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## RECENT ADVANCES IN THE APPLICATION OF LEECH THERAPY

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**Abstract:** Leech therapy gaining global popularity in the treatment of many chronic and life-threatening disorders such as cardiovascular problems, venous thrombosis, non-healing wounds, various skin disorders and infectious diseases etc. Various types of leeches like *Hirudo medicinalis* (European medicinal leech), *Hirudo. orientalis*, *Hirudo. troctina*, *Hirudo verbenae* etc. are found in various places of the world. Among these freshwater leeches i.e. *Hirudo medicinalis*, a fresh water hermaphrodite is most commonly used for therapeutic purpose. Leech saliva contains different type of bio-active substances including prostaglandins, vasodilators, bdellins, hyaluronidase etc. In the 21<sup>st</sup> century, leech therapy has been established in the reconstructive surgery as a protective tool against venous congestion and served to save the replanted digits and flaps. Leech therapy is used as successful treatment modalities to improve blood flow after plastic and microsurgery. Leech therapy has been practiced traditionally for the treatment of skin disorders as toxins are removed along with impure blood.

**Keywords:** Leech therapy, *Hirudo medicinalis*, antithrombin, antiplatelet (calin, saratin), factor Xa inhibitors, vasodilators, plastic and reconstructive surgery etc.

**Introduction:** Medicinal leeches have gained popularity in the field of medical science. Different species of medicinal leeches are popular, among which, the most commonly known is the *Hirudo medicinalis*, a fresh water hermaphrodite. Other *Hirudo* species sometimes used as medicinal leeches are *H. orientalis*, *H. troctina* etc. Recently, extensive researches on leech saliva unveiled the presence of a variety of bioactive peptides and proteins involving antithrombin (hirudin, bufrudin), antiplatelet (calin, saratin), factor Xa inhibitors, antibacterial (theromacin, theromyzin) and others. Consequently, leech therapy gaining popularity in the treatment of many chronic and life-threatening abnormalities such as non-healing wounds, various skin disorders, cardiovascular problems, cancer, and infectious diseases etc. In the 21<sup>st</sup> century, leech therapy has been established in the plastic and microsurgery as a protective tool against venous congestion and served to save the replanted digits and flaps. Many clinics for plastic surgery all over the world started to use leeches for cosmetic purposes.

**Various Types of Leeches:** Taxonomists identified more than 1000 leech species around the globe.

1. *Hirudo medicinalis* (European medicinal leech)
2. *Hirudo. orientalis*
3. *Hirudo. troctina*
4. *Hirudo verbenae*
5. *Hirudo manillensis* (Asian medical leech)
6. *Macrobdella decora* (North American medical leech).

**Habitat of Leeches:** Leeches can live in a variety of environments, including aquatic and moist terrestrial regions. Some species live in freshwater, rivers, ponds, lakes, and sea etc.

**A. Freshwater Leeches:** Globally freshwater leeches are most commonly used for therapeutic purpose. These leeches dwell in the shallow waters of ponds, streams, lakes and rivers. *Macrobdella decora* (North American leech) is a leech with orange spots down its sides and an orange belly. Common freshwater leeches like *Hirudo medicinalis*, *Macrobdella decora* (North American leech) are used medicinally, for the purpose of increasing blood flow. These leeches are medicinally useful because their saliva

contains anesthetic and anti-coagulant, which keeps blood flowing painlessly from the patient.

**B. Marine Leeches:** *Notostomum laeve* is the first recorded marine leech species found in North America. It lives in the icy waters of the arctic ocean. Marine leech species feed on either bony or cartilaginous fish.

#### **Morphology of Leech**

Kingdom : Animalia  
 Family : Hirudinidae  
 Phylum : Annelid  
 Genus : Hirudo  
 Class : Clitellata  
 Species : *H. medicinalis*  
 Order : Hirudinida

Leeches (*Euhirudinea*) were first named by Linnaeus in 1758 AD <sup>[1]</sup>. Size of leech varies among families and can reach up to 20 cm in length, in addition to some giant species (up to 50 cm in length). Typically a leech has anterior and posterior suckers. The posterior is used mainly for leverage, whereas the anterior sucker, consisting of the three jaws (tripartite) used for feeding (sucking) and teeth's (100 sharp teeth) used to incise the host. The incision leaves a mark that is an inverted Y shaped inside of a circle. Leeches breathe through the skin and they are considered as hermaphrodites, but always require another leech for fertilization.

