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Role of Leech Therapy in the Management of Diabetic Foot Ulcer: A Case Study

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A B S T R A C T
In today's world, diabetes mellitus has become increasingly prevalent due to sedentary lifestyles and changing dietary habits. Diabetic foot ulcers are a serious complication of diabetes mellitus and a leading cause of lower limb amputations. Proper management is crucial to prevent severe outcomes and typically involves blood sugar control, wound debridement, dressings, and offloading techniques. Despite advancements in healthcare, approximately 3% of patients still undergo lower limb amputations. This case study presents a 45-year-old male with a non-healing diabetic wound on the plantar aspect of his right great toe. The patient was treated using bloodletting therapy (*Jalaukavacharana*) along with Ayurvedic medicines. Over the course of two months, gradual improvement was observed, leading to complete wound healing. This case highlights the potential of Ayurvedic treatment approach in managing chronic Diabetic foot and ulcers is improving patient outcomes.
Keywords: Diabetic foot ulcer, Madhumehaja vrana, Jalaukavacharana, bloodletting therapy, wound healing.

A R T I C L E I N F O

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1. Introduction

Diabetic foot ulcers (DFUs) are a serious and common complication of diabetes mellitus, affecting millions of people worldwide [1]. Studies estimate that around 15% of individuals with diabetes will develop a foot ulcer during their lifetime, often leading to prolonged hospital stays and, in severe cases, lower limb amputations [2]. These ulcers typically occur due to a combination of factors such as Neuropathy, Poor blood circulation, and a weakened immune system [3]. Diabetic neuropathy leads to a loss of sensation in the feet, making it difficult for patients to notice minor injuries, which can later develop into ulcers [4]. Additionally, peripheral artery disease, commonly associated with diabetes, restricts blood supply to the lower limbs, further delaying wound healing [5]. Elevated blood glucose levels also impair immune function, increasing the risk of infection and complications [6]. Due to these challenges, DFUs are often difficult to treat, with delayed healing and a high risk of progression to gangrene, sometimes necessitating amputation [7]. A comprehensive treatment approach involving wound care, infection control, blood sugar management, and surgical interventions such as debridement or revascularization is crucial for better outcomes [8]. Despite medical advancements, many DFUs remain resistant to conventional treatments, highlighting the need for alternative therapies to enhance healing. In Ayurvedic literature, DFUs are correlated with Madhumehaja Vrana, described in Sushruta Samhita as Kashtasadhya (difficult to treat) due to the accumulation of fat (Meda), blood (Rakta), and other Dosha imbalances [9,10]. Acharya Sushruta provides a detailed classification

of wounds and emphasizes the importance of Shashti Upakrama, a set of sixty therapeutic measures aimed at achieving faster wound closure, preventing complications, and minimizing scarring. Among these, Rakta Mokshana (bloodletting) is recognized as a crucial intervention for promoting wound healing and reducing inflammation [11]. Sushruta Samhita (Chikitsa Sthana, Chapters 12 and 16) specifically mentions that leech therapy (Jalaukavacharana), a form of bloodletting, can effectively reduce pain, inhibit infection, and accelerate the healing of chronic wounds, including diabetic ulcers. Medicinal leeches secrete over 20 bioactive compounds in their saliva, such as hirudin, calin, destabilase, hirustatin, bdellins, hyaluronidase, and anesthetic substances, which enhance blood circulation, prevent clotting, reduce inflammation, and promote tissue regeneration. These properties make leech therapy a promising adjunct in the management of non-healing diabetic foot ulcers.

This study explores the clinical efficacy of *Jalaukavacharana* (Leech Therapy) as a natural and minimally invasive treatment for diabetic foot ulcers, offering an alternative approach to conventional wound management. Unlike standard treatments that primarily focus on infection control and wound care, this work highlights the potential benefits of bloodletting therapy in enhancing circulation, reducing inflammation, and promoting faster healing in non-healing diabetic wounds. The findings contribute to expanding therapeutic options for diabetic foot ulcer management and encourage further research into integrating traditional techniques with modern medical practices.

2. Materials and Methods

Case History:

A 45-year-old male patient, working as a journalist, visited the outpatient department of Shalya Tantra at S.V. Ayurvedic College, Tirupati, with complaints of a non-healing ulcer on the plantar aspect of his right great toe for the past eight months. The ulcer was associated with mild pus discharge, blackish discoloration, and swelling over the medial side of the right ankle. Additionally, the patient reported pain, itching, and a burning sensation in the affected area for the past five months.

