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CASE REPORTS

Coagulopathy and placental abruption: changing management with ROTEM-guided fibrinogen concentrate therapy

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ABSTRACT
Placental abruption may cause significant haemorrhage and coagulopathy that can progress rapidly due to simultaneous consumption and depletion of clotting factors. Plasma fibrinogen levels are predictive of further haemorrhage. Rapid detection and treatment of hypofibrinogenaemia is essential in the evolving clinical and haematological situation. The use of near-patient testing of coagulation using rotational thromboelastometry (ROTEM) allows dynamic monitoring of coagulopathy. Following the introduction of fibrinogen concentrate into our unit, a ROTEM-guided algorithm was developed for use in obstetric haemorrhage. We describe four cases of placental abruption, haemorrhage and severe coagulopathy that span the introduction of the algorithm. Three cases were associated with intrauterine death and the fourth with delivery of an extremely premature neonate. Rotational thromboelastometry was used in all cases but methods of fibrinogen replacement differ, illustrating evolving management of the condition in our unit.

Keywords: Placental abruption; Coagulopathy; Rotational thromboelastometry; Hypofibrinogenaemia; Fibrinogen concentrate

Introduction

Placental abruption is a devastating complication of pregnancy that may result in fetal death and significant maternal morbidity. Haemorrhage occurs at the decidual–placental interface resulting in placental separation and the release of tissue thromboplastins into the circulation.[1] A large abruption, particularly if leading to fetal death, may cause widespread activation of the clotting cascade and rapid consumption of clotting factors. Disseminated intravascular coagulation (DIC) leads to severe haemorrhage, which may be concealed. Uterine contraction to promote haemostasis is only effective after delivery of the fetus and placenta. Multidisciplinary management is essential to correct coagulopathy, replace volume and expedite delivery, the urgency of which may be dictated by the health of the fetus.

Fibrinogen is a key factor in obstetric haemorrhage. It becomes depleted early; a plasma level <2 g/L is strongly predictive of severe postpartum haemorrhage,[2] compared with the elevated levels in healthy pregnancy of 4–6 g/L.[3] When DIC occurs, fibrinogen is consumed rapidly, and it can be difficult to monitor and maintain concentrations using conventional laboratory tests and administration of blood products.

Rotational Thromboelastometry (ROTEM, TEM International GmbH, Munich, Germany) analysis allows rapid and specific assessment of coagulation. A blood sample is added to a small cup and clotting is activated. The process of clot formation is measured by the torque produced during rotation of a central pin within the cup. The resulting trace reflects clot strength in real time (Fig. 1). The addition of different reagents allows assessment of individual components of the clotting process. The EXTEM test measures the extrinsic pathway of coagulation. The FIBTEM test measures the effect of fibrinogen following the addition of a platelet inhibitor. The clotting time (CT) and amplitude at 5 min (A5) are rapidly available; the A5 correlates accurately with maximum clot firmness (MCF) and plasma fibrinogen.[4,5] Normal ROTEM values in the hypercoagulable pregnant state differ from non-pregnant patients and so previous studies have defined reference ranges in pregnancy.[5–7] In our unit, treatment threshold values are based on published data and evidence of correlation between A5 and MCF (Table 1).[4]

Prompt correction of hypofibrinogenaemia is possible with fibrinogen concentrate. Since it contains a much

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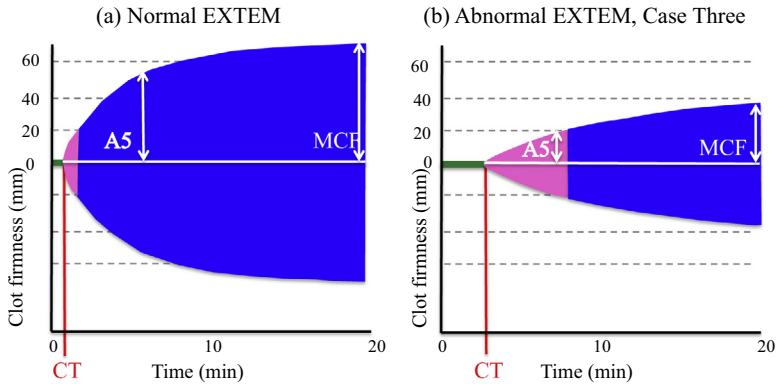

Fig. 1 EXTEM traces in (a) a normal pregnant patient and (b) a pregnant patient with coagulopathy (Case Three). CT: clotting time (time to initiation of clotting, defined as an amplitude of 2 mm); A5: Amplitude at 5 min after CT; MCF: maximum clot firmness (maximal amplitude).

Table 1 Reference ROTEM values for the third trimmest of pregnancy

	Normal pregnancy	Algorithm treatment thresholds
EXTEM		
CT (s)	31–80	>100
A5 (mm)	47–66	<47
MCF (mm)	66–92	
FIBTEM		
CT (s)	20–95	
A5 (mm)	12–31	Low <7; Borderline 7–12
MCF (mm)	15–38	

Normal values are shown for women in the third trimester of pregnancy representing 2.5–97.5 percentiles for MCF and CT,[6] with A5 and threshold values derived locally from correlations between A5 and MCF.[4]

Table 2 Comparison of fibrinogen content in fresh frozen plasma, cryoprecipitate and fibrinogen concentrate

	Fresh frozen plasma	Cryoprecipitate	Fibrinogen concentrate
Fibrinogen content (g)	0.8	1.5	2
Volume (mL)	300	190	100
Fibrinogen concentration (mg/mL)	2.7	7.9	20

Published values are shown.[8,9] The fibrinogen content of individual units of fresh frozen plasma and cryoprecipitate may vary depending on the content within donor plasma.

higher concentration of fibrinogen than fresh frozen plasma (FFP) or cryoprecipitate (Table 2),[8,9] a smaller volume is required to raise plasma concentrations. We report in chronological order, four cases of severe DIC and haemorrhage associated with placental abruption, illustrating the evolving management of this condition in our unit.

Case One

A 31-year-old G3P2 woman was admitted at 24 weeks of gestation following a vaginal bleed. Ultrasound revealed a grade four posterior placenta praevia and a normal fetal heart rate. The bleeding settled; her haemoglobin (Hb) concentration was 12.3 g/dL and platelet count 188×10^9/L. Three days after admission the patient suffered a sudden large vaginal bleed. Maternal heart rate (HR) was 112 beats/min with an unrecordable blood pressure (BP). Immediate intravenous fluid resuscitation was started. A large placental abruption and intrauterine death were diagnosed using ultrasound. Rotational thromboelastometry demonstrated an extremely prolonged EXTEM CT of 733 s and a flat line FIBTEM trace, indicating severe hypofibrinogenaemia. This corresponded to a plasma fibrinogen of <0.5 g/L. Her Hb was 5.1 g/dL and platelets 13×10^9/L. Treatment was guided by both ROTEM and laboratory tests (Table 3). Options for fibrinogen replacement at the time were limited to FFP and cryoprecipitate. Despite administration of large volumes of FFP, cryoprecipitate, packed red blood cells (RBC) and platelets, her Hb remained at 5.0 g/dL. Once partial correction of coagulopathy had been achieved a midline laparotomy with caesarean section was performed under general anaesthesia. A Couvelaire uterus