

HIRUDO-THERAPY IN THE PAST AND ITS FUTURE POTENTIAL

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ABSTRACT

Bloodletting is one of the most ancient ways of dealing with chronic diseases. Among several ways through which the blood may be let out, leech is considered as the most sophisticated and softest way of bloodletting. Leeching is one of the most ancient healing methods documented in the history of medicine. The first clearly identifiable account of leeching appears in ancient writings from India. According to Hindu mythology, Dhanvantari, the physician who revealed the secrets of traditional Indian medicine to the world, held nectar in one hand and a leech in the other. The most extensive description of leech therapy is found in Ayurveda and Siddha systems of medicine which originated in India. Pioneering information about leech's healing potential was found in the Vedas followed by the history of use in different medical traditions including Europe. An attempt has been made to document some ancient instruments associated with leech therapy. In the West, leech therapy is popular and the Food and Drug Administration (FDA) have accepted leech as a medical device in the year 2004. In this connection, clinical trials establishing the efficacy of leech have been compiled. Nevertheless, adverse reactions and contraindications of leech therapy are documented in this review. The primary focus of this article is to enhance systematic research by rigorous randomized controlled trials to revalidate the quality, safety, efficacy of leech therapy thereby providing evidence to utilize leech therapy to its fullest potential.

Keywords: Bloodletting, Leech, Hirudo-therapy, Siddha Medicine, Osteoarthritis

Introduction:

Leech is derived from the Anglo-Saxon word *loece*, to heal, medieval doctors called themselves leeches, the leech was used as an adjunct to bloodletting, in places too sensitive or confined for the lancet or other blood-letting instruments. The earliest record

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of leeches being used for curative purposes is a painting in an Egyptian tomb dating back to 1500 B.C.E. Compiled between 500 B.C.E. and 200 B.C., a medical encyclopedia from India also mentions leeches. The earliest references to the medicinal use of leeches may be found in the writings of Theocritus (3rd century BC), Nicander (2nd century BC) and Horace (1st century BC, while the phenomenon of swallowing a leech is first mentioned in one of the Epidaurian 'iamata' dating to the 4th century BC. Leeching was a practice of the great Arabic physician Avicenna (d. 1037). He believed that leeches drew blood from deeper sources than did wet cupping. Avicenna provided guidelines for the use of leeches and suggested that they should not be taken from unhealthy water or used if their excrement was black and muddy. He was also the first to recommend that a thread should be drawn through the tail to prevent the leech from crawling into any unreachable areas such as the anus or nose¹.

Medicinal leeching first gained true significance in the Methodist School, which differentiated two main causes of disease, e.g. 'constriction' and 'dilation'. Chronic headache, general febrile conditions, psychoses, epilepsy, ear ailments, liver disease, splenic and intestinal disorders, ischialgia, arthritis, and gout were the main indications for medicinal leeching ; general diseases causing symptoms of hardening , heaviness , rigidity, tension, swelling , pain, and cramps (referred to as 'status strictus' in the ancient nomenclature) were additional indications. Leeches were regarded primarily as tools for alleviating the tension associated with status strictus. Advocates of the pneumatic theory of medicine valued leeches as a useful cure for 'putrefaction' and 'plethora' of blood. The object was to replace 'bad blood' with 'good blood'. The therapeutic use of leeches became fashionable and had its first heyday around the middle of the 1st century C.E. An ancient writing credited to the school of the Roman physician Galen (129-199 C.E) classified leeching as part of the system of elements (fire, earth, air and water) and temperaments (Sanguine, Phlegmatic, Choleric and Melancholic), the healthy balance of which required the drainage of excess corporal substances. Distinctions were made between plethora (superabundance) and putrefaction of body fluids, as well as between qualitative and quantitative fluid excesses. Plethoric changes were treated by draining blood from the body, which was chiefly achieved by leeching and blood letting. According to the humoral concept of disease, organs or organ systems are not at risk of damage as long as the body fluids remain in motion and are excreted by the natural routes. However, if one part of the body is directly afflicted and the process become chronic, it should be treated locally in order to restore the healthy flow of humours. Ancient physicians therefore applied leeches for symptomatic local treatment of

febrile and inflammatory diseases. Roman military physicians also used leeches to treat battle wounds².

Evolutionary History of Leech

Leeches were presumably 'applied' very much earlier than the documented records of medicine show - although not by humans. In the Cambrian explosion of life form development roughly 400-500 million years ago, prehistoric annelids evolved as segmented invertebrates from the first multi-cellular organisms. These 'arch-annelids' ultimately evolved into leeches. Since they were among the first hunters in the earth's history, they were one of the factors that guided selection and drove the pace of evolution. The prehistoric annelid was also an ancestor of humans. Segmentation is a consequential biological trait shared by the two species. Surprisingly enough, the blood of leeches and humans also has similarities, suggesting a common ancestry: Haemoglobin serves as the carrier of oxygen in medical leeches as well as in humans, but is dissolved in the respiratory fluid of the one (leech) and is stored in blood platelets/erythrocytes in the other (human). The leech belongs to the class of legless, backboneless animals called annelids or the ringed ones. Of the over 130 species of them, the one used in medicine is called *Hirudo medicinalis* (Linnaeus, 1758). This quaint, dark cylinder of 33 body rings has 5 pairs of eyes to see better, several pairs of testes to breed better and two suckers both on its front and backside. The head sucker 'searches' and penetrates while the tail sucker holds fast to the host. Young hirudo feed on frogs and not mammals, since their jaws are not strong enough to cut through mammalian skin, while adults feed on mammalian blood. The *Hirudo* is a sparse eater, though in a full meal lasting 30 minutes, it takes in about 15 ml of blood, bloating up to 10 times its size, and when done, simply drops off. It feeds only once in 6 months, taking all this while to digest the blood. Bacteria that live within the leeches body help keep the blood from decaying. Sometimes, when blood is not easily available, it may go even longer on a fast, digesting its own tissues³.

