Utility of viscoelastography with TEG6s to direct management of haemostasis during obstetric haemorrhage: a prospective observational study

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Abstract

Background: The TEG6s is an automated cartridge-based device with limited evidence describing its role in obstetric haemorrhage. The aim of this analysis is to describe the utility of TEG6s to identify abnormal laboratory results of coagulation and platelets, and inform an interventional treatment algorithm for PPH.

Methods: A prospective observational cohort study identified 521 women with moderate to severe obstetric haemorrhage (>1000mL blood loss) including 372 women with at least one TEG6s test. A non-pregnant control group was used for reference. TEG6s test parameters Citrated Functional Fibrinogen (CFF), Citrated Kaolin TEG (CK) and Citrated Rapid TEG (CRT)were compared with paired laboratory tests of fibrinogen, PT/aPTT and platelets, obtained during obstetric haemorrhage.

Results: There were 456 TEG6s tests, of which 389 were matched with laboratory coagulation results. The ROC AUC (95% CI) for CFF amplitude by 10 min to detect Clauss fibrinogen ≤2 g/L was 0.95 (0.91-0.99), $p<0.0001$ with sensitivity 0.74 and specificity 0.97 at ≤17 mm. False positives had Clauss fibrinogen median

(IQR) 2.4 (2.3-2.7) g/L. The CK-R time had some utility for detecting prolonged PT/aPTT, however a threshold for fresh frozen plasma (FFP) transfusion was not established. A CRT maximum amplitude <57 mm, when CFF was ≥15 mm, identified 4 of 8 samples with platelet count <75 $x10^9$/L.

Conclusion: The TEG6s CFF can be used to identify low fibrinogen during obstetric haemorrhage and inform a fibrinogen-based treatment algorithm. A value to identify transfusion thresholds for PT/aPTT and platelets was not established, and laboratory results should continue to be used.

Introduction

Viscoelastic haemostatic assays (VHA) are increasingly performed for the management of postpartum haemorrhage (PPH) and may improve outcomes through rapid identification and treatment of coagulopathy.[1-5] Hypofibrinogenaemia is the commonest cause of haemostatic impairment in PPH, and Clauss fibrinogen ≤2 g/L associated with ongoing bleeding should trigger fibrinogen replacement.[6-8] The importance of early identification and treatment of hypofibrinogenaemia is stated in national guidelines.[9-13] The main advantage of VHAs is that a result is available within 10 min compared to about 60 min using laboratory assays.[14] The UK National Institute for Health and Care Excellence (NICE) does not recommend the use of VHA in PPH citing lack of evidence,[14] and this is supported by other groups.[7] Algorithms to guide haemostatic therapies in PPH have been published for ROTEM (Werfen, Barcelona) and have been associated with improved clinical outcomes,[6,15] although sensitivity and specificity of the intervention thresholds have not been described.

The TEG6s® (Haemonetics Corporation, Braintree, MA) is an automated cartridge-based device that measures clot viscoelasticity in whole blood using resonance, a technology differing from the TEG5000 device. The TEG6s has advantages over TEG5000 including reduced pipetting and standardised reagents within a cartridge. It has not been evaluated during PPH, although data are published for cardiac surgery and trauma.[16-18] Evaluation in PPH is important because of the hypercoagulable state of pregnancy,[19] and the unique causes of haemorrhage associated with childbirth.[3] The optimal TEG6s intervention threshold to guide fibrinogen transfusion during PPH has not been investigated. An algorithm to guide decision making with VHA during PPH is recommended by Obstetric Anaesthetist Association and Royal College of Obstetrics and Gynaecology (RCOG)[9]. Describing the sensitivity and specificity of a specific intervention threshold is crucial to understanding the utility of the test when applying it to guide treatment decisions.

The TEG6s measures a range of coagulation parameters related to but not directly comparable with laboratory tests of Clauss fibrinogen, activated partial thromboplastin time (aPTT), and prothrombin time (PT).[20] The TEG6 citrated kaolin (CK) test measures coagulation activated through the intrinsic system, R time in s measures time to clot initiation (CK-R) reflecting adequacy of procoagulant factors in plasma. Citrated rapid TEG (CRT) measures whole clot firmness activated by tissue factor; clot initiation is faster and R time shorter, enabling rapid reporting of maximum amplitude (MA). The citrated functional fibrinogen (CFF) assay contains a platelet inhibitor, giving a surrogate measure of the contribution of fibrinogen to clot strength. Previous studies have investigated the TEG5000 in PPH but it is not possible to extrapolate data from this device to the TEG6s because the technology differs.[14] The aim of this analysis was to assess whether TEG6s parameters can identify clinically relevant abnormalities of laboratory coagulation tests and platelet count during PPH, to inform the design of TEG6s-based coagulation treatment algorithms.

