Updates in post-partum haemorrhage

Moderators: Nicolas Brogly

Monday, June 08, 2026

1. CALCIUM AND NEW UTEROTONIC STRATEGIES

Paloma Toledo

The United States is one of the few developed countries in which maternal mortality and serious morbidity have increased in recent years[1,2]. Specifically, an increase in mortality due to severe haemorrhage has been identified; together with infection and sepsis, this is one of the most common causes of death[3].

Definition

- Blood loss > 1000 mL or signs/ symptoms of hypovolaemia.

Main consequences:

- Need for transfusion
- Organ damage
- Hysterectomy and loss of fertility.

A large proportion of deaths from haemorrhage are considered preventable and are due to an underestimation of the volume of blood loss or failure to recognise the signs and symptoms of hypovolaemia[4].

Therefore, it is key to improve the measurement of obstetric blood loss, using gravimetry rather than visual estimation[5,6].

From an aetiological perspective, postpartum haemorrhage can be attributed to 4 causes. It is important to identify and recognise at an early stage patients at high risk of postpartum haemorrhage, and to prepare appropriate preventive strategies. Uterine atony is the most common of those[7].

70% Tone	**20%** Trauma	**10%** Tissue	**1%** Thrombin (coagulopathies)

It is hard to predict what patients will experience postpartum bleeding, but there are certain factors that indicate a high risk.

Placenta praevia or low-lying placenta	Placenta accreta	Premature placental abruption	Active bleeding greater than expected	Coagulopathy
≥ 1 HPP previous	HELLP syndrome	Platelets < 50,000	Haematocrit < 24%	Intrauterine foetal death

HELLP, *Hemolysis, Elevated Liver enzymes and Low Platelets.*

In such cases, it is crucial to mobilise the necessary resources before the birth. In addition, postpartum monitoring should be initiated in patients who showed risk factors during labour and the postpartum period.

USE OF UTEROTONICS:

- Uterotonics should be tailored to each patient's risk.
- EIn the active management of the third stage of labour, oxytocin is the first-line uterotonic.
- As a second-line treatment, methylergonovine and carbetocin have been shown to have similar effectiveness[8].

USE OF INTRAVENOUS CALCIUM:

As well as playing a part in muscle contraction, calcium is an essential ion at various stages of the coagulation cascade[9].

In a clinical trial evaluating the efficacy of prophylactic intravenous calcium administration during C-section, the bleeding was reduced in the subgroup of patients with haemorrhage due to uterine atony[10]. A very recent meta-analysis also reported that the intravenous administration of calcium during the peripartum period is associated with a lower incidence of uterine atony, reduced blood loss and improved uterine tone within 5 minutes of delivery in patients with uterine atony during C-section[11].

ANAEMIA MANAGEMENT:

In order to prevent postpartum haemorrhage, it is important not to ignore anaemia during pregnancy:

- Between 30% and 40% of pregnant women suffer from anaemia[12].
- One third of women of childbearing age have an iron deficiency.
- Outcomes relating to postpartum haemorrhage are poorer in anaemic women.
- Anaemia is a common factor that can be addressed through screening and treatment.

The concept of allowable blood loss (ABL) is useful for estimating the volume of blood a patient can lose before requiring a transfusion. A recent analysis showed that a modest increase in reoperative haemoglobin has a positive impact on ABL and can avoid the need for a transfusion[13].

Overall, the available evidence proves that the implementation of Patient Blood Management (PBM) in obstetrics is essential for reducing exposure to transfusion and optimising maternal outcomes.

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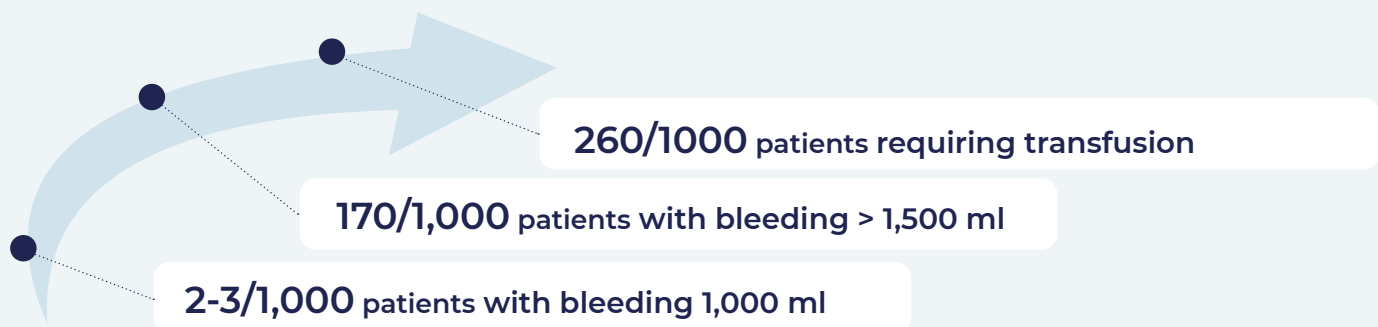
2. COAGULATION FACTORS REPLACEMENT

Lucy De Lloyd

Although coagulopathy is the least frequent primary cause for postpartum haemorrhage, an effective haemostasis is key for the measures aimed at treating the other causes of bleeding to be effective.

The incidence of coagulopathy in postpartum haemorrhage is relatively low in the early stages; however, it increases gradually along with the severity of the haemorrhage. In that regard, the frequency of coagulopathy is closely related to the volume of blood lost:



The extrapolation of evidence from other populations, such as patients with severe trauma, is not appropriate in the obstetric context, due to the specific physiological features of haemostasis during pregnancy. During this period, there is an increase in the plasma concentration of most coagulation factors, an enhanced capacity to generate thrombin, and a rise in fibrinogen levels, particularly during the third trimester and towards the end of pregnancy.

In patients with postpartum haemorrhage, two types of coagulopathy can be distinguished:

Dilutional coagulopathy

- It is secondary to massive replacement with crystalloids and packed red blood cells, and it usually appears at a later stage.
- Factors II, VII and X, as well as platelets, progressively decrease as blood loss increases, although they do not reach critical levels until the haemorrhage is very severe (> 3000 ml)[14].
- Factor VIII levels may rise in the early stages of bleeding, promoting thrombin generation[14].
- Factor XIII levels are reduced even at the onset of the bleeding[14]. However, the clinical significance of this finding has not yet been fully established and is currently being assessed in the SWIFT trial.
- Fibrinogen levels decrease linearly as postpartum haemorrhage progresses and reach critical concentrations before any other coagulation factor. This is why it is considered a "sentinel factor"[15].