The patient had a history of Diabetes mellitus for the past ten years and was on anti-diabetic medication prescribed by a nearby allopathic hospital. His blood glucose levels were within normal limits. Initially, he developed a small blister on the plantar aspect of right great toe, which later turned into an ulcer. Over time, he experienced blackish discoloration and swelling in the ankle region, along with persistent discomfort. Despite receiving treatment at a private clinic, he found no significant relief and subsequently sought Ayurvedic management at S.V. Ayurvedic Hospital, Tirupati.

Clinical and Laboratory Findings

On examination, the ulcer showed signs of chronic non-healing with mild discharge and surrounding discoloration. The laboratory investigations revealed the following:

Hemoglobin: 14.6 g/dL
Total Leukocyte Count: 9000 cells/mm³
Differential Count: Neutrophils – 54%, Lymphocytes – 37%, Eosinophils – 8%, Monocytes – 1%
Erythrocyte Sedimentation Rate (ESR): 80 mm/hr
Clotting Time: 5 min 30 sec
Bleeding Time: 3 min 30 sec
Fasting Blood Sugar Level: 176 mg/dL
Postprandial Blood Sugar Level: 230 mg/dL
HIV and Hepatitis B Surface Antigen Tests: Negative

The patient was on regular medication, including Metformin 500 mg twice daily, Vildagliptin 50 mg once daily, and Supradyn once daily.

Considering the chronic nature of the wound and the lack of response to previous treatments, Jalaukavacharana (Leech Therapy) was planned as the primary mode of intervention, along with supportive Ayurvedic management.

Wound Examination

a) Inspection

Number of Ulcers: 2
Site: Plantar aspect of the right great toe
Shape: Irregular
Size: 2 × 2 cm and 1 × 1 cm
Edges: Rough
Granulation Tissue: Unhealthy
Surrounding Area: Shows inflammatory changes
Discharge: Serous

Palpation

Tenderness: Present (+)
Local temperature: Raised

Treatment Plan

After a detailed wound assessment, leech therapy (*Jalaukavacharana*) was initiated. Two leeches were applied once a week for a total of five sessions. Each leech was allowed to remain on the wound for 30 minutes to facilitate bloodletting. Once the leeches were detached, the wound was cleansed with *Panchavalkala Kashaya*, followed by the application of *Jatyadi Taila* and proper bandaging. The dressing was changed daily, while leech therapy was repeated weekly for five weeks. In addition to the local treatment, the patient has been continuing the diabetic medications alongwith Ayurvedic formulations, including:

- **Tablet Kaishora Guggulu** – 1 tablet, three times a day (TID), after food (AF)
- **Syrup Amritarista** – 10 ml, three times a day (TID), after food (AF)
- **Tablet Nishamalaki** – 1 tablet, three times a day (TID), after food (AF)
- **Madhunorm Churna** – ½ teaspoon, twice daily (BD), with buttermilk, after food (AF)

3. Results and Discussion

The progression of wound healing throughout the treatment period was carefully documented, with significant observations captured in Figure 1. The patient's response to leech therapy was assessed after multiple sittings, demonstrating a clear and progressive improvement in wound condition.

Figure 1. Stages of treatment

After the **first sitting**, the patient experienced a notable reduction in itching, which is often an early sign of inflammatory modulation. Additionally, a slight improvement in pain was reported. The initial stage of leech therapy primarily facilitated local bloodletting, reducing localized congestion and initiating microcirculatory enhancement, which is crucial for wound healing in ischemic tissues.

As seen in Figure 1**,** by the third sitting**,** there was a significant decrease in burning sensation and swelling, accompanied by a complete cessation of pus discharge and foul odour. These changes suggest an active resolution of infection, likely due to the antibacterial and thrombolytic properties of leech saliva. The presence of bioactive molecules such as hirudin, calin, and destabilase played a key role in improving vascular flow, thereby reducing edema and enhancing nutrient and oxygen delivery to the wound site. Importantly, the initiation of healthy granulation tissue formation was observed, indicating that the inflammatory phase was transitioning into the proliferative phase of wound healing. The absence of necrotic tissue and pus further emphasized the effectiveness of the therapy in modulating local immune responses and promoting natural debridement.

By the fifth sitting**,** Figure 1 illustrates a marked reduction in blackish discoloration, a crucial sign of reduced tissue necrosis. The pain levels continued to decrease, suggesting that inflammation was under control and that new, healthy tissue was developing. The wound demonstrated progressive healing, further corroborating the role of leech therapy in expediting tissue regeneration. The presence of bioactive enzymes such as collagenase and hyaluronidase facilitated the breakdown of fibrin clots and extracellular matrix components, thereby accelerating wound remodeling.

