ROTEM guided components

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Background

- Major haemorrhage is a clinical emergency that results in morbidity and mortality (BSH, 2022)
- One of the most common causes of death worldwide in women at the time of delivery
- 'Diagnosis' of Major Haemorrhage is often difficult
- Often clinicians use clinical measures (↑heart rate,↓BP etc)
- These measures are insensitive – detection & correction of coagulopathy is therefore important in severe haemorrhage management
- Point of Care testing for haemostatic analysis can be used in clinical settings

Viscoelastic tests

- ↑use in the management of major haemorrhage
- Viscoelastic tests include thromboelastography (TEG), thromboelastometry (ROTEM) and Sonoclot
- Point of Care test
- Allows rapid assessment of coagulation
- Widely used in Trauma, Vascular, Liver transplantation, Cardiac Surgery and Obstetrics

Surely just do a Coagulation screen..

- ‘Serial haemostatic tests should be checked regularly (every30-60min)…’ (BSH, 2022)

> We suggest that serial haemostatic tests should be checked regularly, every 30–60 min depending on the severity of the haemorrhage, to guide and ensure the appropriate use of haemostatic blood components. (1B)

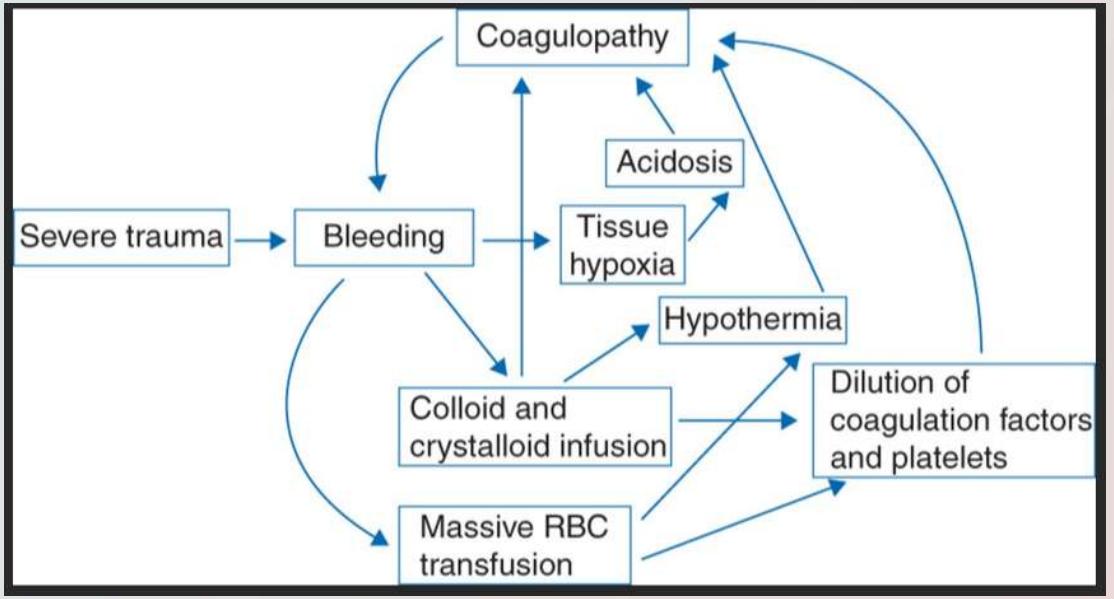
- However, intrinsic difficulties with the above guidance in reality when managing major haemorrhage
- Turn around times for laboratory coag screens vary and can often be too slow for rapidly evolving clinical situations (BSH, 2018)
- Viscoelastic haemostatic assays (VHA) are increasingly being used to assist the management of haemorrhage

Coagulopathy

"Inability of the blood to clot"

Coagulopathy of bleeding is related to;

