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Unified Review of Leech Therapy: Administration and Implications in Various Clinical Areas in the world of diseases in *Shalyatantra*

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Abstract:

The treatment of disease conditions with the application of medicinal leeches is termed as Leech Therapy. It has been termed as *Jaloukavacharana* in ancient *Ayurvedic* texts. *Acharya Sushruta*, the father of Surgery has stated the uses of leeches in *Anushastras*, which means the instruments or tools which can be used as Para surgical tools *Jaloukavacharana* has been an established therapy of *Raktamokshana* by *Anushastras*. Leech therapy (Hirudotherapy) is one of the oldest practices in medicine; it is known from the time of extreme antiquity and is still alive . Leeches were used for treatment in Egypt as early as 1500 BC. Salivary glands of a medical leech contain more than 100 bioactive substances and the salivary gland secretion has anti-edematous, bacteriostatic, and analgesic effects; it possesses resolving activity, eliminates microcirculation disorders, restores the damaged vascular permeability of tissues and organs, eliminates hypoxia (oxygen starvation), reduces blood pressure, increases immune system activity, detoxifies the organism by antioxidant pathways, relieves it from the threatening complications, such as infarct and strokes, and improves the *bioenergetic* status of the organism. By the virtue of salivary gland secretions which are *proteinatious* enzymes, it acts on various diseases like Arthritis, Chronic non healing wound, Venous diseases, Reconstruction surgeries, and many more. It has been said by *Sushrutaacharya* that Leech Therapy is a sole treatment in many surgical diseases.

Keywords:

Leech Therapy, *Hirudo* Therapy, Salivary gland secretions, Reconstruction Surgery, Arthritis

Introduction:

The treatment of disease conditions with the application of medicinal leeches is termed as Leech Therapy [1]. It has been termed as *Jaloukavacharana* in ancient *Ayurvedic* texts. Acharya *Sushruta*, the father of Surgery has stated the uses of leeches in Anushastras, which means the instruments or tools which can be used as Para surgical tools in the delicate and elderly people and also can be used in the absence of surgical instruments.[2] According to the modern Medical Science, in this non-invasive treatment modality, medicinal leeches (*Hirudo medicinalis*) are used, hence this is also called as "*Hirudotherapy*" which takes

the advantage of several biological properties of medicinal leeches. Among these, the earliest known fact was that leeches feed on the blood of their host and, during the course, release anesthetic, anti -inflammatory and anticoagulants enzymes along with their saliva. For centuries, leeches were the common tools of physicians, who were of the belief that diseases were the result of an imbalance of various *doshas* or humors and that the body can be stabilized by letting blood out.[3,4]. Later on with due course of time, physicians employed these spineless *hemo* parasites as a remedy for a large number of diseases from cysts, tumors, *Cellulitis*, abscess, congested limbs, musculoskeletal disorders to the treatment of various eye diseases.[5]Modern leech therapy differs from the ancient therapy; in a way, only the leeches, which are grown in farms and which have undergone strict quarantine, are employed for the therapy. Wild leeches are not recommended anymore and a leech is used for a single treatment [6,7]. Today, scientific studies concerning the active substances in the leeches have given us a better understanding of how these wonder creatures work and have increased the field of applications of this ancient therapy.

Review of Leech Therapy in Ayurveda:

It is called as *Jaloukavacharana* by *Ayurved Acharyas* and *Jalloukavacharana* has been an established therapy of *Raktamokshana* by *Anushastras*, others being *Ghatiyantra*, *Shringa* karma and Alabu Karma.30 It is stated by *Acharyas* that, In the field of Shalyatantra, bloodletting deserves supreme importance. Similarly, various tools to carry out bloodletting which means Raktamokshana have been described such as *Shringa* (Horn), *Alabu* (Gourd), *Jalouka* (Leech), and *ghatiyantra* (Cupping therapy). For cessation of progress of the disease as well as for cure of the disease one has to aim at removal of vitiated blood i.e. *Raktamokshana* therapy. In *Sushruta Samhita*, the procedure of *Raktamokshana* has been hailed as one of the most effective therapies of Vranashopha[8]. *Raktamokshana* is considered as half of the treatment of any disease in *Shalya tantra*[9]. Among various methods for Blood Letting, *Jalloukavacharana* is described as the supreme therapy because of its safety and high efficacy in the disorders involving the vitiation of blood[10]. *Jalloukavacharana* procedure by its mechanism arrests the progress of Vranashopha and removes the vitiated *Rakta* from the disease site.

