



REVIEW ARTICLE

A Narrative Review of Leech Therapy

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Abstract

Leech therapy, or *Jalaukavacharana* in Ayurveda, is an ancient therapeutic practice utilizing medicinal leeches (*Hirudo medicinalis*) to treat various ailments by drawing impure blood and promoting healing. This method, detailed in classical Ayurvedic texts like the *Sushruta Samhita*, has a long history of use for treating blood-related disorders (*Raktaja*) and inflammatory conditions. The therapeutic efficacy of leech therapy is attributed to the bioactive compounds secreted in leech saliva, such as hirudin (an anticoagulant), hyaluronidase (which enhances tissue permeability), and calin (a vasodilator). These compounds improve blood circulation, reduce inflammation, and facilitate wound healing. Contemporary applications of leech therapy have expanded beyond Ayurveda, finding utility in reconstructive plastic surgery, osteoarthritis, venous insufficiency, and chronic pain management. Compared to other bloodletting methods, leech therapy is minimally invasive, cost-effective, and environmentally sustainable, especially with advancements in leech cultivation. This review examines the clinical benefits, bioactive components, and potential for integrating leech therapy into modern healthcare systems. This review highlights the economic potential of leech farming. Leeches (*jalouka*) are used for the treatment of *raktha pitaja* diseases. Many trees are cut down and destroyed to prepare herbal formulations (*oushadha yogas*) used for treating *rakta pitaja rogas*, both internally and externally. By using *jalouka* (leeches) as an alternative to these formulations, sustainable nature conservation can be ensured. Despite its ancient roots, leech therapy continues to show promise as an alternative, integrative treatment in traditional and modern medical practices.

Introduction

Leech therapy, also known as medical leech therapy (MLT), is a treatment method involving the controlled use of leeches to promote healing and improve health outcomes. This therapy has been refined and modernized to use only specific species of leeches, particularly *Hirudo medicinalis*, which are specially bred and prepared for medical purposes. These leeches secrete biologically active substances that have beneficial effects, such as anticoagulant, anti-inflammatory, and vasodilatory properties, as well as bacteriostatic and extracellular matrix degradative action, making them suitable for various medical applications.⁽¹⁾

Hirudin, an anticoagulant compound found in leech saliva, can potentially have broader therapeutic applications in preventing and treating thromboembolic diseases. Markward first isolated Hirudin from the saliva of *Hirudo medicinalis* in 1955.⁽²⁾

Medicinal leeches alleviate venous congestion in graft tissue, promote healing, and offer a nonsurgical alternative for plastic surgery patients. In plastic and reconstructive surgery, the primary role of leeches is to alleviate venous congestion in compromised tissue flaps. Leech therapy helps to alleviate tissue capillary pressure and promote local anticoagulation. Leech saliva contains anticoagulant, thrombin-regulating, anti-inflammatory, analgesic, platelet-inhibitory, extracellular matrix-degrading, and antimicrobial properties. These properties are beneficial in reconstructive surgery.⁽³⁾

The term "leech" is derived from the old English word *laece*, meaning physician, highlighting an enduring association between doctors and bloodsucking parasites since ancient times.⁽¹⁾

The use of leech therapy dates back over 3,500 years and is depicted in ancient Egyptian hieroglyphics. Leech therapy is also referenced in historical medical texts from various ancient civilisations, including Arabic, Chinese, Greek, and Roman medicine. Leech therapy is an affordable, effective, and straightforward treatment method, with its mechanisms of action well understood for certain diseases. In 2004, the Food and Drug Administration certified leech as a medical device.⁽⁴⁾ In Europe during the 17th and 18th centuries, bloodletting, particularly leeching, gained immense popularity and became a widely practised method. It formed an essential component of the tools and techniques used by physicians and barbers.

Leech therapy is also recognized as an Ayurvedic practice known as *Jalaukavacharana* which is detailed in the *Sushruta Samhita*, an ancient Sanskrit text on medicine and surgery dating back to the 2nd century BCE in India. Detailed descriptions of *Jalaukavacharana* are also explained in other classics like Charaka Samhita, Astanga Samgraha, Astanga Hrudaya etc.