**The Biology of Leech feeding:** Hematophagous leeches are ectoparasites, feed on the blood of vertebrates including human. With the help of suckers and the biting jaws leeches are able to suck blood. It is interesting to note that leeches generally suck 2-20 ml of blood within 10-30 min, then drop-off spontaneously after being completely engorged with no immediate desire of more feeding. Leeches, both hematophagous and predacious, digest their food in their intestine. The hematophagous species only store blood inside their body for months. Actually, the digestion process of blood in hematophagous leeches undergoes many slow stages allowing leeches to store the ingested blood for up to 18 months. Symbiotic bacteria named *Aeromonas* species, located in the leech's gut, secrete enzymes that help not only in breaking down the components of the ingested blood, but also in producing antibiotics to prevent blood putrefaction after a long storage period in leech crop. Another role of these enzymes is to prevent B complex deficiency, which often occurs in blood nutrition depending animals.

**Indications of Bloodletting:** Skin disorders, erysipelas, boils and carbuncle, abscess, ring

**C. Terrestrial Leeches:** All leeches need high moisture to maintain their protective covering of mucus. Land leeches live in the moist soils of rain forests in places like South America, Africa and Asia. Terrestrial leeches are specially adapted to life on land but can survive submerged in water for short periods.

worm, scabies, eczema, discoloration of the body, pigmentation in the face, moles, pruritus, gangrene, leucoderma, haemorrhoids etc <sup>[2]</sup>.

**Contraindications of Bloodletting:** Leech therapy is contra-indicated in patients suffering from generalized anasarca, emaciated and debilitated, anaemia, ascites, pregnant women etc. <sup>[3]</sup>

#### **Materials & Methods**

**A. Accessories for Leech Therapy:** Four bowls, sterilized needle, cotton, gauze, bandage, fresh water, turmeric powder, leeches etc.

**B. Selection of Patients-** Diagnosed patients suffering with various medico-surgical diseases like thrombosed haemorrhoids, chronic wounds, ischemic limbs, skin diseases etc.

**C. Informed Written Consent:** A well informed written consent has been taken before starting the leech therapy.

**D. Collection and Preservation of Leeches:** The leeches are collected from a pond by keeping wet leather in the stream. Best time for leech collection is autumn season (*Sarad ritu*). Leeches are preserved in fish pots and kept in cold climates. Water is changed frequently ie. every 3<sup>rd</sup> day while changing of pot should be done at 7<sup>th</sup> day.

**E. Application of Leeches:** The method of leech application is done according to ancient method as described by Acharya Sushruta. Leech therapy is a parasurgical measure and the procedure is divided into 3 parts.

#### **1. Purvakarma (Pre-operative)**

**a. Purification of Leeches:** Selected leeches are kept in a mixture of turmeric powder & fresh water for 5-10 minutes to make them active & then kept in clean water, now these leeches are ready for application.

**b. Preparation of patient:** Diseased part should be cleaned and sudation therapy performed. Patient should be in lying down position.

**2. Pradhankarma (Leech Application):** If leeches do not stuck, then it is applied after making a fine puncture by sterile needle. Even after this, if it does not stuck, another leech is tried. The leeches sucks blood by its anterior sucker and attached to the base by posterior sucker. The number of leeches and frequency of leech application to be applied varies according to severity of the disease.

**3. Pashchatkarma (Post-operative Care):** The leeches are removed from the site by sprinkling turmeric powder or otherwise leeches left the site on its own when properly sucked. Dressing of site application is done by turmeric powder. Patient has been given idea of oozing of blood from the site upto 6-8 hrs and advised to must attend the OPD on next day. Sucked blood from leeches is removed by sprinkling turmeric powder on its mouth after this vomits the blood naturally, also performed with gentle squeezing from tail to mouth and then kept in fresh water. If blood is not removed from leeches after application, the leeches may die due to indigestion of ingested blood. Acharya has already described "Indramad disease" of leeches which occurs if blood is not removed properly.

