# Point of care monitoring of haemostasis during postpartum haemorrhage

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Bwrdd lechyd Prifysgol Caerdydd a'r Fro Cardiff and Vale University Health Board



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### Outline

#### Background

- Why women bleed during childbirth?
- Haemostatic changes
  - Pregnancy
  - PPH
- Practical application of point of care testing
- Evidence of improved outcomes

#### **PPH: Leading cause of global maternal mortality**



Maternal Mortality Collaborators. Global, regional, and national levels of maternal mortality, 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015. Lancet 2016;388:1775–1812)

Knight M, Bunch K, Tuffnell D, et al. Lessons Learned to Inform Maternity Care from the UK and Ireland Confidential Enquiries into Maternal Deaths and Morbidity 2016-18. MBRRACE-UK; 2020. 2014;2(6):e323-333.

#### Why do women bleed?



Prevention and Management of Postpartum Haemorrhage. BJOG: 2017;124(5):e106-e149.

### Arresting obstetric bleeding



#### **Procoagulant changes**

#### Non-pregnant

Procoagulants Anticoagulants

#### **Procoagulant changes**



- 18,501 consecutive deliveries
- Investigated PPH ≥1500 mL
- n = 456 (2.5%)
- Most abnormal PT, aPTT and fibrinogen recorded

**Fibrinogen falls first** 

# Other clotting factors adequate until large bleeds



Normal range

#### Majority of PPH coagulation is preserved

 Empirical fibrinogen or FFP does not improve outcomes if coagulation is within normal parameters<sup>1,2,3</sup>



- 1. Collins et al. BJA 2017; 119(3): 422
- 2. FIDEL working group. Early and systematic administration of fibrinogen concentrate in PPH following vaginal delivery: BJOG. 2021;128(11):1814-1823.
- 3. FIB-PPH trial group. Pre-emptive treatment with fibrinogen concentrate for PPH: randomized controlled trial. Br J Anaesth. 2015 Apr;114(4):623-33.

#### Early coagulopathy

- Hypofibrinogenemia in <5% of PPH >1000mL
- Associated with certain pathologies (e.g. abruption), but not always predictable



Bloods taken after 1L blood loss and before any FFP



1. Bell et al. Comparison of haematological indices and transfusion management in severe and massive PPH: analysis of a two-year national prospective observational study. IJOA. 2022;50.

2. Bell et al. The incidence, aetiology, and coagulation management of massive postpartum haemorrhage: a two-year national prospective cohort study. IJOA. 2021;47

3. Gillissen et al. Coagulation parameters during the course of severe postpartum hemorrhage: a nationwide retrospective cohort study. Blood Adv. 2018;2(19):2433-2442.

4. Lasica et al. Haematological features, transfusion management + outcomes of massive obstetric haemorrhage: findings from the Australian + New Zealand Massive Transfusion Registry. Br J Haematol. 2020;190(4):618-628.

5. Green et al. The haematological features and transfusion management of women who required massive transfusion for major obstetric haemorrhage in the UK. Br J Haematol. 2016;172(4):616-624.

### Laboratory results during PPH

- 60-90 mins at best
- Either
  - Bleeding has stopped
- OR

 The situation has evolved and the results are retrospective so you have to employ empirical transfusion ratios







#### **Results available within 10 minutes**







#### Relationship between Fibtem + laboratory fibrinogen

- NOT the same test (plasma vs whole blood)
- ROTEM Delta (manual pipetting)





Collins PW et al. Fibrin-based clot formation as an early and rapid biomarker for progression of postpartum hemorrhage: a prospective study. Blood. 2014;124:1727–1736. Huissoud C et al. Bedside assessment of fibrinogen level in postpartum haemorrhage by thrombelastometry. BJOG. 2009 Jul;116(8):1097-102

#### Point of care coagulation testing: OBS + study

#### **ROTEM Sigma<sup>1</sup>**

- Mod linear correl, r=0.63 (Fibtem A5+ fibrinogen)
- ROC AUC Fibtem A5 to detect fibrinogen  $\leq 2 \text{ g/L}$



#### TEG6S<sup>2</sup>

- Mod linear correl, r=0.67 (CFF by 10+ fibrinogen)
- ROC AUC for Fibtem A5 to detect fibrinogen ≤2 g/L



1. Bell SF et al. The sensitivity and specificity of rotational thromboelastometry (ROTEM) to detect coagulopathy during moderate and severe postpartum haemorrhage: a prospective observational study. IJOA 2021.

2. Roberts TCD et al. Utility of viscoelastography with TEG 6s to direct management of haemostasis during obstetric haemorrhage: a prospective observational study. Int J Obstet Anesth. 2021 Aug;47:103192.