Jalaukavacharana is performed using *Jalauka*. *Jalauka* refers to the medicinal leech used in Ayurvedic procedures. The term *Jalauka* refers to a creature whose life or existence is associated with water, emphasizing that leeches thrive in water and depend on it for their survival (*Jalam āsām āyuriti Jalaukā*).⁽⁵⁾ Thus, *Jalauka* can be interpreted as a water leech, referring to the leech used in the Ayurvedic practice of *Jalaukavacharana*. This term highlights the aquatic nature of the leech employed in the treatment.

Leeches are segmented, hermaphroditic, carnivorous worms that inhabit freshwater environments. They are highly perceptive to various stimuli, including vibrations in the water, touch, light, heat, sound, and chemical signals. These creatures comprise multiple segments, each containing different organs, such as ganglia (clusters of nerve cells) and testicles. Notably, some of

these segments include structures that function as "brain parts," contributing to their complex sensory and behavioural responses⁽⁶⁾.

Acharya Sushruta described twelve types of *Jalauka* (leeches), dividing them into six poisonous (*Savisha*) and six non-poisonous (*Nirvisha*) types.⁽⁷⁾ *Jalaukavacharana* is a painless, minimally invasive method of controlled bloodletting known as *raktamokshana*. Acharya Sushruta, an ancient Indian physician known as the "father of surgery" (7th or 6th century BC), highlighted the therapeutic value of *raktamokshana* for treating blood-borne diseases. *Jalaukavacharana* (Leech Therapy), a key method of Ayurvedic bloodletting (*Raktamokshana*), has been an integral part of traditional Indian medicine for centuries, as described in classical texts like the *Sushruta Samhita*, *Jalauka* therapy has historically been employed for treating a variety of blood-borne and inflammatory disorders, leveraging the unique properties of medicinal leeches (*Hirudo medicinalis*).

In modern medicine, there is a growing interest in *Jalaukavacharana* therapy, especially in dermatology, plastic surgery, and pain management, owing to its anti-inflammatory, analgesic, and anticoagulant effects. Medicinal leeches secrete bioactive substances like hirudin, calin, and hyaluronidase, which contribute to improved microcirculation, reduced tissue congestion, and enhanced healing. These pharmacological actions offer a promising, minimally invasive treatment option for several chronic and acute conditions, including venous insufficiency, osteoarthritis, and non-healing wounds.⁽⁸⁾ *Raktamokshana* (Bloodletting) is an ancient Ayurvedic therapeutic procedure to remove impure or vitiated *Doshas* and *Dhatu*s from the body. It is used to cleanse the *rakta dhatu* (blood) and help to treat diseases caused by blood vitiation. The selective action of leeches during *Jalaukavacharana* (leech therapy) draws a metaphor from a swan's legendary ability to separate milk from water, symbolizing the leech's capacity to identify and remove only the impure blood (vitiating by *doshas*, particularly *pitta*) while sparing the pure blood. This emphasizes the precision and therapeutic value of *Jalauka* in detoxifying the body.⁽⁹⁾

The practice of bloodletting persisted for so long, from the period of Sushruta (between 1000-800 BC) Charaka (AD 150-200) and Vagbhata (between 400-475 AD) Blood is a vital *dhatu* (tissue) in the human body, essential for sustaining and supporting the body's overall function.⁽¹⁰⁾ When *rakta dhatu* becomes imbalanced or vitiated various diseases can arise. When the blood is free from toxins, it sustains life (*Jeevanam*) and prevents the onset of diseases. Preserving the purity of blood is essential for health, highlighting the importance of *rakta moksha* (bloodletting) in treatment. The *rasa dhatu* serves as the precursor for the formation of *rakta dhatu*. *Rasa* is acted upon by *tejas* and is converted into *rakta*.⁽¹¹⁾

