CASE REPORT

Chronic Diabetic Plantar Foot Ulcer Closure Facilitated Through Standard Of Care And Use Of A Catalytic Advanced Wound Care Matrix And Hypochlorous Acid Spray Wound Cleanser

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Successfully healing diabetic foot ulcers continues to be one of the most challenging chronic conditions for the medical system to address. In Ontario, many hospitals north of the city of Toronto do not employ chiropodists, and patients often find they do not receive much more than antibiotic and wound dressing care when treated in an ER unit. Recurrence rates of foot ulcer formation in diabetic patients is very high: one source citing 40% within one year, and 65% within five years.[1] Considering that as many as 34% of all diabetics will have an ulcer at some point in their lifetime, this is very concerning and a costly undertaking. Indeed, if improperly addressed, mortality rates vary from 5% in the first 12 months to as high as 42% within five years.[2]

The standard of care has long involved hyperkeratotic tissue/granulation tissue management (i.e., debridement through various methods and wound cleansing), pressure offloading, moisture balance (using a variety of dressings), control of blood

sugar levels/appropriate nutrition and inflammation/bacterial burden modulation/reduction. Wound dressings have been a staple for many years, including: low/non adherent dressings, hydrocolloids and alginate, alongside more niche foams, hydrofibre, protease-modulating matrix dressings and nano particles of silver.[3] They have been used too good effect at moisture/bacterial management, and offloading to some degree, and yet have not demonstrated significant impacts on the healing timeline of wounds.[4]

Advanced Wound Care Treatment Matrix Technology

NanoSALV™ Catalytic Advanced Wound Care Treatment Matrix (NanoTess Inc., Calgary AB) is a medical device authorized for sale by Health Canada that aims to shorten healing times through the application of an advanced catalytic treatment matrix (CTM) that utilizes copper, titanium dioxide and silica suspended within a liquid-to-solid cellulose matrix.[7] It is intended to actively promote wound healing. Beyond the active promotion of wound healing through catalytic modulation by actively reducing the energy thresholds needed to achieve optimal healing timelines and outcomes, the product also simultaneously regulates inflammation, moisture balance, and broad-spectrum microbial/bacterial burden.[6,10,11]

In particular, the CTM technology utilizes copper, a well-known facilitator of angiogenesis and re-epithelialization.[9] Additionally, the cellulose matrix aims to provide a scaffolding effect to facilitate the cellular progression through the wound healing stages.[8]

To date, this product, as a whole, has demonstrated the ability to eliminate yeasts, fungi, viruses and bacteria, including antibiotic-resistant strains, particularly MRSA.[7]

Indeed, it is these combined effects from the CTM technology that has enabled this wound matrix to demonstrate improvement in wound surface area closure rates and timelines for chronic venous leg ulcers, pressure ulcers and diabetic foot ulcers. In a 56 day cross over study sponsored by Alberta Health Services, the use of catalytic advanced wound treatment matrix decreased wound area percentage by 56.6% on average (day 56), compared to a 1% increase on average (day 28 - when the product was introduced) in the incipient phase, using only best-in-class variety antimicrobial silver dressings (i.e. promogran prisma, silver aquacel, acticoat).[7]

Wound Cleansing

Low cytotoxicity and broad spectrum anti-bacterial properties at a reasonable cost have also been sought in the area of wound cleansers as well. A growing body of evidence is signaling hypochlorous acid as the leading candidate in fulfilling all of these demands.[12]

Case Study

In an effort to study the wound healing potential of this combination, the author conducted a case study involving a chronic non healing, worsening ulcer in a diabetic patient.

Background and 1st visit: Patient AA is a 37-year-old male of southeast Asian background with a chronic history of type II diabetes. He presented to a clinic just north of Toronto on September 14, 2024. He was complaining of "calluses that won't go away" and that had become "scabs". They started forming around spring time and became purple and thicker.

Figure I: Objective first visit findings

Since the scabs started forming, he would have burning pain/pins and needles around the right 5th plantar metatarsophalangeal joint (PMPJ) and the right 1st medial plantar metatarsophalangeal joint, and this has settled down for the prior two weeks. The patient went to his family doctor a few weeks prior and was prescribed Fucidin®, which he put on consistently for five weeks with no improvement in his condition.

