The relevance of the coagulation screen before surgery

ABSTRACT

Coagulation testing has long been part of the routine assessment of the preoperative patient, with the aim of identifying those with a bleeding disorder who might suffer significant perioperative bleeding. Some of the issues surrounding this involve the low prevalence of bleeding disorders in the general population, and the implications of further testing for both the patient and the health-care system. Studies suggest that this practice is not evidence based and is considered to be outdated. Most guidelines now advise against routine coagulation screens before surgery, and instead recommend taking a thorough personal and family history of bleeding in order to determine the need for further investigations. This review analyses current evidence on this topic and provides a comprehensive view of the relevance of preoperative coagulation testing.

The benefit of routine testing of a patient's haemostatic function preoperatively has been claimed to be the identification and appropriate management of those patients who are more likely to subsequently suffer bleeding complications in the perioperative period. Often referred to as the 'coagulation screen', the use of the coagulation profile as a screening tool is immediately undermined by the frequency of inherited coagulation disorders in the general population. von Willebrand disease, thought to be the commonest congenital haemostatic disorder, is found in around 1% of the population, and is often not detected by the standard coagulation assay (as will be discussed later) (Sadler et al, 2000). The incidence of haemophilia A is estimated to be around 1 in 5000 males, and haemophilia B 1 in 30 000 males (Soucie et al, 1998). The incidence of even rarer bleeding disorders, such as deficiency in fibrinogen or other coagulation factors, ranges between 1 in 300 000 and 1 in 2 000 000 (Bolton-Maggs et al, 2004). As such, the likelihood of identifying patients with a congenital bleeding disorder (who are not themselves aware of it) through routine testing is remarkably low.

This review explores national and international views on this matter, and challenges current practice in the routine pre-assessment of the surgical patient.

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Limitations of the coagulation assay

Since as early as the 1980s, the role of coagulation studies in predicting bleeding has been questioned. When looking at 200 patients, Ewe (1981) found that bleeding time after liver biopsy was unrelated to coagulation tests. Indeed, most coagulopathies which can be clinically significant in this context are unlikely to have gone unnoticed by the time these patients present to surgery – 95% of patients with severe haemophilia A have their first bleeding episode before the age of 1 year (Pollmann et al, 2010).

Most basic coagulation assays include at least the prothrombin time and the activated partial thromboplastin time. Although these are useful and widely used, they have their own limitations. As with most other laboratory tests, they involve the manipulation of blood in vitro, under different conditions to those found in the human body – this removes the biological interactions that occur in natural haemostasis, such as those in the vasculature and endothelial system. As such, careful interpretation is needed to account for physiological variations.

Furthermore, coagulation testing does not always identify an underlying clotting disorder – for example, a patient with von Willebrand disease can show no abnormality in prothrombin time or activated partial thromboplastin time, and yet suffer clinically significant symptoms (Laffan et al, 2014). On the other hand, an abnormal result does not automatically imply an underlying pathology – confounders such as heparin contamination, inappropriate mixing, use of inadequate devices and prolonged tourniquet use can result in deranged clotting results (Magnette et al, 2016). The difference in instruments and the variability in the reagents used to test prothrombin time and activated partial thromboplastin time also account for significant disparities between results (Funk, 2012).

Last, as with all blood tests, the reference ranges including those results deemed as 'normal' are based on taking the commonest value in the population and adding or subtracting two standard deviations – this automatically excludes nearly 5% of the healthy population, which by definition are 'abnormal' as they do not fall into the reference range. Therefore, this group of patients is vulnerable to the physical and psychological harms of unnecessary investigations.

An additional deterrent to indiscriminate testing is the cost implications. While a single coagulation profile might be inexpensive, the sheer volume of those routinely done preoperatively (i.e. with no clinical indication) will invariably cost a sizeable amount. Likewise, the subsequent

tests triggered by deranged clotting results will produce additional costs – in the tests themselves, as well as in procedure delay or cancellation.

> “A thorough bleeding history is an effective tool in the diagnosis of coagulopathies.”

How do we identify the bleeding risk?

A thorough bleeding history is an effective tool in the diagnosis of coagulopathies: a multicentre European study found that bleeding after tooth extraction in patients with von Willebrand disease was predicted by clinical assessment (e.g. personal and family bleeding history) as effectively as by laboratory tests, and in the case of bleeding after surgery it was found to be superior (Tosetto et al, 2006). Young children are an exception as they may require surgery at an age when they might not yet have had any manifestation of their underlying clotting disorder, especially those who are not yet walking. A common paediatric surgical intervention is tonsillectomy, which is associated with a high incidence of postoperative haemorrhage – in these cases, preoperative haemostasis testing might be considered. Nevertheless, a paediatric study found the benefit of routine pre-procedure coagulation testing to be questionable, when fewer than 20% of children with deranged coagulation results had a bleeding disorder (Shaw et al, 2008).