Leech in Ancient European Medicine

In Europe, medicinal leeching was viewed as a science æbased therapeutic method right from the beginning. Leeching was an integral part of conventional and folk medicine from antiquity to the 19th Century. Medicinal leeching initially remained primarily the domain of empirically minded physicians. Then, most proponents of medicinal leeching deduced its therapeutic efficacy within the framework of the prevailing scientific paradigms of their respective school of medicine. Leeching remained part of various systems of medicine through the centuries. The underlying basis for its use was the widespread belief in the

concept of body humours (humoral pathology). This broad concept of disease was based on the notion that all illnesses are caused by an imbalance of one of the four body fluids, or humours (blood, phlegm, yellow bile and black bile). Leeching had a fixed and relatively modest range of indications in humoral pathology, the dominant paradigm in ancient European and Arabic medicine until the 17th century. Like bloodletting, leeching was mainly conceived as a means of eliminating the superabundance of blood, or plethora. The other main indications for leeching in early medicine were acute infection, local inflammation, heart problems, and circulatory disorders. Following the decline of humoral pathology, an age of misuse of leeching ('the age of vampirism') began in the 18th and 19th centuries. Mainly influenced by the teachings of the French physician F.J.V. Broussais (1772-1838), the indications for leech application were extended for no rationally justifiable reason, and leeching was performed at an intensity of hitherto unknown proportions⁴.

Leech in Sacred Literature

In Bible

Leech has been mentioned in the bible in proverbs chapter 30, verse 15 as 'the leech has two daughters. Give! Give!' according to the New International Version (NIV). The Geneva study bible explains the blood sucking nature of leech which has two forks in her tongue, which here he calls her two daughters, by which she sucks the blood, and is never satisfied: even so, the covetous extortioners are insatiable⁵.

In Rig Veda

A clear mention about Leech, the parasite physician who happily or willingly heals the sick has been mentioned in The Rigveda in Book 9, Hymn 112, translation by John Muir as follows:

'Men's tastes and trades are multifarious,
And so their ends and aims are various
The smith seeks something cracked to mend,
The leech would fain have sick to tend
The priest desires a devotee,
From whom he may extract a fee'

Before medicine and surgery, physicians depended on what was available in the surroundings to treat illness. The materials used were minerals, metals and stuff from plants, and some animal products but seldom whole animals. One outstanding exception has been the use of live adult leeches. Up until a hundred years ago, the physician's bag

usually had a few leeches, which were used for blood-letting of patients who had circulation problems. In doing so, the physician was continuing a four millennia old tradition. Yes, the ancient Egyptians, Greek and Indian medicine men used the leech to help maintain what they supposed to be the humoral balance in the body. They attached the leech to the body for the cure, and detached it by sprinkling some salt water.

Moreover, in Rig Veda translated by Griffith (1896), also mentions about leeches that has medicinal properties to heal in Hymn CLVII. Ásvins as follows:

'Leeches are ye with medicines to heal us, and charioteers are ye with skill in driving.

Ye Strong, give sway to him who brings oblation and with his heart pours out his gift before you'⁶.

In Shukla Yajurveda

The texts of the Shukla (White) Yajurveda, translated by Griffith (1899) in verse 57 (book twenty, page 193) mention that leeches brought sweet medicine. It is commendable to note the astounding insight of the authors having foretold the various chemical constituents of leech and its medicinal properties⁷.

In Atharva Veda

In the Hymns of the Atharva Veda, the significance of Leeches are mentioned in Chapter nine entitled 'A charm to cure dangerous disease' translated by Griffith (1895) as follows:

1. Free this man, Dasavriksha! from the demon, from Grāhi who hath seized his joints and members,
And raise him up again, O Tree, into the world of living men.
2. He hath arisen and come once more, rejoined the band of those who live.
May he become the sire of sons, and of all men most fortunate.
3. He hath returned to consciousness, rejoined the living's firm abodes,
For hundred leeches are in this, yea, and a thousand healing herbs.
4. The Gods, the Brāhman-priests, and plants observed the way to gather thee:
All deities described the way men gather thee upon the earth.
5. Let him who made it also heal: he, truly, is the deftest leech.
Pure, with a leech he verily shall give thee medicines that heal.

The phrase 'hundred leeches are in this' in the 3rd stanza refers to the amulet possessing the healing power of a hundred physicians and a thousand medicinal leeches. An amulet from Latin amuletum is used in the earliest in *Naturalis Historia*, which means an object

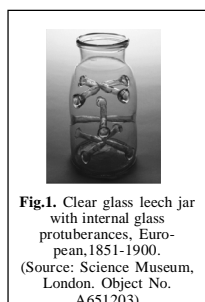


Fig.1. Clear glass leech jar with internal glass protuberances. European, 1851-1900. (Source: Science Museum, London. Object No. A651203)

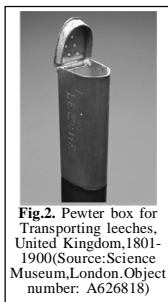


Fig.2. Pewter box for Transporting leeches, United Kingdom, 1801-1900. (Source: Science Museum, London. Object number: A626818)

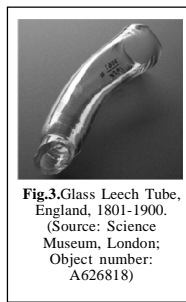


Fig.3. Glass Leech Tube, England, 1801-1900. (Source: Science Museum, London; Object number: A626818)

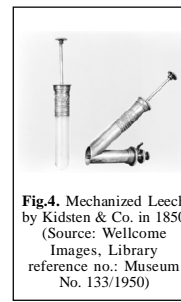


Fig.4. Mechanized Leech by Kidsten & Co. in 1850 (Source: Wellcome Images. Library reference no.: Museum No. 133/1950)

that protects a person from trouble indicating the significance and medicinal properties of leeches. The 5th stanza underlines the potential of leech by defining them as 'deftest' which means quick and skilful and its capability to heal⁸.

