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EDITORIAL

Towards perioperative point-of-care viscoelastic testing

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In October this year, it will be seventy-five years since Helmut Hartert, at the University of Heidelberg, Germany, described a "new" method of detecting the changes in blood clotting from a viscous to a more elastic clot, known as *"thrombus stressography."*[1] The apparatus measured the changes in resistance when applying a continuous rotational force to whole blood. These changes in resistance were then transduced and presented graphically (Figure 1).

Initially, this assay was mainly used in research laboratories, with its clinical value recognised in liver surgery in the 1960s. Surgeons and anaesthetists realised its value in identifying coagulopathy and guiding the appropriate administration of blood products to correct any defects, minimising unnecessary transfusions. However, haematologists were sceptical of this method for years due to several reasons. The test was often conducted as a point-of-care (POC) procedure outside the laboratory's rigid quality control system. Haematologists also expressed concerns regarding operator-depended variability and the initial absence of prospective controlled trials demonstrating improved clinically relevant outcomes in bleeding patients managed with thromboelastography (TEG) measurement.[2] Nevertheless, following pressure from clinical colleagues, more laboratories started offering viscoelastography (VET), either as TEG or as rotational thromboelastometry (ROTEM). Several publications followed, including an educational publication on TEG by the American Society of Hematology,[3] a discussion on viscoelastographic haemostatic assays as the "Test of the Month" in the American Journal of Hematology[4] and dedicated entire issues on VET in Seminars in Thrombosis and Hemostasis in October 2022 (issue 7, volume 48) and again in March 2023 (issue 2, volume 49).

Common coagulation tests (CCT), such as prothrombin time (PT/INR), activated partial thromboplastin time (aPTT), and fibrinogen levels, were developed to measure clotting factors or to assess the effects of anticoagulant drugs on these factors, using cell-free plasma. However, these tests measure only the time-to-clot formation (which constitute only approximately 10% of the clotting process), offering no insight into propagation, clot strength or clot breakdown.[5] VET provides additional valuable information, especially when performed serially. Coagulation

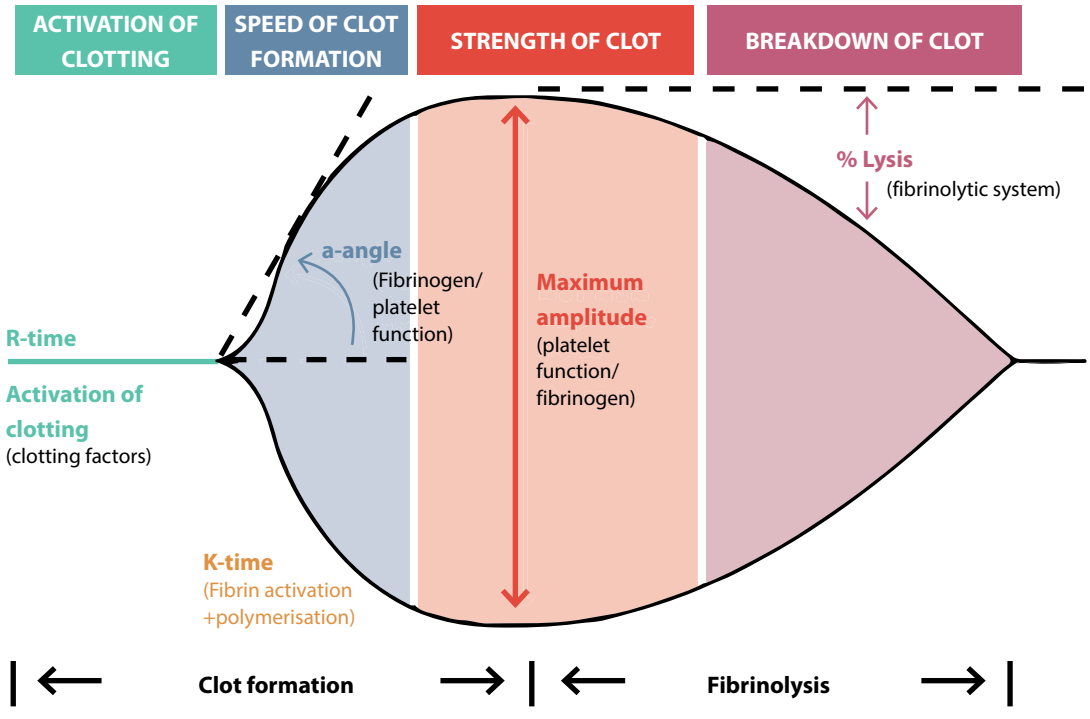

Figure 1: Thromboelastography

has been viewed for many years as a plasma-based enzymatic cascade, but we now understand this to also be a cell-based process, with the coagulation factors being activated on the surface of cells such as platelets and endothelial cells, along with various interactions between white cells and clotting factors. Consequently, both plasma-based common coagulation tests (PT/aPTT) and cell-based VET offer insights into bleeding patients and the choice of tests should consider all coagulation processes, depending on availability, turnaround time, cost, and physician interpretational experience.[6]

With the increasing recognition of the importance of patient blood management, TEG has played a vital role in blood product management. Presently, VET finds utility in various scenarios, often in combination with CCT. These include:

- VET-guided transfusions in cardiac surgery
- Managing bleeding and thrombotic risk in liver surgery and liver transplantation
- Facilitating trauma resuscitation and managing severe bleeding such as post-partum haemorrhage
- Supporting the management of extracorporeal membrane oxygenation and left ventricular assist devices
- Evaluating the rebalanced fragile haemostatic balance in liver disease, which is not reflected by the standard plasma-based tests
- Managing haemophilia A and B patients by guiding novel therapy and managing patients with high-titre inhibitors
- Aiding in the reversal of heparin therapy
- Assisting in the management of disseminated intravascular coagulation

Over the years, both the instruments used for VET and the test itself have evolved. There are now small, portable instruments available, such as the TEG6, which utilise a cartridge system and are ideal for bedside POC use.[5] The TEG assay itself has been modified to provide additional information, including evaluating the coagulation status of patients on heparin (by adding heparinase to the test), testing the levels of direct oral anticoagulants, and assessing platelet inhibition caused by antiplatelet drugs, through platelet mapping tests. The ROTEM instrument offers an assessment of the activation of clot formation via tissue factor (such as with prothrombin time assay), the activation of clot formation via the contact phase (such as with aPTT measurement) as well as fibrinogen function, platelet function, degree of fibrinolysis and detection of heparin.

VET has come a long way, gaining popularity, and evidence-based medicine has confirmed its clinical value. However, successful implementation of the test requires proper education, the establishment of appropriate algorithms using multidisciplinary teams, and the development of normal reference values. Failure to do so would result in the underutilisation of this valuable tool in coagulation management. As is often the case with medical issues in South Africa, the cost of the test remains one of the major obstacles. The article in this issue by Padayachee and Louw[7] highlights some of these challenges.

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