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The medicinal legacy of leeches: Historical roots and therapeutic perspective

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Abstract
Leeches have played a significant role in medicine for centuries, with their therapeutic applications dating back to ancient civilizations such as those of Egypt, Greece, and India. Historically, associated with bloodletting, leeches were believed to restore balance to the body's humors. In modern medicine, their role has evolved significantly, supported by scientific validation. Leech therapy, or Hirudotherapy, has become a keystone in various medical fields, particularly in microsurgery and reconstructive procedures. Their ability to alleviate venous congestion is invaluable in grafts, reattachment surgeries, and plastic surgery, where their anticoagulant saliva helps restore blood flow, preventing tissue necrosis. The medicinal efficacy of leeches lies in their saliva, which contains a variety of bioactive compounds; Hirudin, a potent anticoagulant, prevents clot formation, while Calin inhibits platelet aggregation, ensuring prolonged bleeding and improved venous drainage. Additional components like Hyaluronidase enhance tissue permeability, and Bdellins provide anti-inflammatory effects, broadening their therapeutic potential. Beyond surgical applications, leeches have been successfully used in the management of osteoarthritis, offering pain relief and reducing inflammation, as well as in treating conditions such as varicose veins and hemorrhoids. The medicinal legacy of leeches highlights the seamless connection between ancient wisdom and modern science, providing a foundation for innovative therapeutic strategies in contemporary medicine. This article explores the historical roots of leech therapy, highlights its transition from traditional practice to scientifically supported medicine, and provides insights into specific applications in conventional healthcare.

Keywords: Leech, bloodletting practices, microsurgery, reconstructive surgery, varicose veins, treatment, platelet aggregation inhibitors

Introduction

Leeches have long been a part of human medicine, dating back to ancient civilizations, where they were valued for their probable ability to restore the balance of body's internal systems. These small, segmented parasites have an interesting medicinal legacy that spans thousands of years, from their use in ancient bloodletting practices to their modern application in microsurgery and beyond. The medicinal leech, *Hirudo medicinalis*, has been particularly recognized for its therapeutic properties due to its salivary secretions, which contain biologically active compounds eglins, antistasin, guamerin, saratin, hirudin, bdellins, carboxypeptidase inhibitors with anticoagulant, anti-inflammatory and antimicrobial properties (Rahul Set.al., 2014, Ali K Sig *et.al*., 2017) [1, 8] The use of leeches in medicine can be traced to ancient Egypt, Rome, Greece, and India. In ancient Egypt, leeches were depicted in medical texts as tools for bloodletting, which was believed to cure ailments by balancing the body's humors (Mory R.N. *et.al.*, 2000) [2]. Greek physicians, like Hippocrates and Roman practitioners, including Galen, advocated for leech therapy as part of humoral medicine, emphasizing its role in removing excess blood (Whitaker *et al*., 2004) [3]. "Sushruta Samhita", an ancient Indian text on medicine, describes the use of leeches for localized bloodletting to treat skin diseases and inflammatory conditions (Singh, S. K., & Rajoria, 2019) [4]. During the middle Ages, leech therapy reached its peak in Europe. It was widely believed that diseases were caused by imbalances in the four humors—blood, phlegm, black bile, and yellow bile—and bloodletting with leeches were a common remedy. By the 19th century, leeches were so widely used that their overharvesting led to a decline in their populations (Busra Arabacı B, 2023). The advent of scientific medicine in the 19th and 20th centuries led to a decline in the popularity of leech therapy. However, renewed interest emerged in the late 20th century when the anticoagulant properties of leech saliva were scientifically validated (Mohamed Alaama *et.al*., 2024) [6].

The therapeutic effects of leeches are largely attributed to the components of their saliva. Hirudin, the most well-known compound, acts as a potent anticoagulant by directly inhibiting thrombin, preventing the formation of blood clots. Calin, another significant component, inhibits platelet aggregation, ensuring prolonged blood flow from the application site. Hyaluronidase enhances tissue permeability, facilitating the spread of the leech's salivary compounds into surrounding tissues, while bdellins exhibit anti-inflammatory and protease-inhibitory properties (Ali K Sig *et.al*., 2017) [1]. These compounds not only aid in

improving blood circulation but also have localized analgesic and anti-inflammatory effects, making leeches a valuable tool in various medical disciplines. Modern medicine has embraced leeches in a variety of clinical applications. In reconstructive and plastic surgery, leeches are used to manage venous congestion, which occurs when reattached tissues or grafts fail to establish adequate venous drainage. By removing excess blood and promoting circulation, leeches help prevent tissue necrosis and improve surgical outcomes. They are frequently used in digit reattachment surgeries and skin flap procedures. Leeches also play a role in the treatment of osteoarthritis, alleviate symptoms of varicose veins and hemorrhoids (Abdualkader A.M, 2013) [7]. This article aims to provide a comprehensive understanding of leech therapy, from its historical roots to its current and potential uses.