Instruments associated with Leech Therapy

In the past, there were several instruments associated with leech therapy.

Clear glass leech jar (Fig.1.) is a jar used to store leeches temporarily. Earlier leeches were collected from natural habitat.

Pewter box (Fig.2.), a special box has been used to transport leeches to where they were needed. This box is made of pewter and has air holes in one end. The word 'LEECHES' is engraved on the side.

Glass leech tube (Fig.3.) was used to apply leech at the place of focus on the body.

Mechanized Leech (Fig.4.), was invented by Messrs. Kidsten & co. The blades of the lancet are designed to give a puncture resembling that of a natural leech. After puncture, blood is drawn off by means of the glass cylinder and piston.

Specific Historical Uses of Leeches

Leeches were particularly useful for bloodletting in areas not easily accessible to other tools such as the rectum and the esophagus, when the surgeon desired to remove only a fixed quantity of blood, and when patients were unable to withstand other methods of bloodletting due to weakness or otherwise. Leeches were used to treat many common disorders and diseases including mental illness, epilepsy, insomnia, headaches, obesity, tumours, gout, cirrhosis, bladder problems, bronchitis, laryngitis and menstrual disorders. Generally, the leeches would be placed as near as possible to the site of complaint, for example, on the temples for headaches, on the abdomen for gastrointestinal inflammation,

and on the vulva, groin and thighs for menstrual disorders. In 1818 William Brown described a procedure for applying leeches to the anus which he believed cured abdominal inflammations including hepatitis, enteritis, puerperal fever, suppressed menses and lochia. The patient 'is seated on a perforated chair, which only uncovers the anus itself; the operator, stooping or kneeling, by means of a taper, sees the part to which the leech is to be applied; and, provided with a small round wide-bottomed bottle with a long neck, just large enough to contain one leech, he allow the animal to crawl out and fix itself on the part intended. The operator having applied one leech withdraws the bottle, and proceeds to fix one after another till the desired number have been applied; a basin is placed under the chair into which the blood flows⁹.

Leeches were also applied to mucous membranes to treat inflammation. Rather than place leeches on the temples and eyelids, in 1822 Phillip Crampton experimented with placing the leech directly on the conjunctiva and found that it was actually more effective. This success led him to apply leeches to such areas as tonsils when they were inflamed, and nostrils when treating nose-bleeds. This involved, the threading procedure in which threading silk through the leeches tail so that it could be pulled out of the dangerous area once it had completed its feeding. By 1833, physicians had found that when a patient's intestines were inflamed it was sometimes not effective to place leeches just at the anus, but rather the leeches had to be positioned internally into the rectum. Thus, the technique described above was modified to deal with the internal sphincter mechanism which served as a hindrance to leech entrance into the rectum. A leech was placed in a grooved metal rod and the operator, holding the ends of the threads, introduces the instrument into the rectum, and pushes it up so as to cause it to draw up the leeches along with it into the rectum. When they have thus been conveyed up beyond the sphincter, the instrument is withdrawn, and the leeches are suffered to remain till gorged with blood and loosened from their hold, when they are drawn out by means of the threads which the operator retains outside the anus. A similar technique was used in the 1840's to apply leeches to the prostate gland. Brown's method for treating suppressed menses was replaced in 1852 by a method devised by Samuel Ashwell. He recommended that leeches be applied to the uterine os by 'clever nurses' to stimulate menstrual flow¹⁰.

Leech in Siddha Materia medica

Leech is an effective deobstruent used for its antiphlogistic action. Leech therapy is especially utilized for delicate and geriatric subjects, women, children, persons who are afraid to undergo surgery and possessing predominant azhal (pitha) constitution. The significance

of leech therapy is emphasized by the unique quality of the bird named 'Annaparavai' (Swan) in Tamil Language. The exceptional quality of this bird enables to separate the diluted milk with water and feeds on the milk alone. Just like Annaparavai, leech feeds on the toxic components and removes them from the body thereby purifying the blood. Since leeches are born and live in water, it possesses sweet and coolant properties, which are effective to check azhal diseases. One leech can suck up to 120 drops of blood accounting to blood-letting to the tune of 12 inches. In one sitting, it is not advisable to use more than 4 or 6 leeches. Leech application is said to be successful only after the removal of toxic components of the blood and the absence of pain and discomfort due to the disease¹¹.

Purification of Leech & Preparation of the Subject

Before using the leech for therapy, they are purified by leaving them in a wide mouth glass container containing turmeric mixed with water. From the body of the leech, phlegm like substance comes out, after which the purification process is complete, and leech is now ready to use. If phlegm like substance is more or if the leech does not swim briskly, it indicates that leeches will not fix to the skin properly.

The subject should be prepared by administering medicine for purgation or vapour bath (steam inhalation) or vomiting one day before the application of leech. During the application of leech, the subject should not be subjected neither to fasting therapy nor starvation and insomnia. The site of leech application should be cleaned by fuller's earth and sand followed by application of red ochre sand¹².