Acharya Charaka regards *rakta* as one of the *dasa pranaayatana* (Ten seats of life force), where vital life energy resides. Acharya Sushruta, on the other hand, considers *rakta* as

the fourth *dosha*. In the classical texts, *rakta* is described as one of the seven *dhatu*s, formed through the transformation of *rasa dhatu* by the action of the *yakrut* (liver) and *pleha* (spleen). The characteristics of *sudha rakta* (pure blood) include having the colour of *indragopa* (red velvet mite), being *asamhatam* (neither too thick nor too thin), and *avivarnam* (without any unusual or abnormal colours).⁽¹²⁾

Raktamoksha, a therapeutic bloodletting technique, helps to eliminate the vitiated *doshas*, promoting the treatment and healing of numerous ailments. *Rakha* is derived from *rasa dhatu* and plays a crucial role in the formation and balance of all other *dhatu*s (tissues) in the body. The proper functioning and equilibrium of the body's *dhatu*s depend on the health of *rakta dhatu*.⁽¹³⁾

MLT is often included as part of multidisciplinary treatment approaches due to the presence of various bioactive substances in leech saliva. These substances differ among leech species, making it essential to evaluate different species for both their therapeutic potential and the unique molecules they produce. Its therapeutic benefits include anticoagulation, stimulation of blood and lymph flow, and alleviation of inflammation and pain. There is significant potential for the discovery of new substances within these secretions, which could lead to future therapeutic innovations.⁽¹⁴⁾

In the context of growing antibiotic resistance and the demand for natural, non-pharmacological interventions, *Jalauka* therapy offers a unique, evidence-based alternative that aligns with the principles of personalised and integrative medicine. By bridging the gap between traditional Ayurvedic wisdom and modern scientific inquiry, *jalaukavacharana* can play a significant role in enhancing patient outcomes and expanding the therapeutic repertoire of Ayurvedic and Modern medicine practitioners alike.

The integration of *jalauka* therapy into modern clinical practice highlights its therapeutic potential as a complementary and alternative medicine approach. Despite its ancient origins, ongoing research and clinical trials are uncovering new applications and validating its efficacy and safety in contemporary medical settings.⁽⁸⁾

Aim

To explore and analyse the contemporary potential of leech therapy (*Jalaukavacharana*) in Ayurveda, emphasizing its therapeutic applications, scientific advancements, and integration into modern medical practices.

Objectives

This comprehensive review aims to explore the outcomes of various therapeutic indications of leech therapy in managing diseases and contemporary research and clinical studies on the efficacy and safety of leech therapy. The review examines the biochemical properties of leech saliva and their relevance to

modern pharmacology. This review also aims to explore the historical significance and principles of leech therapy in Ayurvedic texts and modern medicine.

Methodology

The search was conducted using databases such as PubMed, Google Scholar, and Scopus. Keyword combinations included terms like *Raktamoshana* (bloodletting) *Jalaukavacharana*, leech therapy, hirudotherapy, treatment of *Raktadhatu janaya rogas*, classification of poisonous and non-poisonous *Jalauka* (leeches), and their importance in medical therapy. The search also included topics such as habitat, morphology, active components in leech saliva, and the medical uses of leeches, along with published papers on their role in medical therapy. This meticulous approach ensured a comprehensive collection of recent and relevant studies on *Jalaukavacharana*, medical leech therapy and different types of bloodletting.

Categories of *Raktamokshana* (bloodletting)

Raktamokshana (bloodletting) can be divided into two main categories. *Sastra Visravana* (bloodletting using surgical instruments) and *Asastravisravana*. *Siravyadhana* (venipuncture) and *prachchana* (scarification)⁽¹⁵⁾ are performed with surgical instruments. In *Sira vyadhana*, bloodletting is done by puncturing veins or arteries using surgical blades. In *prachchana*, localised bloodletting is done by puncturing the skin with specific surgical instruments. *Asastra visravana* refers to minimally invasive para-surgical procedures where bloodletting is performed using *jalauka* (leech), *srunga* (animal horn application), and *alaabu* (cupping therapy with bottle gourd).⁽¹⁶⁾