The British Committee for Standards in Haematology's guideline (Chee et al, 2008) argues that although an unstructured bleeding history is an inaccurate predictor of postoperative bleeding, a structured one including 'bleeding symptoms, prior haemostatic challenges, family history and drug history' could have a significant positive predictive value, and as such is recommended practice before surgery or invasive procedures.

While no standardized questionnaire currently exists for determining a patient's probability of having an underlying haemorrhagic disorder, it is accepted that when taking a personal bleeding history, certain points should be explored. A patient's tendency to have prolonged bleeding episodes, either spontaneously (e.g. epistaxis) or secondary to trauma, as well as his/her propensity for the development of ecchymoses and haematomas can reliably disclose an underlying diagnosis. Equally, previous episodes of major haemorrhage after surgical interventions (e.g. tooth extraction, tonsillectomy) can be diagnostically significant. In women specifically, the presence of menorrhagia or previous post-partum haemorrhage is also relevant. Asking about any of these features in a patient's family history is also advised.

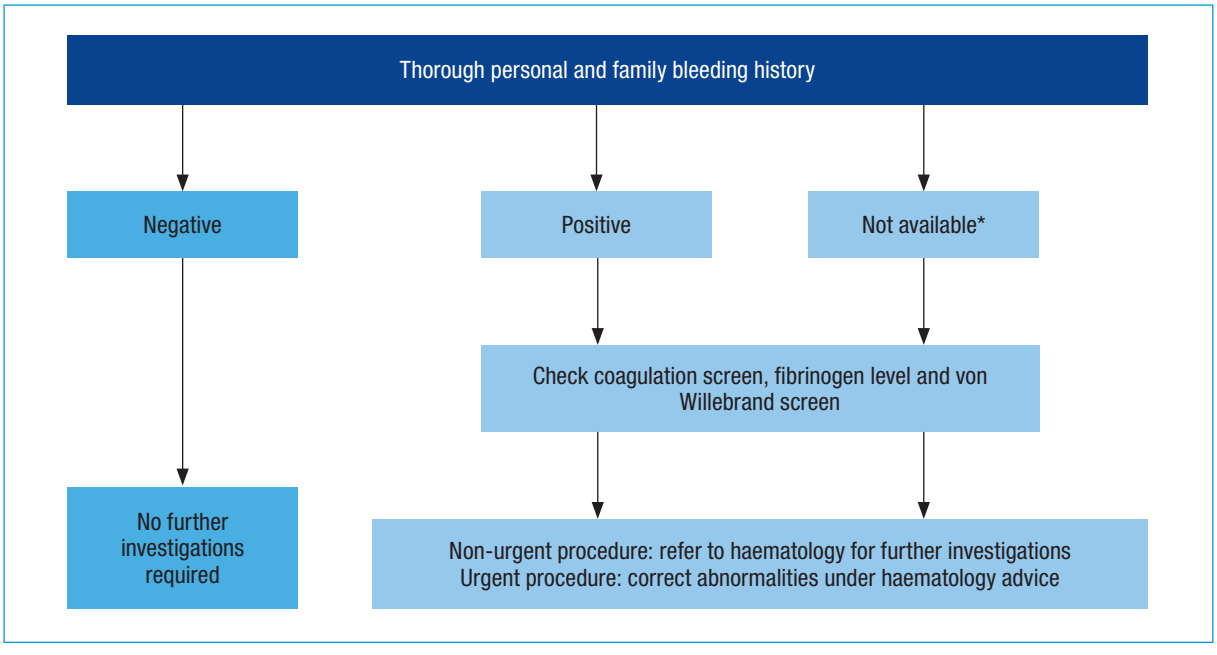
As previously mentioned, the case with children is different as some might be too young to have presented with any bleeding at all. Nevertheless, family and past medical history still apply, such as bleeding surrounding birth (e.g. umbilical stump bleeding and cephalo-haematoma). A suggested approach is given in *Figure 1*.

What is the recommended practice?

The UK approach

In the UK, two sets of guidelines exist. The British Committee for Standards in Haematology is a group of consultants and clinical scientists which issues evidence-based guidelines for the diagnosis and management of haematological conditions in the UK. Their 2008 guideline (Chee et al, 2008) emphasizes a positive bleeding history (personal and family history of bleeding, and use of antithrombotic agents) and relevant past medical history (e.g. liver disease) as reasons to consider performing a

Figure 1. An approach to investigating and managing a bleeding history. *No prior surgeries, or patient unable to provide history.



coagulation screen before surgery or invasive procedures. They clearly advise against routine preoperative coagulation testing.

