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Hemorrhage Control
& Vascular Dysfunction

MedDefender Chitosan Hemostatic System for Rapid Control of Arterial Bleeding

David Melnick, MD, Richard Nii Lante Lamptey, PhD, Christian Nkanga, PhD, Iris Nguyen, BS, Thomas England, MS, Dorcas Dzewu, MS

Memsel, Inc Fort Worth Texas

David.Melnick@memsel.com Christian.Nkganga@memsel.com

Introduction

Uncontrolled hemorrhage is the leading cause of preventable death on the battlefield. Chitosan-based hemostatic agents accelerate clot formation through electrostatic interactions with erythrocytes and platelets, offering coagulation-independent hemorrhage control. MedDefender (M-D), a chitosan-alginate gel deployed through a compact, single-handed auto-injector, was developed to enhance hemostatic efficacy compared with currently marketed chitosan dressings.

Methods

A standardized femoral artery injury (5–7 mm arteriotomy) was created in anesthetized swine (n=6/group). Subjects received MedDefender (48 mL) or a commercial chitosan gel control (Traumagel, 60 mL), followed by 5 minutes of compression. Primary outcome was time to hemostasis (VIBe 0) after end-of-treatment (EOT). Secondary outcomes included total blood loss over 3 hours, survival, and histopathology.

Results

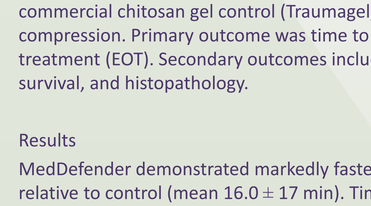
MedDefender demonstrated markedly faster hemostasis (mean 2.7 ± 2.7 min) relative to control (mean 16.0 ± 17 min). Time-to-event distributions differed significantly (Mann-Whitney U, p=0.04). All M-D–treated animals (6/6) achieved hemostasis within 10 minutes of EOT, compared with 3/6 in the control group. Although Fisher's exact test did not reach statistical significance (p=0.182), effect direction strongly favored MedDefender (risk difference +50%; RR 2.0). Post-treatment bleeding rates were comparable between groups (M-D: 2.7 ± 3.6 mL/min; control: 1.9 ± 1.1 mL/min), with no significant difference by either Welch's t-test (p=0.62) or Mann–Whitney U (p=0.81).

Discussion

MedDefender consistently outperformed the comparator in time-to-hemostasis endpoints, suggesting a meaningful operational advantage in rapid bleeding control. Comparable post-treatment bleeding rates indicate the primary benefit lies in accelerated clot formation rather than reduction of ongoing minor oozing.

Impact / Significance to the Warfighter

Improved early hemorrhage control, faster stabilization, and reduced compression burden may enhance survivability, mobility, and combat medic efficiency.



TCCC SOC FOR HEMORRHAGIC WOUNDS IS INADEQUATE

Torniquets are still the mainstay of treatment for hemorrhage, but…

- Not useful for **junctional wounds**
- Temporary, and do NOT support **Prolonged Field Care (PFC)**
- **TCCC directs** replacement of tourniquets with hemostatic dressings within 2 hours
- **Ischemia and Tourniquet syndrome** are major problems

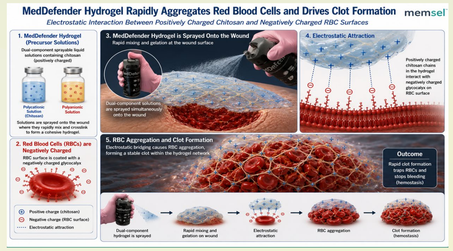
Current SOC hemostatic wound dressings

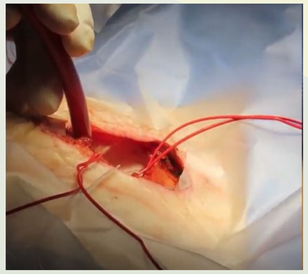
- **Cannot be self-administered**
- **Require manipulation** of the injured Warfighter
- Require packing risking **contamination**
- Not approved for prolonged residence time and **must be replaced**

Uncontrolled hemorrhage is the leading cause of death on the battlefield. Prolonged field care in austere settings has supplanted the "golden hour"