A diagnosis of Type II diabetes was made many years ago, and the patient notes he doesn't regularly measure his fasting blood glucose level, however, his last hemoglobin A1C % was around 6.0%, five to six months prior. He had recently purchased New Balance® wide fit size 13 synthetic leather running shoes. In terms of his working life, AA is largely working from home but going into the office some days of the week. He has a job working on a computer. He and his wife were expecting their first child in the spring of the new year. AA has been participating in body weight resistance exercise and walking barefoot (10 k steps a day including going up and down stairs), which he started not too long before the calluses started forming.

Dermatological: Right 1st medial interphalangeal (IPJ) joint - 30 mm wide area of HK with pronounced extravasation of blood at base nodule like projection of moderately macerated soft tissue appears to have pinched underneath HK. Right 5th PMPJ - demonstrating similar presentation (30 mm wide area of HK with pronounced extravasation of blood), except more maceration at the base and break down in skin; moderately macerated with denuded area of epidermis about 1/3rd the diameter of the macerated tissue in width and half its length with hypergranulation tissue presenting with malodor but has no exudate, undermining nor tunneling present. There is bilateral forefoot fat pad atrophy

Footwear: Patient is wearing extra long shoes (size 13) for a size 11 foot, in spite of foot being regular D width

Vascular: Bilateral pedal pulses palpable around dorsalis pedis, anterior tibial and posterior tibial artery, gradual cooling from shins to toes, capillary refill time of < 3 seconds around bilateral (B/) 1st apex. Patient denies consistent calf, thigh or buttock cramping when walking, reclined or sleeping at night. Normal pattern of hair growth on dorsal feet (proximal 1st-3rd phalanges and 1st metatarsal region).

Neurological: Vibration C tuning fork - B/ 2/5 boney locations localized (malleoli felt and midfoot/ forefoot felt faintly and very delayed off signal), monofilament: R/ 2/10 locations localized (5th apex and 3rd apex felt), L/ 1/10 (3rd apex), B/ achilles pinch mild to moderate pressure produces pain. B/ lower legs signs of slight muscle atrophy

Initial Treatment Approaches

- Both feet were cleansed with 70% Isopropyl alcohol prior to treatment.
- Debrided HK around R/ 1st medial IPJ and R/ 5th PMPJ
- Pinpoint bleeding point created both areas
- Pressure and gauze required to stop R/ 5th PMPJ
- Cleansed both areas with seaclens and post op iodosorb and 2-4 layers of non woven sterile gauze and hypafix.
- Advised patient to dress similarly at home every 1-2 days (may use Betadine if iodosorb or mefix/ hypafix tape are unavailable); if getting areas wet he was advised to change dressing immediately then try and cleanse wound with sterile saline; if not available, then salt water in basin.

Figure 2: Treatment/Post Treatment A

- AA was educated to start wearing running shoes inside the house; purchase ones with appropriate size 11: D width; to never walk barefoot and inspect feet at end of day for areas of broken down skin and signs of infection.

There were five similar treatment sessions spread out between two and four weeks, depending on the patient's availability. He had been dressing with sterile non-woven gauze and porous medical tape, cleansing with salty water (non-sterile) and using some form of liquid iodine as a topical treatment at home. AA had been working from home for a few days each week, and for a few weeks entirely from home during this period. During the fourth of these five treatment sessions he obtained and started wearing custom foot orthotics through the practitioner with metatarsal padding to offload the tripod stanced pes cavus foot profile and fat pad atrophy that enabled his ulcer formation. On the fifth visit he noted he has been wearing them in Croc-style shoes indoors and his New Balance® shoes outdoors; with no more pain on the R/ 5th PMPJ ulcer present since. The ulcer area post debridement was now 5mm long by 2mm wide by 1mm depth with mild maceration in a small ring around its periphery. The right 1st medial interphalangeal joint now has smooth skin with minimal hyperkeratotic build up/ slight fissuring.

Extreme Tissue Break Down

On the seventh total treatment session for the R/ 5th PMPJ ulcer, AA presented to the clinic noting that until two days prior "everything was progressing fine with no concerns". He reported that he started getting pain/sensitivity around the right central forefoot just proximal to MPJs, where the metatarsal pad is and started limping because of the pain. He got approval to work from home full time. He reported that he was feeling better, but was uncertain what could have caused his spike in pain, as he had not been more active or done anything different.

