
Case study: Complex past – clear future

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Presentation

Mr G, a 44 year old single gentleman who lived alone, presented with a 5 year history of a pre-tibial ulcer related to a minor trauma. He demonstrated good mental, emotional and general physical health.

Medical history

Mr G's past medical history was complicated and included the following: renal transplant following renal failure secondary to reflux nephropathy (1998); ex-smoker; previous excessive alcohol intake; hyperlipidemia; hypertension; gastro-oesophageal reflux and gout.

Medications

On presentation, Mr G was taking the following medications: Prednisolone and Sirolimus as immunosuppressant therapy, Atorvastatin, Ranitidine and Atenolol. He had no known drug allergies.

Wound profile

Mr G's wound began as a minor pre-tibial graze from a rock whilst swimming in a creek. The wound was on the anterior aspect of the lower left pre-tibial region and, on assessment, consisted of a distal and a proximal wound bed (Figure 1). The distal area was 32cm² and the proximal area 15cm²; both wounds were superficial in depth. There was no obvious odour to the wound, exudate was minimal, the wound margins were unremarkable and the surrounding skin was in good condition with only small areas of dryness apparent.

Histopathology from the wound showed non-specific granulation tissue and scarring. There was no evidence of malignancy or vasculitis. Gram-positive cocci were found on gram stain, and on culture there was shown to be a moderate growth of *Staphylococcus aureus*. Mr G was found to have an

ankle brachial index (ABI) of 1.3, indicating he had a good blood supply to the left lower limb.

Initially, Mr G's wound was treated conservatively; over the preceding 4.5 years he had undergone three split skin grafts to the ulcer, all of which had failed. The most recent graft had been in September 2005. Application of a vacuum assisted closure (VAC) dressing had been instigated on two separate occasions. Mr G had spent a total of 8 months as an inpatient along with 4.5 years of continual community nurse support prior to his referral to the diving and hyperbaric medicine unit (HMU) at the Royal Hobart Hospital (RHH).

Treatment aims

The objective of the HMU is to actively promote healing¹ and increase tissue oxygenation through the adjunctive use of hyperbaric oxygen (HBO)². The HMU provides excellent consistency in wound management and dressing techniques due to a small number of staff.

Following a referral from the plastic surgery team of a regional hospital, Mr G's initial presentation to HMU involved a full medical assessment and examination. Included at this time was tissue oxygen tension monitoring; transcutaneous oxygen pressure (tcpO₂) is a non-invasive method and its measurements have been shown to correlate with wound healing². Measurements are taken on the area surrounding the wound and not directly on the wound surface.

Hyperbaric referral was undertaken as a last option for Mr G and the decision was made that he would initially undergo 40 treatments over 8 weeks, 5 days per week. This was a significant commitment by Mr G who lives 300kms from the RHH and therefore had to arrange travel and accommodation nearby. The treatment table used on a daily basis at the RHH HMU for wound healing is two hours in length at 2.4ATA. 100% oxygen is breathed via a closed hooded circuit during this time.

To date, Mr G has undergone 25 HBO treatments. Figure 2 shows the wound at this stage. The wound is notably smaller, and the wound bed clean, with minimal slough and

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obvious granulation tissue present. The wound margins are pink. tcpO_2 measurements repeated at this time showed a marked improvement. Mr G also described less pain and general discomfort. At this point in time, HBO is playing a role in healing and improving tissue oxygenation and cellular function at the wound level.

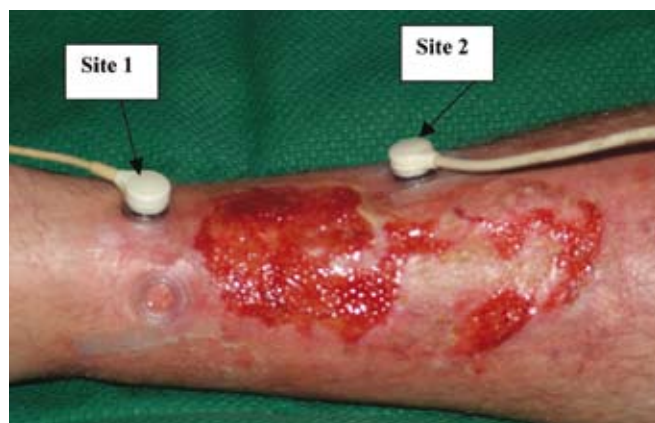
Mr G will complete his course of 40 treatments, after which a full review of wound and treatment regimens will take place. Further grafting is a possibility, with improved survival of the graft due to re-vascularisation of the wound bed. Mr G feels as though his wound with its complex past now has a clearer future.

Figure 1. tcpO_2 measurements at 1ATA taken on initial assessment.



	Site 1	Site 2	Site 3 (chest wall control)
Room air	23	30	36
100% O_2	172	236	300+

Figure 2. tcpO_2 measurements at 1ATA following 25 HBO treatments.



	Site 1	Site 2
Room air	34	42
100% O_2	207	288

Discussion

Space limitations here disallow a full explanation of the benefits of HBO in hypoxic wounds. In brief, HBO increases the capillary oxygen tension which increases the amount of oxygen available to advancing cells of a wound. These cells are able to migrate further and retain the ability to divide. This enables the vascular supply to advance more quickly, thus ensuring faster closure of the wound. With large wound beds where closure is not complete, the foundation is laid for successful skin grafting³. It should be considered that tcpO_2 greater than 20mmHg in room air predicts a positive response to HBO (Figure 3 shows Mr G's tcpO_2 measurements at 1ATA breathing both room air and 100% O_2 via a closed system).

Referral to a hyperbaric unit/specialist and subsequent HBO can advance the healing in many different types of wounds, thereby improving the lifestyle of patients who suffer with a chronic non-healing wound. Timely referrals are therefore recommended. Many health professionals see patients with chronic wounds on a regular basis and are unaware of the role that HBO can play in the healing process. Hyperbaric treatment may not heal a wound completely, but may provide the stimulus for the body to continue its own healing process. Hyperbaric education to health professionals is therefore very important in order to broaden the possibilities for patient care and improved outlook for patients with wounds.

References

1. Wound Care Association of NSW. Standard 3 (online) www.clininfo.health.nsw.gov.au/wcansw
2. Jain KK. Textbook of Hyperbaric Medicine (3rd ed). Hogrefe & Huber Publishers Inc. Germany, 1999, p.214.
3. Roth RN & Weiss LD. Hyperbaric oxygen and wound healing. Clin Dermatol 1994; 12:141-156.

Figure 3. Benefits of HBO to ischaemic and hypoxic wounds. Note that HBO acts at the same points where hypoxia interferes with wound healing.

