure. We found that use of TA did not correlate with postoperative neurological and cardiovascular complications.
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Effects of antifibrinolytics on blood product transfusions in paediatric cardiac surgery: aprotinin versus tranexamic acid

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Introduction: The upcoming release of aprotinin as an antifibrinolytic agent in paediatric cardiac surgery prompted a re-evaluation of its use in comparison to tranexamic acid (TXA) focusing on their effect on blood product transfusions.

Methods: This retrospective study was conducted in a tertiary children hospital from 2002 to 2015. Patients receiving aprotinin (Aprotinin group: 2002-2007) were compared with those receiving tranexamic acid (TXA group: 2008-2015) using propensity score analysis based on age, preoperative weight, ASA and RACHS-1 score, the presence of a cyanotic disease, and cardiopulmonary bypass and aortic cross clamping times. The primary outcome was exposure to blood products defined as any transfusion of red blood cell (RBC), fresh frozen plasma (FFP), and/or platelets concentrates up to the 5th postoperative day.

Results: From the 2157 patients included in the study, 1136 were included in the Aprotinin group and 1021 in the TXA group. Intraoperative and postoperative blood losses were higher in the Aprotinin group as well as the calculated blood loss on day 3 (Figure 1). Overall, exposure to blood products was significantly higher in the Aprotinin group, related to higher RBC and platelets transfusions. The amount of RBC transfusion was also higher in the Aprotinin group while FFP and platelet concentrate volume were similar in both groups (Figure 2).

Conclusion: In our population, children receiving aprotinin were more frequently transfused than those receiving TXA. These results might be explained by major changes in our patient blood management strategies associated in particular with a reduction in perioperative blood loss.
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**P89**

**Effects of antifibrinolytics on severe postoperative morbidity or mortality in paediatric cardiac surgery: aprotinin versus tranexamic acid**

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**Introduction:** The upcoming release of aprotinin as an antifibrinolytic agent in paediatric cardiac surgery prompted a re-evaluation of its use in comparison to tranexamic acid (TXA) focusing on their effect on postoperative mortality and morbidity.

**Methods:** This retrospective study was conducted in a tertiary children hospital from 2002 to 2015. Patients receiving aprotinin (Aprotinin group: 2002-2007) were compared with those receiving TXA (TXA group: 2008-2015) using propensity score analysis based on age, preoperative weight, ASA and RACHS-1 scores, the presence of a cyanotic disease, and cardiopulmonary bypass and aortic cross clamping times. The primary outcome was mortality and/or severe postoperative morbidity, which included respiratory failure, prolonged inotropic support and/or renal failure, as defined previously.1

**Results:** From the 2,157 patients included in the study, 1,136 were included in the aprotinin group and 1,021 in the TXA group. Incidence of mortality and/or severe morbidity was higher in the aprotinin group (Table 1). Postoperative neurologic deficit and infection episodes were also more frequent in the aprotinin group. Intensive care and hospital length of stay were similar in both groups.

**Table 1. Incidence of postoperative mortality and morbidity**

<table>
<thead>
<tr>
<th></th>
<th>TXA group</th>
<th>Aprotinin group</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary outcome (%)</td>
<td>28</td>
<td>33</td>
<td>0.007</td>
</tr>
<tr>
<td>In-hospital mortality (%)</td>
<td>3.0</td>
<td>3.5</td>
<td>0.681</td>
</tr>
<tr>
<td>Respiratory failure (%)</td>
<td>24</td>
<td>25</td>
<td>0.428</td>
</tr>
<tr>
<td>Prolonged inotropic support (%)</td>
<td>42</td>
<td>58</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Acute renal failure (%)</td>
<td>3.5</td>
<td>3.0</td>
<td>0.278</td>
</tr>
<tr>
<td>Neurologic deficit (%)</td>
<td>6.0</td>
<td>13.0</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Infection episodes (%)</td>
<td>40</td>
<td>45</td>
<td>0.004</td>
</tr>
<tr>
<td>ICU length of stay (days)</td>
<td>10 ± 20</td>
<td>9 ± 21</td>
<td>0.206</td>
</tr>
<tr>
<td>Hospital length of stay (days)</td>
<td>22 ± 36</td>
<td>23 ± 33</td>
<td>0.338</td>
</tr>
</tbody>
</table>

**Conclusion:** In our population, children receiving aprotinin had higher risk of developing severe postoperative morbidity or mortality than those receiving TXA. These results clearly call into question the reintroduction of aprotinin in our routine clinical practice.

**REFERENCE**

P90

QuikClot in spine surgeries

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Introduction: QuikClot gauze is made of a non-absorbable material containing kaolin. It comes in sizes from 5x5 cm to 30x30 cm. It is a textile that does not contain any artificial substances of animal origin, it is internal and there are no known contraindications. The contact of human blood and kaolin results in blood coagulation on the basis of contact activation, i.e. the ability of blood to coagulate in contact with different surfaces. QuikClot not only reacts by means of electrostatic interaction with factor XII, turning it into its active form, but it also increases the adhesive power of blood platelets in the wound.

Methods: To make an assessment, 40 people of approximately the same BMI undergoing an idiopathic scoliosis surgery participated in the trial. QuikClot gauze was placed on osteophytes during the surgery of twenty patients with idiopathic scoliosis. Consequently, blood loss was measured for all subjects by means of weighing the gauzes and measuring the blood volume in the suction pumps.

Results:

<table>
<thead>
<tr>
<th></th>
<th>Average (SD)</th>
<th>Median (Min-Max)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood volume</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of QuikClot in ml</td>
<td>1,515 (1,071)</td>
<td>1,300 (400; 4,000)</td>
</tr>
<tr>
<td>Without QuikClot in ml</td>
<td>2,180 (1,365)</td>
<td>1,850 (1,000; 5,500)</td>
</tr>
<tr>
<td>Blood saving in ml</td>
<td>655 (327)</td>
<td>550 (400; 1,500)</td>
</tr>
<tr>
<td>p (Wilcoxon test)</td>
<td>0.005</td>
<td></td>
</tr>
</tbody>
</table>

Conclusion: Among other measures aimed at reducing perioperative bleeding, the QuikClot gauze is taking the fore among other haemostatic agents thanks to its results.
Retrospective analysis of the use of fibrinogen concentrates over one year in a central hospital

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Introduction: Massive bleeding and coagulopathy may occur in various clinical conditions such as liver disease, DIC, obstetric complications, major trauma or surgery; which usually leads to critically low levels of clotting factors, mainly low levels of functional fibrinogen. That may reach a critical low level relatively early during bleeding. Clinical studies have shown that fibrinogen supplementation facilitates haemostasis and has a beneficial role in the management of critical traumatic and surgical bleeds. Plasma fibrinogen can be carried out with fresh frozen plasma (FFP), cryoprecipitate or fibrinogen concentrate. FFP and cryoprecipitate are allogeneic products that require crossmatching and thawing before administration and there are no viral inactivation processes to cryoprecipitate. Fibrinogen concentrate (Haemocomplettan®) is a pasteurized drug stored as a lyophilized powder at room temperature, with a concentration of 1 g/50 mL that can be reconstituted and administered quickly. We report the clinical conditions and the patients to whom a fibrinogen concentrate was administered in our hospital during 2017.