Jalaukavacharana is a type of *Asastra krita raktamoksha* in which bloodletting is done using live leeches (*Jalauka*). Approximately 700 species of leeches have been identified, inhabiting both terrestrial and aquatic environments. In Ayurveda, only aquatic leeches are used. Aquatic habitats include freshwater, estuarine, and marine ecosystems. Leeches are known to thrive in a range of extreme environments, including those with extreme variations in temperature, moisture, salinity, pressure, light, and pollution.⁽⁶⁾

Medical Leech therapy

Leeches are used to reduce inflammation and pain in systemic diseases such as rheumatic and inflammatory conditions. Leech therapy is a multifaceted therapeutic approach involving a biting stimulus, blood extraction, and the injection of pharmacologically active compounds from leech saliva into a patient's blood and tissues. Its therapeutic benefits include anticoagulation, stimulation of blood and lymph flow, and alleviation of inflammation and pain.⁽¹⁷⁾

Classification of *Jalaukas*⁽¹⁸⁾

Jalaukas are of two types: *Savisha* (poisonous) and *Nirvisha* (non-poisonous). Each group has six types of *Jalauka*

Table 1. Classification of *Jalaukas*

Savisha (poisonous) jalauka (leech)		Characteristics
1	<i>Krishna</i>	Blackish coloured (<i>Anjana varna</i>) with a large head (<i>Prudhu sira</i>)
2	<i>Karbura</i>	Grey coloured. The body is long like a prawn (<i>Vatmeeka matsya</i>) and the abdomen is segmented and bulged
3	<i>Alagarda</i>	Hairy with big flanks. Mouth is blackish
4	<i>Indrayudha</i>	Has rainbow-like stripes on the body
5	<i>Saamudrika</i>	Blackish yellow in colour with a flower-like design on the body
6	<i>Gochandana</i>	The Body has two bulging similar to the testicles of an ox. The face is very small.
Nirvisha (non-poisonous) Jalauka (leech)		Characteristics
1	<i>Kapila</i>	Green coloured (<i>Mudga varna</i>) body with hue reddish orange resembling <i>Manasila</i> paste (realgar-arsenic sulphide mineral) on either side of the body. The body is soft (<i>Snigdha</i>).
2	<i>Pingala</i>	The body is round and amber-coloured (a mix of red and yellow colour). It moves very fast
3	<i>Sankhumughi</i>	Reddish brown coloured - colour of <i>Yakrut</i> (liver) and long and sharp-faced. It sucks blood very fast
4	<i>Mooshika</i>	It has the shape and colour of a rat (<i>Mooshika</i>) with an offensive or unpleasant smell
5	<i>Pundarika mukhi</i>	Face has the shape of a lotus (<i>Pundareeka mukhi</i>) and the colour is greenish (<i>Mudga varna</i>)
6	<i>Savarika</i>	The body is very soft (<i>Snigdha</i>), similar to the colour of the lotus leaf (<i>Padmapatra varna</i>) and eighteen fingers (<i>Ashtadasa angulipramana</i>) length. Used for bloodletting to cattle or animals

Several leech species are used for therapeutic purposes. These include *Hirudo medicinalis*, *Hirudo verbena*, *Macrobdella decora*, *Haementeria officinalis*, *Hirudinaria manillensis*, *Hirudotroctina*, *Hirudo quinquestriata*, *Hirudo nipponia*, *Poecilobdella granulosa*, and *Hirudinaria javanica*. Leeches are segmented annelids with 33 to 34 body segments. They belong to the phylum Annelida, class Clitellata, and subclass Hirudinea. Among these, *Hirudo medicinalis*, commonly known as the medicinal leech, has been approved by the U.S. Food and Drug Administration (FDA) for medical use and is characterised by a slightly flattened, cylindrical body.⁽¹⁹⁾ Blood-feeding leeches either protrude their proboscis into host tissue with the support of secreted proteolytic enzymes or make an incision with their teeth and jaws and feed on the pooled blood.⁽⁶⁾

