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REVIEW ARTICLE

A REVIEW ON LEECH APPLICATION (JALAUKACHARANA) IN AYURVEDA AND SRI LANKAN TRADITIONAL MEDICINE

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Abstract

Medicinal uses of leech application (jalukacharana) is practiced globally, including Sri Lanka and India, since ancient days. Details are collected from Ayurveda and Sri Lankan tradition medical books, physicians, internet and personal experience. Detailed descriptions on this therapy is available in Susruta Samhita. It is used in management of various diseases in all most all systems of the body, ears, head and eyes. According to Ayurveda these diseases are caused by vitiation of three dosha. Leech application (jalaukacharana); a type of blood letting therapy (raktamokshana) which is a procedure of panchakarma, helps to eliminate vitiated dosha and toxins that accumulate in the body. Leech application removes some of these toxins accumulated in the body. Bioactive substances present leech saliva also exerts a therapeutic effect in several ailments. Though despised by most, medicinal leeches can be of immense benefit that may help people to surmount numerous health disorders.

Key words: Leech application, Leech Therapy, Hirudotherapy, Bloodletting, Jalukacharana, Ayurveda

Introduction

Leeches are invertebrates. In Ayurveda and Sri Lankan traditional medicine, they are use for treating various diseases since ancient days. Leeches are segmented worms that belong to the phylum Annelida. In Ayurveda, Sage Susruta¹ describes raktamokshana (bloodletting therapy) as one of the panchakarma procedures. Application of leeches (jalukacharana) is one of the Bloodletting therapeutic (raktamokshana) procedures in Ayurveda. Leech application is also known as hirudo-therapy and leech therapy. This therapy is practised in diverse countries such as Sri Lanka, India, China, Germany, England, America, Scotland, France, Hungary,

Ukraine, Turkey, Iran, Russia, Romania, Algeria, Africa and Egypt.

Material and Methods

Data was gathered from Ayurvedic and Sri Lankan traditional medicinal text books, physicians, internet and through personal experiences.

History of leech application (Jalukacharana)

Leech therapy is explained in ancient Ayurvedic and Sri Lankan traditional medical texts. Susruta Samhita gives a detailed description on leech application. Many ancient peoples including Indians, Europeans, Greeks and Sri Lankans practiced leech therapy. The use of

leeches in medicine dates beyond 2,500 years ago. The use of leeches in modern medicine made its comeback in the 1980's after years of decline, and today, leeches are used in microsurgeries including cosmetic surgeries.

jala and ayu which means 'the animals having water as life'. Leeches are also known as jalayuka. This word also comprises of two words jala and ayuka which means 'one who survive only in water'.

Synonyms of leeches according to Ayurveda and Sri Lankan Traditional Medicine

Different synonyms are used in Ayurveda for leeches such As Jalauka, Jalaukasa, Jalayuka, Jalanti, Jalayuki, Jalika, Jalsika, Jalajantuka, Jala soochi and Jalsarpini. In Sri Lankan traditional medicine leeches are known as Koodella, Pudawa, Diya Koodella and Diya Pudawa.

Classification of leeches according to Ayurveda

Sustruta Samhita² describes 12 types of leeches and classify them into two main categories, namely: Non-poisonous leeches (nirvisha jaluka) and Poisonous leeches (savisha jaluka). Kapila, Pingala, Shankamukhi, Mushika, Pundarikamukhi and Savarika are the six types included under the group of Non-poisonous leeches. Krushna, Karbura, Alagarda, Indrayudha, Samudrika and Gochandana are categorised under Poisonous leeches.

Morphological characters of Leeches according to Ayurveda

Sustruta Samhita describes morphological features of 12 types of leeches as given below.

Non-poisonous leeches (Nirvisha Jaluka)

The following leech are considered as non-poisonous and are used in treatment³.

Kapila-These leeches have their sides coloured like Manashila (realgar) and their dorsal surface are slimy and coloured like Munga (green gram)

Etymology of Jalauka (leeches) according to Ayurveda

In Ayurveda leeches are known as Jalauka. The word jalauka is comprised of two components.

Pingala-These are slightly red or brown in colour, have rounded bodies and move fast.

Shankamukhi-These are coloured like liver, are fast suckers and have tapering mouth.

Mushika- These leeches have their colour and shape similar to those of a mouse and possess a disagreeable odour.

Pundarikamukhi-These are coloured like Mudga (Moong pulse) and have their mouth like lotus petals.

