Case Report

Journal of Plastic Surgery and Transplantation
Volume 4 Number 1, January–June 2023

Role of Hemoglobin Spray in Management of Electric Burns

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How to cite this article:
Neljo Thomas, Ravi Kumar Chittoria, Nishad K., *et al.*/Role of Hemoglobin Spray in Management of Electric Burns/Journal of Plastic Surgery and Transplantation. 2023;4(1):43--46.

Abstract

Electric burns causes severe morbidity and mortality and is still a common problem in our country despite the advancement in safety measures. electric burns range from mild blistering to deep burns with charring of tissues. When the electric burns wound begin to heal there is difficulty in healing owing to the size of the wound and the charring of tissues in the burn skin

Keywords: Hemoglobin spray; Electric burns.

INTRODUCTION

Electric burns is a common problem in our country, ranging from low voltage household to high voltage burns. Fatalities due to electric burns has come down as well as low voltage burns due to progress in the field of household safety. Electric burns causes burns over the surface with loss of tissue and the plastic surgeon faces difficulty in the wound management. Wound bed preparation is a novel concept which is used for the management of wounds that fail to heal well and can be summarized with the T.I.M.E with T for tissue: non-viable or deficient. I for infection/inflammation, M for moisture balance. E for epidermis which was later changed to E for edge which allows the granulation tissue to come. Recently in literature, we have come across use of hemoglobin spray for use in wound bed preparation.

MATERIALS AND METHODS

This study was conducted in the department of Plastic Surgery at tertiary care center after the departmental ethical committee approval was taken. Informed written consent was taken from the patient in study. The details of the patient in study are as follows: 40 year old female with no known co morbidities with h/o Accidental electric burns from household supply who presented to our casualty and sustained circumferential 3rd to 4th degree burns over the left little finger with loss of vascularity of the distal part and 2nd degree burns over the medial aspect of the ring finger in the proximal phalanx. Patient was taken for little finger disarticulation after 1 week when the line of demarcation developed. Following the procedure

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Received on: 13-12-2022

Accepted on: 28.12.2022

patient was dressed regularly. She developed a raw area over the medial aspect of the ring finger which did not show any evidence of healing. Wound bed preparation was planned for the patient with Hemoglobinspray harvested from the patient blood. Under all aseptic precautions, 2.7ml of blood was harvested from ante-cubital vein. It was mixed with 0.3ml of 3.8% sodium citrate solution (Na-citrate to blood ratio=1:9) to prevent coagulation. The blood was transferred to glass vial and a cap with spray nozzle mechanism was placed on it. The blood was sprayed uniformly on wound and sterile dressing was applied. The spray was given twice a week for 2 weeks. The wound was assessed after 2 weeks and found to have good granulation tissue. Athough the cost of commercially available Hemoglobin spray is 12000 INR, we used the patients own blood and also materials easily found in the hospital setup.

Fig. 1: Electric burns raw area

Fig. 2: Application of Hemoglobin spray to raw area

Fig. 3: Hemoglobin spray applied

Fig. 4: Healing wound bed

DISCUSSION

Burn injury is a major cause of trauma to the human body, causing death as well as disability, with a long healing period and high cost in hospital treatment. The mortality rate of burn injury has decreased with new treatment modalities, but secondary infections and prolonged healing periods still affect the mortality rates. Early debridement and skin grafting have been successful, but insufficient graft donor area and poor patient circumstances for surgery hinder skin grafting. In these circumstances, using products that would increase the wound-healing process can be used.

For this purpose, different kinds of dressings and pharmacotherapies have been developed, but most are costly, and the mechanisms underlying these therapies have not been fully documented.

Oxygen is an essential component in the wound healing[1] process and without it, wounds fail to heal. There is an increased demand for oxygen in the healing of damaged tissue, hence enabling wound healing to progress. Local oxygen delivery is a crucial element in wound healing, and it is widely recognised that limited oxygenation can lead to a chronic non-healing ulcer.[2] All normal wounds heal has been shown to be oxygen dependent. Fibroblast replication, collagen deposition, angiogenesis, resistance to infection, and intracellular leukocyte bacterial killing are oxygen sensitive responses essential to normal wound healing.[3,4] Evidence suggests that intermittent oxygenation of wound bed starts events that leads to wound healing. Increased tissue oxygen level leads to increase in reactive oxygen and nitrogen species. This leads to increased neovascularization by increased level of VEGF, TGF-beta, angiopioetin etc. There is enhanced ECM formation due to raised FGF expression and increased collagen synthesis. It reduces inflammation by decreasing edema, proinflammatory cytokines etc.[5] The approach to facilitate oxygen diffusion by a transporter molecule like hemoglobin generated the possibility to enable a constant supply of oxygen to the wound bed after topical application of the hemoglobin spray to the wound. The evaluation of the clinical data summarized above showed a clear improvement of wound healing in terms of time and quality. Therefore, the use of hemoglobin to facilitate oxygen diffusion seems to be an ideal way to increase the oxygen supply to the wound bed and, as a result, enhancing the underlying wound healing processes.

In this end, Barnikol et al [7] exploits the principle of haemoglobin mediated facilitated oxygen diffusion in aqueous solutions by applying haemoglobin to the wound bed as an aqueous solution. In addition to the free diffusion of oxygen, which is otherwise limited by the fluid barrier, the addition of haemoglobin possibly results in considerably improved facilitated diffusion.[8] Carrier molecules that are well-suited for this include mammalian haemoglobins, which are water-soluble and are capable of transporting oxygen outside of red blood cells.[7,8,9]

The most widely utilized modality to increase the local tissue oxygen level is hyperbaric oxygen (HBO) therapy. Hyperbaric oxygen therapy was first used in the field of wound care in the 1960s following the discovery that patients with burns who received treatment for carbon monoxide poisoning healed faster. More recently the role of topical oxygen therapy, without the need for full-body hyperbaric chambers, has come into existence.

Granulox™ is a commercially available product from In First Ltd, UK, which is designed to be more straightforward to deliver oxygen to tissue than HBO.[10] The product, Granulox™ contains porcine haemoglobin contained in a spray canister. It is applied twice weekly to a DFU wound during redressing, and can be used in a clinic or patient's home setting.

When Granulox™ sprayed, haemoglobin binds to atmospheric oxygen. Once saturated with oxygen, the haemoglobin becomes oxyhaemoglobin (HbO_2), which diffuses to the base of the wound, and increases the oxygen supply to the cells by diffusion. We have used our innovative way of using patient's own blood for spraying oxygen by means of a simple glass vial and a cap with nozzle and spray mechanism.

There are no adverse effects of using topical hemoglobin spray even after extensive studies and has been found tolerable for use.[11]

Limitations: This was done on a single patient and needs large population based study to apply in practice.

Conflictof interest none: Disclosure none

Financial support: None

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