Composition of leech saliva

Leech saliva contains a variety of biologically active substances that contribute to its therapeutic properties. Analgesic and anti-inflammatory substances in leech saliva include antistasin, hirustasin, ghilantens, eglin C, complement C1 inhibitor, guamerin, piguamerin (a carboxypeptidase inhibitor), bdellins, and bdellastatin. Anticoagulants and thrombin regulators in leech saliva include hirudin, bufrodin, gelin, lefaxin, destabilase, new leech protein-1, and whitide. Platelet inhibitors include saratin, calin, apyrase, and decorsin. Antimicrobial agents are estabilase, chloromycetin, theromacin, theromyzin, peptide B. Extracellular matrix degradation enzymes in leech saliva include hyaluronidase, collagenase. These enzymes facilitate the breakdown of the extracellular matrix, which enhances tissue remodelling and healing.⁽³⁾

Indications for Medical leech therapy (*Jalaukavacharana*)

Leech therapy functions by reducing tissue capillary pressure and facilitating local anticoagulation. This is achieved through active suction, the secretion of vasoactive substances like hirudin, and passive blood oozing from bite wounds following leech removal.⁽³⁾

Natural hirudin, a bioactive compound derived from *Hirudo medicinalis*, is acknowledged as the most potent natural thrombin-specific inhibitor. Pharmacological studies suggest that hirudin provides substantial protective benefits in chronic kidney disease (CKD), especially in conditions such as diabetic nephropathy, diabetic foot ulcer⁽²⁰⁾ nephrotic syndrome, and renal interstitial fibrosis.⁽²¹⁾ In a study, it was found that leech therapy is beneficial in evacuating hematoma in post-invasive procedures. Leeches can drain the blood and reduce venous congestion.⁽¹⁾ Salivary contents of the leeches have thrombolytic, anti-coagulant, anti-inflammatory, antimicrobial and pain-relieving effects. They increase blood flow and inhibit platelet function. Consequently, leech therapy is highly effective in facilitating wound healing. Medicinal leech therapy has convincing potential in healing varied types of chronic wounds. The therapy appears to work through by venous decongestion, thrombolysis, blood and lymph flow enhancement and the suppression of inflammation.⁽¹⁷⁾ Leech therapy is beneficial in the reduction of pain, tenderness, stiffness and swelling in patients with osteoarthritis.⁽²²⁾ Leech therapy is a safe, cost-effective, and easy-to-use traditional treatment commonly employed in reconstructive plastic surgery to salvage reattached body parts and flaps, particularly in cases involving blood circulation issues.⁽²³⁾

Acharyas say that removing impure blood from the body using *Jalauka* (leeches) is beneficial as it is a non-invasive procedure. *Jalaukavacharana* aims to purify the body by eliminating toxins and improving local circulation. *Jalaukavacharana* falls under the category of *anusastra* (parasurgical) procedures. *Anusastra* procedures are less invasive and are designed to complement primary surgical treatments or address conditions that do not require full surgical intervention. *Jalaukavacharana* (Leech therapy) is a key therapy for *raktaja* (vascular) disorders and also play a significant role in reconstructive surgery.⁽³⁾

Jalaukavacharana is indicated for privileged individuals, such as king, economically advantaged groups, children, the elderly, timid

individuals, the weak, and women due to less complications. *Jalaukavacharana* offers advantages over instrumental bloodletting, as the leech's bite is less painful than the incision made by a lancet or scarifier.⁽²⁴⁾ Additionally, leeches can be applied to anatomical areas that are difficult to treat with traditional methods, such as the tonsils, haemorrhoids, or cervix.⁽²⁵⁾

Since *jalauka* is predominantly aquatic and has *madhura* rasa properties, it is used for *raktamoksha* when the blood is vitiated by *pitta*.⁽²⁶⁾ *Jalaukavacharana* is effective even in cases of persons with a lack of physical ability, severe mental pressure, and stress. Despite these challenges, it can still provide therapeutic benefits and support the healing process. The diseases to which *jalaukavacharana* is beneficial include *gulma* (abdominal masses or tumours), *arsas* (hemorrhoids), *vidradhi* (abscess), *kushta* (skin diseases), *vatarakta* (rheumatoid arthritis), *galaroga* (diseases of neck region), *netraroga* (diseases of the eye), *vishaja rogas* (diseases caused by poisoning or toxins), and *visarpa* (erysipelas).⁽²⁷⁾