Indications for *Raktamokshana* (bloodletting):

- Vranashopha (Cellulites)
- Kushtha (Skin Diseases),
- Visarpa (Erysipelas)
- Pidaka (Skin eruptions)
- Raktapitta (Bleeding disorders)
- Gudapaka (Proctitis)
- Pleeha (Splenomegaly)
- Vatarakta (Gout)
- Arsha (Haemorrhoids)
- Vidradhi (Abscess)
- Arbooda (tumour)
- Shwitra (Leucoderma)

- Dadru (ring worm) [11]

Complications of Jalloukavacharan (Leech Therapy)

Shotha (swelling), *Kandu* (*Severe Itching*), *Murcha* (Shock), *Jwara* (fever), *Daha* (local Burning), *Chardi* (Vomiting).[12]

Leech therapy Review-a Modern Science Way-

The first description of leech therapy, classified as blood Letting, was found in the text of *Sushruta Samhita* (dating 800 B.C.) written by *Acharya Sushruta*, who was also considered the father of surgery. He described 12 types of leeches (6 poisonous and 6 non-poisonous).[10] Diseases where leech therapy was indicated were skin diseases, sciatica, and musculoskeletal pains etc. Medicinal leeches have been found to secrete saliva containing about 100 different proteins. These achieve a wide variety of goals useful to the leech as it feeds, helping to keep the blood in liquid form and increasing blood flow in the affected area. Several of these secreted proteins serve as anticoagulants (such as *hirudin*), platelet aggregation inhibitors (most notably *apyrase*, *collagenase*, and *calin*), vasodilators, and proteinase inhibitors. It is also thought that the saliva contains an *anaesthetic*, as leech bites are generally not painful and enzymes containing analgesic and anti-inflammatory properties. Medicinal leeches are any of several species of leeches, but most commonly *Hirudo medicinalis*, the European medicinal leech. Hence Leech Therapy has been established as one of the most efficacious therapies in the management of various disease conditions in body like like psoriasis, Eczema, cysts, abscess, *celulites*. [13]

Historical Perspective from other part of world;

Leech therapy (*Hirudotherapy*) is one of the oldest practices in medicine; it is known from the time of extreme antiquity and is still alive . Leeches were used for treatment in Egypt as early as 1500 BC, where they were used to treat ailments, like nosebleeds and gout. Leech therapy was documented in Sanskrit writings from 1300 BC. *Themison* of *Laodicea* also reported HT in 50 BC. Greek and Roman writings described leech therapy in 50 AD [10]. Therapeutic use of leeches has appeared in ancient Greece, China, India and Pre Columbian America. *Nicander* of Colophon (200-130 BC) was probably the first medical practitioner to use leeches for therapeutic purposes. Leech therapy is well documented in the works of Pliny, Galen, *Themison* and Avicenna. Leeches were named *Hirudo medicinalis* by Linnaeus in 1758 . During the seventeenth and eighteenth centuries, leech therapy played a pivotal role in therapeutic practices, which involved bloodletting and purification, a practice employed to treat many ailments, from gout to headaches. The greatest use of leeches was in Europe during the 1800s. In 19th-century America, leeches were often a home remedy for gum disorders, hemorrhoids and large bruises. The major event in the history of leech therapy was the discovery by J.B. *Haycraft*, a professor at King's College in *Birmingham*, that the throat and mouth of the leech contained a substance that