**Chemical Composition of Leech Saliva:** Leech saliva also contains several other bio-active substances including

1. Prostaglandins.
2. Vasodilators.
3. Anesthetics and protiens like calin, apyrase hyaluronidase, egline, destabliase.
4. Kollaginase and Pi-yavit etc.
5. Bedallin.
6. Factor Xa <sup>[4]</sup>

**Mechanism of Action of Leeches:** Leeches have anticoagulant property, is the most potent action which was explained in 1884 when John Berry Haycroft, a Birmingham chemist, discovered an anticoagulant, called "hirudin," from the saliva of leech <sup>[5,6,7]</sup>.

- It is known to act at different steps in the coagulation cascade, thereby preventing blood clotting by inhibiting conversion of fibrinogen to fibrin <sup>[8]</sup>.
- It is also known to inhibit platelet aggregation, which further contributes to the process.
- In addition to this, it also has antiseptic qualities. There are also other proteins

present in leech saliva which are said to exhibit analgesic effect and reduce numbness.

**Therapeutic Application of Leeches:** The effectiveness of leech therapy in Cardio-vascular disorders is the results of specific thrombin inhibitors ie. Hirudin. It was first isolated from *H. medicinalis*. Hirudin possesses a potent inhibitory effect on both free and clot-bound thrombin. Hirudin is the only hematophagous animal-derived anticoagulant has been approved by FDA for clinical purpose. Certain studies revealed that hirudin is more effective than heparin in preventing deep venous thrombosis (DVT) and ischemic disorders in patients with unstable angina <sup>[9]</sup>. Leech therapy is used as successful treatment modalities to reduce venous congestion and improve blood flow after microsurgery <sup>[10]</sup>.

1. Leeches were also used to decongest completely amputated organs or parts eg. Ears, foots etc. Leech applications are useful after resection and replantation procedures (ie.plastic and reconstructive surgery <sup>[11,12]</sup>).
2. Used in diabetes mellitus (DM) complications like diabetic foot (diabetic ulcer), cellulitis etc.
3. Leech therapy used in inflammatory and painful conditions eg. Various type of arthritis <sup>[13]</sup>. Hirudin can reduce synovial inflammation in arthritis patients by inhibiting DING protein (inflamed synovial membrane protein), acting as auto antigen in rheumatoid arthritis patients.
4. Leech therapy has been practiced traditionally for the treatment of skin disorders as toxins are removed along with impure blood.

#### Complications in Leech Therapy

1. Most commonly prolonged bleeding may occur.
2. Other complications such as-
  - Allergic reactions such as itching, burning sensation, blister formation and ulcerative necrosis due to toxins present in leech saliva and bacterial infections <sup>[14]</sup>.
  - Infection is the common complication of leeching and occurs in 2-36% of the patients.
  - Transmission of certain infections (various blood borne infections) may take place <sup>[9]</sup>.
  - Tissue or graft loss.
  - Psychological responses.
  - Migration of leeches to other sites.

**Note:** Each leech has to be used only once and then euthanized in 70% alcohol for 5 minutes.

**Conclusion:** Now days, leech therapy has gained a lot of popularity around the globe. It is clinically used cosmetically in conditions like acne vulgaris, vitiligo, psoriasis, non-healing wounds, diabetic foots, ischaemic limbs (Buerger's disease, gangrene etc). Leech therapy is also used in various types of reconstructive or micro surgeries to salvage tissue flaps and skin grafts whose viability is threatened by venous congestion. Leech saliva contains hirudin, which has anticoagulant properties may lead to wider therapeutic applications in the prevention and treatment of thrombo-embolic disorders like varicose veins, DVT etc. Hence, the leech therapy which was used during ancient periods had a scientific approach. Indian systems of medicine have an ethical, scientific, validated approach for various diseases. In present era leech therapy should be established on the basis of scientific parameters and well documentation is the need of time.

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