Acute obstetric coagulopathy

- It appears at an early stage, is difficult to predict and is usually associated with greater severity.
- It is characterized by accelerated destruction and inhibition of fibrinogen and by a decreased proportion of functional fibrinogen relative to the total.
- It is accompanied by a steep elevation in D-dimer levels an activation of plasmin.
- The ability to generate thrombin remains intact at first.
- This phenotype may require high doses of fibrinogen from the early stages of treatment[14].

ADMINISTRATION OF FIBRINOGEN

Differences in the fibrinogen content of blood products justify prioritising fibrinogen concentrate or cryoprecipitate when the goal is rapid and effective fibrinogen replacement[16]:

FRESH FROZEN PLASMA	CRYOPRECIPITATE	FIBRINOGEN CONCENTRATE
• 2 g/L • 3000 mL to administer 6 g	• 12 g/L • 500 mL to administer 6 g	• 20 g/L • 300 mL to administer 6 g

Other recommendations regarding the treatment of postpartum haemorrhage-related coagulopathy

- Administering tranexamic acid as soon as abnormal bleeding is identified.
- Activate massive haemorrhage protocols at an early stage.
- Requesting coagulation studies from the beginning, since postpartum coagulopathy can be unpredictable.
  - Fibrinogen target > 2 g/L.
  - Coagulation time targets below 1.5 times the normal value.
- Regularly reassessing analytical or viscoelastic parameters following interventions to guide blood product replacement.
- Maintaining platelet counts > 50 × 10^9/L.

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3. RESUSCITATIVE ENDOVASCULAR BALLOON OCCLUSION OF THE AORTA (REBOA)

Alexander Ioscovich

REBOA (*Resuscitative Endovascular Balloon Occlusion of the Aorta*) is an endovascular balloon that is inserted through the femoral artery and inflated in the aorta to temporarily reduce the distal blood flow and control the bleeding while the final treatment to address the primary cause is applied.

In obstetrics, the REBOA procedure is carried out in zone 3 (between the lowest artery and the aortic bifurcation) because it enables pelvic bleeding to be controlled and has proven to be effective in massive haemorrhages, both predictable and unpredictable, particularly in cases of placenta accreta.

Shaare Zedek Medical Center handles approximately 20,000 deliveries a year, with around 10-12 yearly cases of placenta accreta. In 2019, the centre replaced prophylactic ligation of the uterine and iliac arteries and occlusion of the iliac arteries using REBOA in patients with a high suspicion of placenta accreta. The implementation of this strategy has been associated with the following outcomes:

- Reduction of the hysterectomy rate from 0.7% to 0.02% over a five-year period.
- Decrease in the use of blood products.

The REBOA is inserted via a femoral approach, guided by ultrasound, and, when performed by an expert, it can take between 5 and 15 minutes.

EFFICACY AND SAFETY RESULTS

- In women with placenta accreta spectrum disorders, REBOA is associated with better vascular control, lower perioperative blood loss, a reduced need for transfusion and hysterectomy, and shorter times in surgery, when compared to bilateral occlusion of the common iliac arteries[17].
- In patients with morbidly adhered placenta, REBOA has proven to be effective in preventing massive haemorrhage and reducing both the hysterectomy rate and transfusion requirements[18].
- A meta-analysis including six studies found no significant differences in the incidence of lower limb thrombosis between REBOA and the occlusion of the internal iliac arteries. However, REBOA was more effective at reducing intraoperative haemorrhage and foetal exposure to radiation[19].

POTENTIAL COMPLICATIONS OF REBOA

Complications are rare, but may include:

Vascular lesions | **Embolisation**

In a retrospective cohort including centres in Spain and Israel, a very low rate of complications was observed (4,3%)[20].

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4. CAN WE IMPROVE SAFETY IN PPH THANKS TO ADEQUATE PROTOCOLS IN EUROPE

Emilia Guasch

The implementation of standardised evidence-based protocols on postpartum haemorrhage brings down morbidity and mortality, improves team coordination and optimises the use of resources.

Although recommendations in current first-world clinical practice guidelines vary[21], the main international guidelines agree on several fundamental aspects of postpartum haemorrhage management:

- Active management of the third stage of labour
- Early diagnosis
- Early administration of uterotonics
- Rapid escalation of treatment
- Transfusion protocols
- Early correction of coagulopathy
- Surgical or interventional treatment where necessary

Clinical protocols must be standardised and evidence-based. Ideally, they should promote equity and include the following:

- **Multidisciplinary approach: obstetricians, anaesthesiologists, haematologists, blood bank, nursing, and ICU**
- **Early identification of bleeding**
- **Standardised bundles of measures, suitable for any site, regardless of the resources available**
- **Team simulation and training**
- **PBM**

The EMOTIVE protocol is an example of a bundle of measures that has proven to be effective in improving clinical outcomes, even in low-income countries[22].

The following variables must always be assessed:

- Blood loss should be assessed using validated methods to avoid underestimation[23–25].
- The severity of the patient may be assessed on the basis of the vital signs, clinical symptoms, and abnormalities in coagulation and haemodynamics, or using the Shock Index[26].

PBM is particularly necessary in obstetrics for several reasons:

- High prevalence of iron deficiency
- High incidence and maternal morbidity and mortality
- Postpartum anaemia can affect the care of the newborn the family
- There is a gender bias
- Limited access to high-quality healthcare in high-income countries
- Lack of resources and knowledge in low- and middle-income countries

PROS AND LIMITATIONS OF PROTOCOLS TO MANAGE POSTPARTUM HAEMORRHAGE:

Pros

- They improve coordination within the multidisciplinary team, by promoting communication, role allocation, well-defined escalation procedures and a faster response.
- They help to optimise the use of resources through the early activation of the blood bank, the availability of uterotonics, the setting-up of the operating theatre, and the coordination with intensive care units.
- They are a key tool for continuous training: resident qualification, continuous education, mock exercises and audits aimed at improving the quality of care.

Limitations

- Availability of resources, such as blood products, interventional radiology, viscoelastic tests, access to the ICU or to lab support.
- Protocols developed in tertiary hospitals cannot always be directly applied to regional or rural hospitals, centres with limited resources, or institutions located in low- and middle-income countries.
- They do not replace individualised clinical judgement. Consequently, they may require adaptation in particularly complex situations, such as placenta accreta spectrum disorders, severe heart disease, hereditary coagulopathies, or sepsis.

In conclusion, international protocols to manage postpartum haemorrhage should be adapted to the resources, the organization and the clinical characteristics of each centre, while maintaining common elements such as an effective communication, early risk assessment and interventions with the highest level of evidence. Furthermore, it is key to promote a multidisciplinary approach and to strengthen strategies aimed at improving safety.

