THE USE OF ACTIVATED CARBON CLOTH (ACC) DRESSING IN MANAGING BIOFILMS: A CASE STUDY

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INTRODUCTION

Wound care management is essential in healing the wound, reducing risk of amputation and improving patient's quality of life. It requires multidisciplinary dedicated teams. A correct method of wound bed assessment and wound bed preparation allows wound to heal rapidly and hence avoiding major amputation.

Managing biofilms is a challenging area to be deal with when it comes to managing chronic wounds. Its ability to shroud makes it even more difficult to be detected by the inexperienced eyes. It becomes even harder as there is lack of clinical studies in understanding the whole concept of biofilms, let alone to prevent its formation. However, with the advancement of technologies, biofilms become the key target in eliminating bio-burden of the wound and heals chronic wounds.

Multiple dressings are known to have antimicrobial properties, such as silver, honey and polyhexamethyline biguanide (PHMB). The antimicrobial agents contained within the dressings lead to bacterial cell death and this helps in managing the infection.

In this study, I will highlight the use of a primary dressing, ACC dressing (Zorflex, manufactured by Chemviron, UK) in managing biofilm and accelerates healing process. While ACC dressing is also known as an antimicrobial dressing, its unique mode of actions is what make it difference from any other antimicrobial dressings.

METHODOLOGY

CASE PRESENTATION

PATIENT'S HISTORY
Madam H, a 58-year-old lady with history of long standing Diabetes Mellitus and hypertension for 15 years, on high dose basal bolus insulin first presented at Emergency Department, HSNZ on 28 December 2018 with complaints of left leg pain and swelling for 5 days. She started to have foul smelly discharge over the left big toe prior to seeking treatment.

Examination at that time revealed that she was septic looking, otherwise alert and conscious. She was afebrile. Blood pressure 171/90 mmHg, pulse rate was 92 and random blood sugar was 28. Local examination revealed an area of swollen over the left big toe, with area of erythema and warm to touch till mid foot. Left foot was swollen with area of blister at the sole. There was a loss of sensation over both feet following a glove and stocking distribution. Distal pulse of left foot was feeble. ABSI revealed a reading of 0.8 of both feet.

She was seen by orthopaedic team and diagnosis of Necrotising fasciitis of left foot with uncontrolled diabetes and hypertension was made at that time. She was advised for wound debridement left foot and left big toe ray amputation. She was however refused for intervention and chose for At Own Risk (AOR) discharge. Soon after, she sought treatment in Hospital University Sains Malaysia (HUSM), by which the same intervention was advised. She was then agreed with the advice and underwent wound debridement and ray amputation of left big toe on 5th January 2019 followed by hyperbaric oxygen therapy. She was fit for discharge after 2 weeks, when her blood pressure and blood sugar were controlled. She went to a few clinics soon after discharged for dressing and was then referred to Wound Care Unit, Outpatient department, HSNZ due to a non-healing wound. She was first seen by wound team on 28th January 2019. She had a good family support and always accompanied by her daughter during visits in wound care.

EXAMINATION:
Examination in wound care at that time revealed that she was healthy looking, alert and conscious. Blood pressure was 151/76, pulse rate was 108, random blood sugar was 12. She was ambulating with a wheelchair. Local examination revealed an extensive wound with the size of 15x19 cm over the dorsum aspect of left foot started from the base of toes till hind foot region. There was absence of big toe. Wound bed was heavily covered with biofilm. 2nd toe was unhealthy and compromised. 2nd toe was pale coloured and capillary refilled was delayed. The phalanx of second toe was partly necrosed and dry. There was a tracking of slough over the base of 2nd toe. There was loss of sensation of the whole foot region.

INTERVENTION:

1. WOUND CARE:
Surgical debridement with mayo scissors and forceps was done on the first visit due to the extensive slough. Thick biofilm was scraped out of the wound bed. Wound bed was cleansed with superoxidized solution (Dermacyn wound care solution,manufactured by Sonoma Pharmaceutical) then covered with superoxidized hydrogel (Dermacyn wound care hydrogel, manufactured by Sonoma Pharmaceutical), before ACC dressing was applied. Dressing was changed every four days and wound was reassessed during every visits.

2. MEDICATION AND LIFESTYLE MODIFICATION
Blood sugar was monitored with adjustment of basal bolus insulin. Patient and her caretaker were taught on Self-Monitoring Blood Glucose (SMBG) with insulin adjustment. Education was given to patient and her caretaker on importance of controlling blood sugar and proper protein and sugar intake for better wound healing. Blood pressure was also being monitored and anti-hypertensive medications were optimised. She was advised for offloading whereby she ambulated with a wheelchair.

3. OTHER INTERVENTION
She underwent routine CT angiogram of both lower limbs where she was diagnosed with Extensive Peripheral Vascular Disease (PVD) of both lower limbs and she was then referred to Surgical Outpatient Department (SOPD) for further vascular intervention.

