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The Leech: Biology, Etymology and Medical practice

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ABSTRACT

Leeches are blood sucking worms that have been used in medicine as far back as 2500 years ago. The word leech comes from an old English word 'laece' meaning 'physician'. The spelling later became leech. In medieval England, leeches were linked with healing because of the etymology of the word. In old English the word "lacian" meant to heal and physicians were known as "leche". Leeches are annelids or segmented worms. All leeches have 34 body segments. In medieval and early modern medicine, the medicinal leech- Hirudo medicinalis and its congeners was used to remove blood from a patient as part of a process to "balance" the "humours". Hirudotherapy was introduced by Ibne Sina in the Canon of Medicine (1020s). He considered the application of leech to be more useful than cupping in "letting of the blood from deeper parts of the body". The secretion of leech saliva contains like Hirudine, Histamine, Hyluronidase, Collgenase, Fibrinases, Hementin, Bdellin, Eglins, Elastase, Cathepsin, Inhibitor of Kellikerin, Anesthetics, Protinase inhibitor, Tryptase inhibitor, Antibacterial.

Key words: Leeches, Hirudotherapy, humours, Hirudine, Histamine, Hyluronidase

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INTRODUCTION

Leeches are blood sucking worms that have been used in medicine as far back as 2500 years ago. The word leech comes from an old English word 'laece' meaning 'physician'. The spelling later became leech [1,2,3]. In medieval England, leeches were linked with healing because of the etymology of the word. In old English the word "lacian" meant to heal and physicians were known as "leche" [4].

Leeches are annelids or segmented worms, closely related to the earthworms and are anatomically and behaviourally more specialized. There are fresh water, terrestrial and marine leeches. Leeches breathe through the skin. The digestive system contains a crop or pouch, in which food can be stored for several months. One to four pairs of eyes are located at the anterior end[5]. All leeches have 34 body segments. The first 5 or 6 form a small anterior sucker and last 7 form a powerful posterior sucker[6].

Scientific classification of *Hirudinaria granulosa*[5]

Kingdom	:	Animalea
Sub Kingdom	:	Eumetazoa
Phylum	:	Annelida
Class	:	Hirudinea
Order	:	Gnathobdellia
Genus	:	Hirudinaria
Species	:	Granulosa

The phylum annelida or segmented worms constitute more than 9,000 species and includes three classes

a. The marine worms (Polychaeta)
b. The earth worms (Oligochaeta)
c. The leeches (Hirudinea)

The medicinal leech "*Hirudo medicinalis*" are native to Europe, and its congeners have been used for clinical bloodletting for thousands of years. All over the world about 650 species are found, out of which 45 species belonging to 22 genera occur in India. The commonly known leeches of India belong to the genera *Hirudinaria Whitman, Haemadipsa tennent, Hirudolin* and *Dinobdella moore*[7].

All leech species are carnivorous some are predatory, feeding on a variety of invertebrates such as worms, snails, insect larvae, crustaceans, while a very few are haemophagic parasite blood

sucking leeches, feeding on the blood of vertebrates such as amphibians, reptiles, fish and mammals (including humans).The most important predators of leeches are fish, aquatic insects, Cray fish and other leeches specialized for predation on leeches. Haemophagic leeches attach to their hosts and remain there until they become full and they fall off themselves[8,9].

Leech body is composed of 34 segments. They all have an anterior (oral) sucker formed from the first six segments of their body, which is used to connect to a host for feeding, and can also release an anesthetic to prevent the host from noticing the leech. They use a combination of mucus and suction (caused by concentric muscles in those six segments) to stay attached and secrete an anticlotting enzymes in the hosts blood stream.

Some species of leech nurture their young, providing food, transport and protection which are unusual behaviours in an invertebrate[8,9].