Savarika-These leeches are slimy; coloured like Lotus leaves and are eighteen finger breadths in length.

Poisonous leeches (Savisha Jaluka)

The following leeches are indicated as poisonous and are not used in treatment⁴.

Krushna-These leeches are black like powder of Anjana (collyrium) and have broad head.

Karbura-These leeches are elongated like the Varuni fish, having cleft and elevated ventral surface.

Alagarda-These are hairy, have prominent sides and black mouth.

Indrayudha-These leeches have raised linear marks and thus appear in variegated colours like those of a rainbow.

Samudrika-These are slightly black and yellow in colour and are spotted, and possess the feature of an attractive flower.

Gochandana-These leeches appear to be divided in their hind part like the scrotum of a bull and have a pin-pointed mouth.

Medicinal Leeches

Hirudo medicinalis, *Hirudo verbena*, *Hirudo orientalis*, *Hirudo troctina* and *Hirudo verbana*, *Hirudinaria manillensis*, *Macrobdella decora*,

Haementaria officinalis, *Hirudo michaelsoni*, *Haementeria ghillanii*, are some of the leeches used in medicine.

Hirudo medicinalis is the leech used most commonly in Europe whereas *Hirudinaria manillensis* is the commonest leech use in Asian region. *Haementeria ghillanii* is the Amazonian medicinal leech and *Macrobdella decora* is the North American medicinal Leech. *Haementaria officinalis* is the medicinal leech found in Mexico. Specimen of *Hirudo verbana* was first observed in Stracos Valley, within the Tasad Reserve (Bihor county, north-western Romania)⁵.

Habitat and origin of non-poisonous leeches

According to Sustruta⁶, non-poisonous leeches live in Yavana, Pandya, Sahya and Pautana areas of India. The leeches that live in these areas are bulky (maha sharira), stout (balavatya), gluttonous (mahashana) fast blood suckers (shighrapavinyo) and are non-poisonous.

Leeches who originated from purifying urine and faeces of poisonous fishes, insects and frogs and inhabiting dirty contaminated water are of poisonous variety.

Those which owe their origin to clean and purifying aquatic plants such as Utpala, Nalina, Kumudu, Saugandhika, Kawalaya and Pundirika or moss, and inhabiting in clear water are non-poisonous.

Some species of leeches live in fresh waters, the others in the sea or on the land. Leeches are more abundant during the rainy season. In Sri Lanka, land leeches are found in tea, rubber, cinnamon and vegetable plantations or in low foliage in wet rain forests. Freshwater leeches prefer in still or slowly flowing waters, but some species have been collected from fast flowing streams. Freshwater leeches also can be collected from reservoirs. In Sri Lanka population of leeches is on decline due to usage of agrochemicals.

Presently in Sri Lanka, leeches living in fresh water are used in treatment and most of them are collected from small water streams, paddy fields, ponds and lakes.

Indications of leech application in bloodletting therapy

In Ayurveda and Sri Lankan traditional medicine, in bloodletting therapy through leeches, purified and cleaned medicinal leeches are applied in management of various disorders, especially which are caused due to vitiation of pitta dosha.

According to Ayurvedic texts, skin diseases (kushtha), Erysipelas (visarpa), boils and carbuncles (pidaka), abscesses (vidradi), ring worm (dadru), scabies (pama), eczema (vicarchika and charmadala), discoloration of the body (vaivarnata), pigmentation in the face (vyanga), moles (tilakalaka, masaka and piplava), blue pigmentation in the body (nilika), black pigmentation (nyaksha), pruritus (kandu), allergies (kotha), tumours (arbuda), leucoderma (svitra), inflammation in the anorectal region (gudapaka), penile inflammation (medhrapaka), gout (*vata rakta*), fever (santapa), bodyache (angamarda), dyspepsia (agnimandaya), anorexia (aruchi), thirst (pipasa), heaviness of the body (gurugatrata), burning sensation after taking meals (annapana vidaha), bitter eructation (tiktoḍgara), acid eructations (amlodgara), acrit eructations (katu udgara), neurasthenia (klama), tremors (kampa), aphonia (swarakshaya), alcoholism (mada), haemorrhagic diseases (raktapitta), uterine bleeding (asrigdara), haematuria (raktamutra, raktameha), piles (arshas), excessive sweating (sweda) and strong body odour (sharira daurghandhya) splenomegaly (pleeha dosha), abdominal swelling (gulma), stomatitis (mukhapaka), uvulitis (upajihwika), foul swelling in the mouth (puti asyagandhata), gingivitis (upakusha), saltish taste in mouth (lawanasyata), eye diseases (akshi roga), alopecia (indralupta), headache (shiroruja), anxiety (prasmelaka), anger (Krodha), confusion (buddhi sammoha), vertigo

(*Bhrama*), excessive sleep (*atinidra*), drowsiness (*ati tamodarshana*), are diseases for which, leech application (*Jalukacharana*) can be indicated^{7,8}.

