Point of Care: 
Should be mandatory on the labour ward 
Proposer

Dr Rachel Collis 
Consultant Anaesthetist

University Hospital of Wales
## Disclosures

<table>
<thead>
<tr>
<th>Disclosures</th>
<th>Details</th>
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<td>Research Support</td>
<td>CSL Behring and TEM International</td>
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<td>Employee</td>
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<td>Honoraria</td>
<td>CSL Behring</td>
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Current situation: Coagulation support

- Very little differentiation in literature of different clinical situations (cardiac, trauma, obstetrics)

1. Wait for coagulation tests from the laboratory
   - About 60-90 minutes
2. Guess and use generic formulaic approach
3. Use POC testing: Results available in about 10-minutes
   - No standardised approach to interpreting results
APTT
Measure clotting defect in haemophilia

PT
Measures effect of Warfarin on Vit K dependant factors

Source: MedMarket Diligence, LLC; Report #S190.
APTT and PT

- Standard laboratory tests were not developed to predict bleeding
- Or guide coagulation product management.
- They are able to identify when blood is not clotting
- Standard laboratory tests are performed on platelet-poor plasma and therefore do not reflect the physiological clotting process.
- Performed at 37 °C so can’t measure problems associated with hypothermia
Current recommendations

• There is no NICE clinical guideline on managing blood coagulation during cases of major bleeding.

• The British Committee for Standards in Haematology guidelines on management of major haemorrhage currently state that:
  – Prothrombin time and activated partial thromboplastin time should be maintained at less than 1.5 times baseline
  – Platelet count should be maintained at greater than 75 times $10^9$ platelets per litre
  – Fibrinogen level should be maintained at greater than 1.0 gram per litre.
Concept of haemostatic impairment: enzymes and cofactors

Haemostatic competence

“Able to make sufficient thrombin”

PT, aPTT 1.5 x N

Adequate

Inadequate

20% Coagulation factors

100%
Concept of haemostatic impairment: fibrinogen

Adequate

Haemostatic competence

“ability to form clot”

Inadequate

Current recommended treatment level

Normal adult population 2-3 g/L

Pregnancy-related normal range 4-6 g/L

Fibrinogen
Standard coagulation tests

• Were not designed to inform coagulation therapy support
• TAT too slow in inform clinician in the acute clinical situation
• Current recommendations represent established coagulation failure
What is POC coagulation testing

• Viscoelastometric principles
• Whole blood +/- activators or inhibitors interacts with a pin. As clot forms the resistance between blood and pin increases
• Read-out is a graphical representation of the increasing viscosity
TEG(Haemonetics)
ROTEM(TEM International)
TEG® Directed Therapy For Bleeding Patient

- Coagulation
- Fibrinolysis

Platelets (MA)

- Low MA Platelets indicated

Enzymatic (R)

Fibrinogen (K, α)

Thrombolysins (Ly30, EPL)

- Prolonged R (not heparin) FFP indicated
- Clot kinetics
- High LY30 antifibrinolytics indicated
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<th>TEG®-based tests</th>
<th>ROTEM®-based tests</th>
<th>Diagnostic use</th>
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<td>RapidTEG (RapidTEG™ reagent)</td>
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<tr>
<td>Kaolin-activated TEG® + heparinase</td>
<td>Kaolin Heparinase</td>
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Haemostatic monitoring during postpartum haemorrhage and implications for management C. Solomon1, R. E. Collis and P. W. Collins
Relationship between FIBTEM and claus fibrinogen

Cardiff prospective study

Bedside assessment of fibrinogen level in postpartum haemorrhage by thrombelastometry

C Huissoud, N Carrabin, F Audibert, A Levrat, D Massignon, M Berland, R-C Rudigoz

BJOG 2009;116:1097–102

- FIBTEM and fibrinogen correlate during PPH but are not interchangeable.
So what does this all mean??

- Complicated
- Confusing
- Different devices do slightly different things
- Difficult to compare with traditional testing
- No direct comparison between devices
- No predefined results that inform treatment
Obvious benefits

• Turn around time of 10-minutes compared to 60-90 minutes for APTT/PT
• Real time management of clotting disorders
• Different tests will focus on specific deficiencies
• Platelet count is taken into account as there number and function is an important part of clot formation
• Measure fibrinolysis
Viscoelastic point-of-care testing to assist with the diagnosis, management and monitoring of haemostasis: a systematic review and cost-effectiveness analysis

Penny Whiting, Maiwenn Al, Marie Westwood, Isaac Corro Ramos, Steve Ryder, Nigel Armstrong, Kate Misso, Janine Ross, Johan Severens and Jos Kleijn
Current evidence