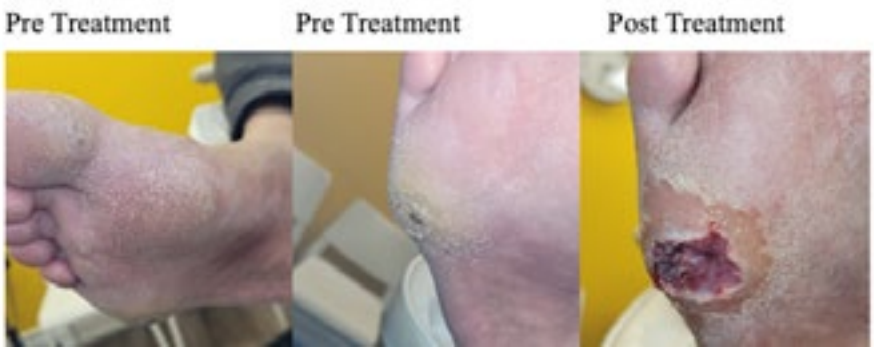

Figure 3: Treatment/Post Treatment B

Assessment: The R/ 5th PMPJ feels warm to touch whereas L/ feels cool and has some palpable fluctuant edema. An area 12 mm x 4 mm of dried hemosiderin stained HK with larger ring of diffuse HK and around is present over it. As the practitioner was debriding it, a significant amount of exudate came out. It appeared largely serosanguinous, with some white haziness to it (no significant malodor) and was of a moderate to large quantity. Post debridement, an area of 24 mm long by 18 mm wide and 12 mm depth, exposed layers of muscle but that did not probe to bone. There was no tunneling or undermining noticed.

Response: New Treatment Approaches

Considering the depth of the wound and its widespread moist nature it was considered that the non-sterile saline solution the patient was using at home to cleanse the wound (he had not tracked down sterile saline), alongside Iodosorb topical in clinic and "Betadine" at home, would no longer suffice to enable a smooth healing transition.

All things considered, it had been 98 days since treatment had started on the right 5th plantar MPJ ulcer and on the previous visit it had still not closed, leading to an environment ripe for infection and which would further slowdown the healing timeline. Povidone Iodine is, after all, considered a cytotoxic topical agent after prolonged use.[13] Thus, evidence for a decreased healing timeline and low cytotoxicity were the main reasons for the decision to switch to using hypochlorous acid and the NANOSalv™ catalytic wound care matrix.[7,12] [Hence called the advanced wound care treatment matrix.]

AA was advised to start using E11ement™ hypochlorous acid spray (0.015%) - an easily accessible, affordable Canadian brand - as the wound cleanser (to be thoroughly sprayed on the wound), alongside applying the catalytic wound care treatment matrix in a paper-thin layer (ideally with sterile Q tip) on the ulcer every one to two days (whenever showering), dressing with four layers of sterile non-woven gauze, and secured with porous tape.

As an indicator of potential spreading infection, AA was to monitor the temperature difference between the bilateral 5th MPJs with a handheld infrared thermometer; if he detected a difference of more than two degrees, he was to seek ER care.

The patient was prescribed an antibiotic (cefadroxil 500 mg) to be taken bi-daily for ten days preventatively, given the depth of the wound and temperature difference between both feet. He was also advised to postpone his wisdom tooth extraction which he had planned for next week.

AA was advised to seek the use of a forefoot offloading surgical shoe on the right foot and a regular shoe worn on the left foot until his orthotics could be adjusted for better fit, and to walk minimally over the next few weeks, as well as to work from home (a letter for his employer was provided).

Figure 4: One Week Follow Up

His custom orthotics were retained in order to be sent out to have a thicker, softer 1-5th metatarsal pad put in place to replace the 2-4th firmer one.

AA confirms he has been following the practitioner's advise as noted, except for delaying the use of hypochlorous acid spray as a cleanser until two days post last visit.

Upon assessment, the right plantar 5th MPJ wide area - the same size as the deep ulcer last visit - has now completely filled in, with epithelialized tissue (very thin) and demonstrated only dark hemosiderin staining around the borders with slight hyperkeratotic build up.

Conclusion

Expediently addressing pressure offloading for a chronic diabetic foot ulcer through appropriate dressing materials and footwear, wound cleansing with a low cytotoxic agent and using a topical wound agent, such as an advanced wound care matrix, that facilitates the natural healing process while addressing bacterial burden and moisture balance can prove to provide impressive wound healing results.

Disclosures: *The author has no conflicts of interests to disclose at this time in relation to any of the companies associated with products used in the treatment for the above patient.*

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