Therapeutic Indications

- Used in the same sites for blood-letting in conditions such as oedma due to wounds resulting from trauma, abscess, incipient swelling, sprain, and inflammation affecting the skin and bones.
- Obstinate vomiting may be checked by applying few leeches to the pit of xiphisternum.
- In violent headache, leeches are applied to the temple. If the headache persists, then apply leech to the nape of the neck.
- In severe pain of the chest or abdomen occurring during fever, leeches are applied in that respective areas for relief.
- In severe headache caused during bleeding haemorrhoids due to obstruction of bloody discharge, leeches are applied around the anus for clearance. But care is taken to prevent the leech not to enter the anus.
- For headache due to amenorrhoea, leeches are applied to the inner parts of the thigh.
- To relieve abdominal colic caused by bloody dysentery, leeches are applied around the anus.

- For liver swelling, leeches are applied over the region of the liver.
- For whooping cough in children, leeches are applied to the middle of the back.
- For chronic and different types of swelling / inflammation of the joints, leeches can be applied with beneficial results.
- For many eye diseases, such as cataract, leeches can be applied to the area near the eyes (1/2 inch away from the eyes just below the eyebrows)¹³.

Side Effects & Treatment

If more than the specified number of leeches is used or if the blood loss is heavy, the place of leech bite will be itchy and develop into a painful swelling. Fermented gruel or rice-vinegar. (Kadi), black variety of sesame seeds (Kar- ell) and Aloe vera are made into a paste and applied over the swelling (or) the fleshy pulp of Aloe vera is heated, incised into two pieces in which turmeric powder is sprinkled, placed over the site of inflammation and tied to relieve the same. If the bleeding continues, after the fall / removal of leech, various haemostatics can be applied to arrest bleeding such as fried (desiccated) alum, copper sulphate, turmeric powder cotton ash, cloth ash, cobweb, powder of oak gall - Quercus infectoria (massikkai), etc., to the site of the bite. If bleeding persists, finger is pressed over the site of bite or a very fine point of caustic nitrate of silver (kadikasan) is applied or a bandage cloth is tied tightly to stop bleeding. If no result, red hot needle is applied over the bite is useful. Medicated oil with bee wax (Mezhugu thylam) can also be applied.

In order to facilitate more blood flow from the bite site, fomentation with hot water or rice bran or five-leaved chaste tree leaves or neem leaves be utilized, if necessary.

Leech sucks blood within 5 hour to 4 hours and automatically falls off after accomplishing its job. When the leeches are to be removed, sprinkle a small quantity of salt water or kadi neer (rice vinegar) at the site of the bite. The same can be used to remove leech, if leech enters the nostril, anal or genital orifice¹⁴.

Chemical Constituents

The bite of the Hirudo is painless. It has an anesthetic effect that makes the bitten host feel nothing. Hirudin is a naturally occurring peptide in the salivary glands of medicinal leeches that has a blood anticoagulant property. Besides this, the leech saliva has many other molecules of great medicinal interest as listed in Table 1. One of them is a vasodilator, a histamine that increases the diameter of blood vessels, helping to promote blood flow. Another is an enzyme called hyaluronidase, which breaks down hyaluronic acid, the bonding material of connective tissue, thus fostering the flow of blood and fluids from affected areas.

Table 1. Chemical Constituents of Leech Saliva 15

Bio-constituent	Effect on the host
Hirudin	Inhibits blood coagulation by binding to thrombin
Calin (saratin)	Inhibits blood coagulation by blocking the binding of von Willebrand factor to collagen inhibits collagen-mediated platelet aggregation
Destabilase	Monomerizing activity, Dissolves fibrin & Thrombolytic effects
Hirustasin	(Serine proteinase) Inhibits kallikrein, trypsin, chymotrypsin, and neutrophilic cathepsin G
Bdellins	Anti-inflammatory Inhibits trypsin, plasmin and acrosin
Hyaluronidase	('Spreading factor'), Increases interstitial viscosity & Antibiotic
Leechæderived trypt--ase Inhibitor (LDTI)	(Tryptase inhibitor), Inhibits proteolytic enzymes of host mast cells
Eglins	Anti-inflammatory, Inhibit the activity of a-chymotrypsin, chymase, subtilisin, elastase, and cathepsin G
Factor Xa inhibitor	Inhibits the activity of coagulation factor Xa by forming equimolar complexes.
Complement inhibitors	May possibly replace natural complement inhibitors if they are deficient
Carboxypeptidase A inhibitors	Increases the inflow of blood at the bite site
Suspected saliva components	Effect on the host
Histamine like substances	Vasodilator. Increases the inflow of blood at the bite site
Acetylcholine	Vasodilator
Anesthetic substance	Anesthetic

The most interesting substance in leech saliva has been hirudin, a molecule that is the most potent inhibitor of blood clotting known to date. Hirudin in leech guarantees continued blood flow, by breaking off the aggregated fibrin plugs that clot and seal blood leaks. Hirudin also shuts off the mechanism of Factor VIII - mediated blood coagulation. Indeed, even after the leech drops off after feeding, blood is seen to flow for a while from the animal¹⁶.

Significant Milestone

In the Act of June 28, 2004, the Food and Drug administration (FDA) cleared for the first time the commercial marketing of Medicinal Leeches for medicinal purposes and determined that leeches are medical devices because they meet the definition of a medical device¹⁷.

Clinical Evidence of Leech Therapy

The evidence for the efficacy of leech therapy is documented through clinical trials and case studies which are tabulated as Table 2.