RESULTS

After around 1 month of applying hydrogel and ACC dressing, there was significant improvement over the dorsum left foot, with more than 50% wound size reduction, presence of healthy granulation tissue over the wound and absence of infection or biofilm. Second toe however was further compromised and became gangrene due to extensive PVD, when she was then referred to orthopaedic team and und went Ray amputation of 2nd toe on 13th February 2019. She was discharged from wound care unit on 10th March 2019 and planned for Split Skin Graft (SSG) by orthopaedic team HUSM on 12th March 2019.

28/01/2019 (BASELINE)

Wound size measured at 15 x 19 cm, there was thick biofilm covering the wound with extensive slough over at the base of 2nd toe till mid foot.

04/02/2019 (DAY 7)

There was reduction in wound size (13 cm x 11 cm), and emerging of granulation tissue (10%) with reduction in slough formation. There was thick biofilm covering the wound at base of 2nd toe. There was advancing of epithelization tissue.

11/02/2019 (DAY 14)

There was further reduction in size of wound (11 cm x 9 cm), with remarkable amount of granulation tissue (> 50%), biofilm was minimal with advancing epithelisation. However, due to Gangrenous of left 2nd toe, patient was referred to Orthopaedic team and underwent Ray amputation of left 2nd toe.

21/02/2019 (DAY 21)

Post ray amputation Left 2nd toe. There was marked improvement of wound in terms of reduction in wound size (9x9 cm), healthy granulation tissue with no sign of infection.

03/03/2019 (DAY 31)

Wound Size 6cm x 5 cm, healthy granulation tissue seen with absence of infection, good moisture balance with advancing epithelization. Patient was planned for split skin graft (SSG).

DISCUSSION

Biofilms exist in most non-healing wounds and famously being addressed as a precursor of infection. Its appearance as a slimy and pale coloured over the wound surface often disregarded as a 'healthy wound' by non-experienced healthcare personnel. Its masking appearance contributes to secondary infection of a non-healing wound and rather the main reason why chronic wound never heals. A wound biofilm occurs when planktonic (i.e solitary, non-attached and free floating) bacteria attach to wound surface to form a polymicrobial community that is protected by a slimy extracellular polymeric substance (EPS). The biofilm matures within 2-4 days of attachment, when it becomes resistant to antibiotics and antimicrobial agents (Cooper *et al.*, 2014). The biofilms held the tissue in a prolonged state of inflammation with the release of numerous inflammatory cytokines. As a result, it creates an environment which not only stimulates bacterial growth, it impedes healing by creating an antibiotic-resistant walls through its surface.

ACC dressing used in this study (Zorflex, manufactured by Chemviron) brings about the new concept of advanced dressing by means of using activated carbon impregnated in an interconnected cloth to physically bind and remove bacteria from the wound surface. It uses a Van der Waals force, the same physical force that is used by bacteria to bind to each other. These forces attract and bind bacteria to its cloth surface, which are then subsequently removed during dressing changed. Its ability to penetrate through bacterial biofilm layer is what makes it suitable to heal chronic wounds and accelerates healing process.

As mentioned earlier, ability of ACC to physically attracts organism to reduce bioburden is what makes it such a unique property in antimicrobial dressings. In comparison, the use of silver dressings may be useful in managing bioburden, however, it cannot be used more than four weeks, without good clinical rationale (Wounds UK, 2013). Hydrocolloid on the other hand, although effective in absorbing exudates, and liquefying necrotic wounds, is not recommended in treating infective wounds (Cuschieri *et al.*, 2013).

The ability of this ACC dressing to entrap bacteria, penetrating through the thick layer of biofilm and absorbs excess exudates is proved to be beneficial in eliminating infection, stimulate healing and reducing the size of the wound by means of advancing epithelization tissue as demonstrated by this case study. The use of super-oxidised solution to cleanse the wound promotes bactericidal effects as well as preventing growth of biofilm layer, whilst the hydrogel helps debride sloughy tissue and promotes growth of granulation tissue. In combination, these materials of advanced dressings help in managing the bioburden of this case and certainly avoiding the need for major amputation. In this case, it required less than 6 weeks for the wound to heal, and this shorter time required for healing is what improves patient's quality of life. Patient's motivation is improved and she has a better care for herself now that she understands the need for proper blood sugar control to help accelerate the wound healing process.

LIMITATIONS

Patient and the caretaker's initial lack of educations in managing her blood sugar levels was what made it challenging to control the bioburden process. With the addition of underlying bilateral PVD, the healing process may look impossible.

CONCLUSION

In conclusion, the use of activated carbon cloth dressing as primary dressing, enhanced by super-oxidised solution and hydrogel is proven to be beneficial in managing bioburden and accelerates healing process.

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