Vernacular names [10,11,12,13,14,15,16,17]

Arabic	:	Alaq
English	:	Leech
Greek	:	Bdella
Hindi	:	Jalu, Jok, Jonk
Kannada	:	Jiganey
Kashmiri	:	Drik
Latin	:	Hirudo
Persian	:	Zlucha, Zalu
Sanskrit	:	Raktapa, Jalauka, Jala-sarapini
Urdu	:	Jonk

Phylogeny, classification and relationship

The leeches are presumed to have evolved from the Oligochaeta, most of which feed on detritus. Leeches are related to Earthworm and Lugworm (Oligochaetes) and Bristle worms (Polychaetes). But unlike other worms they have a sucker at each end– one for feeding, the other for hanging on while they feed. They all belong to a group of legless invertebrate (animals without a skeletal) called Annelids---"annulus" is the Latin for "ring". This means that the body is divided into separate segments (which look like rings) connected by a continuous gut, a nerve and blood vessels. They use external bristles (chaetae) to pull out themselves along in a sort of concertina like motion[8].

The bodies of all leeches are divided into the same number segments, with a powerful clinging sucker at each end. Body shape is variable, but to some extent depends on the degree to which

their highly muscular bodies are contracted. The mouth is in the anterior sucker and the anus is on the dorsal surface (top) just in front of the rear sucker. Leeches usually have three jaws and arranged in a Y-shaped pattern. Each jaw contains about a hundred teeth that penetrate the skin in a "sawing motion" [18].

Types of leeches:

Leeches are grouped according to the different ways they feed.

1. The Jawed leeches or Gnatbobdellida.
2. The Jawless leeches or Rhyncobdellida.
3. The Worm leeches or Pharyngobdellida.

First group, the jawed leeches or Gnatbobdellida –have jaws armed with teeth which they bite the host. The blood is prevented from clotting by production of a non- enzymatic secretion called hirudin.

Second group, the jawless leeches or Rhyncobdellida – insert a needle like protrusion called a proboscis into the body of the host and secrete an enzyme, hemetin which dissolves clots once they have formed. Leeches which live on body fluids of worms and small fresh water snails possess such an apparatus.

Third group, the worm leeches or Pharyngobdellida have no jaws or teeth and swallow the prey whole. Its food consists of small invertebrates[8].

Zoological description of the leech

There are about 300 species of leeches, of the class Hirudinea, generally found in fresh water or humid environments. They are elliptical in shape, with 34 segments each and a sucker at both ends of the body (the large sucker on the posterior end). They can reach of up to 16 inches (40cm) in length. [Britannica vol.1] The smallest leeches are 1cm in length, and most species are 2 to 5 cm long, but the giant of the class is the Amazonian Haementeria ghiliani[19].

External anatomy:

The anatomy of leeches is remarkably uniform. The body is typically dorsoventrally flattened and frequently tapered at the anterior. The segments at both extremities have been modified to form suckers. The anterior sucker is usually smaller than the posterior one, and frequently surrounds the mouth. The posterior sucker is disc-shaped and turned ventrally. There are no setae present. A clitellum is present and is always formed by segments IX, X and XI. The body of a leech can be divided in to five regions.

1. Head or cephalic region: it is composed of six segments and prostomium. Dorsally, the head bear a numbers of eyes and ventrally it bears the anterior sucker surrounding the

mouth.

2. Preclitellar region: it is composed of four segments.
3. Clitellar region: it is composed of three segments. It bears single male gonopore and a single female gonopore.
4. Middle region: it is composed of 15 segments. Comprises the greater part of the trunk.
5. Terminal or posterior region: it is eight fused segments. These segments are modified to form the ventral posterior sucker. The anus opens dorsally in front of the sucker.