Patients and methods: Patient’s clinical data and administration of fibrinogen concentrates were obtained retrospectively from medical records. Data of transfused blood components were obtained from the transfusion data base of our Hospital Blood Bank. Laboratory parameters registered were: platelet count, fibrinogen concentrate, activated partial thromboplastin time and prothrombin time.

Results: Fibrinogen concentrate was administered to 63 males (63.6%) and 36 females (36.3%), average age of 59 yr (range 26-89 yr). Most of the administrations of fibrinogen concentrate were in the ICU- 47, 20 in the emergency room, 24 in the operating room and 8 in other services. The most frequent reasons for the administration of fibrinogen were: acute haemorrhage (62%), hyperfibrinogenemia (21%) and with no data in the other cases (16%) and the underlying conditions were trauma (34%), gastrointestinal bleeding (28%) and neurosurgical complications (12%). 81% of patients were transfused with red blood cells concentrate (RBC) (average 3.67 units), 57% with platelets concentrate (average 1.58 units) and 36% with fresh frozen plasma (FFP) (average 4.51 units).

Conclusions: Fibrinogen concentrate plays an important role in achieving and maintaining haemostasis and is fundamental to effective clot formation, representing an important option for the treatment of coagulopathic bleeding. In the last year in our hospital haemorrhage, mainly due to trauma and/or gastrointestinal bleeding, was the main reason to the administration of fibrinogen concentrate. In 16% of the clinical conditions was not evident the reason for fibrinogen concentrate administration, based on the medical records. The administration of fibrinogen concentrate showed an increase of plasma fibrinogen concentration with only slight alterations in the other laboratory parameters. No adverse events were recorded.
Fibrinogen use in obstetric haemorrhage: five-year review

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Introduction: Haemorrhage in obstetrics is the leading cause of maternal mortality and the most preventable one. Postpartum haemorrhage (PPH), its most frequent form (5-10%), has increased in the last decade. The plasmatic level of fibrinogen is determinant for an effective haemostasis, being the first coagulation factor to reach critically low levels during the haemorrhagic event. Our obstetric unit doesn’t have its own blood bank but fibrinogen concentrate (FC) and ORh+ red blood cells (RBC) are available since July 2014 and January 2017, respectively. The aim of this study was to analyse the utilization of FC and blood component (BC) transfusion, from November 2012 to December 2017.

Methods: We conducted an observational retrospective study. All women given FC were considered. Files were sourced for data on demographics, obstetrics, comorbidities, pre and post transfusion haemoglobin (Hb), fibrinogen plasma levels, and transfused BC. Statistical analysis was performed using IBM SPSS Statistics 23. Descriptive and inferential (Pearson’s correlation coefficient and Student’s t-test) analysis procedures were performed at a significance level of 5%.

Results: During the study period 30 women (12,614 deliveries) were treated with FC. The average age was 34.73 ± 5.63 years and gestational age 35.73 ± 4.93 weeks. 73.3% (n = 22) were ASA II and 31.0% (n = 9) had a history of uterine surgery. 70.0% (n = 21) of deliveries were dystocic (14 C-sections: 8 emergent), with 5 (16.7%) stillbirths. Pre-eclampsia was diagnosed in 20.0% (n = 6) and HELLP in 6.7% (n = 2). Pre- and post-transfusion Hb was 6.75 ± 1.17 and 10.04 ± 1.25, respectively. The lowest plasma value of fibrinogen was 1.60 ± 1.01 g/l [64.0% (n = 16) <2 g/l] and 3.92 ± 1.07 g/l at discharge. On average 2.30 ± 1.47 g FC were administered. 5.30 ± 3.62 RBC and 3.27±3.23 inactivated human plasma (IHP) were administered; 36.7% (n = 11) and 63.3% (n = 19) received platelets and tranexamic acid, respectively. The RBC:IHP ratio was 1.62:1. Uterine atony was found in 50.0% (n = 15) of cases, 53.3% (n = 8) and 20.0% (n = 3) underwent hysterectomy and B-Lynch suture, respectively. A woman died. Women with lower plasma fibrinogen values were transfused with more RBC, platelets, IHP (P = 0.002), FC (P = 0.004) and total BC (P = 0.008), the last three with a statistically significant relationship. Plasma fibrinogen values <2 g/l have a statistically significant relationship with increased RBC (P = 0.020), IHP (P = 0.002), FC (P = 0.031) and total BC (P = 0.002) administration.

Conclusion: In our maternity, the CF administration has been increasing. The European Society of Anaesthesiology (ESA) 2017 guidelines suggest fibrinogen dosing in bleeding parturients, as <2 g/l levels can identify those at risk of severe PPH, which is in accordance with our results. We believe that the early administration of FC can reduce the amount of BC transfused.

REFERENCES
Development and implementation of a haemorrhage protocol in obstetrics: work in progress

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Introduction: Haemorrhage in obstetrics is the leading cause of maternal morbidity and mortality, but also the most preventable. The implementation of institutional protocols, with a standardized multidisciplinary approach, has led to the reduction of morbidity. The main objective of this study is to present the development and implementation of a haemorrhage protocol in obstetrics in Portugal.