Cardiac surgery
11 RCTs
(14 publications)
3 prediction studies
(3 publications)

Trauma coagulopathy
1 ongoing RCT
1 CCT
15 prediction studies
(18 publications)

PPH
2 prediction studies
(2 publications)
Conclusion (cardiac surgery)

- Reduces Blood and FFP use
- Cost effective
- Limited evidence that
  - Reduced return to theatre
  - Reduced hospital stay
  - Reduced mortality (one study-60 mortality)
- Overall recommended POC testing
“trials were generally poorly reported; all were rated as 'unclear' or at 'high' risk of bias on at least 50% of the assessed criteria.”
NICE
PPH

• Anecdotal
• Descriptive

• NICE recommended that POC testing was only used in the context of clinical research
POC testing: Should be mandatory

• Hardly a ringing endorsement
What reviews don’t say

Know the coagulation status of patient

Change Behaviour

Normal

• Bleeding has another cause
• Surgical focus on physical bleed (early return to theatre)
• Anaesthetic focus on appropriate monitoring and resuscitation

Abnormal

• Coagulopathy is contributing to the bleeding
• Rapid identification and early ordering of products
• Focused ordering of products (Plasma, platelets, fibrinogen concentrate)
Change of behaviour-due to knowing results and being able to react appropriately

• More proactive
• More interested
• More willing to rapidly repeat tests
• More time at the patients bedside (outside theatre)
Don’t explain

• By knowing coagulation status
  – Reduce FFP
  – Reducing platelets
  – Reducing RBC
  – Reduce long term morbidity/mortality

• Over transfusion of FFP is harmful
• With increased RBC transfusion in “normal care group” is FFP making bleeding worse
Complications related to transfusion include- transfusion-associated

- Graft-versus-host disease
- Administration of an incorrect blood component,
- Haemolytic transfusion reaction
- Transfusion-related acute lung injury
- Febrile reaction
- Transfusion associated circulatory overload
- Acute respiratory distress syndrome
- Multiple organ failure
- Infections (HIV, hepatitis A, B and C, and malaria.)
Implications of early empirical replacement

- FFP 1L
- Cryoprecipitate 10 units (2 pools)
- Fibrinogen concentrate 4 g

Based on Collins et al. Theoretical modelling of fibrinogen supplementation with therapeutic plasma, cryoprecipitate, or fibrinogen concentrate.

The Liverpool Experience

Transfusion Management of Massive Haemorrhage in Obstetrics

**Transfusion Lab Tel Number(s)**
- 0151 227 6013
- 0151 227 8472

**ActIVATE Level 1 transfusion protocol**
- Time to evacuate at clinical area:
  - Level 1: 3 min
  - Level 2: 5 min

**Emergency**
- 0 red cells
- 4 units in blood fridge or DS
- 2 units in freeze thaw

**Blood Course**
- 0151 227 5181
- Consultant Haematologist
- Via RUG switchboard

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**STOP THE BLEEDING**

**Haemorrhage Control**
- Manual compression
- Ergometrine 500 micrograms IV
- Sepsicopen 10 IU IV
- 10 IU Infusion
- Check placenta and for trauma
- Carboprost IM
- EDA
- Tampocoap
- Compression sutures
- Hysterectomy

**Haemostatic Drugs**
- UHT and Prothrombin complex concentrates for uncannoned patients
- Other haemostatic agents: discuss with Consultant Haematologist

**Cell salvage**
- If available and appropriate
- Consider rates of other components:
  - 1 unit of red cells = c. 250 ml
  - salvaged blood

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**TRANSFUSION**

**Give MHP 1**
- Red cells: 8 units
- FFP: 4 units

**Order MHP 1**
- Red cells: 8 units
- FFP: 4 units

**Rescues**
- Sustained/continuous haemorrhage requiring further transfusion

**Take bloods and send to lab:**
- Hb, FBC, PT, APTT, Fibrograms, U+E, Ca++, MPT, ARB, ROTEM

**Order MHP 2**
- Red cells: 8 units
- FFP: 4 units

**Order Blood products**
- According to ROTEM or Order MHP 2
- Red cells: 8 units
- FFP: 4 units
- Platelets: 1 dose (ADS)

**Give MHP 2**
- Once MHP 2 administered, repeat bloods:
  - FBC, PT, APTT, Fibrograms, U+E, MPT, ARB, if available
  - To inform further blood component requiring