Methods

Obstetric Bleeding Study Plus (OBS+) is a prospective, single centre observational cohort study of patients experiencing obstetric haemorrhage (ethical approval REC16/WA/0282). The primary aim of the study was to describe advanced tests of coagulation compared to standard laboratory tests.
Two secondary aims were to describe the utility of the TEG6s and ROTEM Sigma devices to identify abnormal laboratory results. The TEG6s results are described here.

Patients aged 16 or over with PPH activating the major obstetric haemorrhage protocol [10,21,22] (PPH of >1000 mL following gravimetric and/or volumetric measurement) and ongoing blood loss or earlier for clinical concern of bleeding or coagulopathy such as suspicion of amniotic fluid embolus or placental abruption) were eligible for recruitment into all parts of the study. Written informed patient consent was obtained to allow analysis of all results relating to the PPH after the woman had recovered in line with ethical approval. If consent was not obtained or declined TEG6S results and study samples were destroyed and removed from the database (see Fig. 1).

Blood loss was measured by gravimetric and volumetric techniques from delivery.[23] At study entry full blood count, venous blood gas, and citrated samples for TEG6s, ROTEM and laboratory coagulation were taken. After gentle mixing 0.3 mL of whole blood was pipetted into the TEG6s cartridge and analysed immediately in the theatre suite. TEG6s results did not inform clinical care but were collected and analysed by the study team retrospectively. Blood samples were taken during the PPH every 30 min or every additional 500 mL blood loss, in line with national guidance.[9] At each routine PPH venepuncture an additional study coagulation sample was collected and TEG6s analysis performed.

In addition to the PPH group, a group of non-pregnant healthy adult volunteers were recruited following written, informed consent, and a TEG6s test taken to inform a non-pregnant reference range. Anonymised data from the Cardiff Maternity Database were used to describe the denominator population. Data on study participants were entered into a secure electronic study database hosted by Cardiff and Vale University Health Board.

For each outcome (fibrinogen level, PT/aPTT and platelets count), the incidence of abnormality that may have required treatment was identified. This analysis reports TEG6s and laboratory samples matched by time of sample. For each outcome, the appropriate TEG6s parameter was compared to its matched laboratory parameter using correlation, ROC curve analysis, sensitivity, specificity, positive and negative predictive values.

The CFF amplitude at 10 min (CFF A10) was not reported if the maximum amplitude (CFF MA) occurred before 10 min, therefore the largest CFF amplitude available by 10 min was used (CFFby10). Correlation between CFF amplitudes of A10, MA and CFFby10 were performed. Clauss fibrinogen was correlated with CFF A10, CFF MA, and CFFby10. CFFby10 was assessed for utility to identify Clauss fibrinogen ≤2 g/L. We planned to investigate CK-R times for a threshold to detect PT and/or aPTT >1.5x midpoint of normal range (16.5s and 48s, respectively).[7,9] However, very few results fulfilled these criteria in the study precluding analysis. The CK-R normal range in the non-pregnant population was determined and investigated as a threshold to indicate any degree of impaired coagulation, equivalent to any level above laboratory normal ranges (PT 9-13 s and aPTT 26-38 s).

Three methods were investigated to determine a threshold to detect platelet count <75 $x10^9$/L:[7,9,12]
1) Evaluation of CRT MA after exclusion of CRT MA results with low fibrinogen (CFFby10 below the lower limit of non-pregnant normal range). 2) The formula CRT MA-CFF MA. 3) The utility of clot elasticity.[24] Platelet elasticity was calculated as CRT elasticity – CFF elasticity. Elasticity for CRT and CFF was calculated as (100xMA)/(100-MA).

Study cohort and outcomes are reported using descriptive statistics, including median (IQR [range]). Number and percentages were used for categorical variables. Data in the control group were normally distributed (Kolmogorov-Smirnoff method). Pearson correlation was used to describe linear correlations for all available TEG6s samples. The non-linear relationship between CFFby10 and Clauss fibrinogen was described using segmental linear regression. The utility of TEG6s assays to identify clinically significant abnormal fibrinogen (≤2 g/L), PT/aPTT >16.5/48 s (1.5 times normal range) and >13/>38 s (upper limit of the normal range) and platelets (<75 $x10^9$/L) was described using Receiver Operator Curves (ROC), sensitivity, specificity, positive and negative predictive values on TEG6s tests matched with laboratory samples. Statistical significance was defined as p value <0.05. Statistical analyses were performed using Graphpad Prism v8 and Microsoft Excel for Mac.