The nervous system of leeches reflects their specializations of body structure. The cell bodies of ganglia are grouped into distinct masses, or follicles. Each ganglion is composed of six such follicles, arranged in two transfers traids. In the 5^{th} and 6^{th} segments, a large ganglionic nerve ring surrounds the pharynx or proboscis, represents the brain, the circumpharyngeal connectives, and the subpharyngeal ganglia of other annelids, and the ganglion of the first three or four segments that have migrated posteriorly, although each pair of segmental ganglia are fused. The leeches can also contain various type of dispersed sensory cells joined together to form sensory papillae[19].

Hirudo possess no true blood-vascular system. The entire circulatory system is considered to represent a very much reduced coelom. It consists of a well developed system of vessels containing a red coelomic fluid[20]. A true circulatory system persists only in the Acanthobdellida and the Rhynchobdellida. It is closed and usually lack haemoglobin[21].

Special respiratory organs found only in some piscicolidae, as evaginations of the body wall connected with coelomic channels. Glossiphoniidae obtain their oxygen supply through the hypodermal coelomic channels. Other have a densenet of coelomic capillary channels between epidermal cells[21].

Leeches contain from ten to seventeen pairs of nephridia, located in the middle third of the body. The nephridial tube in leeches is especially peculiar. It is in part or completely composed of a cord of cells through the interior of which runs a nonciliated, intracellular canal[19].

Habitat, habits and reproduction

The preferred habitat is muddy, fresh water pools and ditches with plentiful weed growth in temperate climates. Leeches are distributed all over the world, except the polar zones, deserts and altitudes exceeding 3700 meter. Leeches may be aquatic, amphibious or terrestrial. European leeches live in fresh water and damp places[7].

Leeches are hermaphrodite but they are not self-fertilizing, the sperm of one individual fertilizes only the eggs of other individual. Development and growth are directed, without a larval stage [5].

The testes, forms four to ten pairs, are arranged by segments, beginning with segment 12 to 13. The testes on each side of the body are connected with vasdeference, a duct that leads indirectly to the male pore. The female reproductive system consists of one pair of ovisacs containing two ovaries, which although located in front of the testes, may extend same length posteriorly, depending on the animal. The ovaries connect to form an oviduct that forms either a female pore or in those species that copulate, a vagina[5].

In Gnathobdelliae, sperm are transferred by the penis of one animal into the vagina of another. In two other families- Rhynchobdellae and Erpobdellidae, sperm transferred by sperm capsule, or spermatophores, on to the body of leech, after which the sperm leave the spermatophore and enter the ovary through the female pore to unite with the eggs. Leech eggs, numbering from one to more than 100, are usually deposited in cocoons, which may be oval or elongated in shape and are generally attached to rocks, vegetation or any submerged body or lodged in bank side burruos[5].

Little is known about the life span of leeches. One species of Erpodella requires a year to reach sexual maturity after which it lays cocoons once and dies. Another species breeds once a year for two years and dies during the third. It has been said that annelids are the most highly organized animals with the power of complete regeneration. The powers of regeneration are greater in the polychaetes and lower oligochaetes than the higher oligochaetes that's why leeches lack the ability of regeneration[5].

Food and feeding

Leeches are carnivorous or blood sucking annelid worms. The medicinal leech Hirudo feeds principally on mammalian blood, but it also sucks blood from snakes, tortoises, frogs and fish. Most of them are permanent or temporary external parasites, attaching themselves to the host and sucking blood. The anterior sucker, jaws and muscular pharynx serve as an efficient apparatus for the abstraction of blood. Sucked blood is stored in lateral diverticulae of the crop and as the blood passes down the pharynx, it is mixed with a glandular secretion which prevents coagulation. A leech ingests at a single meal several times its own weight of blood which may suffice for several months[5,7].

Medicinal Uses of leeches

In medieval and early modern medicine, the medicinal leech- Hirudo medicinalis and its congeners was used to remove blood from a patient as part of a process to "balance" the "humours" that, according to Hippocrates, must be kept in balance in order for the human body to function properly and these four humours are blood, phlegm, black bile and yellow bile[22].

