DOI: 10.21088/nijs.0976.4747.17226.5

New Indian Journal of Surgery
Volume 17 Number 2, April - June 2026

ORIGINAL ARTICLE

Application of Haemoglobin Spray in Wound Healing in Scald Burns

Rohit Kundra[1], Ravi Kumar Chittoria[2], Kanav Gupta[3]

HOW TO CITE THIS ARTICLE:

Rohit Kundra, Ravi Kumar Chittoria, Kanav Gupta. Application of Haemoglobin Spray in Wound Healing in Scald Burns. New Indian J Surg. 2025; 17(2): 71-74.

ABSTRACT

Wounds resulting from burns, trauma, or infection remain a significant clinical challenge, requiring appropriate infection control and timely soft-tissue coverage. Optimal wound bed preparation is essential before undertaking any definitive reconstructive procedure. Several approaches are available to improve wound bed quality, including dressings, debridement techniques, negative pressure wound therapy, and oxygen-based therapies. Topical haemoglobin spray has recently emerged as a promising adjunct to enhance oxygen diffusion at the wound surface, thereby promoting granulation and epithelialisation. In this report, we describe our experience using an innovative autologous haemoglobin spray formulation for wound bed preparation in a chronic post-burn wound.

KEYWORDS

• Haemoglobin • Preparation • Wound

INTRODUCTIONS

Chronic wounds—defined as wounds that fail to progress toward healing within approximately three weeks—are frequently encountered in plastic and reconstructive surgery. Their persistence is often the result of multiple contributing factors, including infection, vascular compromise, metabolic disorders, immune dysfunction, and inadequate oxygen delivery to the tissues. Among these, diabetes mellitus represents one of the most common systemic contributors, particularly in chronic lower-limb ulcers.

Wound healing is a complex, multi-stage biological process requiring adequate tissue oxygenation. Oxygen is fundamental

AUTHOR'S AFFILIATION:

[1] Junior Resident, Department of General Surgery, JIPMER, Puducherry, India.

[2] Senior Professor and Associate Dean (Academic), Head of IT Wing and Telemedicine, Department of Plastic Surgery and Telemedicine, JIPMER, Pondicherry, India.

[3] Senior Resident, Department of Plastic Surgery, JIPMER, Puducherry, India.

CORRESPONDING AUTHOR:

Ravi Kumar Chittoria, Senior Professor and Associate Dean (Academic), Head of IT Wing and Telemedicine, Department of Plastic Surgery and Telemedicine, JIPMER, Pondicherry, India.

E-mail: drchittoria@yahoo.com

➢ **Received:** 12-12-2025 ➢ **Accepted :** 25-05-2026

to several critical functions, such as fibroblast proliferation, collagen deposition, angiogenesis, leukocyte activity, and resistance to microbial invasion[1,2]. Chronic or sustained hypoxia disrupts these pathways, resulting in non-healing or slow-healing wounds. Strategies to enhance tissue oxygenation have therefore become central to modern wound care.

Hyperbaric oxygen (HBO) therapy has traditionally been the most recognized method of increasing tissue oxygenation, but its availability, cost, and patient tolerance limit its widespread use[3] . More recently, topical oxygen-delivery systems—including haemoglobin sprays such as Granulox™—have gained attention for their ability to bind atmospheric oxygen and transport it directly to the wound surface[5] . However, the Indian literature on haemoglobin spray use remains sparse. This report presents an innovative, low-cost approach using autologous blood to deliver haemoglobin in spray form, and highlights its utility in wound bed preparation.

MATERIALS AND METHODS

This case report details the application of an autologous haemoglobin spray in a 2-year-old male patient who sustained 4 % total body surface area scald burns. The study was conducted at JIPMER, a tertiary-care teaching hospital, in December 2025 . The patient developed a persistent non-granulating raw area over the gluteal region after the acute burn phase (Figure 1). Informed written consent was obtained prior to the intervention.

Figure 1: Showing condition of raw area thermal burn at the time of presenatation

Initial management included routine wound cleansing, appropriate dressings, and targeted antibiotic therapy based on wound tissue culture results. Despite two weeks of standard care, the wound showed minimal granulation and failed to progress toward readiness for grafting or flap coverage.

To improve wound bed quality, autologous haemoglobin spray therapy was initiated. Under strict aseptic technique, 2.7 ml of venous blood was drawn from the antecubital vein and anticoagulated using 0.3 ml of 3.8% sodium citrate (1:9 ratio). This mixture was transferred into a sterile spray vial equipped with a custom nozzle mechanism designed to atomize the solution (Figures 2 and 3). The haemoglobin-containing mixture was sprayed uniformly across the wound surface before applying sterile dressings.(Figure 4)

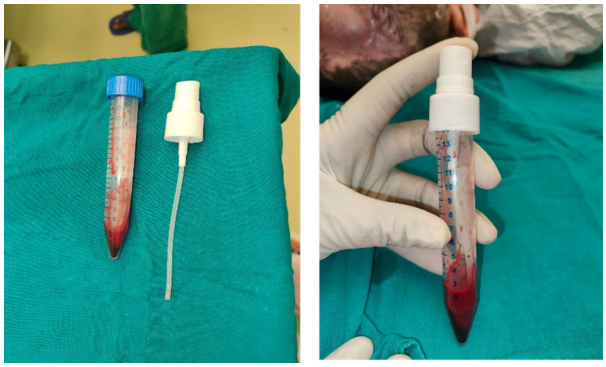

Figure 2 & 3: Showing the preparation of Haemoglobin spray

The spray was administered twice weekly during dressing changes. Clinical assessment was performed at each visit, and wound progression was quantitatively evaluated using the BJWAT scoring system. A total of six applications were provided over a two-week period.