Contraindications of leech application

According to Ayurveda, leech application (bloodletting therapy) should not be performed in patients suffering from generalized anasarca (*Sarwanga Shophya*), cachexia (*kshina*, *shosha*), Anaemia (*pandu*), ascites (*udara*) and also in pregnant women (*garbhini*)⁹.

Procedure of leech application (Jalukacharana)

Collection of leeches-According to Sushruta Samhita¹⁰, leeches should be collected from ponds or lakes with the help of piece of wet leather. According to Charaka Samhita, best time for collection of leeches is autumn season. In autumn, water become hot during day time due to exposure to sun, cools in the night and is well detoxified. A popular method is collecting leeches in certain regions is by using a large tin can. The bait, a head of fish or piece of raw chicken is kept inside the can. The top of the can is crushed leaving the mouth opening of an inch or two wide. The can sunk in the water over night and pull out in the morning¹¹.

In Sri Lanka, most of the leeches for therapeutic purposes are collected from running fresh water especially from small water streams and paddy fields.

Selection of leeches-According to Sushruta Samhita¹² leeches who are having an expanded middle part of the body (*sthulamadhya*), ugly (*pariklishta*), flat and dull in movement (*prutvyo mandacheshta*), do not grip (bite) well (*agrahi*), they suck only a small quantity of blood (*alpapani*). Poisonous leeches (*savisha*) are not suitable for leech therapy.

The leeches who are bulky (*maha sharira*), stout (*balavatya*), gluttonous (*mahashana*) fast blood suckers (*shighrapavinyo*) who moves quickly

live in fresh water and of non –poisonous varieties are suitable for application.

Storage of leeches-According to Sushruta Samhita¹³, collected leeches should be stored in a new big wide pot containing clean water and mud from tanks or ponds. Powder of moss, dried meat and aquatic tubers should be given for feeding. Straw and aquatic plants should be provided for making their bed. Every three days water should be changed and pot should be changed weekly.

Nowadays, the leeches are kept in glass bottles or jars with a lid which prevents leeches from coming out. Small holes should be made in the lid to let in fresh air. It is better to fill the jar with water from their natural habitat. Aquatic plants or grass is put into the jar. The water in the container is changed once a week. The leeches are not fed in order to make them hungry, and it is believed that this would enhance the sucking blood by leeches.

Purification of leeches for application-According to Ayurvedic methods, medicinal leeches should be carefully identified and properly purified before using in bloodletting therapy. Various methods are practised by different physicians to purify leeches.

According to Sushruta Samhita¹⁴, a paste prepared with mustard, turmeric and water should be applied on the body of the leech. They should then be kept in a vessel of water for about 48 minutes (*muhurta*) till they get rid of their exhaustion.

According to Ashtanga Hridaya¹⁵, leeches should be purified by keeping them in medicated water. This may be prepared by (a)mixing turmeric powder with water (b) water in which uncooked rice is washed (*avantisoma*) (c) butter milk (*takra*) for a short time. After purification, the leeches should be kept in pure water.

At Ayurveda Teaching Hospital, Borella, Sri Lanka, the purification of leeches is done by keeping them in medicated water for ten minutes. This medicated water is prepared by

adding 2 gm of powder of dried rhizome of *Curcuma domestica* (Family: Zingiberaceae) to 100 ml of water.

Another method is used by Sri Lankan traditional physician family Alagiyawanna, Wedagama, to purify leeches. In this, leeches are kept for 24 hours in specially medicated water which is prepared by adding five to six slices of fresh rhizome of *C. domestica* into water. After 24 hours, these leeches are transferred to pure water and kept there for another 24 hours before application.

These purifications help to increase the appetite of leeches, enhance the desire of sucking blood and locomotion. I have personally observed the increase of locomotion and activeness. As turmeric powder is an effective antimicrobial agent, it may destroy the harmful bacteria in the leeches thus reducing the risk of infections.

Preparatory procedures (Purva Karma) of the patients for leech application / bloodletting therapy

According to Ayurveda and Sri Lankan traditional medicine, no specific preparation of the patients is needed prior to application of leeches.