Patient Blood Management (PBM) in specific patients and situations

Moderators: Sigismond Lasocki

Monday, June 08, 2026

1. PBM IN INTENSIVE CARE PATIENTS

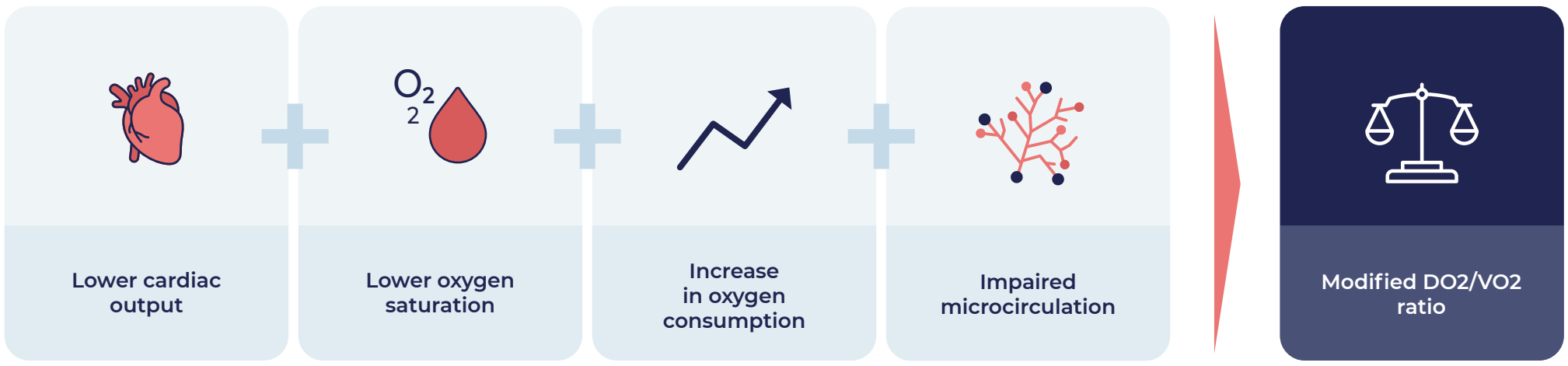
Ecaterina Scarlatescu

Anaemia is a common problem in critical patients[1–6]:

- Between 60 % and 80 % of patients are admitted to the ICU with Hb < 12 g/dL.
- Upon admission, 26% of patients have Hb < 9 g/dL. This figure goes up to 44% during the stay in hospital.
- 97% of patients develop anaemia within a week of admission.
- Roughly one in four patients receives a transfusion of packed red blood cells.

Furthermore, repeated blood samples for diagnostic tests significantly contribute to the development of anaemia.

Haemoglobin is the main factor determining oxygen transport in the body. Therefore, a decrease in haemoglobin reduces the supply of oxygen to the tissues and contributes to organ dysfunction. In critical patients, oxygen supply may be further reduced due to other factors.



In critical patients, it must be taken into account that markers to diagnose iron deficiency may change—inflammation may alter the levels of serum iron, ferritin, reticulocyte haemoglobin, transferrin, transferrin saturation (TSAT), soluble transferrin receptor or hepcidin[7–10].

As for the treatment of anaemia, the transfusion should be based on restrictive strategies. However, the wide heterogeneity of this population makes it difficult to establish universal transfusion thresholds applicable to all patients[11], and several factors must be considered before the transfusion and treatment personalisation.

Anaemia in critical patients should be managed applying packages of measures that favour blood conservation. The approach evaluated by Riessen et al. was able to reduce the blood loss associated with the diagnosis and the number of patients requiring transfusions through some simple measures—a closed-system arterial blood sampling method, lower-volume tubes, less frequent blood draws, and a smaller number of samples[12].

PHARMACOLOGICAL TREATMENT OF ANAEMIA

IRON

The package of measures evaluated by Warner et al., which included measures to conserve blood and to treat anaemia, supports clinical decision-making and the pharmacological treatment of anaemia with intravenous iron, which has proven to be feasible and well-tolerated, and to improve haemoglobin concentrations at one month and three months[13].

At the same time, according to a meta-analysis that included all kinds of patients, the risk of infection is higher in patients receiving intravenous iron than in those receiving it orally or not at all. However, when evaluating the 6 trials including patients admitted to the ICU, no significant increase in the risk of infection associated with intravenous iron was observed[14].

ERYTHROPOIESIS-STIMULATING AGENTS

Epoetin alfa slightly reduces the need for transfusions and minimally increases haemoglobin concentration, but no clinically relevant benefits or effects on mortality or adverse events have been observed. Nevertheless, a decrease in mortality was observed in patients with non-traumatic brain injury[15].

A recent meta-analysis has reported that iron an epoetin are the only pharmacological interventions to manage iron deficiency that are capable of reducing the incidence of transfusions without increasing the risk of venous thromboembolism or infection[16].

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2. PBM IN OBSTETRICS

Tina Tomic Mahecic

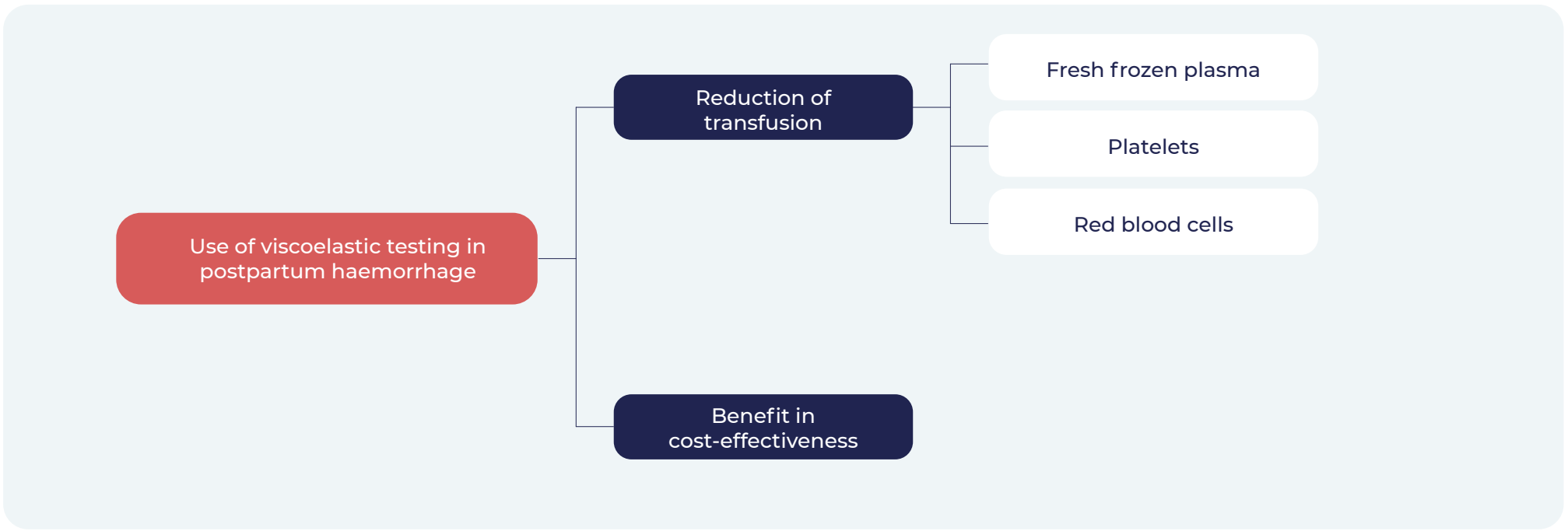
Anaemia is more common in women than men during of childbearing age[17]. In the context of pregnancy, its prevalence is estimated to be as high as 42%; therefore, early detection and treatment are key to reduce the risk of maternal and neonatal complications, as well as complications in the subsequent development of the newborn[18].

