Traumatic coagulopathy and massive transfusion: improving outcomes and saving blood

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Scientific summary

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Introduction

Trauma-induced coagulopathy (TIC) often complicates severe haemorrhage and is associated with significantly worse outcomes for trauma patients. TIC was previously thought to occur late and primarily to be caused by the consumption and dilution of clotting factors. However, the recognition that TIC developed rapidly and was more complex in its aetiology also suggested new management strategies and therapeutic options. There was sparse evidence on the epidemiology of trauma haemorrhage, existing practice patterns, outcomes and costs, as well as little information on the patterns of coagulopathy present on arrival and during haemorrhage and how these responded to transfusion therapy.

Methods

Between 2008 and 2013 we conducted a multimodal programme of work to develop our understanding of coagulopathy and its optimal management. We identified existing evidence, practice patterns and outcomes through systematic reviews of the literature and a national study of trauma haemorrhage, its transfusion management and associated health-care costs. We further examined several point-of-care coagulation tools for their ability to diagnose TIC and to assess the response to blood component therapy. We progressively implemented our findings into practice and assessed the outcomes of trauma patients presenting to our major trauma centre. To examine different approaches to the provision of blood to casualties in a mass casualty event, we constructed a discrete event model based on data from the 2005 London bombings.

Key results

Our national study recruited 442 patients in 22 hospitals and found that the 1-year mortality rate for patients with major haemorrhage [requiring 4+ units of packed red blood cells (PRBCs) in the first 24 hours] was and approached 50% for those with massive haemorrhage (10+ PRBCs). Half of these deaths occurred in the first 24 hours after injury and nearly one-quarter in the first 4 hours. In this critical window the delivery of blood component therapy was often below the recommended thresholds. Studying the pattern of TIC at this time point we determined that loss of fibrinogen and excessive fibrinolysis were key derangements. We were able to determine that rotational thromboelastometry could rapidly identify patients with TIC and high transfusion requirements, based on the clot amplitude at 5 minutes. We were further able to show how existing damage control resuscitation regimens do not maintain haemostatic competence during bleeding. Furthermore, fibrinogen levels started below the recommended range and became dangerously low after 8 units of transfusion without supportive transfusion therapy. Severe fibrinolysis was extremely common (seen in > 60% of patients) and in its most extreme phenotype only detectable by thromboelastometry. In total, the estimated cost of treating a major haemorrhage patient was £20,600 and the estimated cost of treating a massive haemorrhage patient was £24,000. Nationally, the estimated cost of trauma haemorrhage is £85M annually. In mass casualty situations early results show that the only mutable factor that has a large effect on the provision of care in the initial phase of the response is the level of blood stocks held in the receiving hospital.

Conclusions

Outcomes from trauma haemorrhage remain poor at a national level and there are important areas for improvement with regard to the delivery of transfusion therapy within the critical early post-injury phase of care. Implementation of consistent high-dose plasma-based damage control resuscitation improves outcomes but does not correct TIC during haemorrhage. Key features of TIC that may respond to therapy are loss of fibrinogen and excessive fibrinolysis. Thromboelastometry may be able to personalise coagulation therapy using new diagnostic criteria to correct TIC and further improve outcomes for critically injured bleeding trauma patients.

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