Table 2. Clinical Evidence of Leech Therapy

S. N.	Disease condition & participants	Design & groups	Instrument	Outcome	Level of Evidence	Reference
1	Knee Osteoarthritis n = 113	Randomized controlled trial Group I (single leech application, n = 38) Group II (double application, n=35), second treatment after an interval of 4 weeks. Group III (control group n = 40). Simulated with an 'artificial leech	KOOS, WOMAC scores and visual analog scale (VAS) Changes in the use of pain medication was monitored over 26 weeks	Improvement in KOOS and WOMAC scores & also in VAS, were statistically significant for treatment groups I and II during the follow-up period. Reduction in pain medication was statistically significant. Greatest improvement was seen in group II treated twice with the leeches	A	Andereya et al., 2008 ¹⁸
2	Osteoarthritis of the knee	Randomized, controlled trial into 2 groups	Pain, function, and stiffness subscores of the	Pain at day 7, was reduced from a mean	A	Michalsen et al., 2003 ¹⁹

n = 51	leech therapy group : n = 24 (single treatment with 4 to 6 locally applied leeches)	Western Ontario and McMaster Universities Osteoarthritis Index & 36-Item Short-Form Health Survey at days 3,7,28, and 91.	(DSD) of 53.5D 13.7 to 19.3 D 12.2 after leech therapy compared with 51.5 D 16.8 to 42.4 D 19.7 with topical diclofenac (estimated group difference,23.9[95% CI,32.8 to 15.1]; P<0.001).Function, stiffness & total symptoms significant in favor of leech therapy			
3.	Osteoarthritis of the first carpometacarpal joint (thumb saddle joint).	Randomized, controlled open trial. Leech group: single course of treatment with 2-3 locally applied leeches Control group: 30-day course with topical diclofenac twice a day	Pain (mean of VAS for pain at rest, in motion, during grip) Functional disability measured by the DASH-questionnaire (Disabilities of the Arm, Shoulder and Hand), physical quality of life (QoL, SF-36) at days 7, 30 and 60 after treatment	Overall pain score at day 7 was reduced from 59.6 (D13.8,n=16) to 27.1(D20.6) in the leech group and from 50.6 (D13.3, n=16) to 46.9 (D18.5) with diclofenac (group difference-26.5, 95% CI-40.3 to -2.7; p=0.0003). Pain relief in leech treatment increased at days 30 and 60. Statistically significant	A	Michalsen et al., 2008 ²⁰
n = 32						

4. Chronic epicondylitis n = 45	Randomized controlled trial into 2 groups leech therapy group : (single treatment with 2-4 locally applied leeches) control group: (30-day course with topical diclofenac)	Change of pain sum score on day 7 from 3 visual analog scales for pain during motion, grip, and rest. Disability of the arm, shoulder, hand questionnaire, Physical quality of life (Short Form-36), and grip strength. Assessed on days -3, 0, 7, and 45.	differences of DASH score, QoL and grip strength Significant decrease of pain score (143.7 D36.9 to 95.3D45.1) compared with topical diclofenac (131.6D29.6 to 134.7D70.7; mean difference -49.0;95% confidence interval, -82.9 -15.1; P=0.0075)after 7 days. Decrease in functional disability in the leech group, which was most prominent after 45 days (P=0.0007). Quality of life increased non-significantly in the leech group.	A	Backer et al., 2011 ²¹
5. Varicose veins with complications n = 20	Observational	Ulcer healing and decrease in hyperpigmentation, oedema and limb girth Partial pressure	All the ulcers showed healing, while 95% of patients showed a decrease in oedema and	C	Bapat et al., 1998 ²²

		of O ₂ (pO ₂)	limb girth. 75% demonstrated a decrease in hyperpigmentation Mean pO ₂ of blood sucked by the leech was 40.05 +/- 7.24 mmHg, which was similar to the mean pO ₂ of the patient venous blood (34.33 +/- 8.4 mmHg) indicating that leech sucks venous blood		
6. Median nerve compression due to forearm haematoma	Single case study 13 leeches were applied to the volar surface of the right forearm.	Neurological examination revealed sensory deficit of right median nerve with decreased pinprick & light touch sensation & impaired two point discrimination. Motor function of the index & middle fingers was slightly impaired. Circumference of the right forearm was increased by 5 cm	Symptoms markedly improved within 24 hours. Next day, only slight sensory disturbances persisted on the skin. Neurologically, the median nerve function was normal. Motor and sensory nerve conduction velocities and amplitudes, as well as distal motor latency of the	C	Heckmann et al., 2005 ²³

				median nerve, were normal.		
7.	Meningococcal purpura fulminans of the left hand	Single case study (infant) Leeches were applied to the left dorsal hand on a daily basis for 4 consecutive days	Swelling and functionality	Swelling and limited functionality visibly improved after 48 hrs, and by 120 hrs, perfusion in the distal phalanges of the thumb and middle finger was evident. Recovered from the meningococcal septicemic shock; the functionality of left thumb was preserved, and has limited functionality of left hand	C	Dippenaar et al., 2006 ²⁴
8.	Severe pain in the lumbar region due to synchronous renal cell carcinoma and leiomyosarcoma	Single case study Treatment with seven leeches to the lumbar region	Pain which was refractory to radiotherapy and systemic and epidural analgesic infusion.	Complete healing of pain	C	Kalender et al., 2010 ²⁵

Leech Application in Surgical Procedures

Today leeches have found renewed utility in certain surgical procedures, particularly after microsurgery. Doctors sometimes find it helpful, for example, to use leeches to restore circulation to a re-attached finger, or to portions of the skin following plastic surgery. Leeches have enjoyed a renaissance in reconstructive microsurgery during the last 15 years, having been used by maxillofacial and other reconstructive surgeons to aid salvage of

compromised microvascular free tissue transfers, replanted digits, ears, lips and nasal tips. Peer-reviewed evidence suggests that the survival of compromised, venous-congested tissues is improved by early application of a leech. Leeches have also recently been used to treat a wide range of conditions, including periorbital haematomas, severe macroglossia and purpura fulminans.²⁶