Anaemia may be a consequence of postpartum haemorrhage, an obstetric complication associated with poorer clinical outcomes and considered to be the main cause of maternal mortality worldwide. In turn, anaemia is a risk factor for developing postpartum haemorrhage, establishing a bidirectional relationship between both conditions[19].

The implementation of standardises, evidence-based interventions helps to reduce the progression of obstetric haemorrhage. In that regard, the EMOTIVE protocol was shown to improve the detection of postpartum haemorrhage and to reduce by 60% the incidence of the composite outcome of postpartum haemorrhage exceeding 1000 mL, laparotomy and maternal death[20].

Regardless of the original aetiology of the postpartum haemorrhage (uterine atony, genital tract traumatism, retained placenta, placental disorders or coagulopathy), persistent bleeding may lead to the development of an acquired coagulopathy if early and effective treatment is not implemented[21].

During pregnancy, a state of physiological hypercoagulability is developed, characterised by an increase in most coagulation factors, except for factor XIII, as a protective mechanism against childbirth-associated bleeding[22]. Postpartum haemorrhage causes a progressive decline in these factors, the extent of which correlates with the volume of blood lost. In contrast, the levels of factor VIII (FVIII) remain high, which helps to maintain thrombin generation[23]. As a result of these compensatory mechanisms, replacement of coagulation factors may not be necessary in the early stages of bleeding. In this context, viscoelastic tests are a very useful tool for haemostatic monitoring and treatment-related decision-making. A meta-analysis produced the following results [24]:



THERAPEUTIC INTERVENTIONS IN POSTPARTUM HAEMORRHAGE

FACTOR XIII

The role of early administration of factor XIII, the activity of which cannot be evaluated through conventional viscoelastic testing, is being researched in the SWIFT study. The results of this trial may change current recommendations regarding its use in the treatment of postpartum haemorrhage[25].

TRANEXAMIC ACID

The WOMAN trial showed that early administration of tranexamic acid reduces mortality from haemorrhage in women with postpartum haemorrhage, supporting its early use in this clinical setting[26].

INTRAOPERATIVE CELL SALVAGE

Intraoperative cell salvage is a recommended cost-effective strategy for patients with postpartum haemorrhage and massive blood loss. Moreover, when compared to allogenic transfusion, it does not increase the risk of antibody-mediated alloimmunisation[27,28].

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3. PBM IN JEHOVAH'S WITNESSES

Aamer Ahmed

Jehovah's Witnesses constitute the largest group (around 8 million people) of patients who reject blood transfusion and blood products. However, refusal to accept transfusion is not limited to religious grounds. In clinical practice, it is increasingly common to get patients who refuse the administration of blood products for personal, ethical or cultural reasons, as well as for concerns about the risks associated with transfusion.

Furthermore, in the last few years there have been fluctuations in the availability of blood products, exacerbated during the COVID-19 pandemic by a drop in donations and difficulties to maintain blood stocks. This has reinforced the need to optimise the use of this limited resource.

In this context, PBM principles form the basis for perioperative management in these patients, by reducing the need for transfusion and improving clinical outcomes:

- **Optimising erythropoiesis**
- **Minimising blood loss (surgical control) and bleeding (management of coagulopathy)**
- **Optimising physiological tolerance to anaemia**

The implementation of these principles requires painstaking planning of the perioperative process, bearing in mind a number of basic principles applicable to each stage: before, during, and after surgery.

BEFORE SURGERY:

1. Respecting the patient's autonomy, their beliefs and their decisions.

- Perioperative planning should be approached in a multidisciplinary manner, involving, at the very least, the surgeon, the anaesthesiologist and the haematologist, in order to ascertain the patient's preferences and limits with regard to the administration of blood and blood products.
- The blood products accepted or rejected by the patients must be explicitly documented, since some patients may not accept transfusion of blood, platelets or plasma, but may accept the administration of cryoprecipitate, certain coagulation factors or the use of a continuous circuit.
- The anaesthesiologist must clearly inform about the risks and potential clinical consequences of transfusion rejection.
- In some countries, in situations that are life-threatening or could cause serious and irreversible damage to paediatric patients, the protection of the child's health takes precedence over the beliefs or decisions of their legal guardians.
- The administration of a treatment expressly rejected by a competent patient violates the principle of patient autonomy and may entail legal and ethical liabilities.

2. Carrying out the relevant preoperative examination[29,30].

- A haemogram is required, as well as testing for ferritin and transferrin saturation, vitamin B12 and folic acid, together with a coagulation study and fibrinogen test.
- Anaemia should be treated wherever possible before surgery.
- In patients with enough time, treatment with oral iron may be started.
- Intravenous iron may be used when surgery is urgent or the patient does not respond to oral iron.
- In selected patients, recombinant erythropoietin may be used in combination with intravenous iron.

DURING SURGERY:

1. Considering acute normovolaemic haemodilution

- Acute normovolaemic haemodilution involves drawing autologous blood immediately prior to surgery, with simultaneous volume replacement using crystalloid or colloid solutions. The blood collected is reinfused after surgery or when it is clinically necessary, thereby reducing the loss of red blood cells during intraoperative bleeding.
- This procedure must be carried out by teams with experience on adequately selected patients.