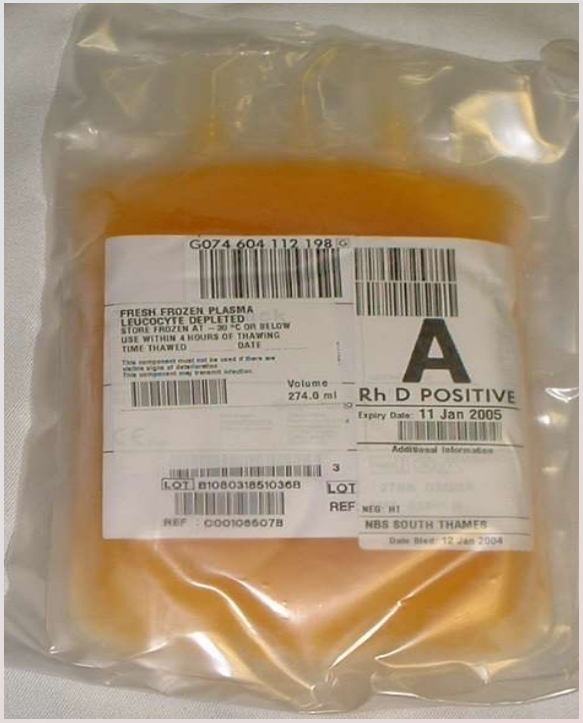
- blood loss
- consumption of coagulation factors
- activation of fibrinolysis
- haemodilution when resuscitation fluids are used *(BSH, 2022)*



Pham & Shaz (2014)

Coagulopathy

- Coagulopathy is associated with worse outcomes therefore imperative to correct as part of initial haemostatic resuscitation
- Significant numbers of trauma patients present early with coagulopathy = increased mortality (CRYOSTAT-2, 2019)
- FFP component of choice to manage coagulopathy of bleeding
- Balanced source of coagulation factors and effective for volume expansion



BSH Guidelines

If major bleeding is on-going and results of standard coagulation tests or near-patient tests are not available, we suggest that units of FFP be transfused in at least a 1:2 ratio with units of RBCs. (2B)

If major bleeding is on-going, and laboratory results are available, we suggest further FFP be administered aiming to maintain the PT ratio at <1.5-times mean normal (or equivalent). (2C)

We recommend plasma should be given early as part of initial resuscitation in major haemorrhage due to trauma, and in a 1:1 (not >1:2 ratio) with RBCs, until results from coagulation monitoring are available. (1B)

We suggest that VHAs are used to guide transfusion therapy in cardiac surgery, although for other clinical settings of major bleeding (e.g. trauma and PPH), hospitals should evaluate the costs and benefits of running these assays and ensure policies are in place to maintain these devices on a daily basis. (1B)

BSH, 2022

ROtational ThromboElastoMetry

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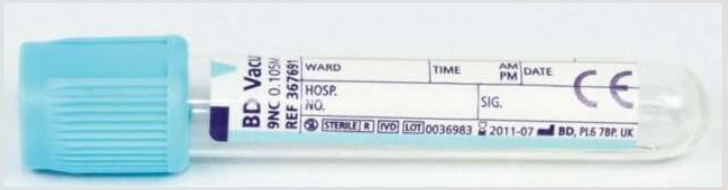
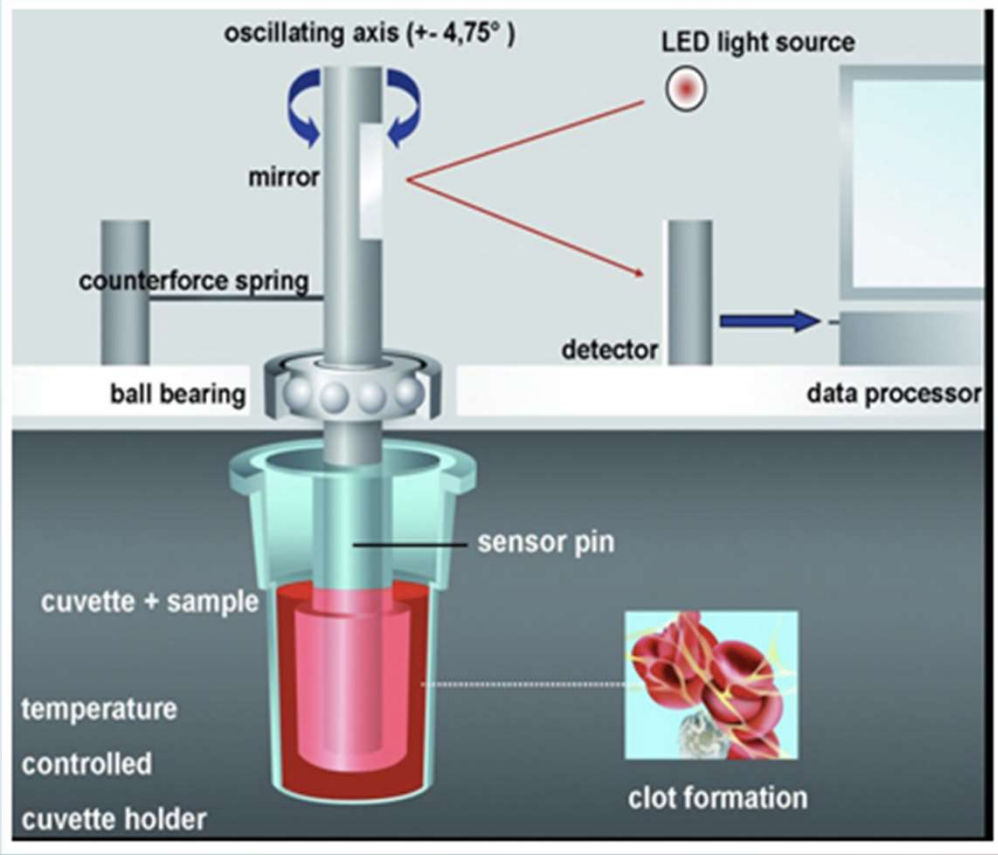