Safety of Leech Therapy

Medicinal leeches have an important and expanding role in medicine, but infection can complicate their use. *Aeromonas hydrophilia* is the most common microorganism in leech infections and may cause a wide spectrum of diseases such as cellulitis, ocular infections, arthritis, myocarditis, peritonitis, meningitis, bacteremia and sepsis. A unique case of *Aeromonas meningitis* associated with the use of leech therapy to salvage a skin flap after central nervous system surgery has been documented by Ouderkirk et al., in 2004²⁷. Levine and his team in 2010 have also observed a case of *Aeromonas septicemia* after medicinal leech use following replantation of severed digits²⁸. In many countries, wild leeches are still provided from local markets and utilized in many plastic and reconstructive surgery clinics depending on antibiotic prophylaxis. In this regard, Aydin et al., 2004 in order to avoid possible infections, investigated the ability of hypochloric acid, a disinfectant, to suppress the relevant microorganisms without changing the life style and behavior of leeches in terms of sucking function. It was observed that external decontamination of wild leeches with 12.5 ppm hypochloric acid enables bacterial suppression without causing negative effects on leech sucking function and life²⁹.

Adverse Effects of Leech Therapy

Blood Loss

Leech therapy is always associated with a certain degree of blood loss, which is clinically irrelevant in most cases. In the clinical trial by Michalsen, the mean hemoglobin loss was 0.7 mg/dL, and clinically relevant blood loss did not occur in any of the patients studied. However, there have been isolated observations of stronger after bleeding with a corresponding decrease in hemoglobin, particularly in cases where a leech was inadvertently applied directly to a superficial vein. Prior occurrences of abnormal bleeding seem to be anamnestically important, and patients should be specifically asked about such events. Anticoagulants are important concurrent medications to watch for. If low-dose aspirin is prescribed in combination with other platelet aggregation inhibitors or high-dose fish oil, a smaller number of leeches (three to four) should initially be used. Blood counts should always be obtained before starting leech therapy³⁰.

Local Pain during Treatment

Perception of the local pain of leeching varies from patient to patient. Most patients

describe a local dragging pain that occurs immediately after the leech bites and persists for around one to five minutes. As more and more saliva is introduced into the tissues, the anesthetic effect of leech saliva begins to take effect. The intensity of the pain of the leech bite and the first phase of feeding is generally described as mild or negligible (depending on the individual's pain threshold), but some patients find the pain more intense, similar to that of a wasp sting. The perceived intensity of the leech bite varies from one individual to another. Subjective pain ratings range from 'hardly noticeable' to 'mild' (similar to the pain of stinging nettle) to 'similar to a wasp sting' (very rare). A slight (or sometimes somewhat stronger) rhythmic pulling sensation is usually noticed for the first one to three minutes after the start of feeding. The intensity of pain perceived depends on the individual's personality, but also depends on that person's concentration on the leech or attitude toward leech therapy³¹.

Local Itching

Transient itching at the site of the leech bite in the first few days after treatment is very common in general and should not be mistaken for an allergic reaction. In a study of the efficacy of leech therapy in patients with osteoarthritis of the knee, roughly 70 % of patients treated with leeches developed local itching that lasted a mean of two days. Transient itching occurs at a comparable frequency, but stronger intensity levels in many cases where leeches were applied to more peripheral joints, for example the thumb, but at lower levels after treatment of large joints and vertebrogenic zones, according to empirical assessments. The patient could be advised of these side effects prior to treatment. The patient should never scratch the leech bite, especially after initial wound closure, because this frequently delays wound healing. We recommend local cooling remedies (curd wraps, cold moist wraps, vinegar wraps). Isolated reports describe brief recurrences of moderate itching in certain situations (e.g., high temperatures) over the course of several months after an otherwise uneventful course of leech therapy.

Hypotension and Vasovagal Attacks

Patients with a history of developing vasovagal attacks or syncope (fainting) before other invasive treatment methods may also develop such a reaction at the start of or during leech therapy. One survey showed that vasovagal attack occurred in one out of 1000 leech treatments performed at Kliniken- Essen- Mitte Hospital, Germany. Therefore, the leech therapist should always ask about the patient's prior history of vasovagal attack or fainting before procedures such as blood sample collection or acupuncture. To guard against vasovagal attack, the patient should drink plenty of fluids before and during treatment, and treatment should always be performed in a calming environment while the patient is lying down. It is important to remember that leeching has a known antihypertensive effect

when treating patients on antihypertensive medications. Patients should drink plenty of fluids. If there is a strong flow of blood from the leech bite, the patient's blood pressure should be monitored and antihypertensive medications should be adjusted as needed³².

Contradictions for Leech Therapy

Hemophilia, Anticoagulant Medications

Any type of congenital or acquired hemophilia or concurrent medication with the anticoagulants Marcumar, warfarin, heparin, or heparinoids is an absolute contraindication to leech therapy. Patients should be specifically asked to subjectively assess whether they have any abnormal bleeding tendencies. Aspirin and clopidogrel are not contraindications per se, but the number of leeches applied should be reduced in the first treatment session, and the patient should be asked about bleeding tendencies. If clopidogrel and aspirin are being used in combination, then clopidogrel should be discontinued five days before leech therapy if medically feasible. Bleeding time after leeching may be significantly prolonged in patients taking high dose fish oil or ginkgo biloba products. These patients should also temporarily discontinue these medications before leech therapy. Before administering leech therapy the physician should note that the patients who have any kind of bleeding tendencies even is gastro intestinal discords also.