prevented the blood from coagulating in 1884. This compound was later isolated from leech saliva by Jacoby and was named *hirudin* around 1904. *Hirudin* was employed in a blood transfusion in 1915. With the advent of antibiotics in the 20th century, however, the practice of leech therapy gradually lost favor. Bloodletting using leeches and other methods enjoyed a revival in the early 19th century, particularly in France. A specific area of leech therapy was soon to be determined by the surgeon *Termier*. He recommended the direct application of leeches in 1922. This technique was called "*hirudinization* of the blood." In 1935, scientist Bottenberg established the general indications for leech therapy . Modern study of leech therapy began in the 1960s, when medicinal leech therapy achieved an international comeback, initially because of the spectacular results in plastic and reconstructive surgery for the treatment of postoperative venous congestion and graft rejections. Since the 1980s, leech therapy has regained recognition in the medical literature after initial publications by Upton's group; Mahaffey's team in Europe also gave this treatment modality new impulse. The use of medical leeching in modern micro-vascular surgery and tissue transfer began when two Slovenian surgeons used the parasites to assist with circulation after tissue-flap transplantation. In 1983, Henderson et a1. reported a case where leeches were used in the post-operative treatment of a scalp avulsion case .In 1985, Harvard physician Joseph Upton used medicinal leeches to successfully reattach the ear of a five year-old boy Since then, leeches have been widely used to reduce venous congestion in fingers, toes, ears, and scalp reattachments, as well as to salvage vascular compromised flaps, or muscle, skin, and fat tissue surgically removed from one part of the body to another, and replants, limbs or other body parts reattached after traumatic amputation. In July 2004, the FDA approved leeches as a medical device in the area of plastic and reconstructive surgery Nowadays, HT is being employed in the surgical field to treat venous congestions of micro vascular replantation, reconstructive surgery and traumatology. In addition, leech therapy is used in neurology, dermatology, gynecology, and is giving good results in these areas as well.[14]

Mode of action of Leech Therapy

Leech therapy involves an initial bite, which is usually painless (leech saliva contains a mild anesthetic), and an attachment period lasting 20 to 45 minutes, during which the leech sucks between 5 and 15 ml of blood. Its main therapeutic benefits are not derived from the blood removed during the biting (although this may provide dramatic relief at first), but from the anticoagulant and vasodilator contained in the leech saliva. These properties permit the wound to ooze up to 50 ml of blood for up to 48 hours. Leech bites usually bleed for an average of six hours [15,16]. Salivary glands of a medical leech contain more than 100 bioactive substances and the salivary gland secretion has anti-edematous, bacteriostatic, and analgesic effects; it possesses resolving activity, eliminates microcirculation disorders, restores the damaged vascular permeability of tissues and organs, eliminates hypoxia (oxygen

starvation), reduces blood pressure, increases immune system activity, detoxifies the organism by antioxidant pathways, relieves it from the threatening complications, such as infarct and strokes, and improves the *bioenergetic* status of the organism [17].

The Salivary Gland Secretions of Leech-

The molecules existing in leech saliva and the most studied to date include:

- *Hirudin*: An active principle in the salivary gland secretion of leeches, which acts as a potent anticoagulant (blood thinner). It inhibits blood coagulation by binding to thrombin [11,15,16]
- *Hyaluronidase* (spreading factor): Facilitates the penetration and diffusion of pharmacologically active substances into the tissues, especially in joint pain and has antibiotic properties [11.15,16.18].
- *Calin*: Inhibits blood coagulation by blocking the binding of the Von *Willebrand* factor to collagen. It inhibits collagen-mediated platelet aggregation [16,19].
- *Destabilase*: Dissolves fibrin and has thrombolytic effects. [16,20].
- *Hirustasin*: Inhibits *kallikrein*, *trypsin*, *chymotrypsin*, and *neutropholic cathepsin* G [21,22].
- *Bdellins*: Anti-inflammatory effect and inhibits trypsin, plasmin and acrocin [15].
- *Chloromycetyn*: Potent antibiotic [23].
- *Tryptase* inhibitor: Inhibits *proteolytic enAbdullah* S et al. Arch *Clin* Exp *Surg* Year 2012 | Volume:1 | Issue:3 | 172-180 enzymes of host mast cells [15].
- *Eglins*: Anti-inflammatory. They inhibit the activity of alpha-chymotrypsin, chymase, *substilisin*, *elastase*, and *cathepsin* G [15,16,24].
- Factor *Xa* inhibitor: Inhibits the activity of coagulation factor *Xa* (very important role during the treatment of *Osteo*-arthritis and Rheumatoid arthritis) [16,21,22].
- Anesthetic-like substances: Reduce pain during biting by a leech [6,25].
- Histamine-like substances: A vasodilator increases the inflow of blood at the bite site [12,15,24,26].
- Complement inhibitors: Replace natural complement inhibitors if they are deficient.[27]
- *Carboxy*-peptidase-A inhibitors: Increase the inflow of blood [25,26].
- Acetylcholine: Vasodilator [15,19,27,28].
- Collagenase: Reduces collagen [12,29].