Results

Between May 2017 and May 2019 there were 11279 maternities and 521 patients were recruited into the PPH study, of whom, 81% had one venepuncture episode during PPH, and 19 % had two or more (range 1-10). Three hundred and seventy two recruited patients had at least one TEG6s test (Fig. 1) and TEG6s tests from 321 patients were matched with laboratory tests; 84% patients had one matched sample and 16% had two or more matched samples (range 1-7 samples). In total, 456 TEG6s tests were performed, 387 were matched with Clauss fibrinogen, 387 matched with laboratory platelet count and 389 were matched with APTT/PT. Sixty-two TEG6s tests were unmatched with laboratory samples and five results were unavailable for analysis. TEG6s results for PPH and non-pregnant control groups are summarised in Table 1 and Supplementary Fig. S1.

Demographic data for all PPH study recruits and those who had at least one TEG6s assay are shown in Table 2. Ninety-two percent of patients with total measured blood loss ≥1500 mL and all patients with blood loss ≥2000 mL were recruited into the study. In all PPH study recruits the incidence of coagulation abnormality that could trigger transfusion with blood products[9] was; Clauss fibrinogen <2, 4% APTT or PT > 1.5 times the normal range, 0.6% and platelet count $<75x10^9$/L, 1.8%. The utility of different TEG6s parameter thresholds to detect abnormalities of fibrinogen, PT/aPTT and platelets using ROC AUC, sensitivity, specificity, positive and negative predictive values are shown in Table 4. The ROC Curve for CFFby10 to identify Fibrinogen $\leq 2 g.L^{-1}$ is shown in Supplementary Fig. S1.

Detection of low Clauss fibrinogen

There was strong correlation between CFF A10 and CFF MA values (r=0.98, 95% CI 0.97-0.98, p<0.0001), and between CFFby10 and CFF MA (r=0.98, 95% CI 0.98-0.98, p<0.0001). Of 387 TEG6s samples matched with a Clauss fibrinogen, in nine (2.3%) CFF A10 was not reported because MA occurred before 10 min, and these were included in CFFby10. There were moderate correlations between Clauss fibrinogen and CFFby10, CFF A10 and CFF MA (Table 3). The non-linear relationship between Clauss fibrinogen and CFFby10, particularly at fibrinogen levels <3 g/L, is shown in Fig. 2. Clauss fibrinogen ≤2g/L occurred in 22/521 of study patients (4.2%), 14 of whom had at least one TEG6s tests and 19 matched samples. Utility of potential intervention points and ROC AUC to detect Clauss fibrinogen of ≤2 g/L are shown in Table 4 with additional information describing true and false positive and negative rates in supplementary Fig. S1. To identify fibrinogen ≤2 g/L a threshold CFFby10 ≤17 mm gave a positive predictive value of 52% and a negative predictive value of 99% (sensitivity 0.74, specificity 0.97).

Detection of abnormal PT/aPTT

Correlation between CK-R and PT was weak (r=0.21, 95% CI 0.10-0.30, p<0.0001). Low aPTT results are reported as <21s by our laboratory so aPTT could not be correlated with CK-R. The RCOG laboratory coagulation target for FFP transfusion (to maintain PT/aPTT below 1.5 times the midpoint of laboratory normal ranges) occurred in 3/521 (0.6%) of study patients. Only one laboratory sample, with APTT/PT of 48.2/13.2s was matched with a CK-R of 5.8 min.

Further analysis was undertaken of PT and/or aPTT results above the upper limits of laboratory normal ranges (13 and 38s) which occurred in 18/521 study patients. Nineteen samples (PT median (IQR [range]) 13.6 (13.4-14.6 [12.7-16.1]) s, aPTT 31.4 (27.6-36.7 [23.2-48.2]) s) were matched with CK-R, 5.5 (4.8-7.4 [3.7-8.6]) min. The upper reference range of CK-R (95th centile) in non-pregnant controls was 7.6 min. Utility of CK-R >7.6 min and other potential thresholds to detect PT/aPTT above laboratory normal range in matched samples and ROC AUC is shown in Table 4. A CK-R threshold of 7.6 min correctly identified normal aPTT and PT in 368 out of 389 samples (95%). Prolonged aPTT or PT was correctly identified in 4/19 results: four prolonged PT (13.1, 14.2, 14.7, 15.5 s), one also had prolonged aPTT (39.7 s). In 15 samples, prolonged PT/aPTT was not identified. There were two false positive results. Further detail describing true and false positive rates can be found in Supplementary Table S2.