Methods: In 2015, the Portuguese Society of Anesthesiology (SPA) appointed a coordinator for the creation of a comprehensive and representative multidisciplinary group (Anaesthesiology, Gynaecology/Obstetrics, Immunohaemotherapy and Haematology), involving countrywide hospitals with organized activity in obstetric anaesthesiology. In order to know the different institutional realities of the obstetric haemorrhage approach, a survey was carried out in the III Update of Obstetric Anesthesiology, which constituted the starting point for the protocol construction. The working group, composed of 27 elements, was divided into 5 subgroups: risk factors, prevention and recognition; obstetric procedures; initial approach and volume resuscitation; haemostatic resuscitation and organization and algorithm of action. Each subgroup systematically reviewed the available scientific evidence and submitted it to the other members for review. During this time, the group met in multiple occasions for discussion, presenting the final version of the protocol at the National Congress of the SPA, in 2017. Subsequently, the document was disclosed on the SPA website and submitted to public consultation and peer review. After a new review by the group and the inclusion of new evidence published in the meantime, the final protocol was sent to all the elements to adapt and implement it in their institutions. To evaluate the implementation of the protocol, anonymous inquiries were sent by email to the supervisors of 55 obstetric units in the country (public and private). The final document of the Consensuses of Multidisciplinary Approach to Haemorrhage in Obstetrics integrates a performance algorithm, practical and succinct, to systematize and organize the response of the professionals and the institution, according to the severity of the haemorrhage. These consensuses will be published in the SPA magazine in 2018, aiming to reach all anaesthesiologists. A new national survey is intended 6 months after its publication.

Results: 19 (34.55%) of the 55 obstetric units reached have already responded and 13 (23.64%) implemented the protocol. The national implementation of the haemorrhage protocol in obstetrics is still ongoing, with multidisciplinary training programs schedule in some institutions.

Conclusion: National scientific societies have a responsibility to improve patient safety promoting evidence based recommendations. All obstetric units must have a multidisciplinary institutional protocol for the management of haemorrhage in obstetrics, preferably based on national guidelines.

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Mildly elevated INR in liver disease: Is it safe to do invasive procedures without correcting it?

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Introduction: Chronic liver disease (CLD) is characterized by complex alterations of coagulation and standard clot-based assays fail to accurately assess bleeding tendency in these patients. Despite the lack of clinical evidence supporting this practice, fresh frozen plasma (FFP) and prothrombin complex concentrate (PCC) are often used prophylactically prior to invasive procedures in CLD patients with mildly prolonged INR (international normalized ratio), INR ≤2. Recent studies have demonstrated that FFP/PCC transfusion has minimal effect correcting INR, exposing the patient to unnecessary risks.

Methods: Our main goal was to assess whether it is safe to perform radiologic invasive hepatic procedures - endoscopic retrograde cholangiopancreatography, percutaneous transhepatic cholangiography, transjugular intrahepatic portosystemic shunt and liver biopsy - in CLD patients with mild altered INR, without correcting it. Secondly, we aimed to evaluate if transfused patients achieved INR correction. We did a retrospective study, assessing all blood products requests (n=172) for the procedures aforementioned, between September 2015 and October 2017. Patients were classified into 2 groups: those transfused with FFP/PCC prophylactically prior to the procedure and those not transfused. We subdivided both groups into 2 classes according to INR intervals (1.3-1.5 and 1.6-2.0). We checked for INR variation after transfusion and haemorrhagic events.

Results: Among 172 patients, 113 (65.7%) were transfused with FFP/CCP. A posterior INR analysis was available for only 40 of those patients, with no INR correction verified for 29 of them. Indeed, 14 out of the 29 patients even maintained an INR >1.6. A single haemorrhagic event occurred after duodenal sphincterectomy in a patient with an INR of 1.0, previously transfused with FFP for an INR=1.4. In 59 (34.3%) non-transfused patients (55 with INR 1.3-1.5 and 4 with INR 1.6-2.0) no haemorrhagic events have occurred.

Conclusion: In our study, correlation between mildly elevated INR (1.3-2.0) and haemorrhagic complications was not found. It remains a challenge to encourage other clinicians not to correct mildly prolonged INR in CLD patients subjected to radiologic invasive procedures.
Impact of a severe high voltage burn injury on plasma factor XIII levels – a case report

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Introduction: Severe high voltage electrical burn injuries are known to cause devastating tissue damage with concurrent endothelial injury, systemic inflammation, and coagulopathy. The clinical course is further complicated by frequent burn wound debridements oftentimes linked to severe blood loss and massive transfusion. The definition of coagulopathy in burn injury is heterogeneous, and no evidence-based data exists favouring a specific bleeding management algorithm. The use of more targeted bleeding management (e.g. viscoelastic testing) may improve the understanding and treatment of coagulopathy induced by burn injury.

Methods: We present the case of a 14-year-old boy who sustained a high voltage electrical burn injury (mainly third degree) affecting 85% of his total body surface area. He was treated in our paediatric intensive care burn unit over the course of 35 days before he died in multiorgan failure.

Results: Following emergency escharotomies and fasciotomies on the day of injury, 14 further sessions of surgical debridement and grafting were performed in the OR. While initial anaesthesiologic bleeding management followed a ratio-driven protocol (1:1 ratio of RBC:plasma), subsequent decisions were mainly based on ROTEM-guided bleeding management. Marked decreases in plasma fibrinogen level were noted frequently during acute episodes of bleeding and treated by administration of fibrinogen concentrate. Plasma factor XIII (FXIII) levels also became critically low on the second day post injury. Despite repeated administration of purified factor XIII concentrate, FXIII continued to fall to levels of less than 40% during severe episodes of bleeding. In total, 47,500 IU of factor XIII concentrate were administered over the course of a month. Although short-term improvement of bleeding occurred after FXIII treatment, levels again deteriorated within a day after each surgical debridement. Overall, 95 units of RBCs were transfused to maintain adequate haemoglobin levels, while platelet count remained fairly stable (total of 16 units of platelet concentrates transfused). Notably, during the entire ICU course, we were never able to detect a lack of coagulation factors necessary to build thrombin (i.e. prolongation of ROTEM clotting times). Transfusion of plasma failed to improve fibrinogen levels; thus fibrinogen concentrate (total of 77 g) was necessary to maintain fibrinogen levels (FIBTEM A10 >10mm). Only 11 units of plasma were transfused during the entire hospitalization, primarily during the initial resuscitation.

Conclusion: Bleeding management in severe high voltage electrical burn injuries may be challenging and may require the use of viscoelastic testing, targeted fibrinogen replacement, and the measurement and replacement of factor XIII. The frequently observed and severe drops in FXIII in this case warrant further investigation into the specific coagulation defects that occur in this setting.
Thromboelastographic monitoring in an acquired FXIII deficiency with severe postoperative bleeding: a case report

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Introduction: Factor XIII deficiency is a rare hereditary bleeding disorder (1 case per two million). However, most of the clinical presentations are acquired, frequently associated with cancer. In a severe bleeding we could find thromboelastographic features to manage the restitution of haemostasis.