2. Implementing intraoperative strategies aimed at minimising blood loss[31–33].

- Minimising blood draws by using paediatric tubes and close-circuit monitoring systems.
- Using viscoelastic monitoring to guide haemostatic treatment where available.
- Considering controlled hypotension.
- Maintaining a normal body temperature.
- Considering the administration of tranexamic acid and intraoperative cell salvage when blood losses above 500 mL are expected.
- In oncological surgery, using leukocyte depletion systems during intraoperative cell salvage.
- Maintaining close monitoring after the release of the tourniquet in surgery, due to the potential for increased bleeding.

3. Considering the use of fractionated blood products and acceptable haemostatic agents for certain Jehova's Witness patients. Some patients may accept the use of cryoprecipitate, prothrombin complex concentrate, fibrinogen concentrate or desmopressin.

AFTER SURGERY:

The goals of postoperative management are to minimise bleeding, optimise haemostasis, correct coagulation disorders, and maintain the right balance between oxygen supply and consumption[34,35]. To this end, the following is recommended:

- Implementing a rational use of laboratory tests.
- Minimising the volume of blood draws by using paediatric tubes and point-of-care tests, where available.
- Considering postoperative cell salvage using drains.
- Considering the administration of 1 g of tranexamic acid in case of postoperative bleeding.

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Disseminated Intravascular Coagulation (DIC)

Moderators: Christian von Heymann

Monday, June 08, 2026

1. DISSEMINATED INTRAVASCULAR COAGULATION - BASIC

Ecaterina Scarlatescu

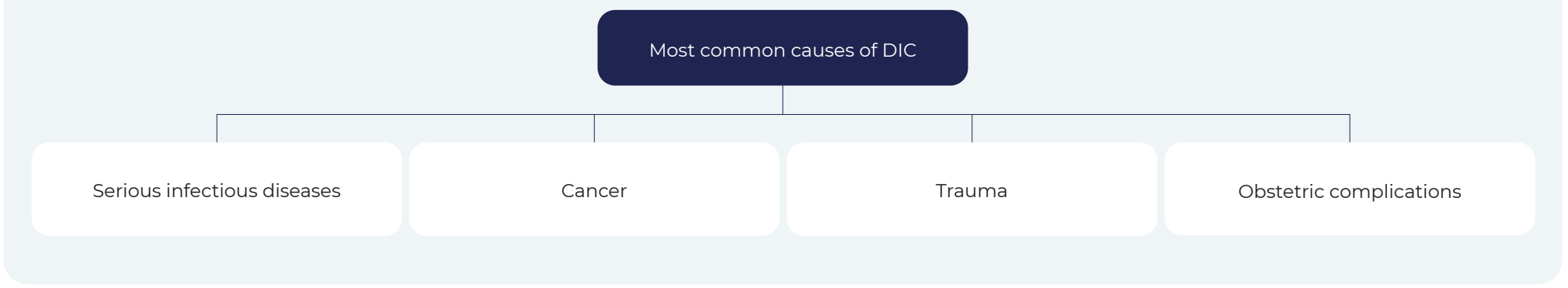
Disseminated Intravascular Coagulation (DIC) is an acquired syndrome characterized by intravascular activation of coagulation, with a loss of its physiological control, due to several causes; this causes damage to the microvasculature and, when severe, may lead to organ dysfunction[1]. This is a heterogeneous concept due to the various criteria used by physicians to determine the presence of DIC.

The DIC Subcommittee of the International Society on Thrombosis and Haemostasis (ISTH) updated the definition in 2025:

DIC is an acquired, potentially-lethal disorder characterised by the systemic activation of coagulation, dysregulated fibrinolysis and endothelial damage, leading to the formation of microthrombi.

Moreover, the ISTH stressed that, although clinical and laboratory manifestations of advanced DIC are similar regardless of the underlying cause, the phatophysiology of the early phase varies depending on the triggering disease, and that diagnosis and treatment in early stages must be adapted to the specific aetiology[2].

DIC always occurs as a consequence of an underlying condition. Sepsis is the most common cause, and roughly 30-50% of septic patients suffer from DIC[3].



DIC is a dynamic condition and behaves differently depending on whether it is compensated or decompensated.

Compensated	Coagulation is triggered with thrombin generation and platelet and white blood cell activation, but the regulatory mechanisms are still able to partially contain the process. There are no clinical manifestations of bleeding or thrombosis. There are no changes in coagulation tests.
Decompensated	When regulatory mechanisms are insufficient, established DIC develops. Clinical manifestations are observed. Abnormal values are observed in coagulation tests and the platelet count.

The clinical expression of DIC depends on the balance between the activation of coagulation and fibrinolysis. The following patterns can be identified, and they can be distinguished using viscoelastic tests[4]:

- **Thrombotic**, characterised by the predominance of microvascular thrombosis.
- **Haemorrhagic**, characterised by the predominance of bleeding.
- **Asymptomatic**, with both systems activated and compensating for one another, with no obvious clinical manifestations and with normal viscoelastic tests.

Although the causes of DIC may vary, there is a common starting event: the increase and systemic spread of thrombin generation[5].

PATHOPHYSIOLOGY OF DIC:

In sepsis, DIC has four distinct causes[6].

1. Activation of coagulation: Infection and inflammation activate coagulation through mechanisms specific to the innate immune system. The activation of coagulation during sepsis does not depend on a single mechanism, but rather on the interaction of multiple components.

Tissue factor	**Extracellular vesicles**	**Platelets**	**Von Willebrand factor**
Extracellular neutrophil traps (ENTs)	**Pathogen-associated molecular patterns (PAMPs) and damage-associated molecular patterns (DAMPs)**	**Polyphosphates**	**Complement**

2. Alteration of anticoagulant mechanisms: Sepsis leads to a progressive loss of the physiological mechanisms limiting coagulation.

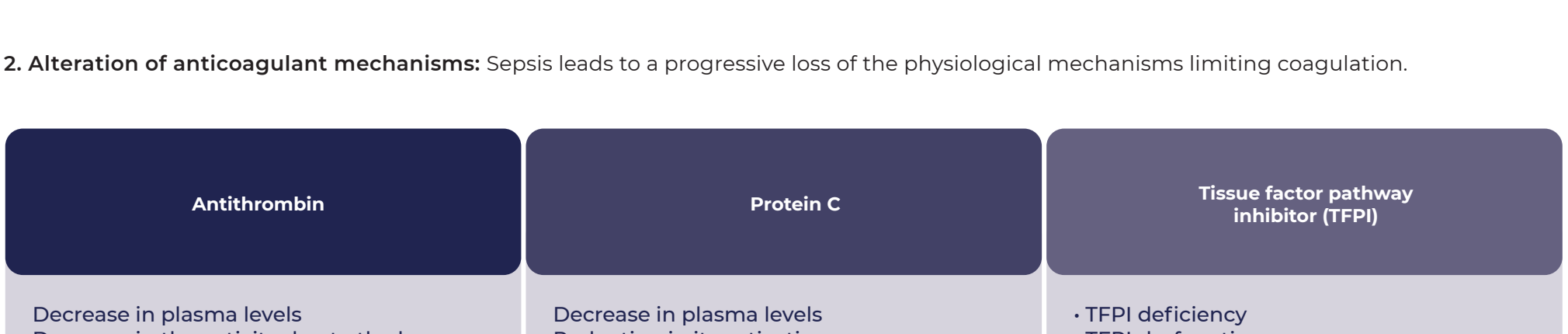
Antithrombin	**Protein C**	**Tissue factor pathway inhibitor (TFPI)**
Decrease in plasma levels Decrease in the activity due to the loss of cofactors	Decrease in plasma levels Reduction in its activation	• TFPI deficiency • TFPI dysfunction