Anaemia

Any type of treatment involving blood removal is generally contraindicated in patients with anemia or bone-marrow suppression³³.

Serious Organic Disease and Immunosuppression

Leech therapy should never be performed in patients with severe, unstable organic disease or marked immunosuppression (chemotherapy). Severe, chronic yet stable organ diseases such as cirrhosis of the liver, connective tissue diseases, dialysis, immune diseases, and diseases of the blood-forming organs are relative contraindications. Leech therapy can be performed with concomitant antibiotic therapy if the patient has normal blood coagulation in the absence of anemia or immuno-suppression if there is a justifiable indication (pain management). Leech therapy is contraindicated in individuals with HIV infection. No treatments involving the removal of blood should be performed in patients with cachexia of any cause. Leech therapy can be administered to patients on corticosteroids if the drug is given in low to medium doses and if the patient does not have a history of wound healing disorders or cortisone related skin changes.

Erosive Gastritis and Potential Gastrointestinal Bleeding

Upper gastrointestinal bleeding occurred on the day after leeching in one of our patients with gastroscopically confirmed erosive gastritis. This adverse event was also reported in

another patient with coronary artery disease who was taking aspirin to inhibit platelet aggregation. Therefore, leech therapy should not be performed in patients with known peptic ulcers or erosive gastritis because the potentially systemic effects of hirudin may increase the risk of gastrointestinal bleeding.

Acute Stages of Infectious Disease

Experience has shown that the administration of leech therapy during the acute stages of infectious diseases may lead to subjective weakness and impaired wound healing. According to the broader concepts of naturopathic medicine and humoral pathology, any treatment that extracts blood from patients with infectious diseases is generally considered to be counterproductive and is not recommended. In plastic and reconstructive surgery, where leeching must often be performed in patients with severe infections, antibiotics are administered concomitantly with leech therapy³⁴.

Severe Allergic Diathesis

In patients with known protein allergies, the possibility of an allergic reaction to the foreign proteins in leech saliva must be considered. Leech therapy should not be performed in patients with a history of severe allergic diathesis and severe systemic reactions. Leech therapy can be performed with concomitant antihistamine therapy if the patient has only mild or uncertain intolerance reactions.

Pregnancy

Treatments involving the withdrawal of blood are generally contraindicated during pregnancy. Furthermore, leech therapy might result in side effects that would require treatment with chemical drugs.

General and Local Wound Healing Disorders

The normally harmless leech bite can lead to local complications in patients with diseases associated with impaired wound healing (e.g., diabetes mellitus). The case history must be thoroughly evaluated to determine whether any relative contraindications to leech therapy exist. In patients with localized areas of impaired wound healing (e.g., leg ulcers), leeches should not be applied directly to the affected region as this may create potential foci for new ulcers³⁵.

Discussion and Conclusion

Blood-letting and the therapeutic use of *Hirudo medicinalis* date back to ancient Egypt and the beginning of civilization. Their popularity has varied over the years, gaining momentum once again in the West more than its place of its origin i.e., India. In this paper, we review the history of use of leech therapy from its origin and in turn reflect the possible future of the annelid.

The history of use of leech therapy is unambiguous, utilized in various traditions, culture, etc., for various clinical conditions. Literary evidence is found in religious and sacred books like the Bible, Rig Veda, Shukla Yajurveda and Atharva Veda. During the last century, several instruments were used to transport, store and apply leeches in a hygienic manner such as leech jar with internal glass protuberances, pewter box and glass leech tube respectively add credence to its usage in the past. As mentioned in the specific historical use of leeches, the site of leech application is near as possible to the site of complaint, for example, on the temples for headaches, on the abdomen for gastrointestinal inflammation, and on the groin and thighs for menstrual disorders is similar in accordance with the Siddha materia medica. However, Siddha literature differs from the view and cautions certain places as unfit for leech application namely eyelids, penis, scrotum, vagina and to the bosom of a woman.

Traditional knowledge medical systems such as Ayurveda, Siddha and Unani possess sound literary base documented through palm leaf manuscripts and passed on to generations by oral tradition (gurukulam method). Siddha materia medica in detail enumerates leech varieties, suitable leech for therapeutics, purification of leech, know-how, time, number of leeches to apply, application sites with specific indications, precaution and preparation of the subject, indications of effective leech therapy, leech removal, methods to arrest and enhance bleeding after the leech application, side effects & its treatment, adverse reactions, contraindication, etc. The aforesaid facts jotted in traditional knowledge are so precise and time tested.

Leech's potential as living apothecaries has stimulated the isolation of scores of bioactive compounds including important anticoagulants, antistasisins, etc., that are responsible for its multifarious therapeutic properties. In addition, an enviable landmark status was achieved in 2004 with United States Food and Drug Administration (US FDA) approval, as a prescription medical device è provided that accurate labelling and branding regulations were followed.

The efficacy of leech therapy is witnessed through clinical trials and case studies and the corresponding level of evidence obtained has been graded according to the World Health Organization (WHO) guidelines³⁶. Four clinical trials of level 'A' grade proves beyond doubt the efficacy of leech therapy especially in osteoarthritis of knee joint and thumb saddle joint. One trial of 'A' grade tells upon its effect in chronic epicondylitis commonly known as tennis elbow syndrome. Moreover, a clinical trial for the treatment of varicose veins amounts to 'C' grade evidence. Amongst the several case studies rated as 'C' grade, it is interesting to note the effect of hirudo-therapy for severe pain in the lumbar region due to synchronous renal cell carcinoma and leiomyo-sarcoma, meningo-coccal purpura fulminans of the hand and median nerve compression due to forearm haematoma. Therefore, it is the need of the hour to convert the experience based medicine into evidence based medicine for various clinical manifestations foretold in materia medica.

