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# Effects of a Self-Assembling Peptide on Second Degree Burn Progression and Healing in a Porcine Model

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## Abstract

A number of tissue sealants are available as adjunctive measures to improve hemostasis and healing of surgical wounds.[1,2] A self-assembling peptide hemostat (SAPH*) is in development to control bleeding during surgical procedures while not interfering with normal wound healing.[3] The purpose of this preliminary study was to examine the effect of SAPH on second-degree burn progression and wound healing in a porcine model.[4,5] This model was selected due to the similarities between pig and human skin.[6] Thirty-two (32) second-degree burn wounds were created. Sixteen (16) wounds were randomly assigned to one of two treatment groups: A) SAPH or B) Saline. All wounds were covered with polyurethane film dressing and four wounds from each treatment group were assessed on days 2, 3, 5 and 7. A trained dermatopathologist blindly assessed biopsies for burn progression, healing and bacterial load. The depth of inflammation (measured and graded) in SAPH treated wounds was less than that in Saline control burns. On day 2, tissue necrosis in SAPH treated burns appeared to have been reduced when compared to Saline control. On Day 5, the percentage of re-epithelialization was higher in the group of burns that had been treated with SAPH when compared to the group treated with Saline. On days 5 and 7, the total bacterial count in the SAPH treated wounds was lower than that in the Saline treated group. These results highlight the potential for SAPH to reduce burn progression and enhance healing. Additional studies are needed to substantiate these findings.

## Introduction

The skin has an important role to play in the fluid and temperature regulation of the body. If enough skin area is injured, the ability to maintain that control can be lost. Second degree burns are one of the most common skin injuries and can involve the superficial (papillary) dermis, as well as the deep (reticular) dermal layer. Progressive burn wound necrosis is an important factor that can cause delayed healing. Methods to inhibit conversion of burn wounds leading to deeper injuries and scar formation as well as stimulate tissue regeneration are urgently needed. The purpose of this study was to examine the effect of SAPH on burn progression and healing.

## References

1. Chiara O, Cimbanassi S, Bellanova G, et al. A systematic review on the use of topical hemostats in trauma and emergency surgery. BMC Surg. 2018 Aug 29;18(1):68.
2. Peng HT, Shek PN. Novel wound sealants: Biomaterials and applications. Expert Rev Med Devices. 2010;7:639–659.
3. Rahmani, G., et al., First Safety and Performance Evaluation of T45K, a Self-Assembling Peptide Barrier Hemostatic Device, After Skin Lesion Excision. Dermatologic Surgery, 2018. 44(7): p. 939.
4. Li J, Zhang YP, ZareiM, Zhu L, Sierra JO, Mertz PM, Davis SC. A topical aqueous oxygen emulsion stimulates granulations tissue formation in porcine second-degree burn wounds. Burns 2014 doi:10.1016/j.burns.201411.016.
5. Davis SC and Mertz PM: Treatment of Wounds with an Oak Bark Formulation: Antimicrobial and Wound Healing Assessments. Ostomy Wound Management 2008 Oct;54(10):16-25.
6. Sullivan TP, Eaglstein WH, Davis SC, Mertz P. The pig as a model for human wound healing. Wound Repair Regen. 2001 Mar-Apr; 9(2):66-76.

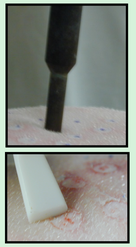
## Materials and Methods

### 1. Experimental Animals:

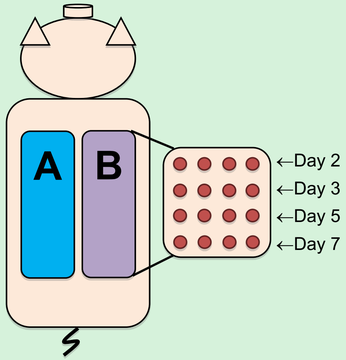
Swine were used as the experimental animal due to the morphological, physiological, and biochemical similarities between porcine skin and human skin.[6]

### 2. Wounding Technique:

Thirty-two (32) second-degree burn wounds were created with cylindrical brass rods heated to 100°C and held vertically on the skin for 6 seconds to make a burn wound 8.5 mm in diameter. Blistered epidermis was removed. Wounds were treated within 20 minutes after creation.



### 3. Experimental Design:




**Treatment Groups**

A. SAPH*†
B. Saline †

* AC5® Advanced Wound System (USA); AC5® Topical Hemostat (Europe), Arch Therapeutics, Inc. Framingham, MA.
† Covered with polyurethane film dressing (Tegaderm™ 3M, St. Paul, Minnesota )

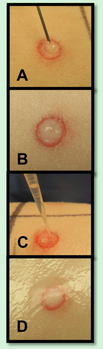
### 4. Treatment Regimen:

A. Wounds were treated once on Day 0 with self-assembling peptide hemostat using a syringe

B. 200mg of SAPH was applied over the wounds and surrounded skin.

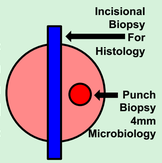
C. 100ul of Saline was applied to each control wound.

