Hypochlorous Acid Enabled Soft Debridement Speeds Healing of Refractory Venous Leg Ulcers - simplicity, low cost and patient comfort are advantages.

Problem

Refractory venous leg ulcers (VLUs) (treatment > 9 weeks) referred to our clinic appear to result from either ineffective elastic compression or ineffective mechanical debridement of biofilm bacteria. A tender painful wound is the culprit behind inadequate compression and debridement. Biofilm bacteria secrete enzymes and inflammatory mediators that unhinge cellular healing mechanisms: circulating progenitor cell can't survive in the wound, matrix metalloproteinases disrupt repair, and inflammatory pain complicates compliance with elastic compression. (1,2)

Hypochlorous acid (HOCl) is synthesized by myeloblasts to kill bacteria after phagocytosis. (3) Pharmacologic bactericidal concentrations of HOCl remain harmless to eukaryotic cells. HOCl is a small moiety, diffusing rapidly intomucopolysaccharide biofilms to kill bacteria. (4)

We observed that a wash cloth saturated with HOCl in concentrations of 250 ppm softens or "macerates" the wound surface eschar after 10 minutes contact time. HOCl reacts with biomolecules including DNA, RNA, fatty acids, cholesterol and proteins breaking structural bonds to "soften" necrotic tissue, dry exudates and biofilm on painful granulation tissue. (5) Additionally, we observed that HOCl softening appears to decrease the pain of debridement of granulating ulcers. (6) We report a novel debridement technique, HOCl-enabled mechanical soft wound debridement with terry cloth.

Methods

Weekly HOCl-enabled (*) soft debridement was used in concert with Longitudinal Yarn elastic Compression (****) (LYC) three layer dressings to treat five refractory VLUs.

Results

All VLUs healed. Photographs document healing of and illustrate soft debridement technique. Cost and patient comfort is discussed.

Conclusions

Hypochlorous acid enabled terry cloth "soft debridement" of refractory VLUs appears to be easy to perform, comfortable, inexpensive and therapeutic for healing refractory VLUs.

References

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Paraplegic Amputee with Ischemic Limb & VLU

Ischemic painful right fifth metatarsal head ulcer in a patient with recent L BKA. Note glistening fibrinoid exudate (bioburden) on surface of fifth metatarsal wound.

Right lateral ankle ulcers in a paraplegic with profound ischemia. ABI in R foot DP & PD artery was zero. Right foot ulcers presented with stalled healing for 10 months. Vascular bypass or angioplasty is not safe (risk vs. benefit) in a paralyzed limb that is profoundly ischemic with no pedal pulses. Observe the heavy bioburden on the 3 ulcers on the ischemic right foot. Patient refused amputation of right foot 15 month after a L BKA. Healing is stalled presumably due to uncontrolled biofilm bacteria in the painful wound.

Presentation

- Three ischemic ulcers refractory to 10 months of Rx
- Profound R leg ischemia
- Paraplegia
- Severe pain on high dose narcotics
- L BKA for ischemic gangrene

R ankle ulcer after initiation of Hypochlorous acid enabled "soft debridement" with clean dry wash cloth. Solution contains 250 ppm of HOCl. A wash cloth is saturated with HOCL solution and left on wound for 10 minutes before performing soft debridement with a dry wash cloth. A 10 minute soak with HOCl softens granulation tissue exudate and may decrease pain during wash cloth back and forth "scrubbing motion" debridement.

Observe that the foot is no longer edematous due to Longitudinal Yarn Compression textile (****). Observe heavy bioburden on extensor forefoot wound. Hypochlorous acid solution (*) enabled soft debridement to the extensive biofilm in these painful wounds.

Therapy

- Weekly Hypochlorous acid (*) soft debridement controls biofilm bacteria
- Control of edema with longitudinal yarn compression (****)
- Bioengineered human skin substitute (***)

Healed right ankle ischemic ulcer after ~15 weeks of soft debridement with Hypochlorous acid (*), sonic powered debridement (**), longitudinal yarn compression (****), and grafting with bioengineered human skin substitute (***). Patient believes that recently purchased crucifix with the Lord's Prayer written on the central embedded crystal was, in part, responsible for this miraculous limb salvage.

Healed skin surface in this photograph is remarkable in a patient with no Doppler signals in the right foot. "Healed" epithelial cells in this wound have three sources: bioengineered cultured human skin cells (***) survive 90 days, epithelial cell from skin appendages migrate to cover wound, and stem cell from the patient's bone marrow in the wound differentiate into epithelial cells.

Clinic physicians and nurses attribute her impressive healing to both bioengineered human skin cells (***) from culture skin cells taken from infant foreskins at time of circumcision and from her own stems cells. Stem cell growth in the wound is thought to be in inhibited by biofilm enzymes. Hypochlorous acid (think "Holy Water") control of biofilm bacterial enzymes and allows these cells to heal the wound surface.