While not focusing solely on coagulation testing, the National Institute for Health and Care Excellence (2016) has issued guidance on routine preoperative investigations in elective surgery, differentiating between severity of physiological insult from the surgery (minor, intermediate, major or complex), and patient baseline fitness according to American Society of Anesthesiologists grading. Similarly to the British Committee for Standards in Haematology, they advise against performing most of these tests unless in the case of patients undergoing major surgery or 'intermediate' surgery with high American Society of Anesthesiologists grades. However, in the particular case of coagulation, the National Institute for Health and Care Excellence (2016) suggests that preoperative testing in high risk surgery be considered only in the context of chronic liver disease and anticoagulation – in line with British Committee for Standards in Haematology recommendations. The authors' suggestion for a bleeding questionnaire (adapted from the International Society on Thrombosis and Haemostasis's Bleeding Assessment Tool; Rodeghiero et al, 2010) can be found in *Table 1*.

International approaches

Efforts have also been made internationally to ascertain the need for preoperative haemostatic testing. The French Society of Anaesthesia and Intensive Care (Bonhomme et al, 2013) has issued guidance on this matter, which echoes UK recommendations. They also place emphasis on personal and family history of bleeding and physical examination as the best bleeding risk assessment tool, and propose the creation of a standardized questionnaire for this purpose. The French go further in stating that, unless a bleeding tendency is suspected from history and examination, routine preoperative haemostatic testing is not indicated regardless of intervention type (minor, intermediate, major), anaesthesia (peripheral, central, general), and patient factors (high American Society of Anesthesiologists grade, pregnancy, age – with the exception of non-ambulatory children, who should be screened for inherited disorders through activated partial thromboplastin time testing and platelet count).

In their more reserved assessment, the American Society of Anesthesiologists Task Force on Preanesthesia Evaluation postulated in their 2012 practice advisory paper (Apfelbaum et al, 2012) that the current evidence is not sufficiently robust to make unambiguous recommendations regarding the use of indiscriminate coagulation testing before surgical procedures, although they do recognize that certain clinical characteristics ('bleeding disorders, renal dysfunction, liver dysfunction, and type and invasiveness of procedure') may justify the consideration of such tests. Although their advice is broad, their stance remains clear as they argue that, as a whole, routine preoperative tests 'do not make an important contribution to the process of perioperative assessment and management of the patient'. The Austrian Society of Anaesthesia, Resuscitation and Intensive Care is more specific, and advise that only patients with an American Society of Anesthesiologists grade above II should have their coagulation profile tested, while a bleeding history in the form of a standardized questionnaire should be applied to all other patients (Pfanner et al, 2007).

On the other end of the spectrum, the Italian Society for Thrombosis and Haemostasis (Cosmi et al, 2009) is of the opinion that routine testing of haemostatic function before elective procedures (with the exception of bleeding time) is not only appropriate but recommended. They justify this with the lack of robust randomized controlled trials and the methodological flaws of some previous studies, and argue their use as a baseline test in order to aid identification of postoperative complications, such as heparin-induced thrombocytopenia in patients receiving thromboprophylaxis with unfractionated or low molecular weight heparin. Furthermore, they do not consider the financial costs of performing these tests significant, when compared with the risk of peri- and postoperative bleeding in those patients who have an asymptomatic underlying bleeding diathesis, which could pose a threat to the patient's life and expose the medical team to litigation. Although the latter point is arguable, it is worth noting that heparin-induced thrombocytopenia is a rare complication, with a study of over 24 000 patients finding that 0.76% of those receiving unfractionated heparin at therapeutic doses and 0.1% of those receiving prophylactic doses developed heparin-induced thrombocytopenia (Smythe et al, 2007).

Table 1. An approach to taking a thorough bleeding history. A positive answer to any of these questions should prompt coagulation testing and discussion with haematology

Please ask the patient about the following types of bleeding
Mucocutaneous: easy bruising, oral cavity, gastrointestinal
Epistaxis: >5/year, lasting >10 minutes, or needing packing or cauterization
Excessive bleeding after procedures: tooth extraction or surgery
Female bleeding: menorrhagia or post-partum haemorrhage
CNS bleeding: any intracranial haemorrhage
Muscle haematomas, haemarthrosis
Any other unusual bleeding: umbilical stump bleeding, cephalohaematoma, cheek haematoma caused by sucking during breast or bottle feeding, conjunctival haemorrhage or excessive bleeding following circumcision or venepuncture
Any previous bleeding requiring blood products
Family history of excessive bleeding or known bleeding disorder

Adapted from the International Society on Thrombosis and Haemostasis bleeding assessment tool (Rodeghiero et al, 2010)

The coagulation profile – what to do with the results?