MEMSEL INNOVATION: MEDDEFENDER AND MEDBEADS

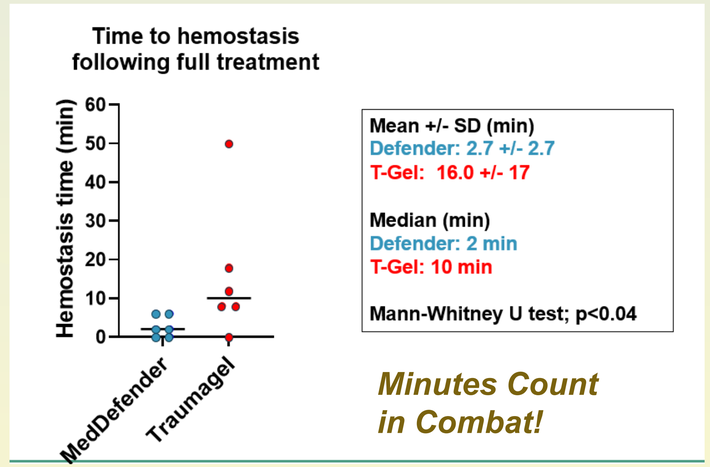
- Hydrogels with **chitosan** embedded in the lattice
- Lightweight, **single-handed**, autoinjectors for rapid **self-administration**
- **Two formulations** allowing treatment of both surface and penetrating wounds
- **Faster hemostasis** than predicate comparators
- Do not compromise **collateral circulation**
- **Wound coverage/protection** as well as hemostasis
- Engineered to stay in place for up to **72 hours**
- They are **bioabsorbable**
- Applicators meet military **SWaP specs** and are aligned with **Role 1 and Role 2 utility**



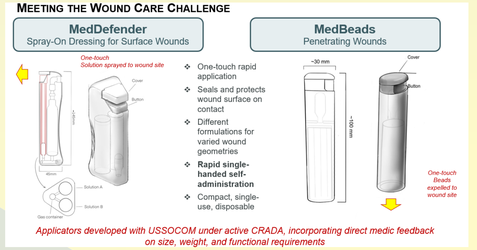


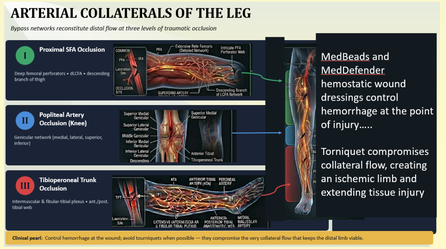
Porcine femoral arteriotomy model: Animals were prepared by dissection of the left femoral area to expose the femoral artery. A 6-7mm incision was made in the anterior wall of the artery, resulting in VIBe 4 arterial bleeding. MedDefender gel was then sprayed (or the predicate applied) into the hemorrhaging wound cavity

The treated wounds were covered with gauze and manual pressure was applied for 5 minutes….



6/6 MedDefender–treated animals were at VIBe 0 at 10 minutes, compared with 3/6 in the control group (risk difference +50%; RR 2.0).





OPERATIONAL SUPERIORITY IN MODERN HEMORRHAGE CONTROL – TCCC COMPARISON

Feature	MedDefender	MedBeads	QuikClot	XSTAT	Std. Gauze
Contactless Self Application	YES	YES	No	No	No
Works Any Wound Shape	YES	YES	Limited	Limited	Limited
Injectable (Deep Wounds)	YES	YES	No	Partial	No
Hydrogel Tech	YES	YES	No	No	No
Antibacterial Properties	YES	YES	No	No	No
Removable/ Biodegradable	YES	YES	No	No	YES
Min. Training Required	YES	YES	Moderate	Moderate	YES
Shelf-Life (Extreme Temp)	2+ yrs	2+ yrs	2 yrs	2 yrs	1 yr
72 Hr PFC Stability	YES	YES	No	No	No
Hemostasis < 3 min	97%	100%	84%	88%	31%

Discussion

- MedDefender significantly outperformed the comparator in the time-to-hemostasis endpoint, suggesting a meaningful operational advantage in rapid bleeding control.
- The MedDefender auto-injector supports far-forward and prehospital use (Roles 1–2), enabling rapid application to complex wound geometries, wound coverage, and prolonged dwell time (up to 72h).
- Advantages during prolonged field care, mass-casualty events, or limited-personnel scenarios.
- The findings support the potential of structured chitosan platforms to enhance rapid hemorrhage control in severe vascular injury.

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