Case report: Woman aged 76 years, hypertensive and with a multi-operated infiltrative neoplasia of the mouth, with no previous bleeding complications. She was submitted to a reconstruction of jugal mucosa, right hemimaxillectomy and radical lymphadenectomy. Five days later she presented a severe bleeding and was treated with surgical revision, massive RBCs transfusion and haemostatic restitution guided by thromboelastography (TEG 6S®), that showed non-enzymatic hypocoagulability (RCK 6.6, KCK 3.1, αCK 61.1, MACK 42.8, MAFF 9.4). Another episode of severe bleeding occurred 13 days later. Meanwhile, the patient had been diagnosed of FXIII deficiency (30.5%) and the treatment was completed with 2000 IU of FXIII concentrated. Two TEG 5000® analyses were performed. Procoagulant changes in TEG (pre--post dose) results (Rk 6.6--4.8, αk 70.5--75.8, MAk 68.7--85, CI 1.1--3.6, LY30 1%--0.1%, G 11--14.9, EPL 3.5%--0.9%, MAFF 29.9--32.8) and a transient effect on activity of the FXIII (69%) were found. The levels of FXIII were normalized 26 days after the first surgery but no other dose of recombinant factor was administered, and no other bleeding complications occurred.

Discussion: The modulators of clot firmness, responsible for cross-linking of fibrin are fibrinogen, FXIII and platelets. A quantitative FXIII activity assay should be used as a first-line screening test. An acquired form of FXIII deficiency may occur via massive bleeding or neutralizing antibodies. The thromboelastographic parameters of elasticity, consistency and clot firmness can orientate the replacement of factor XIII deficit. Besides, their alteration can help the early suspicion of an acquired deficit.

Conclusion: Treatment with FXIII concentrate was effective to normalize the clinical bleeding diatheses associated with an acquired deficiency and a procoagulant tendency was shown by the TEG variables (moderate improvement of clot strength). TEG monitoring in cases of severe postoperative bleeding due to FXIII deficiency may be useful for the diagnosis and treatment.

REFERENCES
Muszbek L, Katona E. Diagnosis and management of congenital and acquired FXIII deficiencies. Semin Thromb Hemost 2016; 42: 429-39
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ROTEM monitoring and treatment of coagulation disorders in patients with end-stage liver cirrhosis admitted to an internal ICU

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Background and aim: In deranged hepatic function such as liver cirrhosis there is a reduced synthesis of procoagulants and endogenous anticoagulants, however, extrahepatically synthesized haemostatic and fibrinolytic factors are disproportionately affected. Also, there are many concomitant factors, such as hemodynamic changes, other organs affection, namely kidney, and predisposition to infection, that shift the balance towards either bleeding or thrombosis. The aim of our study was evaluation of the ROTEM results obtained in the monitoring of the patients with end-stage liver cirrhosis.

Methods: From May 2017 to January 2018, 52 patients with end-stage liver cirrhosis, 36 males and 16 females (med. age 57.2), were admitted to the internal intensive care unit. ROTEM tests EXTEM and FIBTEM were performed in order to follow the haemostasis parameters. In all of them, based on obtained results, adequate doses of haemostatic therapy were administered. All ROTEM results and the applied therapy were evaluated.

Results: EXTEM and FIBTEM results of 20 (38.46%) patients were within reference ranges, suggesting that disease was stable. Prolonged clotting formation time was observed in 8 (15.32%) patients, according to CT EXTEM. Two patient showed only a moderate fibrinogen deficiency measured by FIBTEM, while in 12 (23.07%) patients, only moderate platelet count and activity were registered. In 13 (25%) patients, complete haemostasis disorder was detected, associated with fibrinogen deficiency below 1 g/l, as well as disordered count and activity of platelets. ML EXTEM >15% fibrinolysis was present in 6 (11.52%) patients.

Conclusion: More than 1/3 of patients (38.43%) had a stable disease with no problems in haemostasis. 25% had complete haemostasis disorder. Viscoelastic tests, such as ROTEM, allow dynamic assessment of the entire coagulation process and provide a better illustration of the interactions between pro- and anticoagulants as well as platelets. Adequate haemostatic therapy based on the obtained ROTEM methods enables quick and timely reaction to bleeding as well as appropriate consumption of blood components.
Rotational thromboelastometry or conventional coagulation tests in liver transplantation: where do we stand?

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Introduction: Orthotopic liver transplantation (OLT) remains a potentially haemorrhagic procedure. Rotational thromboelastometry (ROTEM) is a point-of-care device used to monitor coagulation. Whether it allows blood loss and transfusions to be reduced during OLT remains controversial. In our service we have conventional coagulation tests (CCT) and, for a year, ROTEM simultaneously during the transplant surgery. We aimed to compare ROTEM with CCT during OLT to evaluate whether there is agreement between results in the two techniques and to guide and improve transfusion of platelets and fibrinogen concentrates during OLT. We also evaluated for hyperfibrinolysis detection.

Methods: Fifty consecutive OLTs, performed in 2017, where analysed retrospectively. ROTEM and CCT were executed simultaneously during the reperfusion phase and whenever jugged necessary. For this study we only analysed the reperfusion phase in each OLT. We used an algorithm for ROTEM-based coagulation management during OLT, previously published, to compare platelet count and fibrinogen concentration values between these two techniques of monitoring. During these 50 transplants our transfusion policy was based only in CCT.

Results: We found 11 (22%) discrepancies between ROTEM and CCT. ROTEM failed to detect 8 in 10 thrombocytopenias detected by CCT (platelet count: 17,000 – 49,000 /µL). As to fibrinogen concentration, in 1 case we would have administered fibrinogen by ROTEM interpretation despite a normal value (176 mg/dl) and in 2 cases ROTEM did not detect low fibrinogen concentration values (102 and 140 mg/dl) that required intraoperative correction. Hyperfibrinolysis was detected by ROTEM in 7 transplants (14%): 2 had clinical relevance requiring administration of tranexamic acid and 5 were late hyperfibrinolysis, self-limited and without clinical impact.

Conclusions: Our preliminary evaluation does not allow present replacement of CCT-guided transfusion in OLT by ROTEM-guided transfusion. Yet, we will continue to work in development of a ROTEM-based transfusion algorithm in order to improve OLT transfusion practice in our centre.
Thromboelastography in major cancer surgery with a TEG®6s haemostasis analyser – a service evaluation

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**Introduction:** Coagulopathy is a common issue with oncology patients and we believe that conventional laboratory tests fall short when it comes to fully assessing the dynamic clotting profile of our patients. It is widely appreciated that both thrombotic and bleeding complications play a significant role in the morbidity and mortality of cancer. Our hospital is a tertiary referral centre for cancer patients and we perform complex oncosurgical procedures that can precipitate major blood loss. Thromboelastography (TEG) is a validated method of point of care coagulation monitoring. A small sample of blood is analyses by the machine and the live results are displayed on a screen as the test is performed. The TEG provide values for clot formation (R time, K value and alpha angle), clot strength (maximum amplitude) and clot breakdown (Lysis 30%). We recently acquired two new TEG®6s devices to more accurately assess the clotting profiles of our patients. The analysers are used in a perioperative and a critical care setting. We hope that the more accurate view of clotting will help to not only rationalise our use of clotting products but to also more effectively manage haemorrhage during major cancer surgery. In this audit we hoped to look at all of the TEG tests performed in the first year.