3. Alteration of fibrinolysis: The fibrinolytic response can vary depending on the clinical context and the pattern observed:

- Phenotype I: Inhibited fibrinolysis.
- Phenotype II: Increased fibrinolysis.
- Phenotype III: Balanced fibrinolysis, which is usually asymptomatic until the physiological balance is disrupted.

4. Endothelial damage: Endothelial damage: Endothelial damage is the fourth pillar of the pathophysiology of DIC[7]. In sepsis, the glycocalyx is destroyed from the very early stages, which promotes the adhesion of white blood cells and the formation of thrombi.

Organically, a vicious circle develops between hypoxia and the activation of coagulation: microvascular thrombosis leads to tissue hypoxia. This hypoxia stabilises HIF-1α, which increases the expression of the tissue factor and PAI-1, and reduces that of certain anticoagulant proteins, further promoting thrombosis[8].



Last, it is important to note that immunothrombosis is initially a protective mechanism against pathogens, but when it becomes dysregulated, it leads to the development of DIC and multiorgan failure. In this regard, the link between coagulation and the activation of the immune system offers an opportunity to develop treatment strategies based on anticoagulation in sepsis[9].

Disseminated Intravascular Coagulation (DIC)

Moderators: Christian von Heymann

Monday, June 08, 2026

2. DISSEMINATED INTRAVASCULAR COAGULATION - ADVANCED

Marcella Muller

DIC is a dynamic process, the identification of which remains a clinical challenge. Its diagnosis is still based primarily on conventional coagulation tests.

A survey conducted by the ISTH found that platelet count, prothrombin time (PT/INR), activated partial thromboplastin time (aPTT), fibrinogen and D-dimer are the most widely used parameters in clinical practice. Other necessary biomarkers are not universally available, which makes it difficult to consistently apply the diagnostic criteria[10].

A number of diagnostic scoring systems have been developed in the last few years. The *Japanese Association for Acute Medicine* (JAAM) and the ISTH updated their diagnostic criteria in 2024 and 2025, respectively, to include the following parameters: platelet count, PT/INR, fibrin degradation products (FDP) and fibrinogen[11].

All systems share significant limitations:

- They use non-universally available parameters.
- They basically detect established DIC rather than compensated DIC.
- They do not estimate the risk of haemorrhage or thrombosis.
- The validation of JAAM and SIC scores has been carried out primarily in patients with sepsis.

Despite these limitations and the fact that their clinical use remains limited, scoring systems continue to be necessary tools to objectively identify patients with DIC.

Other alternative markers may be used, but they are not always available.

Endogenous anticoagulants	Endothelial makers	Nuclear materials	Other relevant markers	Comprehensive haemostasis tests
• Antithrombin • Protein C • Thrombomodulin • TFPI	• Von Willebrand factor • ADAMTS-13	• HMGB1 • Nucleosomes • Histones • Circulating free DNA	• Complement • Presepsin	• ROTEM • TEG • Quantra • ClotPro

As for viscoelastic tests, they help detect states of hypocoagulability and hypercoagulability. However, presently, they are not sufficiently standardised to detect DIC.

COMPLICATIONS

DIC is associated with both thrombotic and haemorrhagic complications.

- In a large European multicentre cohort of over 1,000 patients at risk of DIC, 5 out of every 100 developed a major haemorrhagic episode (Taha et al. ESICM 2025).
- Thrombotic complications also occur more frequently in patients with DIC, not only microthrombosis and immunothrombosis, but also major thrombotic events (unpublished data from Muller and Juffermans).

Treatment decisions aimed at correcting analytical abnormalities prior to invasive procedures remain a subject of debate. A randomised trial in patients with thrombocytopenia undergoing central venous catheter insertion showed that the discontinuation of prophylactic platelet transfusion increases the risk of procedure-related bleeding[12]. However, the optimal transfusion threshold must be defined. Furthermore, the prophylactic administration of fresh frozen plasma has not been shown to reduce the risk of bleeding in critical patients with coagulopathy[13].

TREATMENT

The treatment of DIC should be based on three fundamental principles:

1. **Treating the triggering condition**
2. **Inhibiting the activation of coagulation where indicated**
3. **Adapting the management of the predominant clinical phenotype, taking into account the triggering condition**

If we focus on the management of patients with fibrinolytic phenotype, the use of tranexamic acid may be considered. In patients with a thrombotic phenotype, anticoagulation is a potential strategy, but there is not enough high-quality evidence on this matter[2].

Heparin

Although clinical trials with heparin in patients with sepsis have not shown a consistent benefit in terms of survival, in patients with sepsis-associated pre-CID, low-dose heparin is suggested to improve hypercoagulability and multi-organ dysfunction[2,14].

Consequently, the ISTH recommendations state that heparin may be considered in patients with coagulopathy before the development of a established DIC, with the aim of preventing its progression[2].

Antithrombin

Clinical trials with antithrombin in patients with severe sepsis have not shown a reduction in mortality, but have shown an increased risk of haemorrhage[15], particularly when administered alongside heparin[16].

Thrombomodulin

The SCARLET trial assessed thrombomodulin in patients with sepsis-associated coagulopathy and did not show a significant reduction in mortality, except for the subgroup of patients with baseline INR > 1.4 and baseline platelet count > 30[17].

FUTURE PROSPECTS

Main needs identified to improve the management of DIC:

- **Developing tools for the early identification of DIC and distinguishing phenotypes at the beside.**
- **Improving the determination of haemorrhagic and thrombotic risk.**
- **Establishing optimal thresholds to correct coagulopathy.**
- **Developing clinical trials of personalised treatment strategies based on the phenotype and the stage of the disease.**

In this context, a number of studies are currently under way to evaluate new diagnostic and treatment approaches, including the use of ROTEM in critical patients at risk of DIC, the determination of the optimal threshold for platelet transfusion, and the role of heparin in sepsis-induced DIC, among others.

