

predisposing to venous thrombosis. The risks of venous thrombosis in pregnancy remain about 1–2 per thousand pregnancies, and despite the increased use of thromboprophylaxis, and excellent guidelines from the Royal College of Obstetricians, venous thromboembolism and haemorrhage remain major causes of maternal death in the UK. The increased risk of venous thrombosis in pregnancy relates to changes in the vessel wall, reduced flow in the pelvis and legs and a prothrombotic state.

The prothrombotic state of pregnancy is demonstrated well by the TEG<sup>®</sup>,<sup>7–9</sup> with normalisation of parameters by a mean of 6 weeks postpartum.<sup>10</sup> Gorton et al.<sup>11</sup> showed that the maximal amplitude (MA) was significantly increased. The MA reflects the strength of the clot and the interaction between platelets and fibrinogen. In pregnancy the amplitude is greater than that of a healthy non-pregnant woman. In gestational thrombocytopenia the MA remains greater than in a normal healthy woman until the platelet count falls well below  $50 \times 10^9/L$ , due to the increased levels of coagulation factors, especially fibrinogen.

So the TEG<sup>®</sup> has enormous potential in the labour ward for assisting the obstetric anaesthetist in haemostatic decision-making. It has been used to assess hypercoagulable states and coagulation defects in pregnancy.<sup>12,13</sup> An interesting observation has been that women with recurrent miscarriage have an increased MA.<sup>14</sup> By giving a global picture of haemostasis, thromboelastography can lead to improved decision-making about safety of using regional anaesthesia, it may be able to reduce inappropriate use of blood products<sup>15</sup> and haemostatic drugs, and its fast feedback time makes it ideal for monitoring in a fast moving situation such as massive blood loss. Practically, quality control is necessary, and is probably best served by running thromboelastography in collaboration with the local pathology laboratory. What is also required is a large-scale study to assess the validity of the TEG<sup>®</sup> and practical algorithms in obstetric anaesthesia.

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The use of near-patient coagulation testing is increasing. In many situations clinicians feel that rapidly available

bedside tests aid clinical decision-making. Good examples of this include the use of activated clotting times to monitor heparinisation during dialysis and following cardiopulmonary bypass. Thromboelastography (TEG) was first developed during the Second World War and was put into clinical practice in the setting of orthotopic liver transplantation in the early 80s.<sup>1</sup> The principles and

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technique are as described in the foregoing text proposing this motion. TEG almost certainly has a role in orthotopic liver transplantation and in addition may be useful following cardiopulmonary bypass. A significant minority of obstetric anaesthetists have decided that in addition it has a valuable role in the labour ward. This was the topic for debate and below I have outlined the reasons why there is not sufficient evidence to support the motion at this time.

In order to be useful an assay must improve clinical decision-making. With regard to obstetric practice there are two possible ways in which TEG could theoretically achieve this. The first would be by reducing the haemorrhagic complications of labour and its management, the second by allowing the safety of epidural insertion to be predicted in those women who are denied it based on present selection criteria. However, haemorrhagic deaths in pregnant women are rare, as demonstrated by the data from the most recent UK confidential enquiry into maternal and child health. In the last triennium more women died because of poorly organised obstetric services and substandard care than by badly managed coagulopathy. The additional observation that no deaths occurred following radiological embolisation or placement of a B Lynch suture suggests that coagulopathy is not the main reason for death in these exsanguinating women. Spinal haematoma is extremely rare in obstetric practice. The American Society for Anaesthesiologists Closed Claims Project, which ran between 1980 and 1999, analysed closed claims from the 50 biggest professional liability companies in the US. In a period of 20 years, only three spinal haematomas were recorded in obstetric practice.<sup>2</sup> It is highly unlikely that the use of TEG could impact on these figures and in addition there is minimal evidence that TEG helps to guide blood product replacement in obstetric practice. The sole remaining indication for using TEG therefore would appear to be to improve decision-making in women requesting regional anaesthesia. Present guidance, based on minimal evidence, is that regional anaesthesia is relatively contraindicated in the presence of a platelet count of  $< 100 \times 10^9/L$ . Present practice appears safe with very few episodes of spinal haematoma related to placement or removal of epidurals.

Are women to whom safe regional anaesthesia could be delivered being denied this therapeutic modality? The answer is almost certainly yes. The question for this debate is, can TEG accurately differentiate those women from all of those excluded based on present criteria?