Leech Photographs

Historical Overview on Leech therapy

Origins of Leech Therapy: Leech therapy, also known as Hirudotherapy, has a rich history dating back thousands of years. Its origins can be traced to ancient civilizations like Egypt, India, Greece and Rome, where leeches were widely used for therapeutic purposes (Wells MD *et al*., 1993) [9].

Ancient Egypt: Evidence from Egyptian medical texts, such as the Ebers Papyrus (circa 1500 BCE), indicates that leech therapy was practiced for treating ailments related to blood and inflammatory conditions. Artistic depictions on tomb walls further suggest that leeches were a recognized part of medical practice in ancient Egyptian society (Wells MD *et al*., 1993) [9].

Ancient India: In India, leeches were used in Ayurveda, one of the world's oldest traditional medical systems. References to leech therapy can be found in ancient Ayurvedic texts like the *Sushruta Samhita* (circa 600 BCE). Sushruta, known as the "Father of Surgery," described the use of leeches to balance the body's doshas (vata, pitta, and kapha) and treat conditions like skin diseases, blood impurities, and inflammation (Whitaker *et al*., 2004) [3].

Greece and Rome: The Greeks and Romans also utilized leech therapy extensively. Hippocrates (460–370 BCE), the father of modern medicine, and Galen (129–216 CE), a prominent Roman physician, both advocated for leeching as a means to balance bodily humors—blood, phlegm, yellow bile, and black bile—central to their understanding of health. Leeches were commonly used to treat fevers, infections, and circulatory issues (Lone AH *et al*., 2011) [10]

Biology of Medicinal Leeches

Leeches are annelids belonging to the subclass Hirudinea. They possess dorsoventrally flattened, segmented body with two suction discs (one at each end), which aid in attachment and movement. They have a closed circulatory system with specialized contractile vessels functioning as a heart. Their gut is highly expandable, allowing them to store large volumes of blood for extended periods. A well-developed central nervous system with ganglia that control movement and feeding behaviour.

Several species of leeches are used for medicinal purposes, in which few important ones are;

Hirudo medicinalis **(European medicinal leech):** Commonly used in microsurgery and anticoagulant therapy.

Hirudinaria manillensis **(Asian medicinal leech):** Used in traditional Asian medicine and modern hirudotherapy.

Hirudinaria granulosa **(Indian leech species):** commonly used in hirudotherapy. It is widely utilized in Ayurvedic medicine for bloodletting and has applications in modern medicine for its anticoagulant and anti-inflammatory properties

Hirudinaria javanica: Found in India and Southeast Asia, known for its anticoagulant propertie. (Nebrass Faleh *et.al*., 2019) [14]

Leeches in Ayurveda and Unani Medicine

Ayurveda: Leeches are classified as living tools (*Jeevaka Yantras*) used to perform *Raktamokshana* (bloodletting). One of the five purification therapies of Panchakarma. Sushruta highlighted their effectiveness in treating conditions like eczema, psoriasis, abscesses, and varicose veins. The process was considered gentle and effective for removing impure blood without causing harm to the surrounding tissues (Anonymous, 2003) [11].

Unani Medicine: Based on the humoral theory, Unani practitioners employed leeches to restore humoral balance, which was believed to govern health. Leeches were frequently used for detoxification and to address issues like chronic headaches, joint pain, and skin disorders. Renowned Unani scholars like Ibn Sina (Avicenna) documented leech therapy in their medical compendiums (Chalain TM, 1996) [12]

Middle Ages and Renaissance

During the Middle Ages and Renaissance, leech therapy became synonymous with bloodletting, a cornerstone of medical practice in Europe. The popularity of leech therapy

surged during the Renaissance, partly due to the rediscovery of classical texts by Hippocrates and Galen. Advances in anatomical knowledge during this period led to more targeted applications of leech therapy, such as treating localized inflammation and improving circulation. Wealthy patrons and royalty often used leech therapy as part of their healthcare regimen, strengthening its role in mainstream medical practice (Munshi Y., et.al., 2008) [13].

Medieval Practices

Leeching was rooted in the humoral theory, which suggested that illness resulted from imbalances in the body's four humors. Physicians used leeches to draw excess blood, believed to correct these imbalances. Leech therapy was recommended for a wide range of ailments, from fevers and hypertension to mental disorders.

