Comparison of a Novel Hemostatic Agent to Currently Available Agents in a Swine Model of Lethal Arterial Extremity Hemorrhage

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INTRODUCTION

Uncontrolled hemorrhage is a significant cause of morbidity and mortality in both civilian and battlefield trauma. On the battlefield, large vascular injuries of the extremity are a prominent injury pattern, and the leading cause of preventable death.1 The standard immediate treatment for these injuries is the application of direct pressure via manual compression and external dressings. This method however, is often ineffective and impractical in the battlefield setting: The use of tourniquets, while effective if applied properly, is controversial except as a method of last resort due to the associated risks of reperfusion, limb ischemia, and neurological injury.2

The development of an effective hemostatic agent that can be easily applied in the pre-hospital or battlefield scenario may significantly reduce mortality following trauma.

To this end, several candidate treatments including dressings based on chitosan (HemCon® bandage), zeolite (QuikClot® powder & QuikClot ACS+™ Bandage), and fibrin have been developed. Although moderately effective in controlling hemorrhage in various animal models, none of these have proven to be an ideal solution. The only human fibrin sealant dressing has consistently demonstrated efficacy in reducing mortality, hemorrhage volume, and resuscitation requirements in animal models of lethal arterial injury.3,4 Fibrin dressings, though effective, are prohibitively expensive and difficult to apply in battlefield conditions. Zeolite-based products, while effective in controlling hemorrhage in several animal models, yield a strong, exothermic reaction and have been shown to increase tissue temperatures up to 70°C at the site of application, leading to inflammation and local tissue necrosis.5

Super QR (BioLife, LLC) is a newly developed non-zeolite mineral hemostatic agent composed of potassium iron oxycarbide and hydrophilic polymer. When in contact with blood, Super QR forms a firm physical barrier or seal, which prevents further blood flow and allows a natural blood clot to external dressings. This method however, is often ineffective and impractical in the battlefield setting: The use of tourniquets, while effective if applied properly, is controversial except as a method of last resort due to the associated risks of reperfusion, limb ischemia, and neurological injury.2

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METHODS

Animal model – Anesthetized porcine model of lethal arterial injury. All animals were allowed to bleed freely for 1 minute, after which they were randomized to 1 of 5 treatment groups: Group I – Super QR (N=8) Group II – HemCon® (N=8) Group III – QuikClot Powder (N=8) Group IV – QuikClot ACS+™ Bandage (N=8) Group V – Army Field Bandage (N=8)

RESULTS

Resuscitation began 2 minutes after injury with Hextend (max vol = 60 ml/kg) and LR (up to 60 ml/kg) until death. Enough Super QR and QuickClot® powders were applied to fully cover the entire wound, gauze dressings were then positioned directly over these products. Therefore, the development of an effective hemostatic agent that can be easily applied in the pre-hospital or battlefield scenario may significantly reduce mortality following trauma.

CONCLUSIONS

In a clinically relevant model of lethal arterial hemorrhage, the application of the new hemostatic agent, Super QR, significantly reduced mortality, hemorrhage volume, and resuscitation requirements as compared to all other hemostatic agents tested in this study. Additionally, Super QR did not result in the marked increase in tissue temperature characteristic of zeolite based products.

REFERENCES