Detection of clinically significant low platelet count

Platelet count correlated weakly with CRT MA (r=0.41, 95% CI 0.33-0.49, p<0.0001). The manufacturer recommends that CFF should be normal in order to use CRT MA to assess platelet contribution. The CFFby10 normal range in the non-pregnant control group (mean +/- 0.96 SD) was 15.1-22.8 mm. Eleven patients (2.1%) in the study had a platelet count <75 x10^9/L during the PPH, the threshold to trigger platelet transfusion according to guidelines.[9,25,26] Eight samples from seven patients were matched with TEG6s. Samples with CFFby10 <15 mm were excluded from the platelet analysis; 373 matched samples remained with no exclusions for low platelets. A threshold CRT MA <57 mm when CFFby10 >15 mm gave a positive predictive value of 80% and negative predictive value 99% (Table 4). When applied to our cohort of 373 matched samples this test gave four true positive results, one false positive result (platelet count 188 x10^9/L), four false negative results (platelet counts 53, 53, 60, 66 x10^9/L), and 364 true negative results (Table S3). CRT elasticity – CFF elasticity measures (dimensionless) correlated moderately with platelet count (r=0.59, 95% CI 0.52-0.65, p<0.0001). Utility of potential thresholds and ROC AUC to detect platelet count <75 x10^9/L are shown in Table 4 with additional information in table S4.

Discussion

The aim of this analysis was to assess whether TEG6s parameters could identify clinically significant abnormalities of laboratory coagulation and platelet count during PPH to inform a PPH coagulopathy treatment algorithm. A CFF by 10 min (CFFby10) threshold of ≤17 mm was a good test to identify fibrinogen levels ≤ 2g/L. False negative and false positive results were 1.3% and 3.1% respectively and most false positives had borderline fibrinogen.

The commonest abnormality of coagulation during PPH was hypofibrinogenaemia (≤2 g/L), with an incidence of 4.2%, which has been reported previously.[3,12] This study is the first to describe the CFFby10, which correlates moderately with Clauss fibrinogen (Fig. 2). This correlation is similar to that of other VHA devices.[3] The TEG6s was able to detect low fibrinogen with a ROC AUC 0.95, similar to previous results for the TEG5000.[27] The strong correlation between CFFMA and CFFA10 shows that there is no clinically useful information to be gained by waiting beyond 10 min, meaning the result is available in a timely fashion.

The non-linear relationship between laboratory fibrinogen and CFF has been described with older machines and is important when designing a treatment algorithm.[28] An interventional threshold for fibrinogen replacement should minimise false negatives whilst accepting some false positives, as the risk of uncorrected hypofibrinogenaemia is likely to outweigh the risk of fibrinogen replacement during haemorrhage when fibrinogen levels are close to 2 g/L. A CFFby10 ≤17 mm provided optimal balance between sensitivity and specificity, with 14/19 (74%) of samples with fibrinogen ≤2 g/L correctly identified. A previous report using TEG5000 had similar NPV and PPV but suggested a value of 12.7 mm,[27] meaning that results from the two machines cannot be used interchangeably. There were 12 false positive results, most of which had fibrinogen near the treatment threshold (IQR 2.3-2.7 g/L). Despite a positive predictive value of CFFby10 ≤17 mm of 0.54, due to the rarity of low fibrinogen in this study, false negative results represented only 1.3% of all tests, with a true negative value of 92%. As with any binary indicator based on a continuous variable, there will be borderline results around the intervention threshold, which should be interpreted within the clinical context, and the test repeated in the face of ongoing bleeding.