**Methods:** We interrogated the two TEG®6s haemostasis analysers in our hospital and the data was analysed independently.

**Results:** In total, 235 TEG tests were completed in the time period from November 2016 to December 2017. The tests were performed on 137 patients, with an average of 1.71 tests per patient. One patient had their clotting assessed 10 times during their admission with TEG. 84% of the tests completed successfully. Of the incomplete tests, 0.85% (2) tests timed out, 3.8% (9) tests failed and 11.9% (28) tests were aborted. Of the completed tests 26.8% (63) displayed a completely normal clotting profile and 56.6% (133) portrayed an abnormal clotting profile. 74.4% (99) of the abnormal tests showed an abnormality with clot formation (abnormal R Time, K Time or Alpha Angle). 45.9% (61) of abnormal tests showed an abnormality with clot Strength (abnormal MA) and only 1.5% (2) of abnormal tests showed an issue with clot breakdown (abnormal Lysis 30%). 1.5% (2) of tests showed a hypercoagulable profile.

**Conclusion:** We have found the use of TEG to be beneficial in the perioperative and critical care management of patients in our hospital. The tests were easy to perform and analyse. It was reassuring to note that 26.8% of the tests were normal and this dynamic point of care test confirmed the effective clotting profile of the patients. It has helped to rationalise the use of clotting products and a further study is being planned to assess the change in practice initiated by the TEG results. The use of TEG has also minimised the need for routine traditional clotting blood tests.
An evaluation of dynamic clot formation in endoscopic mucosal resection

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Introduction: Approximately 17,000 colonic cancers are diagnosed in Australia each year. A majority of these patients undergo surgery which is associated with significant morbidity and mortality, particularly in the elderly.¹ Recently, advances in Endoscopic Mucosal Resection (EMR) have emerged as cost-effective and minimally invasive techniques for the removal of large sessile polyps.² EMR can be performed as an ambulatory procedure in specialised Gastroenterology units. One main risk factor of EMR is clinically significant post-endoscopic bleeding (CSPEB),³ though its underlying mechanisms remain unclear. Rodent studies have demonstrated that electro-surgery increases plasminogen activation and fibrinolysis.⁴ We therefore wanted to examine whether a similar response is detectable in patients undergoing EMR, which would predispose them to coagulation disturbances and an increased risk of bleeding. (ACTRN12617000530325)

Methods: We evaluated dynamic clot formation and fibrinolytic activity in 30 patients undergoing EMR for large sessile intestinal polyps at the LMH. Blood samples were taken prior to EMR, within an hour following the procedure and 2 days post-EMR. Rotational Thromboelastometry (ExTEM and FibTEM), plasminogen levels, tissue-type plasminogen activator (tPA) antigen and plasmin-anti-plasmin complex measures were conducted. Data were analysed using an ANCOVA accounting for patients’ age, sex and anti-coagulant medication use, and the site of endoscopic resection.

Results: Preliminary analyses of 21 patients showed ROTEM parameters and plasminogen levels did not change significantly with EMR. Thromboelastometry showed normal clot formation, without any indication of coagulopathy: clotting time, clot formation time and maximum clot firmness were within normal limits at each time point. There was a trend towards increased maximum lysis post-EMR, however, this did not reach statistical significance (P = 0.06). There was no difference in plasminogen levels across time in 11 of the patients analysed to date.

Conclusion: Our interim analyses have shown that the nature of clot formation does not change over time following EMR in a sample of patients. Further analysis of this cohort is required to examine the sensitivity of ROTEM in determining fibrinolytic activity and any associated risk of CSPEB following EMR.

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Influence of ROTEM platelet aggregometry analysis in transfusion practices in patients on antiplatelet therapy undergoing coronary artery bypass graft surgery

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Introduction: Cardiovascular disease is the main cause of death in the world. Several studies have shown that antiplatelet therapy (AT) including aspirin and P2Y12 inhibitors, has become the mainstay therapy, reducing the risk of cardiovascular events and death. However, in patients undergoing coronary artery bypass grafting (CABG) with cardiopulmonary bypass (CPB), disturbed platelet function can lead to severe bleeding and coronary graft failure. ROTEM platelet aggregometry (RPA) analysis is a point-of-care platelet function test, based on impedance aggregometry. At the Hospital de Santa Cruz it is used concomitantly in the perioperative with rotational thromboelastometry (ROTEM) to measure platelet aggregation and assess quantitatively the effect of AT in platelet function.

Methods: A retrospective cohort study in a single tertiary hospital of RPA assays from 262 patients under AT (aspirin, clopidogrel and ticagrelor) or dual AT undergoing CABG with CPB from January 2017 to December 2017. The assays were obtained from processed samples of whole blood in citrate tubes after a resting period of 15 minutes and within 2 hours.

Results: From the total of patients, 63.36% (166 patients) were under antiplatelet monotherapy (AMT) and 86.14% (143 patients) of them with aspirin. Besides, 13.36% (35 patients) were submitted concomitant valvuloplasty. Patients with low preoperative platelet function measured with RPA and with no abnormalities in ROTEM were associated with increased platelet transfusion requirements but less red blood cells transfusions. In some cases, and more frequently in AMT with aspirin, there was no detection of platelet aggregation with area under the curve above 0.

Conclusion: Managing haemostasis in patients under AT undergoing CABG with CPB remains a challenge. The major bleeding associated can be a partially modifiable risk factor if pre-emptive strategies are applied to limit this event. Early identification of platelet dysfunction with RPA, in the beginning of surgery, enabled a tailored and individualized patient management of transfusion therapy changing our transfusion practices. It has reduced unnecessary red blood cell transfusions and associated adverse events. Using RPA can provide great blood product usage when used timely.
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Multiplate electrode aggregometry and postoperative blood loss in high-risk cardiac surgery

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Introduction: Haemostatic impairment is common following cardiac surgery with cardiopulmonary bypass (CPB) and perioperative coagulopathic bleeding is a clinically important complication that is associated with increased morbidity and mortality. Different factors contribute to excessive bleeding after cardiac surgery, including the effects of preoperative medication and CPB, conducting to thrombocytopenia and platelet dysfunction. This study investigates if perioperative platelet function testing with Multiplate Electrode Aggregometry (MEA) can be used to predict postoperative blood loss in cardiac surgery patients.