Jalaukavacharana is considered superior to other bloodletting procedures and external medicinal applications for treating various diseases. In the field of Shalya tantra (surgical therapy), bloodletting is the most important treatment for several diseases. Under *Raktamoksha*, *Jalaukavacharana* (leech therapy) can be performed in a very short time and at a minimal cost without any wounds or other complications. Through this process, it is possible to eliminate impure blood without causing any damage to blood vessels or nerves, and without the risk of infection, thereby promoting disease relief. By cultivating leeches, one of nature's diversities, and using them in medical therapy, it becomes possible to simplify technical surgical procedures. Leeches can be cultivated at a moderate cost. *Jalaukavacharana* can be administered once a week, and the same *jalauka* (leech) can be reused, making it a more sustainable and eco-friendly option.⁽²⁸⁾

Leech therapy in the context of environmental sustainability

The method of *Jalaukavacharana* allows for the treatment of various diseases without the need to cut down and destroy thousands of trees to prepare medicinal compounds. However, it is essential to protect nature in a way that benefits future generations while treating diseases with leeches, thereby ensuring the preservation of trees. Leeches can be cultivated in a completely scientific manner. To achieve this, it is essential to provide them with a suitable habitat, food, and breeding facilities. Air circulation and moderate sunlight should be provided, with temperatures maintained between 18 and 25 degrees Celsius. The pH of the water should be kept between 5 and 6. Additionally, mosquitoes should be controlled using barriers. The dissolved solid substances in the water (TDS) should not exceed 400 ppm. If TDS in the water is above 400 ppm, the water is not suitable for breeding. The life span of *jalauka* is up to ten years. A single leech can be properly sterilized and used multiple times on a patient and the cultivation is also economical.⁽⁶⁾

Jalaukavacharana's integration into modern medicine exemplifies the convergence of traditional wisdom and contemporary science. Its diverse applications in vascular health, wound care, dermatology, and pain management highlight its relevance in the health care system. *Jalaukavacharana*, or leech therapy, holds significant relevance in modern medicine due to its distinctive therapeutic properties. In cases of venous congestion and deep vein thrombosis, the heparin-like compounds in leech saliva can be effectively utilized. To establish the efficacy of leech therapy, it is essential to conduct more scientifically structured randomized controlled trials with sufficiently large sample sizes. *Jalaukavacharana* can be utilized for detoxifying the blood by aiding in the removal of harmful metabolites, particularly in inflammatory and autoimmune conditions. The anti-inflammatory and analgesic properties of bdelins and eglin, present in leech saliva, hold significant potential for medical applications and warrant further research. Its therapeutic effects can be utilized to alleviate pain in conditions such as rheumatoid arthritis and osteoarthritis, as well as in chronic conditions like fibromyalgia and sciatica. Leech therapy has emerged as an alternative remedy for treating vascular disorders, as leech saliva can temporarily enhance blood flow and alleviate connective tissue hyperalgesia. The effectiveness of leech saliva in cardiovascular diseases (CVDs) is attributed to specific thrombin inhibitors, particularly hirudin. Hirudin has a potent inhibitory effect on both free and clot-bound thrombin. The potential of leech therapy in this area should be recognized and explored for its application in contemporary medical science.⁽²⁹⁾

Penile replantation through non-microsurgical procedures has demonstrated significant success when combined with leech therapy. Patients treated with leech therapy exhibited no oedema and maintained normal functions, including sensation, erection, and proper emptying. This study underscores the significance of leech therapy as an invaluable tool in the surgical field.⁽²⁹⁾ Leech therapy can be used in cosmetic and reconstructive surgery. Anticoagulant properties of leech saliva facilitate circulation and enhance healing mechanisms. Flap necrosis can be prevented by the application of leeches. Leech therapy has a potential role in improving blood circulation, reducing venous congestion and enhancing oxygen supply. Due to these properties, it can be considered an ideal nonoperative approach for tissue salvage in plastic surgery patients.⁽³⁾ *Jalaukavacharana* has gained renewed relevance in modern medicine due to its distinctive therapeutic properties.