Published VHA algorithms for PPH include thresholds for infusion of FFP based on pragmatic intervention points which have not been interrogated for sensitivity and specificity against laboratory tests of coagulation. There is evidence that VHA algorithms are associated with large reductions in transfusion of FFP which has been associated with improved outcomes.[2,10,15,29,30]

National guidelines (UK) recommend transfusion of FFP during ongoing bleeding to prevent PT or aPTT exceeding >1.5 times normal.[9] This degree of coagulopathy was rare in this study with insufficient matched samples for analysis. The low incidence of severe coagulopathy in our study population must be interpreted in the context of our local PPH protocol, which focuses on early recognition of PPH, early obstetric intervention and rapid correction of hypofibrinogenaemia,[4,10,13] which may limit progression to severe outcomes. A threshold CK-R of 7.6 min (upper limit of the normal range) had high specificity but low sensitivity to detect abnormal PT or aPTT: CK-R below this threshold could be regarded as reassuring. Applying the threshold of CK-R of 7.6 min to this population, FFP would have

been correctly withheld in 383/384 (99.7%) matched samples. We suggest that laboratory tests of PT/aPTT should be performed alongside TEG6s to help inform individualised haemostatic therapy for patients who require FFP infusion, and empirical FFP transfusion may be necessary if bleeding continues after low fibrinogen is corrected.

The low incidence of thrombocytopenia in this study is consistent with other research.[31] In spite of the high ROC AUC for CRT MA to identify low platelets, using CRT MA <57 mm and CFFby10 ≥15 mm, low sensitivity limits the clinical utility of the test. An alternative test using platelet elasticity[24] was equivalent on ROC analysis but did not translate into a better clinical test with high numbers of false positives indicating unnecessary platelet transfusion. Laboratory platelet count remains the gold standard that can rapidly confirm deficiency and accurately inform transfusion decisions.

This is the first large prospective real-world study evaluating the TEG6s in PPH. The study recruited consecutive patients with moderate and severe PPH and captured 92% of haemorrhages >1500 mL over a two-year period, with a broad spectrum of PPH aetiologies. Seventy percent of study blood sampling episodes included a TEG6s assay. Due to clinical and logistical constraints a TEG6s sample was not performed at every venepuncture; for example, if venepuncture was difficult, clinical samples were prioritised over study samples. There were also occasions when the supply of TEG6s cartridges was interrupted. However, cases with TEG6s assays were representative of PPH episodes in the whole study and included 389 samples matched with laboratory coagulation tests and 387 matched with FBC.

In conclusion, the TEG6s CFFby10 threshold of ≤17 mm can identify fibrinogen levels ≤2 g/L, the main coagulation target during PPH, and this could be used to inform a binary interventional algorithm directing fibrinogen replacement. CK-R <7.6 min may have utility to inform withholding of FFP, but a threshold for infusing FFP or platelets was not established and requires further investigation.

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Competing Interests

TR, LC, DJ, AR, VJ, VF, SFB: no competing interests declared.

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Table 1 TEG6s results for PPH and non-pregnant control groups.

	CFF A10 (mm)	**CFFby10 (mm)**	**CFF MA (mm)**	**CRT MA (mm)**	**CK-R time (min)**
PPH group samples, n*	403	455	445	437	456
Median (IQR [Range])	24.6 (22.2-27.8 [6.2-41.3])	24.0 (21.0-27.4 [3.0-41.3])	26.0 (21.4-30.8 [3.0-51.8])	67.3 (64.9-68.7 [7.1-73.5])	4.3 (3.4-5.1 [1.2-9.5])
Non-pregnant control group (n=32)† Median (IQR [Range])	18.2 (15.5-21.4 [12.7-33.0])	18.3 (15.5-21.2 [12.7-33])	18.7 (16.6-21.6 [14.3-23.2])	60.9 (55.5-65.0 [51.9-71.0])	5.9 (5.2-6.7 [4.3-7.7])

* For 12 samples the CFF MA was reached prior to 10 minutes so CFF A10 results were unavailable. †For 1 TEG6s sample the CFF MA was reached prior to 10 minutes and so no CFF A10 was available.