The complete healing of the wound was achieved within **60 days** with consistent leech therapy, *Prakshalana* (therapeutic cleansing), and wound dressing. The combination of these approaches proved to be an effective, affordable, and safer alternative for treating chronic, infected ulcers that are otherwise resistant to conventional treatments. The observed healing trajectory aligns with the pharmacological actions of the bioactive compounds present in leech saliva, each playing a critical role in the modulation of inflammation, infection control, and tissue regeneration.

Discussion

The therapeutic benefits of leech saliva in wound healing can be attributed to its anticoagulant, thrombolytic, and anti-inflammatory properties. Hirudin, calin, and Factor Xa inhibitors in leech saliva prevent thrombin formation, ensuring uninterrupted blood flow to compromised tissues. Destabilase, a thrombolytic agent, dissolves fibrin clots, maintaining microcirculatory flow and promoting healing in diabetic ulcers, where vascular complications often lead to hypoxia. Moreover, bdellins and eglins, potent protease inhibitors, modulate inflammation by suppressing excessive enzymatic degradation of tissue components. By inhibiting key inflammatory proteases, these bioactive molecules prevent tissue breakdown and maintain an optimal wound microenvironment for regeneration.

The vasodilatory effects of acetylcholine and histamine-like molecules enhance local blood flow, improving oxygenation and nutrient supply to the wound bed. As shown in Figure 1, the combination of these biochemical interactions promotes the transition from an infected ulcer to a completely healed wound.

Furthermore, collagenase and hyaluronidase in leech saliva break down necrotic material, facilitating wound debridement and accelerating epithelialization. This enzymatic activity ensures new tissue forms in a structured and organized manner, ultimately leading to complete wound closure.

From an **Ayurvedic perspective**, the therapy aligns with the principles of *Vrana Shodhana* (wound cleansing) and *Vrana Ropana* (wound healing). The initial stage of leech application facilitates the removal of local vitiated *doshas*, eliminating toxins and impure blood that impede the healing process. This cleansing action not only detoxifies the wound environment but also prevents secondary infections. The subsequent effect, *Vrana Ropana*, is achieved through enhanced blood circulation, which facilitates the delivery of essential nutrients and growth factors to the regenerating tissues. Additionally, the therapy contributes to the *Madhumeha Pacifying Effect*, addressing the underlying pathophysiology of diabetes-induced wound complications. Bloodletting via leech therapy aids in breaking the pathogenic cycle of diabetes at a cellular level, thereby improving systemic circulation and modulating inflammatory responses.

The supporting role of *Jatyadi Tailam* and *Panchvalkal Kashaya Prakshalana* was also evident throughout the treatment process. These traditional formulations provided additional *Shodhana* (cleansing) and *Ropana* (healing) benefits, ensuring simultaneous wound disinfection and tissue regeneration. The combined approach of leech therapy with these Ayurvedic interventions contributed to an accelerated healing response, minimizing complications and promoting complete tissue restoration.

The results observed in this study highlight the immense potential of leech therapy as a viable therapeutic option for managing **Madhumehaja Vrana** (diabetic foot ulcers).

Chronic diabetic ulcers are often refractory to conventional treatments due to persistent infection, impaired vascularization, and prolonged inflammation. The significant improvements documented in this case—elimination of infection, reduction in necrosis, pain relief, and complete wound closure—demonstrate that leech therapy, when combined with traditional Ayurvedic interventions, can provide a holistic and effective solution for these challenging conditions.

4. **Conclusion**

This study demonstrates the remarkable efficacy of leech therapy in the management of Madhumehaja Vrana (diabetic foot ulcer), showcasing its potential to significantly enhance wound healing while reducing pain, inflammation, and infection. The progressive improvement observed throughout the treatment period highlights the therapeutic impact of bioactive molecules in leech saliva, which facilitate microcirculatory enhancement, thrombolysis, and anti-inflammatory action. The combination of leech therapy with Prakshalana (therapeutic cleansing) and wound dressing proved to be highly effective, leading to complete wound healing within 60 days. Notably, the therapy not only promoted the formation of healthy granulation tissue but also alleviated symptoms of venous insufficiency and improved the overall quality of life for the patient. Given its cost-effectiveness, safe, minimal adverse effects, and holistic healing potential, leech therapy emerges as a promising intervention for chronic Diabetic foot management by preserving and saving the limb amputations. However, further clinical studies and mechanistic research is necessary to comprehensively evaluate its long-term benefits, optimize treatment protocols, and establish its broader applicability in diabetic foot ulcer management.

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