Discussion

Jalaukavacharana (Leech therapy) is an ancient form of treatment. It is used extensively in traditional medicine across cultures due to its unique benefits. Leech therapy dates back thousands of years with records showing its use in India, Greece and ancient Egypt.

Leeches, particularly the species *Hirudo medicinalis*, secrete saliva containing bioactive substances that have multiple therapeutic effects. Hirudin, a potent anticoagulant found in leech saliva, prevents blood from clotting during feeding. This property aids in improving blood circulation and preventing clots. Leeches secrete analgesics making the bite painless. Vasodilators and anti-inflammatory agents in the saliva help widen blood vessels and reduce inflammation, enhancing the therapeutic effect. Calin and other enzymes present in leech saliva promote wound healing and blood flow. Medical leech therapy is beneficial in Reconstructive Surgery for improving blood circulation in tissues and reducing venous congestion.⁽³⁾

Its anticoagulant effect helps to prevent blood clotting and supports patients with cardiovascular conditions, such as deep vein thrombosis. Leeches can reduce pain and inflammation in arthritic joints through their anti-inflammatory compounds. Leeches help improve microcirculation by drawing out pooled blood and allowing fresh, oxygenated blood to flow into the area. It's a natural treatment that avoids the use of strong drugs or invasive procedures. The anticoagulant effects can reduce the risk of thrombus formation in certain patients.⁽⁸⁾

As demonstrated in animal studies, leech therapy has been shown to reduce damage to testicular tissue caused by torsion and detorsion through its antioxidant, anti-inflammatory, and anti-apoptotic properties. Therefore, it may serve as an effective treatment for testicular ischemia/reperfusion.⁽³⁰⁾ Leech therapy is now recognised in some medical centers as an adjunct therapy, particularly in plastic and reconstructive surgery. Research continues into its benefits for conditions like osteoarthritis and chronic pain. Sterile and laboratory-raised leeches are safe for use in therapy. Research into leech-derived compounds could lead to the development of new anticoagulant drugs, anti-inflammatories, and treatments for various circulatory disorders. The bioactive components in leech saliva hold promise for pharmaceutical applications, and more refined, synthetic versions of these compounds could provide targeted therapeutic solutions.^(4,31)

Conclusion

Jalaukavacharana (leech therapy) holds a significant place in Ayurvedic therapy particularly for privileged individuals due to its gentle nature, minimal pain, and reduced complications. Leeches are used for *rakta moksha* (bloodletting) when the blood is vitiated by *Pitta*. The therapy is beneficial even for individuals who are physically or mentally strained, as it supports healing and provides therapeutic relief in various disease conditions.

The effectiveness of leech therapy is attributed to the diverse biologically active substances in leech saliva, which possess anticoagulant, thrombin-regulating, analgesic, anti-inflammatory

and antimicrobial properties, contribute to improved blood flow, pain relief, reduced inflammation, and tissue healing by breaking down the extracellular matrix through enzymes like hyaluronidase and collagenase.

Overall, *Jalaukavacharana* serves as a highly beneficial and minimally invasive therapy that offers both systemic and localized benefits, making it a suitable and effective treatment option for a range of conditions, particularly those associated with *Pitta* vitiation and inflammatory states. As medical science advances, the potential applications of leech therapy may expand, unlocking more of the therapeutic secrets hidden within leech saliva.

Establishing leech therapy requires addressing some challenges. Standardization is crucial to ensure the selection of medical-grade leeches, thereby minimising the risk of infections. Addressing these challenges through stringent protocols and patient education is essential for the successful integration of leech therapy into modern medical practice.

Leech therapy has experienced a resurgence in modern medicine due to its unique therapeutic properties. Contemporary applications span various medical fields, including reconstructive surgery, cardiovascular disease, urology, dermatology and chronic pain treatment. Leech therapy plays a significant role in promoting wound healing, particularly in cases of diabetic foot ulcers.

The contemporary potential of leech therapy is vast, with applications across multiple medical disciplines. Ongoing research continues to explore and validate its efficacy, ensuring its place in modern therapeutic practices.

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