How does the machine work?



- Blood is mixed with reagents in cartridge via a magnetic ball into the measuring chamber
- In this chamber there is cup and a pin
- Pin placed on an axis powered by a motor and oscillates
- While the blood in the chamber is liquid, the oscillation is not restricted
- When the blood begins to clot, the firmness restricts the movement of the pin
- Detected via a light beam and sensor, increasing clot strength/firmness then the smaller the movement of the light beam

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Measures Clot Formation & Clot stability

Confirmation of patient's ability to form a firm, stable clot in real time

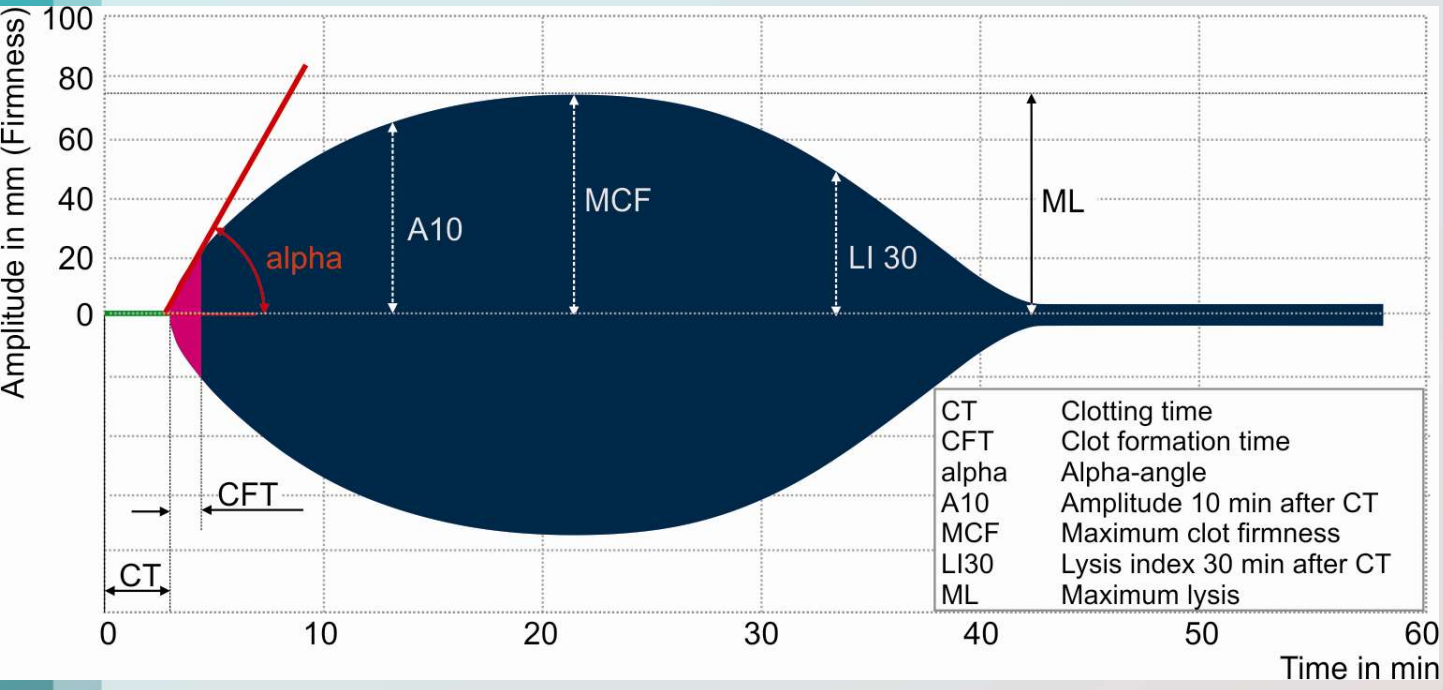
What does it do?