## Using ROTEM in an algorithm

	ROC (95% CI)	Matched samples	Threshold	Sensitivity	Specificity	PPV	NPV
Fibtem A5	0.96 (0.94-0.98)	552	<u>&lt;</u> 11mm	0.76	0.96	0.57	0.98

- Fibrinogen concentrate given to 21/521 (4.0%) women
  - All had either Fibtem A5  $\leq$  11 mm (20/21) or fibrinogen  $\leq$  2 g/L (17/21)
    - 3 had fibrinogen concentrate when results remained >2 g/L
    - 1 woman did not receive fibrinogen concentrate who may have benefited from it
- 101 women had PPH <u>>2000mL</u>, but only 5 women received FFP
  - Prolonged Extem CT results improved after treatment of hypofibrinogenemia alone
- Intervention points for platelet + FFP transfusion not established

Bell SF et al. The sensitivity and specificity of rotational thromboelastometry (ROTEM) to detect coagulopathy during moderate and severe postpartum haemorrhage: a prospective observational study. IJOA 2021.

#### How to use point of care coagulation testing: in a care bundle



McNamara H, Kenyon C, Smith R, Mallaiah S, Barclay P. Four years' experience of a ROTEM®-guided algorithm for treatment of coagulopathy in obstetric haemorrhage. *Anaesthesia*. 2019;74(8):984-991.

Bell SF, Collis RE, Pallmann P, et al. Reduction in massive postpartum haemorrhage and red blood cell transfusion during a national quality improvement project, Obstetric Bleeding Strategy for Wales, OBS Cymru: an observational study. *BMC Pregnancy and Childbirth*. 2021;21(1):377.













### **Clinical case 1**

- Healthy 21yrs, G2P1, term pregnancy
- Induction of labour for preeclampsia
- Precipitous labour
- Maternal collapse
  - CPR (PEA arrest)
  - Instrumental delivery
- PE or AFE?
- 6g Fibrinogen concentrate, 4 units FFP, 1 platelet



Loughran JA, Kitchen TL, Sindhakar S, Ashraf M, Awad M, Kealaher EJ. Rotational thromboelastometry (ROTEM<sup>®</sup>)-guided diagnosis and management of amniotic fluid embolism. Int J Obstet Anesth. 2019;38:127-130.

#### **Amniotic fluid embolism**



#### **Amniotic fluid embolism**



#### **Amniotic fluid embolism**



### **Clinical case 2**

- Rapid bleeding noted at elective caesarean section
- First ROTEM taken at 1000ml MBL

 Obstetrician concerned that coagulopathy was contributing to bleeding but there was no evidence of this



#### **Bleeding at elective caesarean section**

- 2nd ROTEM taken at 2000ml MBL
   Fibtem A5=23mm, Extem CT=42s
- 3rd ROTEM taken at 3500ml MBL
  Fibtem A5 = 14mm, Extem CT = 50s
- Bleeding controlled surgically when deep uterine extension was identified and sutured
  - Patient transfused 3 units RBC



#### Improved outcomes using point of care testing

#### **OBSCYMRU** Obstetric Bleeding Strategy for Wales

# Liverpool Women's NHS Foundation Trust

McNamara H, Kenyon C, Smith R, Mallaiah S, Barclay P. Four years' experience of a ROTEM®-guided algorithm for treatment of coagulopathy in obstetric haemorrhage. *Anaesthesia*. 2019;74(8):984-991.

Bell SF, Collis RE, Pallmann P, et al. Reduction in massive postpartum haemorrhage and red blood cell transfusion during a national quality improvement project, Obstetric Bleeding Strategy for Wales, OBS Cymru: an observational study. *BMC Pregnancy and Childbirth*. 2021;21(1):377.

#### Incidence of PPH <a>2500mL</a>



Bell SF, Collis RE, Bailey C, James K, John M, Kelly K, Kitchen T, Scarr C, Macgillivray E, Collins PW. The incidence, aetiology, and coagulation management of massive postpartum haemorrhage: a two-year national prospective cohort study. Int J Obstet Anesth. 2021 Aug;47:102983.

#### **Total red blood cell transfusion**



Bell SF, Collis RE, Bailey C, James K, John M, Kelly K, Kitchen T, Scarr C, Macgillivray E, Collins PW. The incidence, aetiology, and coagulation management of massive postpartum haemorrhage: a two-year national prospective cohort study. Int J Obstet Anesth. 2021 Aug;47:102983.

### Summary



- Coagulopathy during PPH
  - Hypofibrinogenemia
  - Early vs dilutional
- ROTEM and TEG can identify hypofibrinogenemia in PPH
- Integrated into a clinical algorithm can guide individualised blood coagulation product administration
  - Treat early coagulopathy in a targeted manner (minority)
  - Avoid empirical therapy (majority)
- Quality improvement reports
  - Reduced RBC transfusion and progression to massive PPH volumes

#### • Further research

- Clinical impact
- Use of point of care coagulation testing to inform FFP and platelet transfusion