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Different guidelines, different recommendations: you should perform preoperative cardiac testing...

Moderators: Giovanna Lurati Buse

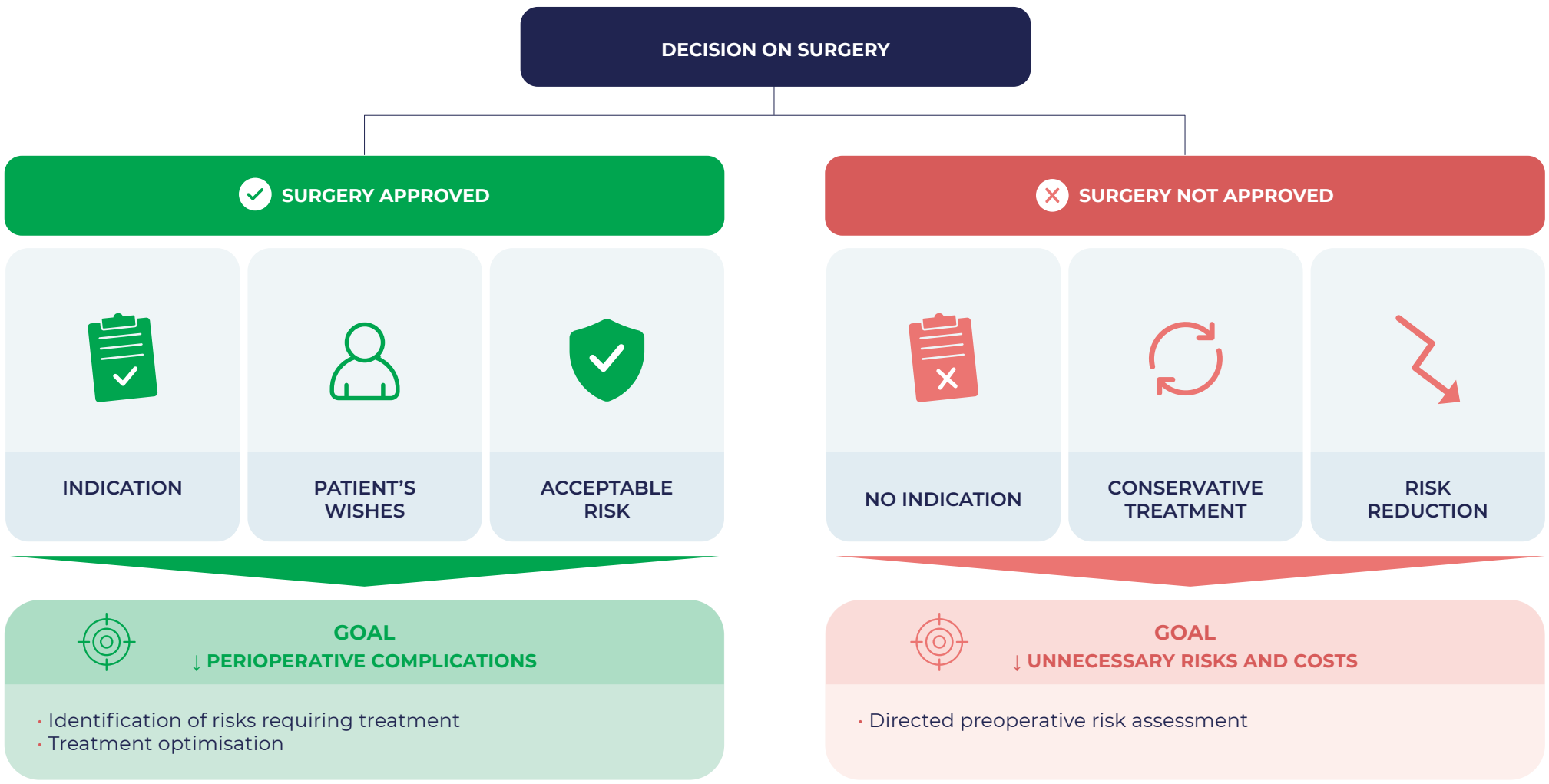
Monday, June 08, 2026

1. ... FOLLOWING THE GUIDELINES OF THE EUROPEAN SOCIETY OF CARDIOLOGY

Kai Zacharowski

The updated guidelines on cardiovascular assessment and management of patients undergoing non-cardiac surgery of the *European Society of Cardiology* (ESC), published in 2022[1], mark the first review conducted in the last decade and address an increasingly evident reality—every year, more surgical procedures are performed, and the population undergoing surgery is getting older and has a higher burden of comorbidities. Therefore, the risk of perioperative complications is increasing.

The guidelines are intended to facilitate decision-making regarding the suitability of surgery, by integrating the following factors and considering the following goals.



In patients who are candidates for surgery, risk assessment helps identify modifiable factors that can be treated, while in situations involving disproportionate risk, it can help in reconsidering surgery or exploring alternative therapies.

The EuSOS study, which included over 46,000 patients from 498 hospitals in 28 European countries, found significant variability in mortality across hospitals for the same procedures[2]. Furthermore, this and other studies[2,3] have identified the following risk factors:

In any case, the clinical history and physical examination are the most valuable tools in preoperative evaluation, and other supplementary tests should be reserved for patients in which they are justified. In fact, when conducting screening and risk stratification, it is always necessary to consider the following to ensure the specificity and sensitivity of the tests used.

- Costs
- Risks of diagnostic techniques
- Possible delays in necessary surgeries
- Some results may give a false sense of security
- Risk of legal liability

Preoperative anaemia is one of the main modifiable factors before surgery. The ALICE study showed that roughly one in three patients undergoing major surgery has preoperative anaemia. Iron deficiency was the most common cause, but the prevalence of other modifiable factors, such as folic acid and vitamin B12 deficiency, was also significant[4].

The clinical significance of preoperative anaemia is considerable, as it is associated with the following outcomes[4–6]:

With regard to the risk of receiving transfusions, is is crucial to bear in mind that, although the safety of transfusions in terms of infections has improved, there are still potentially serious complications, such as transfusion-related acute lung injury (TRALI), circulatory overload (TACO), or transfusion reactions. Consequently, the ESC guidelines recommend determining haemoglobin concentration in all patients scheduled for intermediate- or high-risk non-cardiac surgery and treating anaemia prior to the procedure, whenever possible, to decrease the need for transfusion[1].

Different guidelines, different recommendations: you should perform preoperative cardiac testing...