Methods: Patients undergoing CABG combined with single or multiple valve surgery were enrolled in a prospective, observational, single-blinded, single-centre study. MEA was performed after induction of general anaesthesia (i), during CPB (ii), after aorta decanulation (iii) and at ICU admission (iv). Primary outcome was blood loss at 24 hours after surgery. Effects of patient characteristics, preoperative laboratory values and operation characteristics on blood loss were examined.

Results: Of the 100 cardiac surgery patients included [mean age 71 (SD 9), range (47-87) year, 71% male], 25 patients received multiple valve surgery. Blood transfusions were given to 57 patients, of which 20 received postoperative transfusion. Blood transfusion consisted of RBC in 46 patients, plasma in 21 patients and platelets in 30 patients. Median postoperative blood loss was 550 mL [IQR 440-770]. ADP induced MEA testing (i) was significantly correlated with postoperative blood loss (Figure; Pearson correlation coefficient r = -0.249, P = 0.015). Aspirin-, COL- and TRAP induced MEA testing showed no significant relation with blood loss. Gender, BMI, preoperative haematocrit and ADP test at (i) were independent predictors of 24h blood loss in multivariate analysis (MEA ADP test (i) beta coefficient -2.03, P = 0.009).

Conclusions: Preoperative point of care platelet function testing using MEA ADP test predicts postoperative blood loss after cardiac surgery and has additional value to patient characteristics and laboratory values traditionally used for predicting postoperative blood loss.
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Platelet function in cardiac surgery is highly dynamic and predicts bleeding independently from platelet count

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Introduction: Bleeding therapy with platelet (PLT) concentrates is routinely guided by the PLT count. However, doubts are increasing as to the suitability of the PLT count for reflection of the haemostatic PLT capacity. We used cardiac surgery as a model to compare PLT count with function.

Patients and methods: We prospectively collected data from 3,212 cardio surgery patients. Impedance aggregometry (Multiplate® ADPtest, TRAPtest) was used to assess PLT function based on stimulation with thrombin receptor activating peptide (TRAP) or adenosine diphosphate (ADP) together with routine assessment of PLT count. Testing was performed sequentially at incision (start, ‘S’) and before administration of protamine (‘bP’) as well as during haemostasis after protamine application (‘aP’). Subgroup analyses comprised bypass-, single valve-, combined bypass and valve-, multiple valves-, aorta surgery, heart transplantation and ventricular assist device implantation. Red blood cell concentrate (RBC) transfusion needs during the intraoperative and 24hrs postoperative period were put into relation with aggregation findings.

Results: Sequential testing at ‘S’ and ‘bP’ shows the PLT count to decrease in 83.8% of patients. However, despite this decrease, 55.6% (TRAP) and 35.7% (ADP) of patients demonstrate an increase in aggregation capacity. This mobilisation of PLT function is strongly and rapidly reversible in 68.0% (TRAP) and 90.9% (ADP) of patients with aggregation values dropping below the values at ‘S’. Significant differences in aggregation dynamics are found with respect to ADP- versus TRAP-induced aggregation as well as the type of surgery. RBC transfusion volumes are correlated inversely with aggregation capacities and dynamics independently from PLT counts.

Conclusion: Judgement of PLT haemostasis by PLT count deviates from the functional capacity as assessed by aggregometry. PLT aggregometry allows for inter-individual as well as surgery type-specific distinction of PLT function where PLT count is indiscriminative. According to an inverse correlation of aggregometric results with RBC transfusion needs, PLT function testing predicts bleeding intensity. PLT transfusion tailored by aggregometric testing may allow for optimisation of intraoperative patient blood management.
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More common occurrence of von Willebrand disease (vWD) and combined vWD and rare factor deficiencies in a rural area than in a city area – a five-year follow-up study

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Introduction: Stimulated by referral of patients suffering from bleeding disorders living in a near rural area to specialists we assumed different and variable reasons.

Methods: We observed clinical haemorrhagic diathesis in two groups sent to our Center (CBT), one group (250 patients) mostly sent from an academic teaching hospital in a rural area and the other group (250 patients) sent from hospitals and general practitioners in a city area. The patients were adolescent and young adults without distinction of gender. The catchment area has 250,000 rural inhabitants and 250,000 city residents. The most disorders were noticed during or after surgery.

Results: We see more diagnosed bleeding disorders in general in a rural area (14.4 %) than in a city area (4.4%), von Willebrand disease type 1 7.2 % in a rural area and 2.8 % in a city area.

<table>
<thead>
<tr>
<th>Number (%)</th>
<th>vWd Type 1</th>
<th>vWd Type 3</th>
<th>Vwd Type 2 + FV-Leiden Mut.</th>
<th>FVII deficiency</th>
<th>FX deficiency</th>
<th>FXIII-def.</th>
<th>Vwd Type 1 + F XIII Deficiency</th>
<th>Hypofibrinogenemia</th>
<th>Subhemophilia</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural A.</td>
<td>18 (7.2)</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>36</td>
</tr>
<tr>
<td>City A.</td>
<td>7 (2.8)</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td>11(4.4)</td>
</tr>
</tbody>
</table>

Combined haemorrhagic disorders, factor X and factor XIII deficiencies, hypofibrinogenemia, vWD type 3 and subhaemophilia we detected only in the rural area. One patient had a vWD Type 2 and a thrombophilia (F V Leiden thrombophilia). In the case of combined vWD-Type 1 with F XIII-deficiency we detected a vWD Type 1 in some members of the family of the index patient additionally. The diagnosis of factor deficiencies were confirmed by sequencing and the vWD was determined by multimer analysis.