Hirudotherapy was introduced by Ibne Sina in the Canon of Medicine (1020s). He considered the application of leech to be more useful than cupping in "letting of the blood from deeper parts of the body"[23].

Leech therapy became a popular method in medieval Europe due to the influence of his Canon. A more modern use for medicinal leech was introduced by Abdul-ul-Latif-al Baghdadi in the 12th century, who wrote that leech, could be used for cleaning the tissue after surgical operations. Contemporary leech therapy is pioneered by surgeons[24].

The use of leeches in medieval times was of greater benefit than cupping because the amount of blood removed would be more "predictable" and of a greater amount. The reporting of the practice of using leeches reached its climax between 1820 and 1845. Francois Broussais (1772-1832) proposed that all diseases resulted from excess of blood and that bloodletting was the only cure[23].

Leeches seem to have made both a clinical and laboratory resurgence over the past several years. On the clinical front, plastic and microvascular surgeons in both Western Europe and North America have been utilizing the ability of this medicinal worm to inject anticoagulants and remove blood. The use of leeches has been reported as an adjacent for grafted skin flaps, [25,26] and breast reconstruction [27]. Reports also indicate their utility in the reattachment of severed digits. Local removal of accumulated blood seems to be a task for which the leech is well suited. The leech has been applied to the suture lines of re-implanted digits in an attempt to reduce venous congestion, as following surgery, venous return may be impaired[28]. The anti-coagulant in leech saliva may provide additional therapeutic benefits by causing the bites to bleed for many hours after the leech detaches. The leech has also been recently used in the evacuation of periorbital heamatomas[29]. As folk treatment common man are also have reportedly applied leeches to themselves for conditions such as hemorrhoids and varicose vein [30].

Systemic utilization of the products of the leech salivary gland appears to be growing as the chemicals produced in their salivary glands are further analyzed. Salivary extracts are available from pharmaceutical firms [31], and their clinical effects are being studied [31]. Hirudin has been reported to prevent some pathological changes of diffuse intravascular coagulation (DIC) such as consumption of clotting factors and development of multiple micro thrombi. It also reportedly inhibits localized hemorrhagic necrosis induced by endotoxin injection [32]. Secretion from Haementria salivary cells have been reported to interfere with the metastatic growth of some lung tumors [33] and the efficacy of a fibrinase on atherosclerotic plaques is reportedly under investigation [34].

General indications for leech therapy--

- Inflammatory reactions[30]
- Heart diseases [30]
- Rheumatic diseases[30]
- Tendovaginitis and tendinitis[30]
- Venous diseases and varicose vein [30]
- Arthrosis[30]
- Arthritis[30]
- Muscle tension[30]
- Antidyscratic therapy (blood purification and regeneration) of toxicosis and menta[30]
- Thrombosis and embolism [30]
- Passive congestions and spastic conditions [30]
- Vertebrogenic pain syndrome[30]
- Transudates and exudates [30]
- Hemorrhoids [30]

Contraindications

Leech therapy is contraindicated in certain medical conditions and diseases which include: [35]

- Decreased blood
- Haemophilia
- Sever anaemia
- Hypertension
- Pregnancy
- General fatigue
- Allergy to leeches
- Active tuberculosis
- Mental disorder (during acute episode)
- High temperature
- Ulcero-necrotic process in the intestinal tract
- Don't attach to an extremely fear full patient (varicose 02)

Toxicology[36]

Leeches suck up to 50 ml of blood per application. Repeated leeching may decrease haemoglobin levels dramatically. Drops of 1 to 2 gm% during a 5days course are common. Decreases of up to 7 gm% have been observed following a 6 day course and required transfusion therapy. Following removal of leeches, the wound site may continue to bleed for up to 4 hours.

Leeches adverse reactions

Local allergic reactions, anaphylaxis and infections have been reported[37].