Those favouring the use of TEG would claim that it can predict when administration of regional anaesthesia would be safe, among women excluded by present criteria. The proponents of TEG would argue that a patient's TEG trace gives more reliable information

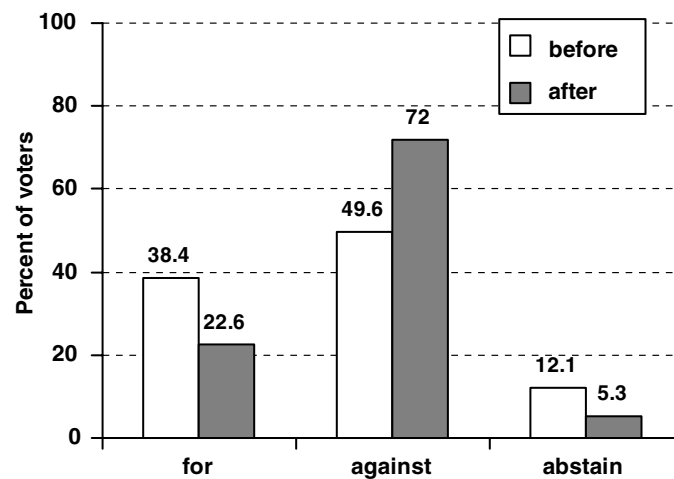
regarding the formation of clot than conventionally available assays. In general the correlation between coagulation factors, fibrinogen and TEG tracings is poor; in the majority of studies the strongest correlation between any TEG measurement and standard coagulation tests is between the maximum amplitude (MA) and the platelet count.<sup>1,3,4</sup> Although it is suggested that TEG is a good measure of platelet function there is little evidence to support this. TEG does not detect the effect of aspirin on platelet aggregation<sup>5-7</sup> and studies on intact and lysed platelets suggest that the only function of platelets detected by TEG is their ability to support phospholipid-dependent clotting.<sup>8</sup> Although the best correlation seen is between platelet count and MA, the coefficient of correlation between them is only moderate to good. A quick look at two of the best studies performed in pregnant women with preeclampsia demonstrates the type of problem that is seen in interpretation of these data. Sharma and colleagues compared TEG with the platelet count in 254 women with preeclampsia. The coefficient of correlation between the maximum amplitude and platelet count was moderate at 0.61. However four women with mild preeclampsia had thrombocytopenia with a platelet count of  $< 100 \times 10^9/L$ , but none were detected by TEG (had an abnormal TEG). Thirty-four women with severe preeclampsia had significant thrombocytopenia with a platelet count of  $< 100 \times 10^9/L$  but only 29% of those were detected by TEG.<sup>9</sup> In a similar study by Orlikowski et al. only one of five women with a platelet count between 50 and  $100 \times 10^9/L$  had an abnormal TEG; one woman, on the other hand, with a platelet count of  $> 250 \times 10^9/L$ , a normal prothrombin time, APTT and fibrinogen and no bleeding history had an abnormal TEG.<sup>3</sup> The decision on regional anaesthesia in both of these studies was not made based on the TEG results. Ultimately the question that has to be asked is the following. Is it safe to proceed with regional anaesthesia in women who have a normal TEG despite a platelet count between 50 and  $100 \times 10^9/L$ ? In the course of the debate the proposer cited a series of examples to support the use of TEG. At present the evidence consists of a handful of positive anecdotes and a handful of negative anecdotes.<sup>10</sup> Given the extremely low incidence of spinal haematoma observed in current practice it is easy to see why colleagues might be more influenced by the report of an adverse outcome.<sup>10</sup> To my knowledge the appropriate study has not been conducted; while indeed it may be the case that normal TEG correlates with safe regional anaesthesia at present there are no good data to support this conclusion.

In summary, although TEG purports to report on global haemostasis, the correlations between it and standard haematological tests are poor. TEG is unable

to diagnose specific haemostatic disorders and this is relevant because our knowledge and treatment strategies are aimed at specific disorders rather than at measurements of global haemostasis. In the areas of obstetrics where its proponents feel it might have a role, there are few data to support this. This is particularly the case with guiding blood product replacement in patients with haemorrhage and it is certainly the case in the prediction of safe regional anaesthesia for women who are excluded based on present criteria. In addition to this, unlike laboratory-based tests, the process of producing TEG results is sub-optimal. The introduction of a laboratory test that is going to influence critical decision-making should include a quality assurance process that includes manuals for staff training and provision and availability of standard operating procedures and the development of internal quality control and external quality assurance schemes. TEG remains a useful promising research tool in the field of obstetrics. At present there are few data to indicate that it has a role in any aspect of obstetric practice. Well-designed and adequately powered prospective studies of the use of TEG to predict outcomes of regional anaesthesia are required.

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Voting before and after the motion "Thromboelastography should be available in every labour ward." Voting by Brähler ICS UK Ltd.