D. After treatment, all wounds were covered with polyurethane film dressing (Tegaderm; 3M, St. Paul, MN) and secured in place with surgical tape, and the area was loosely wrapped with self-adherent bandages (Coban; 3M, St. Paul, MN).




### 5. Histology Assessment:

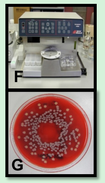
Incisional biopsies on the center of the wounds were recovered, placed in formalin and stained with hematoxylin and eosin (H&E). One section per block was analyzed for the following elements to determine potential treatment response:



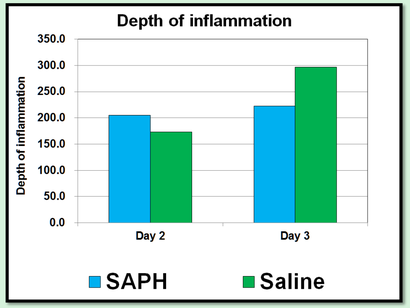

- **Degree of thermal damage.** On days 2 and 3 the depth of injury was assessed on by measuring the amount of thermal damage (identifying regions of damaged collagen and elastic fibers, cellular necrosis and tissues at risk for ischemia/reperfusion injury)
- **Depth of inflammation.** On days 2 and 3 the depth of inflammation was assessed by measuring the identify regions in micrometers.
- **Percent of wound epithelialized (%).** On days 3, 5 and 7 was the measurement of the length of the wound surface that has been covered with epithelium.

### 6. Microbiology Assessment:

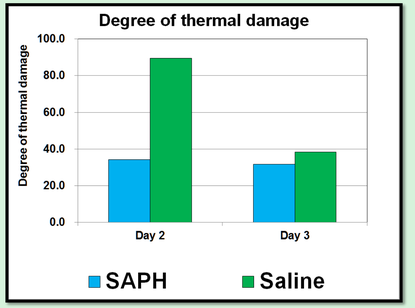
- Punch biopsy (4mm biopsy) was taken from the center of the wound.
- Biopsies were weighed and homogenized with 5 mL of All-Purpose Neutralizing Solution in a sterile homogenization tube.
- Serial dilutions were made from all culture samples and the bacterial load was assessed using the Spiral Plater System (Spiral Biotech, Norwood, MA photo F).
- Tryptic Soy agar with 5% sheep's blood culture media (photo G) was used and plates were incubated aerobically overnight (24 hours) at 37°C, after which the number of viable colonies were counted.



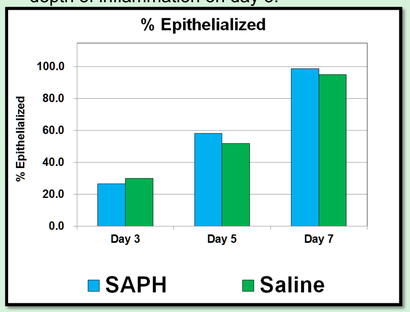

## Results



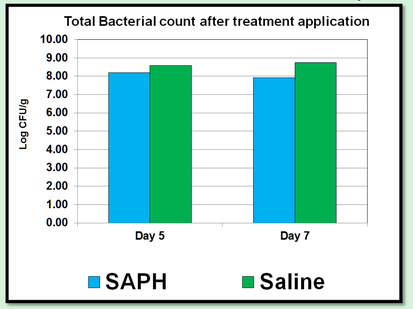

- SAPH showed similar depth of inflammation in both assessment days.
- Wounds treated with Saline showed highest depth of inflammation on day 3.




- SAPH showed similar degree of thermal damage both assessment days.
- Depth of inflammation resulted in a highest value in wounds treated with Saline on day 2.




- SAPH showed a high percentage of re-epithelialization on days 5 and 7 (58.3 and 98.8%, respectively) compared with Saline in both assessment days (52.0 and 95.3%, respectively).




- On day 5, wounds treated with SAPH showed slightly lower bacterial counts (8.20±0.20 Log CFU/g) than Saline (8.58±0.17 Log CFU/g).
- On day 7,SAPH treated wounds showed a bacterial reduction of 0.82±0.01 Log CFU/g (89.42% bacterial reduction) compared with wounds treated with Saline.

## Conclusions

Overall, SAPH treated wounds showed a reduction in thermal damage, as well an increase in the re-epithelialization rate. Interestingly, a lower total bacterial count was also seen with SAPH treatment. These preliminary results suggest that SAPH may have healing benefits when treating second degree burn wounds, however additional studies are needed to substantiate these findings.

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