Outcome

- Healing 15 weeks after bioburden control with 250 ppm Hypochlorous acid
- Bioengineered human skin substitute

Conclusion

- Two board-certified vascular surgeons recommended amputation of this ischemic left foot. Patient refused R BKA.
- Wound did not respond to palliation care until soft debridement with Hypochlorous acid in this painful wound controlled biofilm
- Patient had no Doppler signal in pedal pulses as the wound healed

96 y/o with VLUs Due to CHF Edema

Nonoctogenerian referred to wound clinic for blisters covering wounds with foul smelling exudate. Wounds developed 4 weeks after flare up of congestive heart failure and dramatic pedal edema.

Q-tip unroofing right pretibial bullae. Fluid was foul smelling due to bacterial colonization. Ultrasound powered hand piece used for the first debridement (**). Calf bullae developed ~3 weeks following an episode of congestive heart failure and massive edema. Note lymphedema fluid weeping from bullae.

Presentation

- 96 y/o with uncontrolled CHF and extensive edema
- History of stasis dermatitis
- Blistered skin formed ulcers

Right leg after 7 days of therapy with Robert Jones cotton wool 4 layer dressing. Wounds were debrided with 250 ppm Hypochlorous acid (*) and a dry wash cloth. Note how light refracts off of shiny wound surface, consistent with extensive persistent biofilm mucus on the wound surface.

Therapy

- Four layer dressing with cotton batting to soak up extensive serum weeping
- Weekly soft debridement after a 10 minute soak with Hypochlorous acid

Right leg after 15 days of treatment with HOCl soft debridement and four layer dressings. Note the exuberant epithelial cells migrating from wound edge. Patient was discharged from wound clinic after 4 weeks of therapy with wounds completely healed.

Outcome

- Wounds healed in 4 weeks

Conclusion

- CHF induced ulcers in senile skin presented with a foul smelling exudate, suggesting exuberant biofilm
- Hypochlorous acid enabled soft debridement controlled biofilm bacteria
- Healing was uncomplicated

VLU in Obese Diabetic

Obese diabetic following coronary artery bypass with pretibial ulcer present over 3 months. Open wound has prevented steroid injections for lumbar spine syndrome pain.

Painful pretibial ulcer in area of stasis dermatitis.

Presentation

- Ulcer present 12 weeks following trivial pretibial trauma
- No palpable pedal pulses
- Venous stasis dermatitis
- 5mm pretibial pitting edema

Shiny gel on wound surface is Lidocaine jelly. Minimal brown stasis pigment is present in the skin. Note "cornrow furrows" in ankle and calf skin, result of longitudinal yarn compression textile.

Therapy

- Weekly soft debridement with dry terry cloth after 10 minute Hypochlorous acid soak, 250 ppm
- "Omaha" four layer dressing uses longitudinal yarn compression textile (****) as the elastic first layer

Observe the exfoliation of skin in areas of resolving stasis dermatitis surrounding the ulcer. Ulcer healed with weekly Hypochlorous acid soaks, terry cloth soft debridement and longitudinal yarn elastic compression in 6 weeks.

Outcome

- Weekly Hypochlorous acid soaks and terry cloth soft debridement
- Longitudinal yarn elastic compression

Conclusion

- Hypochlorous acid enabling soft debridement with terry cloth is comfortable and appears to control wound biofilm

Obese Diabetic with VLUs for > 40 Months

Obese diabetic computer programmer who had given up treating his VLU with compression.

Note stasis pigment and edema of noninvolved limb.

At risk skin surrounds 5 large stasis ulcers. Note areas of stasis dermatitis have scales of dry exudate. This skin has evidence of inflammation and thickening due to fibroblast secreting collagen in edematous subcutaneous fat.

Initial curette debridement of thick eschar of dry serum. Chronic exudate supports aggressive biofilm bacteria population that halts growth and differentiation of circulating stem cells that populate the wound granulation tissue.

Presentation

- Obese sedentary 45 y/o diabetic
- Noncompliant with elastic compression
- VLU present for 40 months

HOCl 250 ppm softens wound eschar during a 10 minute soak with damp wash cloth. Using a terry cloth wash cloth to abrade the surface of VLUs and debrides wound surface bioburden.

Wet wash soaked with Hypochlorous acid "dwells" on the wound surface for 10 minutes. HOCl appears to down regulate the perception of pain during debridement. Possible mechanism of decreased pain is a chemical interaction with nociceptive pain receptors. HOCl breaks bonds between proteins with singlet oxygen, which appears to soften granulation tissue eschar and make debridement easier. We say a 10 minute HOCl soak "enables" effective "soft debridement" with terry cloth.

Therapy

- Weekly soft debridement after 10 minute Hypochlorous acid soak
- Longitudinal yarn elastic compression four layer dressing

Outcome

- VLU nearly healed after 9 weeks with HOCl for control biofilm bacteria

Conclusion

- Hypochlorous acid to control wound biofilm enables healing of VLU present for > 40 months in a patient noncompliant with elastic compression

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*Vashe® Wound Therapy, PuriCore, Malvern, PA
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