Decline of Leech Use with the Advent of Modern Medicine

The 19th century marked the peak of leech therapy in Europe, with millions of leeches harvested annually for medical use. However, the advent of modern medicine led to its decline. The development of germ theory and a better understanding of pathology shifted medical focus away from humoral theories. Bloodletting, including leech therapy, was increasingly viewed as outdated and ineffective. The rise of anesthesia, antiseptics, and surgical techniques provided more precise and reliable treatments for conditions previously managed with leeches (Munshi Y., *et.al*, 2008) [13].

Resurgence in the 20th Century: Despite its decline, leech therapy experienced a revival in the late 20th century, particularly in reconstructive surgery and microsurgery. Modern hirudotherapy uses leeches for their anticoagulant properties, attributed to *hirudin*, a peptide found in their saliva that prevents blood clotting and promotes wound healing. Today, leech therapy is recognized as a complementary treatment in both traditional and modern medical systems, blending ancient wisdom with contemporary scientific understanding (Sawyer RT, 2013) [15]

Mechanism of Action - Feeding and Injecting Bioactive Compounds

Leeches feed by attaching to the host using their anterior sucker, making a tri-radiate incision with their sharp jaws. During feeding, they inject several bioactive compounds present in their saliva. Important bio actives and their activities are given below (Zunren C *et.al*. 2021, Shakouri A 2021).

Bioactives	Properties
Hirudin	A potent anticoagulant that prevents blood clotting.
Eglins	Anti-inflammatory molecules that reduce tissue swelling and pain
Bdellins	Protease inhibitors that promote wound healing
Hyaluronidase	Facilitates the penetration of bioactive compounds into the host's tissue
Destabilase	Promotes fibrinolysis and prevents clot formation
Vasodilators	(Histamine like substance): Enhance blood flow to ensure a steady supply of nutrients and oxygen to the affected area. This unique mechanism allows leeches to assist in various medical applications, particularly in improving blood circulation and preventing thrombosis.

Medicinal Applications of Leech

Hirudotherapy

Hirudotherapy involves the use of medicinal leeches to treat various conditions. Some of the key applications include:

a. **Microsurgery and Reconstructive Surgery:** Leeches are used to prevent venous congestion in reattached limbs and tissues.

b. **Anticoagulation and Thrombosis Treatment:** Leech saliva contains hirudin, a potent anticoagulant that prevents clot formation.

c. **Wound Healing and Skin Grafts:** Leeches improve blood circulation and promote tissue regeneration.

d. **Pain Management and Inflammation:** Bioactive compounds in leech saliva possess analgesic and anti-inflammatory properties to use as anti-inflammatory and pain management (Hosseini M *et.al*., 2024, Nigar Z *et.al* 2011, Talebi SS *et.al*., 2022) [17, 18, 20].

Modern Scientific Research and Applications

Recent studies have explored novel applications of leech-derived bioactive molecules in drug development, regenerative medicine, and biotechnology. Some key research areas include (Hosseini M. *et.al*.,2024, Hohmann, C. D *et.al*., 2018) [17, 19]

a. **Nanomedicine and Drug Delivery**: Hirudin-based nanoformulations for targeted anticoagulant therapy.

b. **Cancer Research**: Investigation of leech-derived peptides as potential anticancer agents.

c. **Neuroscience**: Potential use in neuroprotection and stroke recovery.

d. **Diabetes Management**: Research on leech therapy in improving blood circulation in diabetic foot ulcers.

e. **Treatment of Varicose Veins**: Use in treating varicose veins, osteoarthritis, and other conditions

Challenges and Future Prospects

Despite their medicinal potential, leech therapy faces certain challenges:

- **Regulatory Concerns:** Standardization and quality control issues in pharmaceutical applications.
- **Ethical Considerations:** Sustainability of medicinal leech harvesting.
- **Patient Acceptance**: Psychological barriers associated with leech therapy. Future research should focus on biotechnological advancements to synthesize and modify leech-derived compounds for broader therapeutic applications.

Conclusion

Leeches have a well-documented historical significance in traditional medicine and continue to hold a crucial place in contemporary medical practices. Their salivary secretions contain bioactive molecules, such as hirudin, eglins, and destabilase, which exhibit potent anticoagulant, anti-inflammatory, thrombolytic, and antimicrobial properties.