Pertaining to safety aspect of leech therapy, studies stating that the external decontamination of wild leeches with hypochloric acid have been documented in order to avoid infection with *Aeromonas* which is the most common microorganism in leech that may cause a wide spectrum of diseases such as cellulitis, ocular infections, arthritis, myocarditis, peritonitis, meningitis, bacteremia and sepsis, etc. Nevertheless, many individual case studies involving leech therapy with *Aeromonas* septicemia, *Aeromonas* meningitis, etc have been documented. In Siddha system of medicine, the safety aspect of leech therapy is very well taken care off because purification of leech with turmeric is a mandatory prerequisite before using leech in a subject. In vitro and in-vivo studies with turmeric (*Curcuma longa*) convey its effect against the pathogen *Aeromonas hydrophilia*³⁷.

Often the adverse effects (AE) of leech therapy occur due to noncompliance to the principles and regulations of leech therapy as mentioned in traditional knowledge systems. The most common AE is increased blood loss and itching due to usage of more than 4 or 6 leeches in one sitting, which could be prevented. AE can be avoided by preparing the subject and the site of application of leech as per traditional protocol. It is crucial not only to purify the leech but equally essential is the preparation of the subject. Moreover, many modern physicians without purifying the leeches just clean the site of application by using tincture Iodine or turpentine which can cause allergy also to the leeches resulting in problems related to the fixation of the leeches. Siddha materia medica (SMM) doesn't halt just by spelling out precautions to tackle adverse event. But taking into account extreme situations, SMM is more advanced and provides solution to tackle AE, if one occurs.

Taking into account the potential benefits of leech therapy which outweighs the risks, the source and quality of leech assumes prime importance. Even though, leeches are found in the natural habitat, good quality leeches should comply with certain attributes as specified in the classics. So it is better to collect a good quality leech from a natural habitat or obtain them from a leech farm that maintains them in a hygienic environment and follows quality control protocol. Leech farming industries have become lucrative now-a-days and recently one farm in Chennai also provides good quality leeches.

In the West, leech therapy is accepted as a medical device by US FDA, an agency of the United States Department of Health and Human Services, responsible for protecting and promoting public health. In Europe particularly Germany, it is the first line of alternative and complimentary therapy for pain due to osteoarthritis / degenerative arthritis. On the contrary, leech is under utilized in our country despite its healing potential. Therefore, it is need of the hour to stimulate multidisciplinary research and utilize leech therapy in our country to its fullest potential. However, research on zoo-therapy be compatible with the welfare of animals, and the use of their products be done in a sustainable way³⁸. Moreover, it is mandatory that patients at large get the benefit of this economic therapy through opening of specialized leech therapy departments in hospitals across the county.

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सारांश

प्राचीनकाल में हिरुडो-चिकित्सापद्धति एवं इसका सम्भावित भविष्य

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चिरकालिक व्याधियों की चिकित्सा के लिए रक्तमोक्षण प्राचीनतम तरीकों में से एक है। रक्त को बाहर निकालने के बहुत से तरीकों में से जलौका को रक्तमोक्षण का परिष्कृततम और सुलभतम तरीका समझा जाता है। चिकित्सा के इतिहास में लिखित प्राचीनतम स्वास्थ्यविधियों में से जलौकावचारण एक है। जलौकावचारण का सर्वप्रथम स्पष्ट अभिज्ञेय विवरण भारत की प्राचीन रचनाओं में दिखाई देता है। हिन्दू पौराणिक कथा के अनुसार पारम्परिक भारतीय चिकित्सा के रहस्यों को विश्व में उजागर करने वाले धन्वन्तरि एक हाथ में अमृत और दूसरे हाथ में जलौका धारण करते थे। जलौकावचारण चिकित्सा का अधिकांश व्यापक वर्णन भारत में जन्मी चिकित्सा की आयुर्वेद एवं सिद्ध पद्धतियों में मिलता है। सम्भवतः जलौकावचारण चिकित्सा के बारे में पथप्रदर्शक सूचना वेदों में पायी गई थी, इसका अनुसरण यूरोप सहित विभिन्न चिकित्सा परम्पराओं में इतिहास का उपयोग करते हुए किया गया। जलौकावचारण चिकित्सा से सम्बन्धित कतिपय प्राचीन उपकरणों को प्रमाणित करने के लिए एक प्रयास किया गया है। पश्चिम में जलौकावचारण चिकित्सा लोकप्रिय है एवं आहार और द्रव्य प्रबन्धन (एफडीए) ने जलौकावचारण को सन् २००४ में चिकित्सा आविष्कार के रूप में स्वीकार किया है। इस सम्बन्ध में जलौकावचारण के प्रभाव को प्रमाणित करने वाले चिकित्सीय परीक्षणों का संकलन किया गया है। तथापि इस समीक्षा में जलौकावचारण चिकित्सा की विरुद्ध प्रतिक्रियाओं और दुष्प्रभावों को प्रमाणित किया गया। इस लेख का प्राथमिक केन्द्र रिगरस् रेंडमार्इज्ड कंट्रोलड ट्रायल्स के द्वारा व्यवस्थित अनुसन्धान द्वारा जलौकावचारण चिकित्सा की गुणवत्ता, सुरक्षा और प्रभाव को पुनःप्रमाणित करने के लिए साक्ष्य जुटाकर जलौकावचारण चिकित्सा के उपयोग की पूर्णतम सम्भावना को बढ़ाना है।