Procedure of Leech Therapy-

In *Ayurveda*, *trividha Karma* which means, three steps of procedures have been described by *Acharya sushruta* for the action of *Jaloukavacharana* to take place. They are Poorva Karma, *Pradhana Karma* and *Paschata* Karma.[30]

Purvakarma:

1. Procurement- table, Leeches, Gauze Cotton, mustard powder, Haridra Churna (Turmeric powder), Kidney Tray, Disposable Needles

2. Written Consent- Written Consent should be taken in local language (Marathi).
3. Leech storage and preservation should be done in a leech aquarium with muddy environment and adequate water. Care will be taken to change the water frequently.
4. Patient care - General health care of the patient. Mornings should be the preferred time to apply leeches. Pulse, blood pressure of the patient should be examined prior to application of Leech.
5. Care of the Leech (Leech disinfection) – Before use, leeches should be smeared with a paste of mustard and turmeric which acts as a disinfectant and increases their appetite and blood sucking. These disinfected leeches should be kept in a fresh jar of water for half an hour prior to use.

Pradhana Karma:

The area where leech is to be applied should first be cleaned thoroughly with sterile water. Disinfectant or soap should be avoided, as this can irritate a leech and prevent it from attaching. The leech should be taken and its mouth placed precisely over the spot where the blood is to be removed. The leech's tail should be held until it begins to withdraw blood, at which time it can be gently released. The leech will be lightly covered with moist cotton (pads), while it works. This will be kept wet until the end of the procedure. Leeches normally suck about 5ml to 15 ml of blood. Leech should be allowed to finish on its own. The maximum amount of blood to be withdrawn from an individual patient depends on the patient's general condition and the nature of the disease.

Paschata Karma:

a) Aftercare of patient - after the removal of leech, blood should be allowed to flow from the wound for a few minutes .Turmeric powder or *Goghrita* (Cows ghee) should be applied for its antiseptic, antibacterial effects
b) Care of the Leech - Leech can be used with the same patient more than once, but it should be purified after each application. Massaging the leech from tail to mouth will help to vomit ingested blood. Keeping leeches in Turmeric water will also help to vomit the blood without force. Once the leeches are evacuated of blood, they should be kept in dilute saline, turmeric water and plain water in sequence. The leeches will be placed in jars labeled date wise.. The water in the jar should be changed every day to remove any toxins. Used, leeches should not be considered fit for use, for at least 7 days. [31]

Applications of Leech Therapy in Clinical Surgery:

Leech therapy is most often used in the settings of localized venous congestion associated with flap reconstructions and surgical replantations.

1.**Trauma/Hematoma**; *Hirudotherapy* or *Leech* Therapy has also been used to treat soft tissue swelling and hematomas in trauma [32].

2.**Arthritis:** The leech's saliva assists in the treatment of arthritis [12,33]. There are a number of substances and compounds in its saliva that help to reduce inflammation in a joint, some of these compounds are bdelins and eglins, acting as anti-inflammatory substances [11,12,15]. Apart from anti-inflammatory components, its saliva also has an anesthetic component that alleviates the pain felt in the joint and also contains a histamine-like substance that acts as a vasodilator [12,27,28]. Acetylcholine, another component of the leech's saliva, is also a vasodilator [27,28].

2. **Skin flap:** Leeches are being employed in skin flap transplantations [19,33,34,35]. As soon as the leeches attach themselves to the skin flap site, they begin to suck blood. During this, they also release a component called *hirudin* from their saliva [11,12,15]. This component is very vital for the inhibition of platelet aggregation and coagulation cascade. If these two complications continue to supervene in a skin flap, there will be marked venous congestion, which slows down the healing process of the skin graft. Because of the presence of *hirudin* and the Factor Xa inhibitor in the leech's saliva, these processes are inhibited.

