Hemorrhage Wounds Helped by Sprayable Foam

By: Matthew Dowling, Ph.D.

Worldwide, trauma affects as many patients as heart disease or cancer, and severe bleeding accounts for over one-third of deaths due to trauma. Trauma wounds can be compressible or non-compressible, i.e. bleeding which is not accessible to direct pressure, usually at an intracavitary site. This type of hemorrhage results in the vast majority (85 percent) of deaths due to severe bleeding. Researchers at Remedium Technologies, Inc. (RTI), a University of Maryland start-up, are developing a sprayable foam that expands rapidly into an injured body cavity, adheres to tissue and quickly stops hemorrhage during the expansion process. [1,2]

The sprayable foam hemostat, Hemogrip™, is based on the biopolymer chitosan, and the mechanism of action of the foam can be reversed by a complementary technology, Hemogrip™ Reverse, which allows the trauma surgeon to clean the wound site and perform surgery unimpeded.

The foam, dispensed from a handheld, lightweight canister, is particularly useful for treating non-compressible hemorrhage. While several advanced hemostatic technologies (i.e. products which stop bleeding) have been developed over the last decade to offer improved patient outcomes over the perennial Army Field Dressing (Cotton Gauze), none of them are robustly suited to treat non-compressible hemorrhage on the field.

All of the currently available hemostatic products, with one exception, are bandages or powders that require manual compression and direct wound visibility to address bleeding. The exception, X-Stat® mini-sponges, do not require compression, however X-Stat® is only applicable to very specific tight wound cavity geometries. Thus, at present, surgical intervention continues to be the reliably available method of controlling non-compressible hemorrhage and preventing death. Since evacuation times can be extremely lengthy during combat, many soldiers bleed out completely before the trauma surgeon has a reasonable chance to resuscitate.

The innovative approach RTI is taking is to utilize hydrophobically-modified (hm) chitosan as both a hemostatic and foaming agent. Hm-chitosan is an amphiphilic biopolymer that is created by covalently attaching single-tail fatty grafts along the chitosan backbone. This proprietary modification allows hm-chitosan to rapidly clot blood, whereas native chitosan is ineffective at controlling bleeding. [3,4] Furthermore, the modification to chitosan does not diminish the compelling antimicrobial and anti-scarring properties of native chitosan.

This hydrophobic modification allows hm-chitosan to rapidly clot blood as well as stabilize gas bubbles to form an expanding, sprayable foam. In addition, the clots formed by hm-chitosan can easily be dissipated and subsequently removed by aspiration following the addition of the amphiphilic supramolecule cyclodextrin (CD). CD is able to screen hydrophobic interactions between the fatty grafts and blood cells, thus quickly disassemble the clots. This biocompatible anti-clotting material will be delivered via aqueous spray to the injury by the trauma surgeon. The end result is an inexpensive, easily produced and highly effective hemostatic system which includes a sprayable foam hemostat (for the pre-hospital period) and a sister anti-clotting solution spray. The hemostatic foam will be utilized as a first line treatment of hemorrhaging, including non-compressible wounds, by medics or EMTs in the field to stabilize patients for evacuation.
transport to the emergency room or field hospital. If upon arrival of the patient to the surgical room more definitive treatment is needed, a trauma surgeon can then easily remove the hemostatic foam via Hemogrip™ Reverse.

References:

About the Author:
Matthew Dowling, Ph.D. is the CEO and co-founder of Remedium Technologies. Matt completed his graduate work at the Fischell Department of Biomedical Engineering at the University of Maryland in May 2010 and has since pursued RTI on a full-time basis. In 2005, he was awarded the Fischell Fellowship in Biomedical Engineering for his ideas for commercially viable drug delivery systems after graduating in chemical engineering at the University of Notre Dame. At UMD, he developed the platform Hemogrip™ technology which acts as the cornerstone of Remedium’s R&D pipeline for hemostasis and wound healing products.

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