Conclusion: The more common occurrence of coagulation disorders in the sense of haemorrhagic diathesis noticed in surgery (esp. ENT) requires a special history taking and sometimes an investigation of some family members. It is best to use a specialized questionnaire. Perhaps there should even be established a register. The diagnosis of the haemorrhagic disorders as shown above should be performed by a specialized centre for blood clotting disorders.
Neuraxial anaesthesia in a patient with severe haemophilia and inhibitors

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Introduction: Chronic haemophilic arthropathy is a well-known complication of haemophilia which leads to severe pain and disability affecting major joints. Total Knee Replacement (TKR) is the most common arthroplasty surgery in haemophilia. A subgroup of patients with severe haemophilia A (20 – 33%) develop inhibitory antibodies against factor VIII. Patients with inhibitors may be denied all but essential surgery due to concerns about reliability with which haemostasis can be achieved and maintained in such patients. While central neuraxial anaesthesia such as spinal or epidural is routinely used for arthroplasty surgery due to its known benefits, it is usually avoided in haemophilia patients due to potential increased risks of vertebral canal haematoma with subsequent spinal cord compression. Although there are some cases reported in literature on managing selected haemophilia patients with neuraxial blocks for surgery, it remains inadequate with sparse information on subtypes, treatment methods and target factor level not indicated. We describe the perioperative management of a patient with severe Haemophilia A with inhibitors for bilateral simultaneous total knee replacement using neuraxial anaesthesia safely.

Methods: Our patient was a 68-year-old male presenting with severe haemophilic arthropathy in both knees. He was known to have severe Haemophilia A with Factor VIII inhibitors. Managing two separate surgical instances in this patient for staggered knee replacements was discussed among a multidisciplinary team involved in his care and bilateral simultaneous total knee replacement surgery was planned to minimise inhibitor related complications & to ensure optimal rehabilitation. Due to the significant predicted postoperative pain in bilateral joint replacement surgery, and the overwhelming evidence of superiority of regional anaesthesia in reducing hospital stay, a combined spinal epidural anaesthesia technique was considered to be optimal for this patient’s perioperative management; the rationale being the spinal element providing satisfactory anaesthesia for surgery and the epidural element to offer the option of prolonging the duration of surgical anaesthesia as well as managing post-operative pain on multimodal levels. The potential risk of cord haematoma and compression was discussed extensively and a shared decision was made with the patient to proceed. The patient’s coagulation was normalised prior to the procedure after treating the inhibitors with rituximab and by maintaining a continuous infusion of ReFacto AF® to maintain maximum levels perioperatively. Continuous arterial monitoring was established prior to anaesthesia. Combined spinal epidural anaesthesia was performed at first attempt by an experienced Anaesthetic Consultant and the patient was sedated using target-controlled infusion of propofol. Factor VIII levels were measured at various stages and the ReFacto AF® infusion adjusted accordingly. The adequacy of clot function was also monitored perioperatively at regular intervals using Thromboelastography (TEG®).

Results: The surgery was completed uneventfully with minimal blood loss, diamorphine was given epidurally for postoperative pain management and the epidural catheter was removed after ensuring Factor VIII correction to safe levels. The patient had full recovery of motor and sensory block subsequently.

Conclusion: In light of current surgical and rehabilitative techniques, the long experience with safe and effective antihaemorrhagic ReFacto AF®, the monoclonal antibody rituximab and the availability of point of care testing (TEG®) have all revolutionised safe perioperative management of such patients.
Total knee replacement in patients with bleeding diatheses: large single-centre experience

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Introduction: Patients with bleeding diatheses develop end stage knee arthritis at an early age due to repeated episodes of haemarthrosis into their joint. Total knee replacement helps them achieve better quality of life and fulfil demands of life.

Methods: We compared 27 episodes of total knee replacement (TKR) in patients having haematological disorder from 2012 to 2017 with 27 episodes of standard patients having TKR. These patients are jointly managed by haematological and orthopaedic teams during their inpatient stay. The purpose of this study is to understand the effect of common factors between the two groups of patients and identify specific factors pertinent to haematological patients to overall outcome of these patients with TKR.

Results: There were 24 patients with various bleeding diatheses in our study including haemophilia, von Willebrand disease and platelet storage pool disorders. Two of these patients had bilateral TKR at same time and one patient had TKR on both knees though at different dates. As compared to standard patients with TKR patients who usually are discharged home on average between 3-5 days, patients with haematological disorders stay longer as inpatient averaging 10-15 days. They need their haematological factors optimised every day during postoperative period until the wound has healed. These patients are slow to recover due to pain issues and usually will have residual stiffness of knee range of movements as compared to standard patients. These patients need close follow-up during postoperative period in outpatient clinics to monitor their range of movements in the knee. 2 of these patients had manipulation of total knee replacement for stiffness post-surgery. As these patients are usually younger, anaesthesia management is relatively straightforward and quick. They are usually given general anaesthesia with nerve blocks to help with pain management in postoperative period. We feel that the advantage of doing bilateral total knee replacements at the same time is immense in these group of patients as there is overall saving on cost of haematological factors which are administered every day, total inpatient days stay for both TKRs during single episode and no significant increased risk of complications in the post-operative period.

Conclusion: Patients with haematological disorder needs special consideration of all the relevant factors, optimisation preoperatively, intraoperatively, postoperatively and during follow up on outpatient clinics. Both orthopaedic and haematological teams should work in perfect harmony for patients to achieve the best possible outcome after Total knee replacement surgery.
An Italian study on risk factors for venous thromboembolism in blood donors

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Introduction: The impact of several risk factors in the occurrence of venous thromboembolism, (VTE), is well known in patients with previous VTE, whereas little is known about their distribution in a healthy population.

Methods: We evaluated the incidence of a series of risk factors for VTE in a population of Italian blood donors. The study started on June 1st, 2017. Information were collected by means of a self-administered questionnaire. All analyses were performed using SPSS version 11.0. Adjusted OR and 95% confidence interval (CI) were calculated using logistic regression models that controlled for potential confounding variables such as age, BMI, blood group, surgery, plaster cast, immobilization, transfusion.

Results: Until November 20th, 5 506 questionnaires were collected. 4 120 (75.3%) men and 1 354 (24.7%) women were consecutively enrolled. Mean age (±SD) was 42.7 ± 12.3 yrs in men, 38.4 ± 13.4 yrs in women (P<0.001), BMI was 26.05 ± 4.14 in men and 24.5 ± 4.93 in women (P<0.001). Group 0 was observed in 48% and non-0 in 52%. With regards to smoking habits, no significant difference was observed between men and women. A history of vein thrombosis (mostly superficial ones) was referred by 36 (0.7%) subjects, gross veins by 320/5 442 (5.9%), previous surgery by 1 896/5 478 (34.6%). Previous transfusion was reported by 73/5 019 (1.5%) individuals and 236/5 268 (4.5%) had used at least once anticoagulation drugs. At univariate analysis, gross veins, bed rest/plaster cast, surgery and transfusions were associated with vein thrombosis. At logistic regression, a significantly and independent association was found between VTE and gross veins (OR: 15.8, 95% CI 7.7-32.6), plaster cast/bed rest (OR: 2.3, 95% CI 1.0-5.3) and transfusion (OR: 5.1, 95% CI 1.3-19.5).