Point of Care Coagulation

Guides transfusion therapy

How are the results used to guide decision making?

The ROTEM produces a graph of coagulation against a time axis called a temogram



CT (clotting time): time from start of measurement until initiation of clotting
=> initiation of clotting, thrombin formation, start of clot polymerisation

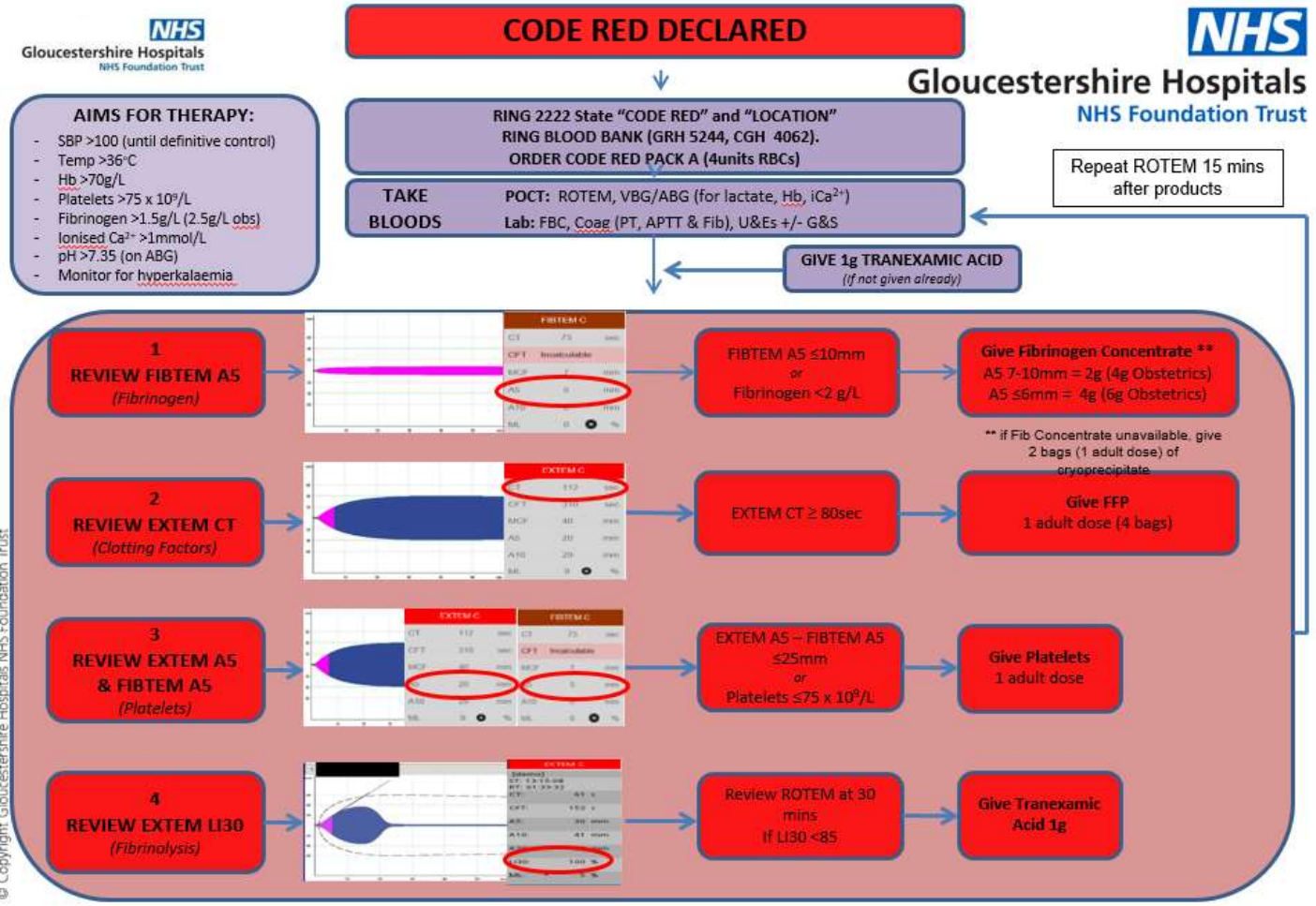
CFT (clot formation time): time from initiation of clotting until a clot firmness of 20mm is detected
=> fibrin polymerisation, stabilisation of the clot with thrombocytes and F XIII