4. **Venous congestion:** Leech therapy has been proven to help patients suffering from venous diseases [5,33,34]. It can help reduce the pain and the swelling, due to varicose veins, and can help dissolve blood clots. However, leech therapy is not effective for diseases caused by insufficient valves and inadequate vessel dilation.

5. **Vascular diseases:** Vascular disorders are now being cured by leech therapy [36]. Their saliva has over 100 bioactive substances that are very beneficial. One such component is *hirudin*, which acts as an anticoagulation agent [11,12,15]. *Calin* is another component that also inhibits blood coagulation [11,12,16]. A component that dissolves fibrin clots as well as inhibits the formation of thrombus is the destabilase [11,12,17]. Leech saliva also contains a Factor Xa inhibitor, and this compound restrains the coagulating effect of the coagulation Factor Xa [12,21,22]. It also has *hyaluronidase* that enhances the viscosity of the interstitial fluid [11,12,16]. For a *vasodilating* effect, it has acetylcholine and histamine-like substances as well as *carboxypeptidase*-A inhibitors [28].

6. **Chronic non healing Wound;** While treating a Chronic non healing wound with leech therapy for wound bed preparation, the agendas for the use of leech therapy is biological debridement and blood-letting, in order to accelerate endogenous healing and to facilitate the effectiveness of other therapeutic measures. If the wound is infected, and the wound bed is distorted, then T.I.M.E. principle of wound management should be followed. ,that summarizes the four main components of

1)Tissue management

2)Control of infection and inflammation

3)Moisture imbalance

4)Advancement of the epithelial edge of the wound. The salivary enzymes like *Bdelins*, *Eglins*, *Xa* inhibitor, *Hyaluronidase* being anti-inflammatory and anesthetic in action, and having the blood oozing and thrombolytic activity helps to pool out the toxins and infected blood out of the wound site rendering wound healing and formation of wound bed[41]

There are just some of the very useful components in leech saliva, which work in background to decrease the viscosity of the blood, so as to promote better flow. Blood that has a thick consistency makes it prone to clot formation as well as increases the blood pressure of an individual. These clots can travel to different parts of the body and can block a vessel, which could then cause a stroke or heart attack. Thick blood poses a risk that the distal extremities, especially the tips of the fingers and toes, will not receive adequate oxygenated blood and the nutrients they need. Therefore, the anticoagulation component in a leech's saliva is vital with all these components working together; there will be a remarkable improvement in the vascular status of the patient.

Complications of Leech Therapy:

1. Excessive bleeding can occur with leech therapy; it can be controlled by applying direct pressure or topical thrombin [37].
2. Excessive blood loss may necessitate a blood transfusion, so patients should be informed of the possibility [38].
3. Allergic responses, including anaphylaxis, can also occur. Patients and their families should be alerted to watch out for and report allergy symptoms.[39]
4. Scarring may also occur, but is usually minimal. Infections can arise 2 to 11 days after therapy begins and can result in abscesses and cellulitis, which can progress in some cases to sepsis [39].
5. The most serious complication of leech therapy is infection. The leech's digestive system contains *Aeromonas hydrophila*, a Gram-negative bacillus that enables the breakdown of ingested blood. Although most infections involving leech therapy are caused by A. *hydrophila*, infections with *Serratia marcescens*, A. *sobria*, and *Vibrio fluvialis* have been reported . Prophylactic antibiotics are usually recommended: An established infection is treated with antibiotics, such as third-generation *cephalosporins*, along with aminoglycosides, *fluoroquinolones*, *tetracycline*, or *trimethoprim* [40].

Future Prospects of Leech therapy:

Leech therapy has a long history, going from popular and well accepted, to falling out of favor. Compared to other techniques of complementary and natural therapy, Leech Therapy can be learned relatively quickly and can reduce the complications arising from the excessive use of synthetic drugs. Nowadays, research is being conducted in various fields to determine the therapeutic role of

leeches in various disease conditions, like male and female sterility, diabetes, prostate diseases, lupus *erythromatosis* and many more. Recently, leech Therapy has been successfully employed for relieving symptomatic cancer pain [42]. In view of all the facts about Leech therapy, efforts should be made in optimizing the success of this age old miraculous *para* surgical therapy in clinical and private practice.

Conflict of Interest-Nil

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