Table 2 Demographic data of all maternities and the women recruited to the study

	All deliveries during study period	**All women recruited to PPH group**	**Women recruited with one or more TEG6s**
Number	11279	521	372
Age (y)			
Mean (SD)	30 (5.74)	31.2 (5.7)	31.3 (5.5)
Median (25^{th}-75^{th} centiles)	30 (26-34)	32 (28-35)	32 (28-35)
BMI ($kg.m^{-2}$)[a]			
Mean (SD)	27 (5.94)	27.5 (6.2)	27.7 (6.2)
Median (25^{th}-75^{th} centiles)	26 (23-30)	26 (23-31)	26 (23-31)
Mode of delivery, n (%)[b]			
Uncomplicated vaginal	7056 (63)	167 (32)	123 (33)
Instrumental vaginal	1469 (13)	130 (25)	87 (23)
Elective caesarean	1397 (12)	79 (15)	64 (17)
Nonelective caesarean	1370 (12)	144 (28)	98 (26)
Primary cause of PPH, n (%)			
Uterine atony	NA	69 (13)	45 (12)
Surgical bleeding or genital tract trauma	NA	333 (64)	234 (63)
Adherent or retained placenta	NA	667 (13)	51 (14)
Placental abruption	NA	331 (6)	25 (7)
Placenta praevia	NA	17 (3)	13 (3)
Uterine rupture or dehiscence	NA	1(<1)	1 (<1)
Sepsis	NA	3 (<1)	3 (<1)
Blood loss			
Measured[a] blood loss at study entry (ml), median (25^{th}-75^{th} centiles)	NA	1198 (1000-1400)	1165 (1000-1400)

Total measured blood loss (ml), median (25^{th}-75^{th} centiles)	350 (200-550)	1500 (1200-1800)	1500 (1200-1800)

NA not available. [a] Gravimetric and/or volumetric blood loss measurement for all patients. No data were available for blood loss at study entry for 78 women and BMI of 1 woman in the study. [b]11292 modes of delivery were recorded for 11279 deliveries during the study period. Mode of delivery was not recorded for one study participant.

Table 3 Correlation of Clauss fibrinogen with TEG CFF parameters

	CFFby10	**CFF A10**	**CFF MA**
No of paired values	387	344	377
Linear Regression			
r	0.67	0.65	0.68
95% CI	0.62 to 0.73	0.59-0.71	0.66 to 0.73
p value	<0.0001	<0.0001	<0.0001
Non-linear Regression			
r^2	0.50	0.46	0.49

Table 4 TEG6s parameters and their utility to detect abnormalities of fibrinogen, PT/aPTT and platelets

Abnormality	**No of matched samples**	**Parameter** ROC AUC, (95% CI), p	**Threshold**	**Sensitivity**	**Specificity**	**PPV**	**NPV**
Clauss Fibrinogen ≤2g/L	387	CFFby10 0.95 (0.91-0.99), p<0.0001	≤19mm ≤18mm ≤17mm ≤16mm	0.84 0.79 0.74 0.58	0.90 0.93 0.97 0.97	0.30 0.38 0.54 0.52	0.99 0.99 0.99 0.98
PT and/or aPTT above laboratory reference range	389	CK R Time 0.82 (0.73-0.91), p<0.001	>7 min >7.6 min >8 min >9 min	0.26 0.21 0.16 0	0.98 0.99 1.00 0.99	0.38 0.67 0.75 0	0.96 0.96 0.96 0.95
Platelet count <75x10^9	373*	CRT MA when CFFby10 ≥15mm 0.91 (0.82-0.99), p<0.001	<56 **<57** <58 <60	0.25 **0.50** 0.50 0.63	1.00 **1.00** 0.99 0.97	0.67 **0.80** 0.57 0.29	0.98 **0.99** 0.99 0.99
Platelet count <75x10^9	385†	CRT elasticity- CFF elasticity 0.92 (0.86-0.98), p<0.001	<120 **<110** <100 <90	0.50 **0.50** 0.25 0.33	0.95 **0.97** 0.99 0.99	0.17 **0.24** 0.29 0.33	0.99 **0.99** 0.98 0.98

* In total there were 387 TE6s samples matched with laboratory platelet count; 373 samples remained after the exclusion of samples with CFFby10 ≥15mm. †Both CRT MA and CFF MA were not reported by the device for 2 matched samples.

For more detail see supplementary tables S1-4

Legends for Figures

Figure 1 Study population, total blood loss for women recruited into the OBS+ study and number of matched TEG6s/laboratory samples. *No data available number of women with suspected placental abruption, AFE or coagulopathy. †Not recruited means patients who met the inclusion criteria but from whom consent was not obtained: 154 patients discharged before consent, 23 unable to consent due to mental health or communication issues, 12 declined consent, others not recorded. ‡Patients not otherwise recruited due to blood loss: In total 77 patients were initially recruited due to clinical concern but 50 later met the blood loss criteria. Three of the clinical concern recruits developed coagulopathy as a result of severe sepsis, one of whom subsequently met the blood loss criteria.

Figure 2 Correlation between Clauss fibrinogen and CFFby10. Line of best fit is non-linear segmental regression.