**Thromboprophylaxis**
- Should be considered when stable

---

**Aims for therapy**
- Fx:
  - Hb: > 10 g/dl
  - Platelets: > 75 x 10^9/l
  - PT ratio < 1.5
  - APTT ratio < 1.5
  - Fibrograms: 2 g/l
  - Ca++: > 2.2 mmol/l
  - Temp: < 36°C
  - pH: > 7.35 (mm Hg)
  - Monitor for hyperkalaemia

**Prevent Hypothermia**
- Consider Calcium Chloride
- Continuous cardiac monitoring

**STAND DOWN**
- Inform lab
- Return unused components
- Complete documentation
- Including audit proforma

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**ABG** – Arterial Blood Gas
- FFP – Fresh Frozen plasma
- PT – Prothrombin Time
- APTT – Activated partial thromboplastin time
- MHP – Massive Haemorrhage Pack
- TEG/ROTEM – Thromboelastography
- ATD – Adult Therapeutic Dose
- NPT – Non-Patient Testing
- XM – Crossmatch

v1 2011
Move patient to HDU when safe to do so

Take bloods and send to lab:
- XM, FBC, PT, APTT, fibrinogen, U+E, Ca\(^{2+}\)
- NPT: ABG, ROTEM

and

Order MHP 1
- Red cells* 4 units
- FFP 4 units
- Platelets 1 dose (ATD)

(*Emergency O blood, group specific blood, XM blood depending on availability)

Give MHP 1
Transfusion Management of Massive Haemorrhage In Obstetrics

**STOP THE BLEEDING**

**Haemorrhage Control**
- Bimanual compression
- Ergometrine 500 micrograms IV
- Systonicen 10 IU IV
- 40 IU infusion
- Check placenta and for trauma
- Carboxprisne IM
- EUA
- Tamponade
- Compression sutures
- Hysterectomy

**Haemostatic Drugs**
- Vit K and Prothrombin complex concentrate for warfarinised patients and
- Other haemostatic agents: discuss with Consultant Haematologist

**Cell salvage** if available and appropriate
- Consider ratios of other components:
  - 1 unit of red cells c.250 mls salvaged blood

**Order 4 units red cells and follow ROTEH Pathway**

**Aims for therapy**
- Aim for:
  - Hb
  - Platelets
  - PT ratio
  - APTT ratio
  - Fibrinogen
  - Ca²⁺
  - Temp
  - pH
  - Monitor for hypothermia

**Prevent Hypothermia**
- Consider Calcium Chloride
- Continuous cardiac monitoring and CVP line insertion

**STAND DOWN**
- Inform lab
- Return unused components
- Complete documentation including audit proforma

**Thrombophrophaxis should be considered when patient stable.**

**Discuss with Consultant Anaesthetist/Obstetrician and Haematologist.**

**RESUSCITATE**
- Airway
- Breathing
- Circulation

**Call for Help 2222**
- ‘Massive Haemorrhage, Location, Speciality’
- Alert emergency response team (including blood transfusion laboratory, portering/transport staff)
- Consultant involvement essential
- Move patient to ICU when safe to do so

**ASSESS: Take bloods for:**
- XE, FBC, PT, APTT, fibrinogen, U&E, Ca²⁺
- NPT: ROTEH, HEMOCUE, ABG

**RESUSCITATE**

**Order 4 units red cells and follow ROTEH Pathway**

**No ROTEH?**
- Order Red Cells 4 units FFP 4 units Platelets 1 dose

**Suspected or continuing haemorrhage requiring further transfusion:**
- REASSESS consider arterial line, FBC, PT, APTT, fibrinogen, U&E, Ca²⁺
- REPEAT ROTEH, HEMOCUE, Discuss with HAEMATOLOGIST

**Follow ROTEH Pathway**

**No ROTEH?**
- Red Cells 4 units FFP 4 units Platelets 1 dose

**Suspected continuing haemorrhage requiring further transfusion:**
- REASSESS FBC, PT, APTT, fibrinogen, U&E, Ca²⁺
- REPEAT ROTEH, HEMOCUE, ABG
- Consider Tranexamic Acid

**STAND DOWN**
- Inform lab
- Return unused components
- Complete documentation including audit proforma

**Thrombophrophaxis should be considered when patient stable.**

**Discuss with Consultant Anaesthetist/Obstetrician and Haematologist.**

**Notes:**
- ABG – Arterial Blood Gas
- FFP – Fresh Frozen plasma
- PT – Prothrombin Time
- APTT – Activated partial thromboplastin time
- MHP – Massive Haemorrhage Pack
- TEG/RO™EM – Thromboelastography
- ATD – Adult Therapeutic Dose
- NPH/PT – Near Patient Testing
- XM – Crossmatch
LWH Guideline for Massive Obstetric Haemorrhage guided by results from ROTEM

Run ROTEM and order/give 4 Units Red Cells

CT Extem > 90 s

Active bleeding?