RESULTS

Following the commencement of autologous haemoglobin spray therapy, the wound demonstrated progressive and visually appreciable improvement. A marked increase in red, healthy granulation tissue was observed by the second week of treatment. The BJWAT score, initially recorded as 18 (Figure 1), showed a significant reduction to 12 after three weeks of therapy (Figure 5), indicating improvement in wound quality, reduction in exudate, and progression toward epithelialisation. The wound size decreased, and the tissue became more amenable to subsequent reconstructive intervention.

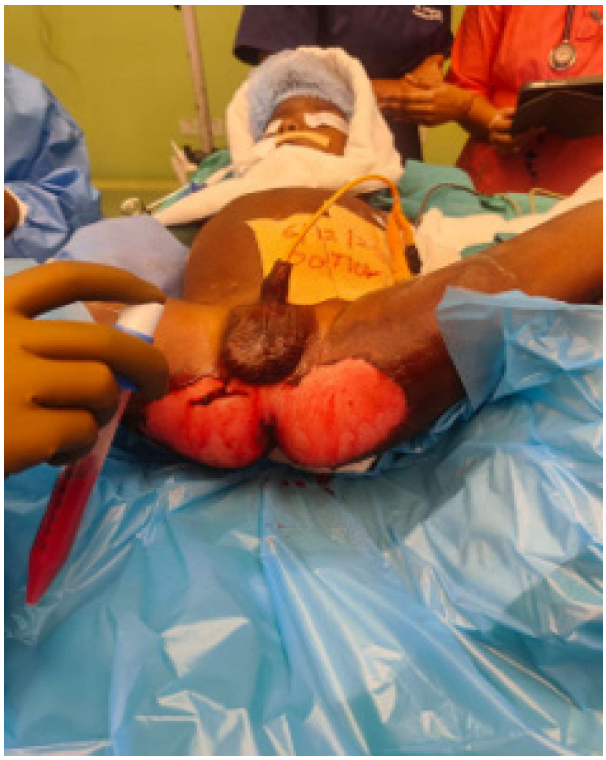

Figure 4: Showing application of haemoglobin spray over the raw area

Figure 5: Showing the result of the application of haemoglobin spray

DISCUSSION

Oxygen plays a pivotal role across all phases of wound healing. Temporary hypoxia stimulates early cellular responses, while sustained hypoxia contributes to chronicity and impaired tissue repair.[1] Oxygen influences several key processes, including fibroblast mitosis, collagen matrix formation, neutrophil-mediated bacterial killing, and angiogenesis—each of which is oxygen dependent.[1,2]

Enhanced tissue oxygenation increases the formation of reactive oxygen and nitrogen species, which in turn activate multiple growth factors such as VEGF, TGF-β, and angiopoietins.[3] These factors promote neovascularisation, extracellular matrix deposition, and progression of the healing cascade. Concurrently, oxygen reduces inflammation by lowering oedema and downregulating pro-inflammatory cytokines.[4]

Existing oxygen-based therapies

Hyperbaric oxygen therapy, first recognized for its beneficial effects on burn healing in the 1960s, has been widely studied and is considered effective for selected patients.[3,4] However, treatment access is limited, and contraindications or intolerance often restrict its use.

More recently, topical oxygen-delivery systems—including continuous diffusion oxygen therapy and haemoglobin-based sprays—have been developed as simpler and more accessible alternatives. Granulox™, a commercially available porcine-haemoglobin spray, binds atmospheric oxygen and transports it as oxyhaemoglobin directly to the wound surface.[5] Studies have shown promising results in diabetic foot ulcers, venous ulcers, and chronic wounds.

Our innovative method offers several advantages:

1. **Cost-effectiveness**: It eliminates dependence on commercial sprays or expensive systems.
2. **Autologous origin**: Reduces risk of immunogenicity or hypersensitivity.
3. **Ease of preparation**: Requires only basic equipment and minimal training.
4. **Physiological oxygen delivery**: Mimics the oxygen-binding properties of natural haemoglobin.
5. **Accessibility**: Can be used in resource-limited settings where HBO therapy is impractical.

Mechanistic justification

When sprayed onto the wound, free haemoglobin binds atmospheric oxygen and facilitates its diffusion into the hypoxic wound bed. Enhanced oxygen availability supports fibroblast and endothelial cell functions, increases collagen synthesis, and improves bacterial control—all essential for granulation tissue formation.[1-4]

Limitations

Being a single case report, the findings cannot be generalized. The long-term outcomes, comparative efficacy against commercial sprays, and optimal dosing frequency require further randomized controlled trials.

CONCLUSION

This case demonstrates that topical autologous haemoglobin spray may serve as a valuable adjunct for wound bed preparation, particularly in chronic or non-responding wounds. The therapy was simple, inexpensive, and effective in enhancing granulation. While the results are encouraging, larger studies are necessary to determine its efficacy, reproducibility, and potential role in routine clinical practice.

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