Complications of leech therapy

Possible complications of hirudotherapy includes:[30]

- Local itching
- Local pain during treatment
- Hypotension and vasovagal attacks
- Excess blood loss
- Impaired wound healing, super infection and allergies
- Sepsis
- Transmission of infectious diseases
- Scarring

Chemical composition of leech saliva

Leeches are a gift of nature that may help people to overcome numerous health disorders. The secretion of leech saliva contains about 100 biologically active substances, having favourable effect on human beings. These substances reduce blood coagulation, dissolve thrombi, reduce cholesterol and sugar content in blood, have anti-coagulant and anaesthetic effects, decrease blood pressure, improve the immune system, diminish oedemas and improve microcirculation.

The secretion of leech saliva contains like Hirudine[38], Histamine, [38] Hyluronidase, Collgenase, Fibrinases,[32] Hementin,[32] Bdellin, Eglins, Elastase, Cathepsin,[32] Inhibitor of Kellikerin,[38] Anesthetics, [38] Protinase inhibitor, Tryptase inhibitor,[38] Antibacterial[32]. These substances reduce blood coagulation, dissolve thrombi, reduce cholesterol and sugar content in blood, have anti-coagulant and anaesthetic effects, decrease blood pressure, improve the immune system, diminish oedema and improve microcirculation.

Leech saliva from the medicinal leech contains Hirudin[38], a powerful natural anticoagulant which was first described over a century ago. Hirudin may have potential as a therapeutic agent in some diseases. Other agents in the saliva of various leech species include histamine[38,] hyaluronidase[39], collagenase, and fibrinase[32]. Fibrinase disrupts clots, an action with additional

therapeutic promise. Many of the chemicals in leech saliva are being presently isolated, sequenced, cloned and patented.

Hementin[32] is a peptide secreted from the salivary glands of the Amazon leech Haementeria ghilianii. Hementin prevents clotting by direct fibrinogenolysis and does not affect thrombin. Saliva of the related leech, H. depressa, may have a plasminogen activator whose mode of action resembles streptokinase .

Leeches also secrete the enzyme hyaluronidase, a potential spreading factors in to wounds [39]. Other secretions, including proteinase inhibitors such as bdellin (a trypsin- plasmin inhibitor)[38], eglins (inhibitors of chymotrypsin, subtilsin, and the granulocytic neutral proteases), elastase, and cathepsin G. have been isolated from Hirudo. Antithrombotic, antifibrinolytic and anti-inflammatory activity has been postulated to exist in these secretions [32.]

In 1913, leech extract was claimed to be efficacious in causing a remission of the growth of carcinoma in the mouse [32]. It has been suggested also that leeches secrete a local anesthetic which deadens the skin to their bites [32]

REFERENCE:

1. Mory RN, Mindell D, Bloom DA. The leech and the physician: biology, etymology and medical practice with Hirudinea medicinalis. World J Surg 2001; 25 (4): 532-533.
2. Seigworth GR. Bloodletting over the centuries. New York State Journal of Medicine 1980; NA: 2022- 2028.
3. Upshaw J, O-Leary JP. The medicinal leech: past and present. American Surgeon 2000; 66(3): 313-314.
4. Newman, P.B. Daily Life in the middle Ages. North Carolina: McFarland; 2001.
5. Anonymous. The New Encyclopedia Britannica. 15th ed., Vol. 7th & 13th. USA: Encyclopaedia Britannica Inc; 2003: 238-239, 778-787.
6. Anonymous. The Encyclopedia Americana. Vol. 17th. USA: Grolier Incorporated; 1992: 160.
7. Anonymous. The Wealth of India. Vol. 6th. New Delhi: Council of Scientific and Industrial Research; 2003: 57.
8. Leech, from Wikipedia, the free encyclopedia
9. Verma PS. Jordan EL. Invertebrate Zoology. New Delhi: S. Chand & Company Ltd; 2002: 464-568.
10. Khan SMA. Mufridaate Maseehi. Manuscript. YNM: 35.