But in Ayurveda, Bloodletting therapy is described as one of the panchakarma (Five-fold evacuation therapies) procedures. Prior performing any one of these evacuation therapies (including raktamokshana), purva karma; snehana (oleation) and swedana (fomentation), should be carried out to enhance the mobility of dosha. Therefore performance of purva karma, prior to application of leeches which is a method of bloodletting therapy (raktamokshana) may help to eliminate the accumulated vitiated dosha and toxic metabolites more effectively.

Shrinivasa Acharya¹⁶ is of the opinion that, in order to get the maximum benefit out of bloodletting therapy (raktamokshana) using leeches, the patient should be subjected to snehana (oleation) and swedana (fomentation).

Abhyantara snehapana (internal oleation) should be carried out with small doses of sneha for three days, followed by abhyanga and vashpa sweda on the fourth day. Then bloodletting therapy (raktamokshana) should be performed on the fifth day.

Procedure (Pradhana Karma) of applying leeches

The area to be treated is thoroughly cleaned with warm water without applying soap or cleansers. The purified leeches are then applied to the selected area to suck vitiated blood. Once the leeches take hold, they are covered with wet cotton wool so as to facilitate the sucking of blood by keeping them cool and moist. In Sustruta Samhita¹⁷, it is mentioned that the physician can understand whether leeches are sucking blood by observing the elevation of middle portion of the leech's body. Sometimes leeches do not bite or start sucking blood. Then a drop of milk or blood should be applied to the site or scratching the site with a scalpel to bring out blood should be done to persuade the leech to suck blood. When the leeches have finished sucking blood, they will fall off.

Sometimes pricking pain and itching may develop at the site of bite. According to Ayurveda, leeches are used to remove vitiated blood. If patient feels pain and itching at the site where leeches are sucking blood, it means they are sucking unaffected healthy blood. Then the leeches should be removed by sprinkling a very small quantity of rock salt at its mouth¹⁸.

Post-operative procedures (Pashchat Karma) on application of leeches

After completion of leech application, physician should pay the attention towards the patients' wounds and to the leeches.

Care of the patients-According to Sustruta Samhita¹⁹, after assessing amount of bleeding, the wounds should simply be anointed with ghee that has been washed one hundred times (shatadauta ghruta) or should be compressed with gauze. Then, the wounds caused by the

leeches are rubbed with bees' honey. Otherwise, cold water should be sprinkled over it or ingredients with the properties of astringent (kashaya), sweet (madhura), greasy (snigdha) and cold paste (sheeta pradeha) should be applied over the wounds.

Currently, the common practise in Sri lankan Ayurveda hospitals is to treat these leech bites by applying turmeric powder with bees honey, powder of Manjista (*Glycyrrhiza glabra*) or traditional Srilankan oil Seethodaka. After performing leech application, patient is made to rest.

Care of Leeches-According to Ayurvedic teaching, though they suck, the leeches are not able to digest vitiated blood. A disease called Indramada will develop in leeches if this blood is not removed. Hence, the leeches are made to excrete the sucked blood and are put into fresh water.

Removal of blood can be done in various ways. According to Sustruta Samhita²¹, the fallen leeches should be massaged; its body with powdered rice, mouth with oil and common salt and then its hind portion should be held by the left hand in between the thumb and fingers of the physician. Then leeches should be slowly and gently squeezed (tail towards mouth) with the thumb and fingers of the right hand of the physician. If the leeches are empty stomached, they move to and fro in search of food. If the leeches sink in the water and do not move, the physician should understand removal of sucked blood from leech is incomplete and steps should be taken to remove the remaining blood in the body by making the leech to vomit. After removing sucked blood, these leeches are kept in a glass bottle or jar with water. These leeches can be used for blood sucking again after seven days with the same patient.

The current practise in Sri Lanka, is to sprinkle some rock salt or turmeric powder to the mouth of the leech to make it vomit the sucked blood or to remove the sucked blood by squeezing the

leeches from tail end towards mouth. As soon as blood is vomited the leeches are put back into water and observe whether they sink or move rapidly here and there. Should they sink it means they have not excreted completely and therefore the excretion procedure should be repeated immediately.

Sri Lankan traditional method of deciding number of leeches should be applied to a person

Some Sri Lankan traditional physician are of the opinion that about six leeches will be sufficient for application at a time. This process should be repeated weekly for four weeks. If further, application of leeches are needed allow patients to rest at least about six months. After considering of the patients physical condition, physician can again perform leech therapy.

