Point of care testing in the perioperative period

The range of point of care tests continues to increase. Point of care testing is frequently undertaken by non-laboratory personnel and clinicians should understand the tests available and their applicability in clinical practice.

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Introduction

Point of care testing is a form of diagnostic analysis that is performed at or near the patient's bedside to provide rapid results that can direct targeted therapy in real time (Hildyard and Curry, 2015). There is a wide range of point of care tests available including urinalysis and human chorionic gonadotropin pregnancy dipsticks; handheld glucose, ketone and haemoglobin meters; benchtop blood gas and coagulation analysers. Another example of a point of care test is the SARS-CoV-2 tests, which enabled rapid detection of COVID-19 infection.

This article focuses on point of care testing in the perioperative period.

Point of care haemoglobin measurement

Knowing the patient's haemoglobin concentration facilitates diagnosis of anaemia and informs decision-making about blood transfusion. A laboratory haematology analyser is the gold standard for its accuracy, but the additional time required may reduce its clinical utility in dynamic situations.

Hand-held haemoglobinometers such as HemoCue rapidly analyse a small sample of arterial, venous or capillary blood. HemoCue can underestimate the quantity of plasma haemoglobin (Sanchis-Gomar et al, 2013), although this is not associated with unnecessary or delayed transfusion (Giraud et al, 2013).

Arterial blood–gas analysis

The arterial blood–gas level is one of the most frequently performed tests. Modern blood–gas analysis includes haemoglobin, glucose and other electrolytes, enabling diagnosis of a variety of metabolic acid–base disorders, hypoxaemia and disturbances of ventilation. Serial testing can determine the physiological trajectory and effectiveness of interventions. In theatre, arterial blood gases are valuable for those undergoing surgery with respiratory compromise, rapid changes in acid–base balance, or significant blood loss such as trauma, major abdomino-pelvic operations or those requiring cardiopulmonary bypass.

Point of care coagulation testing

Viscoelastic point of care testing, most commonly thromboelastography and rotational thromboelastometry (ROTEM), provides real-time measurement and display of the viscoelastic properties of whole blood. Conventional laboratory coagulation tests measure time to fibrin formation in centrifuged platelet-poor plasma (Srivastava and Kelleher, 2013). Viscoelastic tests facilitate rapid and individualised use of transfusion, synthetic clotting products, and antifibrinolytic drugs such as tranexamic acid in the management of haemorrhage.

Thromboelastography and ROTEM use similar technologies, where whole blood is added to a cup, a pin is suspended in the cup and rotational movements occur (in thromboelastography, the cup rotates and in ROTEM, the pin rotates). As the blood clots, changing resistance to this rotation is measured as amplitude and translated into a characteristic tracing (Ganter and Hofer, 2008). The thromboelastography analyser with platelet mapping assay can also provide information about platelet function and the effect of antiplatelet agents.

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Table 1. Key thromboelastography (TEG) and rotational thromboelastometry (ROTEM) parameters and their clinical interpretation

TEG	ROTEM	Definition	Interpretation	Parameter derangement	Key treatment
Reaction time (R-time)	Clotting time	Time to initial fibrin formation	Indicates clotting factor activity in the plasma	Prolonged R-time or clotting time	Administration of replacement clotting factors (fresh frozen plasma, factor concentrates) or anticoagulant antagonists
K-time	Clot formation time	Time to achieve a certain level of clot strength	Indicates activity of clotting factors, fibrin polymerisation, platelet activity	Prolonged K-time or clot formation time	Cryoprecipitate
α angle	α angle	Angle of slope between R and K (TEG) or clotting time and clot formation time (ROTEM)	Measures propagation of clot strengthening, determined largely by the rate of fibrin accumulation and cross-linking	Decreased α angle	Cryoprecipitate
Maximum amplitude	Maximum clot firmness	Maximum clot strength	Indicates concentration and function of platelets	Decreased maximum amplitude or maximum clot firmness	Platelets or desmopressin
LY30	CL30	Rate of clot breakdown over 30 minutes	Indicates clot stability and fibrinolysis	Increased LY30 or CL30	Tranexamic acid

From Srivastava and Kelleher (2013)

Although the tracings for thromboelastography and ROTEM look similar, the nomenclature and reference ranges are different. A basic overview of parameters and their clinical application can be seen in Table 1.

In elective cardiac surgery, thromboelastography- or ROTEM-guided transfusion strategies may reduce the need for blood products and improve morbidity in patients with bleeding (Wikkelsø et al, 2016). Their use has also been incorporated into algorithms for bleeding in major trauma and obstetric haemorrhage, but further evidence is needed in these settings to support their use (Mallaiah et al, 2015). Many hospitals have developed local guidelines for the use of thromboelastography and ROTEM to guide interventions in the management of bleeding and coagulopathy.

Conclusions

Point of care tests facilitate rapid assessment and individualised patient management. Further research may widen their utility in patients with bleeding or coagulopathy. The potential benefits of near-patient testing are likely to further expand their use in future.

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