MCF (maximum clot firmness): firmness of the clot
=> increasing stabilisation of the clot by the polymerised fibrin, thrombocytes as well as F XIIIr

ML (maximum lysis): reduction of the clot firmness => stability of the clot / fibrinolysis

Interpretation

- Results from the temogram are usually available between 5 - 10minutes
- These results are then interpreted using a local algorithm / policy

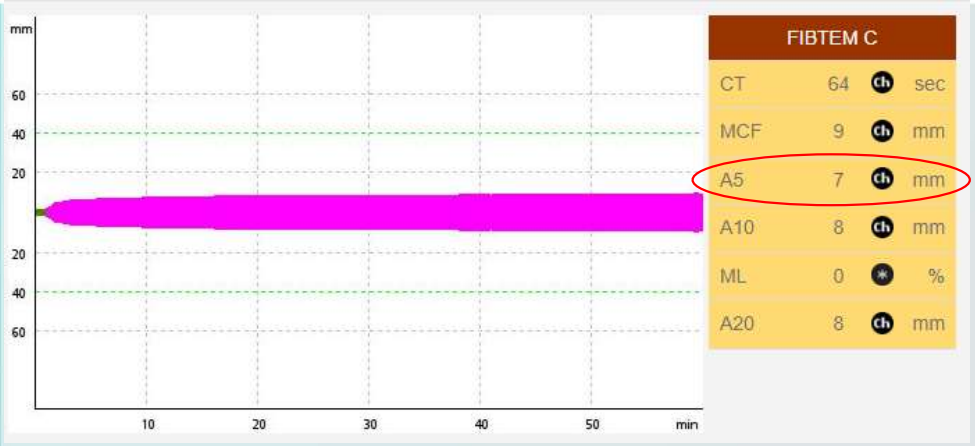


Interpretation – Case Study

- Multipara 3 (2 vaginal and 1 LSCS)
- Low BMI (53Kg at booking)
- 29+6 attended maternity triage with PV bleed
- Strong suspicion of placental abruption
- Decision for emergency LSCS due to ongoing blood loss
- 16:40 – formal bloods done (FBC, Coag screen) and sample also taken for ROTEM
- 16:46 – ROTEM analysis commenced
- 16:59 – Anaesthetist reviewed results and requested Fibrinogen Concentrate from Blood Bank

Interpretation – Case Study

Obstetric APH placental abruption



- ROTEM performed and Fibrinogen assessment result available after ~5 minutes
- FIBTEM A5 = 7
- Give 4g of Fibrinogen Conc or Cryo

