



Case report

Reversal of hypercoagulability with hydroxyethyl starch during transplantation: a case series^{☆,☆☆}

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Abstract During transplant surgery, clot formation resulting in life-threatening thromboembolic phenomena or graft loss may be a consequence unless close monitoring of coagulation and anticoagulation treatment is instituted in a timely manner. Three cases with a hypercoagulable state, as determined by thrombelastography at the time of surgery, but whose hypercoagulation was gradually attenuated with hydroxyethyl starch infusion during transplantation, are presented.

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1. Introduction

Hypercoagulation may occur in transplant surgery, especially during intestine, pancreas, and kidney transplantation. Although the exact incidence of hypercoagulability in those who receive these transplants has not yet been reported in the literature, intestinal and pancreas transplant candidates almost always [1,2], and kidney transplant candidates often, present with a hypercoagulable state [3].

Hypercoagulability is associated with numerous postoperative complications, including graft thrombosis, myocardial infarction (MI), ischemic stroke, deep venous

thrombosis (DVT), and pulmonary embolism (PE), and it significantly increases the morbidity and mortality associated with this type of surgery [4–10]. Antiplatelet therapy in these cases is recommended to prevent thrombosis of the graft [2,11,12]. However, many patients with hypercoagulability may go undiagnosed until they reach the operating room (OR) or until a clinically significant thromboembolic event occurs. In some cases, antiplatelet therapy may be contraindicated prior to surgery. In other cases, clot formation may occur at any time during surgery, rendering intraoperative monitoring of coagulation and prompt treatment of hypercoagulation crucial interventions for the prevention of thromboembolic complications.

Thrombelastography (TEG) is a technology designed specifically for the rapid overall assessment of clotting kinetics in whole blood, whereas most clotting assays identify single specific factor deficiency in plasma. Prothrombin time (PT), activated partial thromboplastin time (APTT), fibrinogen, platelets, hematocrit (Hct), and other assays to quantify levels of coagulation factors involved in the clotting mechanism are all useful in diagnosing a

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hypercoagulable condition, but these parameters may not be available in a timely manner or they may vary over time during surgery [2]. Therefore, TEG is a valuable coagulation monitoring tool to use during surgery; it also has been used successfully in other clinical settings to reliably and accurately detect hypercoagulability [1,2].

In transplantation, the clinical importance of perioperative TEG monitoring in transplantation was first described by Kang et al [13]. It has been increasingly recognized as an important monitoring adjunct, especially during liver and intestinal transplantation [13]. Recently, an association between the diagnosis of hypercoagulation by TEG and postoperative thrombotic events was described by McCrath et al. [14]. Three cases of patients with a hypercoagulable state at the time of surgery, as determined by TEG, but whose hypercoagulation was gradually and successfully attenuated with hydroxyethyl starch (HES) infusion, are presented.

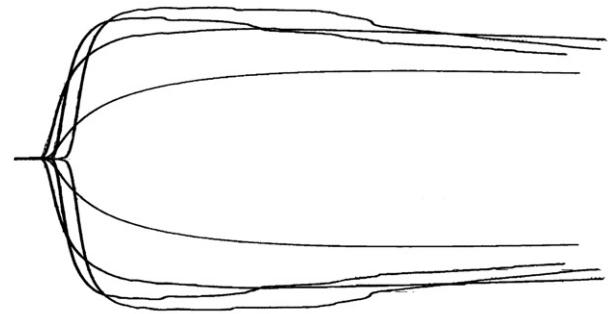
2. Case reports

2.1. Case 1 (isolated intestinal transplantation)

A 14 year-old patient who previously underwent a multi-visceral transplant secondary to dysmotility of the small intestine, presented for an isolated intestinal transplant due to chronic rejection. Preoperative laboratory work up showed platelets 713×10^3 cells/mm³, PT 12.5 sec, APTT 28.6 sec, fibrinogen 309.34 mg/dL, AST 90 U/L, ALT 81 U/L, and Hct 22%. Venous access was secured with a 7-French (Fr) catheter in the azygos vein by previous sternotomy and a peripherally inserted central catheter (PICC). Preoperative magnetic resonance imaging (MRI) and ultrasound studies showed complete occlusion of the right internal jugular vein and right and left brachiocephalic and bilateral femoral veins. Standard ASA monitors as well as arterial catheter and 18-gauge peripheral intravenous (IV) access were secured. Anesthesia induction was achieved with propofol, fentanyl, and rocuronium; and maintenance was achieved with isoflurane, oxygen (O₂), and fentanyl. Kaolin-activated TEG using the TEG 5000 Thrombelastograph hemostasis analyzer (Haemoscope Corp., Niles, IL, USA) was performed on the whole blood sample for monitoring of coagulation after 5 mL of blood was discarded.

Baseline TEG showed a hypercoagulable state (Fig. 1). An infusion of HES was started and serial TEGs were performed after the patient received 15 mL/kg of HES, 30 mL/kg of HES, and after a total cumulative dose of 45 mL/kg of HES.

Fluid resuscitation with HES caused a gradual normalization of TEG during the case. Surgery proceeded uneventfully, with a total time of 11 hours. Estimated blood loss was 2,200 mL. The patient received a total of 4 L of crystalloid, one L of albumin, 10 units of packed red blood



└ 10mm scale

	R (mm)	K (mm)	Angle (deg)	MA (mm)
Normal range:	6-10	1-3	57-69	56-67
Baseline:	7.1	1.2	74.1	76.2
15 mL/kg:	5.2	0.9	76.9	70.8
30 mL/kg:	3.9	1.4	70	63.7
45 mL/kg:	4.8	4.2	44.8	42.6

Fig. 1 Intraoperative thrombelastography (TEG) produced a gradual reduction of maximum amplitude (MA; clot strength) in a patient undergoing isolated intestinal transplantation. Baseline TEG showed hypercoagulable state, TEG after 15 mL/kg, TEG after 30 mL/kg, TEG after 45 mL/kg of hydroxyethyl Starch. R=reaction time or time of clot formation, K=time to clot reaching 20 mm, Angle=tangent of curve as it reaches K.

cells (PRBCs), but no fresh frozen plasma (FFP). Neither excessive surgical bleeding, thromboembolic events, nor renal dysfunction were observed in the postoperative period. The patient is doing well 499 days after transplant, with excellent graft function.

2.2. Case 2 (kidney-pancreas transplantation)

A 55 year-old patient with a history of end-stage renal disease secondary to diabetes mellitus type I, presented for a combined kidney with pancreas transplant. This patient also had a history of ischemic heart disease, for which a coronary stent was placed in 2004. He had been taking aspirin daily. Preoperative laboratory workup showed platelets 306×10^3 cells/mm³, PT 11.8 sec, APTT 22.7 sec, fibrinogen 177.0 mg/dL, blood urea nitrogen (BUN) 54 mg/dL, creatinine 3.7 mg/dL, and Hct 30.8%. Standard ASA monitors, an arterial catheter, an 18-gauge (G) peripheral IV catheter and 7-Fr triple-lumen central catheter were secured. Induction was achieved with propofol, fentanyl, and cisatracurium; maintenance was achieved with isoflurane, O₂, and fentanyl. Baseline TEG showed a hypercoagulable state (Fig. 2). An infusion of HES was started and TEGs were performed after the patient received 15 mL/kg of HES and a total cumulative dose of 30 mL/kg of HES. Prothrombin time, INR, and APTT were also evaluated at the time of TEG. Fluid resuscitation with HES caused a gradual reversal of hypercoagulability by TEG during the case. Activated partial thromboplastin time and PT also decreased in response to HES infusion. Surgery

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