These compounds have facilitated the clinical use of leech therapy in microsurgical procedures, particularly in cases of venous congestion following reconstructive surgeries, digit replantation, and skin grafting. Additionally, leech-derived anticoagulants have shown promise in managing thromboembolic disorders and certain cardiovascular conditions. Recent advancements in biotechnology and molecular pharmacology have further enhanced the therapeutic potential of leeches by enabling the isolation and modification of their bioactive constituents for pharmaceutical applications. Research is ongoing to explore their role in targeted drug delivery, wound healing, and the management of chronic inflammatory disorders. With increasing scientific validation and technological innovations, leech-based therapies continue to evolve, offering novel biomedical applications that may significantly contribute to future medical advancements.

References

1. Ali K Sig, Guney M, Uskudar Guclu A, Ozmen E. Medicinal leech therapy-an overall perspective. Integr Med Res,2017:6(4):337–43.
2. Mory RN, Mindell D, Bloom DA. The leech and the physician: biology, etymology, and medical practice with *Hirudo medicinalis*. World J Surg,2000:24:878–83.
3. Whitaker IS, Rao J, Izadi D, Butler PE. Historical article: *Hirudo medicinalis*: ancient origins of, and trends in the use of medicinal leeches throughout history. Br J Oral Maxillofac Surg,2004:42:133–7.
4. Singh SK, Rajoria K. Medical leech therapy in Ayurveda and biomedicine - A review. J Ayurveda Integr Med,2019:11(4):554–64.
5. Burca Arabacı B. 'Pearls' of the nineteenth-century: from therapeutic actors to global commodities medicinal leeches in the Ottoman Empire. Med Hist,2023:67(2):128–47.
6. Alaama M, Kucuk O, Bilir B, Merzouk A, Ghawi AM, Yerer MB, *et al*. Development of Leech extract as a therapeutic agent: A chronological review. Pharmacol Res Mod Chin Med,2024:10:100355. https://doi.org/10.1016/j.prmcm.2023.100355
7. Abdualkader AM, Ghawi AM, Alaama M, Awang M, Merzouk A. Leech therapeutic applications. Indian J Pharm Sci,2013:75(2):127–37.
8. Rahul S, Swarnasmita P, Janhavi D, Bhuvan J, Shobhit P. Hirudotherapy - a holistic natural healer: a review. Int J Oral Care Res,2014:2(4):59–61.
9. Wells MD, Manktelow RT, Boyd JB, Bowen V. The medical leech: an old treatment revisited. Microsurgery,1993:14:183–6.
10. Lone AH, Ahmad T, Anwar M, Habib S, Sofi G, Imam H. Leech therapy - a holistic approach of treatment in Unani (Greeko-Arab) medicine. Anc Sci Life,2011:31(1):31–5.
11. Anonymous. The wealth of India. VI: L-M. New Delhi: Council of Scientific & Industrial Research (CSIR), 2003, 57–9.
12. Chalain TM. Exploring the use of the Medicinal Leech: A clinical risk-benefit. J Reconstr Microsurg,1996:12(3):165–72.
13. Munshi Y, Ara I, Rafique H, Ahmad Z. Leeching in the history—a review. Pak J Biol Sci,2008:11(13):1650–3.
14. Faleh N, Hassan ZN, Shafeeq MAA. Leeches review: biology, ecology and medical important. Indian J Public Health Res Dev,2019:10(10):3275–7.
15. Sawyer RT. History of the leech trade in Ireland: microcosm of a global commodity. Med Hist,2013:57(3):420–41.
16. Junren C, Xiaofang X, Huiqiong Z, Gangmin L, Yanpeng Y, Xiaoyu C, *et al*. Pharmacological activities and mechanisms of hirudin and its derivatives - a review. Front Pharmacol,2021:12:660757. https://doi.org/10.3389/fphar.2021.660757
17. Hosseini M, Jadidi A, Derakhshan Barjoei MM, Salehi M. Applications of leech therapy in medicine: a systematic review. Front Med,2024:16(11):1417041. https://doi.org/10.3389/fmed.2024.1417041. PMID: 39351007: PMCID: PMC11439709.
18. Nigar Z, Alam MA. Effect of taleeq (leech therapy) in dawali (varicose veins). Anc Sci Life,2011:30:84–91.
19. Hohmann CD, Stange R, Steckhan N, Robens S, Ostermann T, Paetow A, *et al*. The effectiveness of leech therapy in chronic low back pain. Dtsch Arztebl Int,2018:115(47):785–92.
20. Talebi SS, Roudsari AT, Zolhavarieh SM, Majidi L, Ghiasi H, Vafaei SA. Comparison of the pain-killing effects of leech therapy versus physiotherapy in patients with knee osteoarthritis: a double-blind randomized clinical trial. Biomed Res Ther,2022:9:5095.