Some Sri Lankan traditional physicians count the number of leeches should be applied as follows.

According to the age for every two years, one leech should be applied. This should be divided with number of applications.

E.g. If a patient is 40 years, the total number of leeches needed is 20. If you plan to apply leeches 4 times, divide twenty by four to find out the number of leeches should be applied at a time. According to this method 5 leeches should be applied at a time to a person 40 years of age.

Disadvantages of leech application

Due to presence of hirudin, bleeding from wound following leech bites may persist from several hours to three days till action of hirudin is over. Allergy to leech bites, even severe allergic or anaphylactic reactions has been reported^{21, 22}. Red blotches or an itchy rash in the body, swelling around the lips or eyes, feeling of fainting or dizziness and difficulty in breathing are some of the clinical features present in allergies²³. Sometimes due to bacteria in gut of leeches may cause the wound to be infected. On forceful withdrawal of leech from the site of

leech bite, leeches may vomit and contents in the stomach will come into contact with wounds and this may complicate the wound occurred due to leech bite.

Repellents for leeches

In Sri Lanka, soap, juice of tobacco leaves and Balms containing menthol or similar substances are applied on the legs to prevent leech bites.

Biochemistry of leech saliva

During the process of feeding, leeches secrete a complex mixture of different biologically and pharmacologically active substances into the wound. Components of medicinal leech saliva and their effects in the host's body are given in the following table²⁴.

Active Substance	Effect on the Host
Hirudin	Inhibits blood coagulation by binding to thrombin
Calin	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	Inhibits kallikrein, trypsin, chymotrypsin, and neutrophilic cathepsin G
Bdellins	Anti-inflammatory. Inhibits trypsin, plasmin, acrosin
Hyaluronidase	Increases interstitial viscosity. Antibiotic
Leech-derived Trypsin inhibitor (LDTI)	Inhibits proteolytic enzymes of host mast cells
Eglins	Anti-inflammatory. Inhibit the activity of alpha-chymotrypsin, chymase, subtilisin, elastase, 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
Histaminelike substances	Vasodilator. Increases the inflow of blood at the bite site
Acetylcholine	Vasodilator
Anesthetics substance	Anesthetic

Research findings on leech therapy

Various researches had been conducted to evaluate the efficacy of leech application in several ailments.

1. Leech application is effective in Gout. A randomized open phase clinical trial was

conducted to evaluate effect of leech application in sandhigata vata. Leeches were applied weekly for a period of six weeks. This treatment significantly effective in treating Gout. 44% patient relieved in pain, 40% in swelling, 28% in

stiffness, 32% in restriction of movement and 16% in deformities²⁵.

2. A non randomized controlled pilot study was conducted to assess the efficacy of leech therapy in acute Gout (gambhira vatarakta). A group of patients was treated with 2-4 leeches for seven days with a 4-week observation period. Another group was treated with topical Diclofenac sodium gel for 7 days. In comparison, group treated with leech application showed rapid relief from pain and swelling immediately after the detachment of leeches. Highly significant clinical improvement was noted after 14 days and slight reduction of serum uric acid was noted after three weeks of treatment²⁶.
3. Leech therapy is an effective treatment in reducing the symptoms of osteoarthritis in knee joint and improve physical functions clinically²⁷.
4. Leech therapy is beneficial in reduction of pain, tenderness, stiffness, crepitus, and swelling in the patients of osteoarthritis. Leech application was conducted once a week for a period of six weeks²⁸.
5. An open non-randomized trial was carried out on patients diagnosed with sandhi-asthigataavata (osteo-arthritis, synovitis, and bursitis) and snayugataavata (tendinitis). A single trial with two leeches (*Hirudo medicinalis*) applied topically at painful periarticular sites of the knee joint in the experimental group of 4 patients. In conjunction, patients also received a course of Kaishora guggulu and Mahamanjishtadi kashayam. The findings suggested that pain in afore mentioned acute conditions conditions was alleviated following the therapy²⁹.
6. Leech application is effective in yuvana pidaka (acne vulgaris)³⁰. A Randomized open trial Single blind clinical study was conducted to evaluate the efficacy of leech

application and Sarivadyasava in the management of acne vulgaris. 20 patients were subjected to leech application once a week in conjunction with oral administration of 25 ml of Sarivadyasava three times a day for a period of 28 days. The combined therapy showed a statistically highly significant response in reducing the clinical features of acne vulgaris