Moderators: Giovanna Lurati Buse

Monday, June 08, 2026

2. ... FOLLOWING THE GUIDELINES OF THE EUROPEAN SOCIETY OF ANAESTHESIOLOGY AND INTENSIVE CARE

Bernardo Bollen Pinto

Cardiac complications account for approximately one third of deaths within 30 days of non-cardiac surgery. According to a meta-analysis, perioperative miocardial damage affects close to 18% of patients and is associated with an increase in short- and long-term mortality[4,5].

In this context, the *European Society of Anaesthesiology and Intensive Care* (ESAIC) published a specific guideline in 2023 on the use of cardiac biomarkers in preoperative assessment, with the aim of determining their usefulness for conventional perioperative risk stratification[6].

STRENGTHS OF THE ESAIC BIOMARKER GUIDELINE

1. It was prepared by a diverse group of authors, comprising mainly anaesthesiologists from different European regions, but also including other specialities, methodologists, and patients.

2. It was developed using GRADE *(Grading of Recommendations Assessment, Development and Evaluation)*.

Formulating research questions (PICO)	Systematic literature review	Definition of critical endpoints	Evidence quality assessment (biases, inconsistencies, etc.)	Delphi consensus

The GRADE methodology has helped approach different key aspects in determining the quality of the available evidence, but also other aspects:

- Overall certainty of evidence
- Uncertainty on how patients value the outcomes
- Weighing up the pros and cons
- Balance between health benefits and resources required
- Impact on health equity
- Acceptability and feasibility

3. The guideline carries out the assessment in three independent dimensions.

Predictive value	Predictive power	Marker-guided management
How does the biomarker influence risk?	Can the biomarker classify patients into different risk levels?	Can the biomarker improve clinical outcomes?

4. Its implementation may be easier than with other guidelines, such as ESC's[6–8].

The certainty of evidence was assessed through 12 different outcomes, including all-cause mortality, cardiovascular mortality, the incidence of major cardiovascular events and quality of life. In general, the evidence was robust for very few combinations of markers and outcomes.

The biomarkers assessed were the following:

- Preoperative troponin levels
- Postoperative troponin levels
- Combined preoperative and postoperative troponin levels
- Preoperative natriuretic peptide levels
- Postoperative natriuretic peptide levels

The following recommendations were issued:

MARKER	PROGNOSIS	PREDICTIVE POWER	GUIDED MANAGEMENT
Preoperative troponin	Weak recommendation	For research purposes only	For research purposes only
Preoperative natriuretic peptides	Weak recommendation	Weak recommendation	For research purposes only
Combined troponin	Weak recommendation	Weak recommendation	Not recommended (no consensus)

The priority research areas going forward should be the following:

- **Defining specific thresholds adjusted for age and sex**
- **Proving whether biomarker-guided interventions reduce cardiac complications**
- **Assessing relevant outcomes for the patient**
- **Analysing the real implementation of these strategies**
- **Conducting cost-effectiveness studies**

CSL Behring

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3. CRITICAL APPRAISAL OF THE GUIDELINES

Carolina Soledad Romero

The AGREE *Reporting Checklist* is designed to improve transparency in the drafting and publication of clinical practice guidelines, and it is useful for checking whether the authors have reported all the necessary aspects for readers to assess their quality. It is part of the EQUATOR network to improve the quality and transparency in clinical research, and it should be used in the same way as the CONSORT checklist for randomised clinical trials..

1 GUIDELINE PREPARATION SYSTEMS

No all scientific societies prepare their guidelines using the same system for assessing evidence. The ESC, the *American Heart Association* (AHA), or the *Japanese Circulation Society*, have used the classification system developed by the AHA, based on recommendation classes (I, IIa, Iib, and III) and evidence levels (A, B, and C).

The ESAIC, however, drew up their recommendations using the GRADE methodology, which is currently used by many international organisations, including the World Health Organisation (WHO) and Cochrane.

The difference between both systems may have significant consequences. In the case of preoperative troponin testing, for example, although the various societies reviewed virtually the same evidence, and some of them did so using the same methodology, the level of recommendation is different. These differences reveal some limitations of the traditional AHA, and there may also be influences from the panel or the industry.

GUIDELINE	SYSTEM	LEVEL OF EVIDENCE	LEVEL OF RECOMMENDATION
ESC 2022	AHA	B	I
Japanese Circulation Society	AHA	C	IIb
ESAIC 2023	GRADE	Very low	Weak
UpToDate (adapted ESC)	AHA	B	1

2 SCOPE OF THE GUIDELINES

The ESAIC moves away from the so-called *book-style guidelines*, which were intended to address virtually all issues related to a disease in a single document. This is why they have developed targeted guidelines addressing specific clinical questions[9]. This approach has several benefits:

- It makes it easier to prioritise relevant clinical questions
- It improves the development process
- It improves follow-up by the team
- It makes it easier to read
- It helps updating the recommendations
- It favours implementation
- In increases financial sustainability

In the case of the ESAIC biomarker guideline, the group decided to limit the document to three well-defined domains.

3 MANAGING CONFLICTS OF INTEREST

While some societies focus their disclosure of conflicts of interest on financial aspects, the ESAIC has broadened this process to include potential intellectual conflicts, including:

- Previously-published opinionss
- Active areas of research
- Potential professional benefits emerging from a recommendation
- Participation in advocacy groups for a certain intervention
- Personal beliefs, convictions or views that may influence the objectivity of decisions or actions

This model aims to minimise biases which are not always financial in nature, but may nevertheless have an impact on the preparation of recommendations. Moreover, all members sign confidentiality agreements while developing the guideline.

4 PANEL COMPOSITION

The quality of a guideline does not depend solely on the methodology, but also the people who produce it. The diversity and balance of the group are two aspects that may influence the interpretation of the evidence.

The ESAIC guideline includes an AuthorPlot summarising the composition of the panel responsible for its preparation and analyses the panel members by gender, age, origin, race, history, existence of conflicts of interest and other variables.

5 ORGANIZATIONAL ASPECTS

The ESAIC works as part of the *Guidelines International Network* (GIN), including other organizations that use GRADE. The GIN has defined protocols establishing necessary aspects for the proper development of the guidelines, including role allocation, participation and representation, budget negotiation, the role of methodologists, timelines and responsibilities, guideline updates and editorial policy.

In summary, the methodology used to prepare a guideline is just as important as the scientific evidence on which it is based. Furthermore, the guidelines should follow strict methodological standards, as required in randomised clinical trials; to this end, transparent processes must be implemented. The evidence assessment system, the scope of the document, the management of conflicts of interest, the composition of the panel and the methodology used may change the way in which such evidence is translated into recommendations for clinical practice.

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