Low fibrinogen during haemorrhage is an important predictor of the severity of the haemorrhage and poor clinical outcome – especially in Obstetrics

Interpretation – Case Study

Timeline

~16:00 – Patient in triage undergoing clinical assessment

16:30 – Patient in theatre

16:40 – FBC and Coag Screen bloods taken in theatre

16:46 – ROTEM analysis commenced

16:55 – FBC and Coag Screen sample booked into LIMS

16:57 – Anaesthetist reviewed ROTEM results

16:59 – 4g Fibrinogen Concentrate requested. 2g issued from Blood Bank
2g located in theatre drug fridge, taken and administered ~17:00

17:46 – Coag screen results authorised;
PT 12.9, APTT 32.8, Fib 0.77

20:11 – repeat Coag screen sent
PT 12.3, APTT 37.4, Fib 2.20

"Bundle of care"

QI programme described the use of EBL measurement, senior staff escalation, timely VHA guided fibrinogen concentration assessment & risk assessments to successfully reduce transfusion requirement

Bell et al 2021 Obstetric Bleeding Strategy for Wales, OBS Cymru

Goal directed therapy

- Blood components given in response to POCT analytical results
- Rather than 2:1 ratio RBC:FFP *(if results readily available)*
- Major haemorrhage is a clinical emergency and an evolving situation
- POC viscoelastic testing allows real time coagulopathy assessment
- Efficient and evidence based decision making

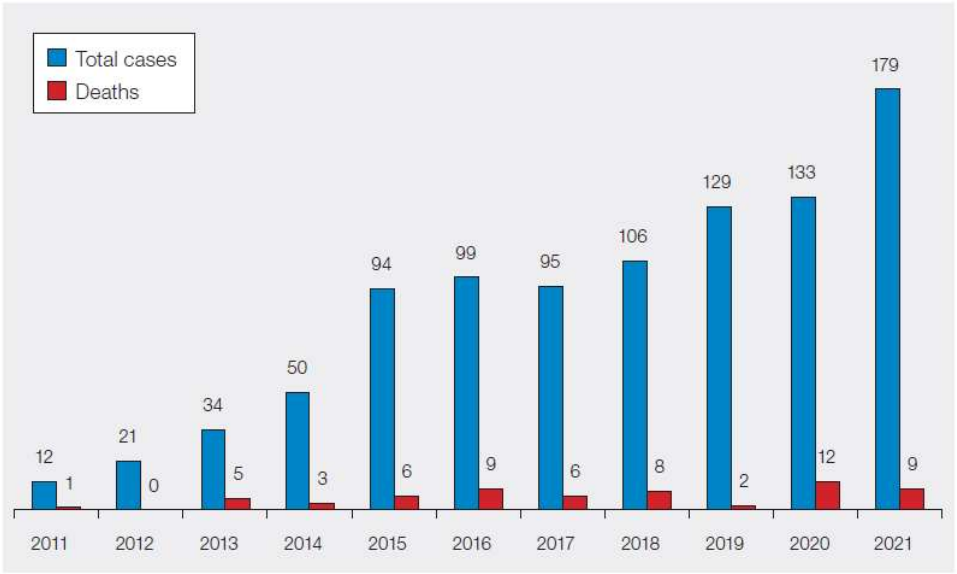


Figure 11a.1: Delayed transfusion reports and deaths by year 2011 to 2021 (n=952, deaths n=61)