YES

Order FFP (give when ready)

NO

Wait for Extem and Fibtem results

Extem A10 <40 AND Fibtem A5 < 7

Active/high risk of bleeding?

Fibrinogen Concentrate 2g* or Cryoprecipitate or FFP if unavailable

Check FibTEM once infusion is completed. Give further concentrate, if required, to achieve FibTEM A5 > 12

Low Extem but normal FibTEM
Or if 10 units of blood or more

Extem A10 40-60 OR Fibtem A5 7-12

Not Bleeding

Reassess and ROTEM in 1 hr if still stable

Extem A10 >60 AND FibTEM A5 > 12

No Products required

Give Platelets

*On agreement between Consultant Anaesthetist and Obstetrician
NB Always base treatment upon clinical scenario
Introduction of an algorithm for ROTEM-guided fibrinogen concentrate administration in Major Obstetric Haemorrhage

S. Mallaiah, P. Barclay, I. Harrod, C. Chevannes and A. Bhalla: Anaesthesia 70:166-175, 2015
<table>
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<th>Shock pack n=42</th>
<th>Fibrinogen protocol n=117</th>
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<tr>
<td>% TACO</td>
<td>9</td>
<td>0</td>
<td>0.004</td>
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<tr>
<td>% ICU admission</td>
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<td>1</td>
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<tr>
<td>% hysterectomy</td>
<td>14</td>
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<tr>
<td>Cost/patient</td>
<td>£632</td>
<td>£487</td>
<td>0.49</td>
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</table>
• Is it POC testing?
• Is it fibrinogen?
• Is it both?

• Don’t know
• Without the POC testing it couldn’t happen
Algorithm for the use of FIBTEM during PPH

1. **Bleeding > 1000ml**
   - Measured or Estimated or Suspected
     - **FIBTEM < 7mm**
       - Order FFP and give fibrinogen concentrate as soon as possible (quantity below)
       - Only give FFP if clinically indicated once it arrives
     - **ORDER FFP**
     - Give 1L FFP if bleeding is on-going and maintain at a 1:1 ratio during on-going PPH
       - *Give Tranexamic acid*
     - Repeat FIBTEM as clinically indicated
     - If PPH is on-going after FFP and FIBTEM < 12mm consider giving fibrinogen concentrate based on FIBTEM and weight of patient assuming that 60mg/Kg will increase plasma fibrinogen by 1g/L

2. **Run FIBTEM**
   - **FIBTEM A5 < 12mm**
     - **ORDER FFP**
     - Active or high risk of bleeding
     - *ORDER FFP*
   - **FIBTEM A5 > 15mm**
     - DO NOT ORDER FFP
     - Not bleeding
     - Reassess and FIBTEM in 1 hour if considered clinically necessary
   - **FIBTEM A5 12-15mm**
     - **Orders FFP**
     - Only give FFP if bleeding is on-going
       - *Give Tranexamic acid*
2013 v2014: PPH

>2500ml
2013 = 5.98 per 1000 deliveries
2014= 4.3 per 1000 deliveries
Transfusion data

Introduction of POC testing
Outcomes

• PPH hysterectomy June 2013
  – No POC testing
  – Delayed diagnosis of coagulopathy

Since introducing POC testing: ICU admissions
• Due to over-transfusion of FFP (TACO)(didn’t follow algorithm) July 2013.
Outcomes Jan 2016

• Very delayed clinical identification of bleeding (POC testing had it been done would have identified the problem hours) ICU admission
Hysterectomy x2

- Grand multip (8 children) CS twin pregnancy developed coagulopathy not associated with massive haemorrhage initially
  - Early identification of coagulation problem with focused blood product use
  - Bleeding not easy to control so decision for hysterectomy, Short stay in ICU

- Massive haemorrhage into broad ligament. Previous surgery for CIN and was due for hysterectomy.
  - Clotting normal throughout. RBC no FFP. Bleeding entirely surgical
  - Early hysterectomy, no ICU admission
• Using POCT algorithms has reduced blood and blood-product usage without increasing harm and may have reduced harm

• POC testing has improved treatment holistically by changing attitudes in the acute situation

• More focused and logical approach when things go wrong

• No universally approved algorithms
POC testing:
Should be mandatory on the labour ward

• **YES:** In 5-years time we will all be using the technology
  • More work on the algorithms
  • Algorithms from TEG and ROTEM
  • Understand limitations
  • Intervention points
  • Best treatment options in different situations
  • RESEARCH