11. Ibn Al Baytar. Al Jame Le Mufridat Al Advia wal Aghzia. (Urdu translation by CCRUM). Vol.3rd. New Delhi: Ministry of H & FW, Govt. of India; 1999: 300
12. Khan MA. Muheete Azam. Vol. 2nd. Part 2nd. Kanpur: Mataba Nizami; 1313 Hijri: 2: 2 105.
13. Khan MA. Asmaul Advia. Aligarh: Muslim University Press; 2002: 176.
14. Momin M. Tuhfatul Momenin. Matba Hasni; 1272 Hijri: 136.
15. Hakeem M. Bustanul Mufridat. New Delhi: Idarae Kitabul Shifa; 2000: 222.
16. Kabeeruddin M. Makhzanul Mufridat. New Delhi: Aijaz Publishing House; YNM: 227-228.
17. Ghani N. Khazainul Advia. New Delhi: Idarae Kitabul Shifa; YNM: 577-579.
18. Colapinto J. Blood Suckers. The New Yorker 2005 July 25; 81 (21): 72.
19. Barnes RD. Invertebrate Zoology 3rd ed. Philadelphia: W.B. Saundars Co. 1974: 301-315.
20. Brown Jr. FA. Selected Invertebrate Types. New York: John Willey & Sons; 1950: 303-308.
21. Kaestner A, Zoology. Vol. Ist. London: Inter science Publisher; 1967: 541-545.
22. http://en.wikipedia.org/wiki/Medicinal_leech. Cited on 13-06-08.
23. Thorwald J. Science and Secrets of Early Medicine. London: Thames; 1962:79.
24. Deuraseh N. Ahadith of the Prophet (SAW) on healing in three things (ALShifa'fi Thalatha): An Interpretational. Journal of the International Society for the History of Islamic Medicine 2004; 18 (3): 14-20.
25. Batchelor AGG, Davidson P, Sully L. The salvage of congested skin flaps by the application of leeches. Br J Plast Surg 1984; 37, 385.
26. Henderson HP, Matti V, Laing AG, Morelli S, Sully L. Avulsion of the scalp treated by microvascular repair: the use of leeches for postoperative decongestion. Br J Plast Surg 1985; 36: 235.
27. Dickson WA, Boothman P, Hare K. An unusual source of hospital wound infection. Br. med. J.; 1984: 289.
28. Leech comeback as doctor's helper. Chicago sun. Times; 16th November 1987:10.
29. Bunker TD. The contemporary use of the medicinal leech, Injury: Br Jr Accident Surg 1981; 12: 430.
30. www.leeches.biz/ Cited on 28.03.08
31. The Leech rich source of biochemical Behring Diagn. Biol.;1986: 12

32. Wood head AD. Non-mammalian animal models for biomedical research. Google Book: CRC Press; 1989: 39-42.
33. Iwakawn A, Gasic TB, Viner ED, Gasie GJ. Promotion of lung tumor colonization in mice by the synthetic thrombin inhibitor (no. 805) and its reversal by leech salivary gland extracts. Clin Cexp Metastases 1986; 4: 205.
34. Sawyer RT. In leech Biology and Behaviour. Claredon press Oxford; 1986:138.
35. www.medicalleech.info/contradictions.htm. Cited on 18. 03.08.
36. Rao P *et al*. Lechmania in microsurgery. Practitioner 1985; 229: 901.
37. Adams SL. The emergency management of a medicinal leech bite. Annals Emerg Med 1989; 18: 316.
38. Baskova IP, Khalil S, Nartikova VF, Paskhina TS. Inhibition of plasma kallikrein. Kininase and kinin-like activities of preparations from the medicinal leeches. Thromb Res 1992; 67: 721-30.
39. Claude A. Spreading properties and mucolytic activity of leech extracts Proc Soc Exp Biol Med 1940; 43: 684.