Despite the various guidelines and recommendations for requesting coagulation screens carefully, they are still widely requested and need to be interpreted and acted upon (*Figure 2*). Factor XII deficiency and the presence of the lupus anticoagulant are common findings which can lead to a prolonged activated partial thromboplastin time without increasing the risk of bleeding. In the case of the former, a cohort study found that as many as 10% of patients awaiting cardiac surgery had moderate factor XII deficiency, with no concurrent bleeding tendency (Halbmayer et al, 1994). In the absence of a positive bleeding history, it would seem hard to justify further investigations.

Although most clinicians are reassured by a normal coagulation profile, this does not completely exclude an underlying haemostatic disorder. von Willebrand disease is a common condition which often goes unnoticed by routine testing, and yet can lead to significant bleeding. Equally, mild haemophilia can evade coagulation testing as factor VIII is an acute phase reactant, and as such its levels can be misleadingly raised in acute illness (Begbie et al, 2000). Without exploring their bleeding history, these patients could proceed to surgery and experience significant morbidity despite their normal test results. In both these scenarios, routine coagulation testing would prove potentially dangerous, and at the very least inconsequential – but certainly never beneficial. In the event of a normal coagulation profile (along with full blood count and blood film) in conjunction with a positive bleeding history or any other reason to suspect a bleeding tendency, referral to a haematologist should be considered for further investigations. If not already part of the laboratory's standard coagulation assay, fibrinogen levels can also be assessed, as well as specific factors such as factor VIII, factor IX and von Willebrand factor. The Platelet Function Analyser (PFA-100) has been used to aid in the diagnosis of von Willebrand disease, and genetic analysis can also be conducted if there is a need to identify specific gene defects.

Conclusions

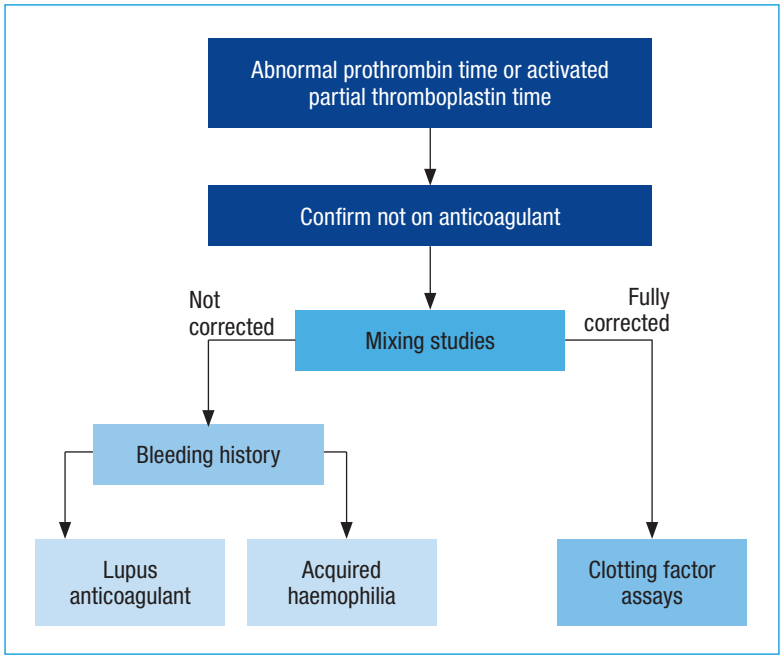
Preoperative investigations in elective surgery remain a controversial topic. Interestingly, this does not seem to be the result of conflicting evidence or a lack of guidance, but is possibly because of deeply ingrained habits among departments and practising clinicians. The question is not whether the coagulation profile is useless or taking a bleeding history is infallible; invariably, a minority of clinicians will have encountered a patient who, after an unremarkable initial assessment, suffered significant bleeding and was found to have a bleeding disorder. However, the move should be towards the universal use of a thorough bleeding history as an initial assessment, which will then guide the need for subsequent testing, in order to avoid unnecessary investigations which have detrimental consequences for both the patient and the health-care system in which he/she is being treated.

Although further studies are needed in the form of randomized controlled trials, current evidence is robust and should at least dissuade indiscriminate testing, and inform clinicians that the use of the coagulation profile as a screening tool is rarely indicated. **BJHM**

KEY POINTS

- Inherited bleeding disorders are rare in the general population.
- The coagulation assay has multiple limitations, and is never absolute in confirming or eliminating a diagnosis of a bleeding disorder.
- There is little correlation between a deranged coagulation assay and bleeding risk.
- A thorough bleeding history is the most useful tool in detecting undiagnosed bleeding disorders.
- Most worldwide guidelines favour a thorough bleeding history over coagulation testing.
- Young children are an exception, and routine preoperative coagulation testing might be considered in these cases.
- Randomized controlled trials are lacking and would be useful in providing definitive support for current guidelines.

Figure 2. A simplified approach to interpreting a deranged coagulation assay.



Conflict of interest: none.

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