SHOT, 2022

Blood Transfusion lab involvement

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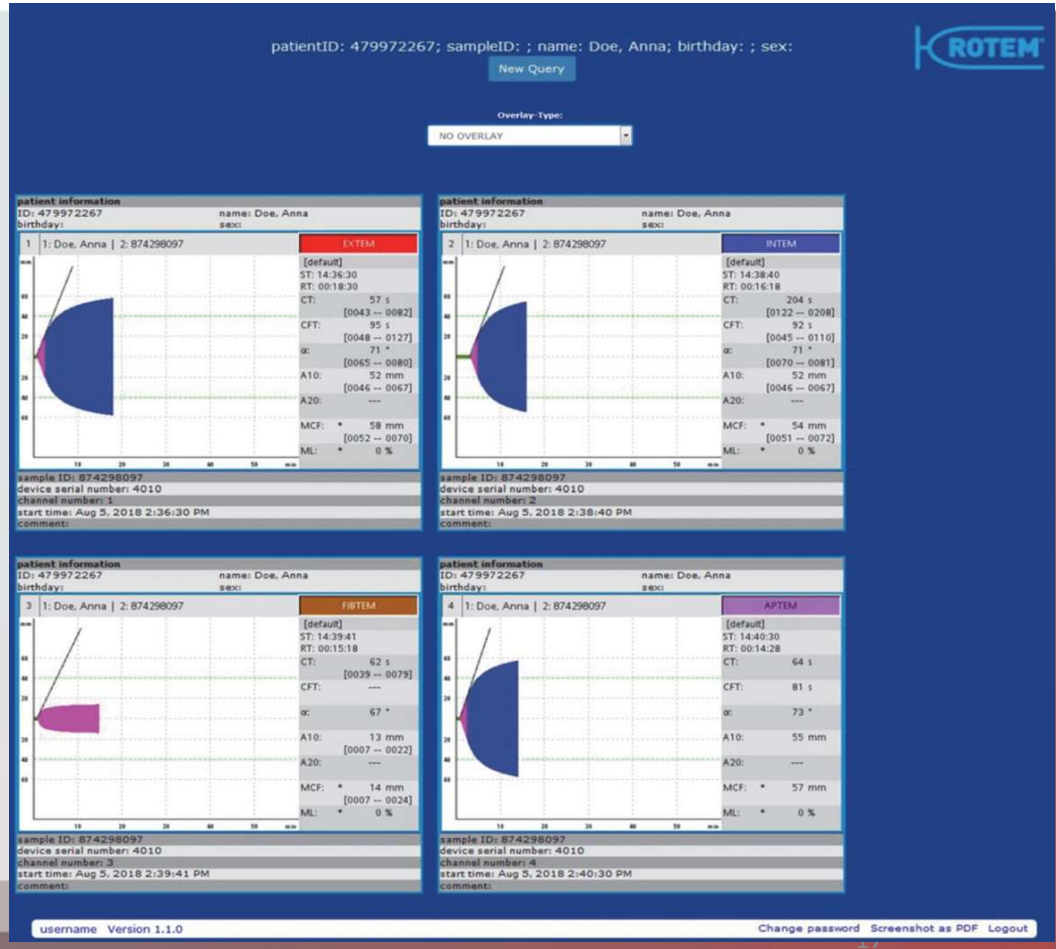
- ROTEM results are visible remotely while the sample is running
- BMS can view in lab – anticipate FFP, Platelets, Cryo, Fib Conc requests
- Soft challenge with requests for clotting components if ROTEM results ‘normal’
- BMS empowerment



Problems / issues

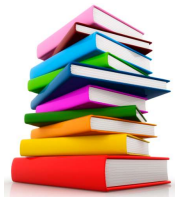
- Quality assurance; IQC (frequency?!), EQA
- Training / education
- Expensive
- Poorly standardised – no published consensus for normal ranges
- Who pays for consumables? Lab? Speciality?
- Low quality published data has not been clearly linked to important clinical outcomes
- BSH guidance currently states…

> We suggest that VHAs are used to guide transfusion therapy in cardiac surgery, although for other clinical settings of major bleeding (e.g. trauma and PPH), hospitals should evaluate the costs and benefits of running these assays and ensure policies are in place to maintain these devices on a daily basis. (1B)

BSH, 2022

Conclusion

- Goal directed therapy – blood components requested based on POCT results
- Gaps in literature and research regarding their proven effectiveness in relation to outcomes in patient care
- Viscoelastic haemostatic assays increasingly used in the management of the bleeding patient



References

- Curry *et al* (2018). A British Society for Haematology Guideline. The use of viscoelastic haemostatic assays in the management of major bleeding
- Stanworth *et al* (2022). A British Society for Haematology Guideline. Haematological management of major haemorrhage
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- Pham & Shaz (2014). Update on massive transfusion

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Thank you

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