



Surgeons can visually detect intraoperative coagulopathy: a pilot study

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In complex and prolonged surgery, there frequently remains scuffle and finger-pointing between surgeons and anaesthetists as to who is responsible for remedying insistent bleeding. Coagulopathy (or ‘anaesthetic’ bleeding) presents a multifaceted challenge: surgical trauma induces a systemic inflammatory response, tissue injury initiates the clotting cascade, administration of intravenous fluids leads to dilutional impairment of clotting factors, hypothermia impairs enzymatic reactions of the coagulation pathway, and acidosis inhibits clot formation. Rotational thromboelastometry (ROTEM) is an increasingly used point-of-care haemostatic test to comprehensively analyse viscoelastic properties of blood clot formation. ‘Surgical’ bleeding may be reduced by precise surgical technique, electrosurgical haemostasis, suture ligation, and an array of adjunct topical haemostatic agents^[1–3]. A surgeon’s visual assessment of intraoperative bleeding is an important aspect of decision-making – albeit subjective and heavily reliant on training and experience – which may suggest coagulopathic changes rather than operative factors as the cause of bleeding. There is, however, no literature that describes or quantifies reliability of this ‘innate’ observation. The aim of this pilot study is to evaluate the correlation between a surgeon’s subjective visual assessment of bleeding and real-time coagulopathy via ROTEM in patients undergoing laparotomy and cytoreductive surgery.

We conducted a prospective cohort study at a tertiary peritoneal malignancy unit in Sydney, Australia, which currently utilises ROTEM as a goal-directed tool in perioperative management. Inclusion criteria were adult patients undergoing laparotomy and cytoreductive surgery for peritoneal metastases. Operating surgeons were tasked with visually evaluating the extent and nature of intraoperative bleeding, which if subjectively assessed as abnormal, an immediate blood sample was drawn for ROTEM analysis in the operating theatre. Specific reagents are added within the analyser that allows measurement of resistance

HIGHLIGHTS

- A surgeon’s visual assessment of intraoperative bleeding is a subjective assessment, which may suggest coagulopathic changes, however, there is no literature that describes or quantifies reliability.
- Patients undergoing a laparotomy received point of care rotational thromboelastometry (ROTEM) when intraoperative bleeding was visually assessed as abnormal by the surgeon.
- In all patients, A10 value (clot firmness at 10 min) of the FIBTEM assay was below normal range, suggesting a consumptive state with increased bleeding risk.
- This novel pilot study contributes the first objective evidence that surgeons can use visual cues based on training and experience to detect low fibrinogen intraoperatively with high positive predictive value.

to rotation as blood clotting occurs, and provides comprehensive information on various contributors: INTEM evaluates the intrinsic pathway, EXTEM evaluates the extrinsic pathway, HEPTTEM isolates the effect of heparin, FIBTEM evaluates fibrinogen contribution, and APTEM evaluates antifibrinolytics. ROTEM sampling and data extraction was performed in accordance with manufacturer guidelines. For each assay, the A10 value (clot firmness at 10 min) was used to categorise the result as within the manufacturer recommended normal range, high, or low^[4]. All surgeons involved were at consultant level to minimise bias attributable to surgical inexperience. Patients received the usual perioperative anaesthetic care such as preoperative deep venous thrombosis prophylaxis, antibiotics, temperature monitoring, and intravenous fluids as required. Ethics approval was obtained from the local health district as low/negligible risk and informed consent obtained.

Four consecutive patients were included who had a normal baseline ROTEM at the commencement of surgery. Mean age was 64 years and equally divided between males and females. The indications for surgery were colorectal peritoneal metastases (50%) and pseudomyxoma peritonei (50%). Surgical detection of abnormal bleeding prompted a ROTEM after a median of 5.5 h (range 4–7.5 h). In all four patients, the FIBTEM assay dropped to low, which equates to a positive predictive value of 100%. The INTEM, EXTEM, HEPTTEM, and APTEM assays remained within normal range. No perioperative mortalities occurred.

There is an increasing use of ROTEM in most surgical specialties due to its impressive turnaround time and ability to measure multiple properties (i.e. assays) of haemostasis from initiation of coagulation cascade to fibrinolysis. The FIBTEM assay represents the functional fibrinogen level and fibrin

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polymerisation which is required for blood clot formation. When low intraoperatively, this suggests a consumptive state and confers an increased bleeding risk which requires correction with cryoprecipitate or fibrinogen (depending on local guidelines or anaesthetic approach)^[5]. This may also trigger serial ROTEM measurements to monitor response.

Existing studies on operative coagulopathy focus on quantifiable tests, or patients with established coagulation disorders^[6]. This novel study contributes the first objective evidence that surgeons can use visual cues based on experience to detect low fibrinogen levels in noncoagulated patients during complex surgeries. Surgeons are indeed a product of their rigorous and extensive training, which hones not only technical skills but also intuitive pattern recognition to operative factors such as bleeding. Further validation of a 'Visual Bleeding Scale' via a larger prospective study is currently underway and may translate to reduced blood loss, lower rates of blood transfusions and reduction in related costs and complications. The results also confirm that derangements in coagulopathy are reliably detected by point-of-care assessments such as ROTEM, and timely management is a shared role of both surgeon and anaesthetist.

Ethical approval

Ethics approval from: South Eastern Sydney Local Health District, Ref: 2023/ETH02752.

Consent

Informed consent was obtained from participants.

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Author contribution

M.S.: data collection, study design, analysis, and writing manuscript; D.M.: study design and reviewing manuscript.

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The authors declares no conflicts of interest.

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