Conclusions: To the best of our knowledge, this is the first study in a large series of blood donors aimed at investigating the distribution of risk factors for VTE. We find that gross veins, plaster cast/bed rest and previous transfusion are independent risk factors for VTE.

REFERENCE
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Validation of the PLASMIC score: prediction tool for thrombotic thrombocytopenic purpura diagnosis

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Introduction: The PLASMIC score was proposed to predict the likelihood of a severe ADAMTS13 deficiency in the context of thrombotic microangiopathies (TMAs), to promptly identify and properly treat acute patients with suspected thrombotic thrombocytopenic purpura (TTP). We evaluated the diagnostic performance of the score in patients consecutively referred to our unit.

Patients and methods: From 2012 to 2017, we tested ADAMTS13 in 42 patients diagnosed with TMA. From electronic records we extracted clinical and laboratory data referred to time of blood drawn used for ADAMTS13 testing: full data were available for 27 of them. The score evaluates 7 parameters (1 point each): platelet count <30×10^9/L, haemolysis variables (reticulocyte count >2.5%, undetectable haptoglobin or indirect bilirubin >2 mg/dL), no active cancer, no history of cell transplant, mean corpuscular volume (MCV) <90 fL, INR <1.5, and creatinine level <2 mg/dL. Scoring system predicts the low (score 0–4), intermediate (score = 5), and high (score 6 or 7) risk for ADAMTS13 <10%. Relevant clinical data, i.e. therapeutic procedures and immunosuppressive agents use, were collected. A ROC curve was generated and the area under the curve (AUC) was calculated to test the discrimination value.

Results: The PLASMIC score showed a good discrimination performance with a resulting AUC of 0.89 (95% CI 0.76–1.00; P=0.008). According to the prediction model, we observed 6 patients in the low risk group, 4 and 17 in the intermediate and high-risk group, respectively. No severe deficiency was found in any case in the low-risk group, whereas a severe deficiency was found in 2 out of 4 intermediate-risk group and in 16 out of 17 high-risk group patients. In the low-intermediate risk group (0–5), we observed 2 short-term (i.e.: within 1 week after the disease onset) deaths, both in patients with severe sepsis. All 27 patients were treated by Plasma EXchange (PEX) and steroids. Nine patients [4 with a refractory TTP and 5 with relapsed TTP (2 of 3 patients having previous episodes of TTP)] were also treated by rituximab. We identified a TTP relapse in 3 (1 with score = 5) severely-deficient patients: in 2 of them (score = 6), who were diagnosed with cancer (pancreatic cancer and myeloproliferative neoplasm), a long-term death occurred.

Conclusion: In our patients, PLASMIC score has a good predictive value of the pretest likelihood of a severe ADAMTS13 deficiency. Further research is needed to confirm present data.
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Patient blood management in transfusion-dependent anemia secondary to gastric antral vascular ectasia (GAVE)

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Introduction: GAVE or watermelon stomach is an uncommon cause of chronic upper GI bleeding that is usually seen in older women with portal hypertension, systemic sclerosis, coagulopathies and chronic anticoagulation best treated with a multimodal team approach.

Methods: We identified a challenging case of transfusion-dependent GAVE-associated upper GI bleeding and highlight our approach to patient blood management.

Results: Case Description: An 83-year-old woman with recurrent upper GI bleeding from GAVE from congestive hepatopathy and severe tricuspid regurgitation worsened by anticoagulation with warfarin for mitral and aortic mechanical valves is evaluated for transfusion dependent anaemia requiring roughly 100 units of red blood cells over a year. Her course is complicated by difficult to control INRs as well as several hospital admissions and episodes of transfusion overload circulation. She undergoes multiple advanced endoscopic treatments including radiofrequency ablations, cryotherapy, heater and bipolar probe as well as argon plasma coagulation. A multimodal team approach with haematology, critical care, gastroenterology and cardiology is coordinated and she is enrolled in a pilot study using anti-angiogenesis agents (bevacizumab and pazopanib).

Conclusion: Recurrent GI bleeding from GAVE, especially in patients on chronic anticoagulation or with coagulopathies is a difficult to manage despite recurrent red blood cell transfusions and iron supplementation. Advanced endoscopic treatment such as use of heater probe, bipolar probe, argon plasma coagulator, laser therapy or radiofrequency ablation obliterate vascular ectasias and reduce bleeding, but other treatment options including combination oestrogen/progesterone therapy or even gastrectomy are alternative options. While novel agents such as anti-angiogenesis such as bevacizumab and pazopanib remain attractive therapies, more research is warranted and underway to elucidate its effectiveness and role in the treatment of severe GI bleeding from GAVE.
A prospective multicentre study on perioperative management of patient taking oral anticoagulants: ORTHO-START registry

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Introduction: Evidence regarding the perioperative emergency management of elderly patients on oral anticoagulants – vitamin K antagonists (VKAs) or direct oral anticoagulants (DOACs) – who need emergent orthopaedic surgery is scarce. Furthermore, most elderly patients show chronic anaemia, mainly due to iron deficiency, thus increasing the risk for perioperative blood cell transfusions. In the last years, patient blood management (PBM), an evidence-based, multidisciplinary, patient-tailored programme was launched worldwide. However, local policies and procedures are still largely lacking or not applied.

Methods: The ORTHO-START is a multicentre, prospective, observational study that will record on perioperative management and complications in patients treated with anticoagulant and/or antiplatelet agents requiring elective intervention of hip replacement or knee or emergent surgery for hip fracture.

Results: Main objectives are: 1) To collect prospectively, via web-based software, data on the perioperative management of patients receiving anticoagulants and/or antiplatelet agents undergoing elective orthopaedic or urgent prosthetic surgery for femoral fracture. For comparative purposes, data on patients undergoing the above listed procedures but not taking antiplatelet or oral anticoagulants will be collected consecutively. Furthermore, data on blood count before and after surgery and possible blood transfusion will be collected. 2) To increase our knowledge on the use of different perioperative management schemes both with regard to anticoagulant/antiplatelet agents and to “blood management”.

Conclusions: Findings from the ORTHO-START register will contribute to the improvement of perioperative management in the elderly poly-medicated patient, with the aim of reducing complications and mortality in the short and medium term. These issues have a significant scientific importance and a potential practical impact on the quality of life of patients and their families, as well as an economic implication, due to the reduction of costs related to the management of complications following the intervention.
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