7. Leech therapy is effective for the treatment of varicose ulcers due to salivary secretions which is injected during bloodsucking³¹.
8. A randomized clinical open trial had been conducted to find out the effect of leech therapy in varicose vein, using two groups. First group was treated with leeches in alternative days for two months. Second was treated with grade 2 compression stockings and limb elevation for two months. Response was measured by assessment of pain / leg discomfort, limb girth at calf, ankle, and feet, pigmentation area & colour on every 15th day. First group showed significant reduction in pain, limb girth, and pigmentation. Second group showed significant reduction in pain & limb girth, but there was no improvement on pigmentation. Both groups do not show significant improvement on SFJ (Saphenofemoral junction) & SPJ (Saphenopopliteal Junction) incompetency³².
9. A single course of leech therapy was effective in relieving pain in the short-term in patients suffering from chronic lateral epicondylitis (Tennis elbow) and reduced disability in intermediate-term. Further the researchers have mentioned that leeches might be considered as an additional option in the therapeutic approach to lateral epicondylitis³³.

10. Tenosynovitis of the quadriceps femoris is a local inflammatory condition. Researchers selected leech therapy in management of this condition, as Sushruta describes bloodletting therapy is beneficial in early stages of oedema. Local leech application was done at the left thigh for 7days, daily at the same time. Mobility of hip and knee joints improved and local tenderness relieved after treatment³⁴.
11. A scientific study showed that a diabetic ulcer was healed after 30 days with repeating leech therapy in four sittings. Improve the blood circulation and reduce the congestion due to presence of Carboxypeptidase. A inhibitors Histamine like substances, Acetylcholine thus it corrects Diabetic angiomicroopathy. Vasodilators presences in leech saliva enhance blood circulation and it corrects ischaemia and diabetic atherosclerosis. Leech application has anti-inflammatory action nerves due to presence of substance like Bdelin and Eglins in saliva, hence correct diabetic neuropathy³⁵.
12. In a clinical study carried out by administering of siravedhana (venepuncture) and jalaukavacharana (application of leeches) in vicharchika (eczema) proved that application of leeches are more effective in the management, whereas results provided by siravedhana was not much encouraging³⁶.
13. A randomized open phase clinical trial had reported that leech therapy is effective in treating patients suffering from psoriasis and indicated statistically significant reduction in clinical features such as erythema, scaling, induration, itching, burning sensation, discoloration and dryness of lesion . Here, leeches were applied once a week for three months³⁷.
14. A quasi-experimental (pre-post test design) study reported that leech therapy is effective in treatment of vitiligo in conjunction with Ayurveda medicine (Arogyavardhani vati and Gudichi satva 500mg each with Haridrakandha 6gm twice a day). Here, leech application was conducted weekly for six months on vitiligo patches. After six months 60% of patients showed repigmentation while arrest of progression of vitiligo was noted in 35%. In 5% vitiligo was spreading³⁸.
15. A series of case studies on application of leeches on Buerger's disease (Thromboangiitis obliterans / TAO) had been conducted by some researchers and reported it is effective in management of Thromboangiitis Obliterans³⁹.
16. A study revealed that Leech Application for a period 6 weeks is effective in treatment of Fileriasis (shlipada). In one sitting minimum 5 and maximum 10 leeches were applied as per the severity of the symptoms. The blood expelled from one patient at one sitting ranged from 80 to 100 ml, without any untoward effect. In this study, selected patients were divided into two groups. First group of patients had clinical features such as itching, redness, inflammation and non-pitting oedema. In 1st group, swelling began to reduce, even after one sitting of leech application. Inflammation was locally reduced after 3-4 sittings. Complete relief from symptoms in 1st group varied from 10-15 sittings. Second group had clinical features such as residual hard swelling and nodules on the lesions. Approximate 40% relief was observed in 2nd group after 20 sittings within 6 weeks⁴⁰.
17. Thrombosed piles possibly occur due to high venous pressure associated with severe anal pain. Twelve patients underwent leech application with a gap of 2 days between two settings. One leech sucks 5-10 ml of blood. Bleeding lasts about 12–24 hours and patient looses

about 20–30 ml of blood. Leech (*Hirudina medicinalis*) application in thrombosed piles is found to be effective in reducing pain, tenderness, oedema and discolouration and shows thrombolytic action, which contributes in re-establishment of circulation. This application also provides analgesic activity. It is observed that, pus and mucous discharge have been reduced after leech application; which may be due to antimicrobial and mucolytic properties in leeches. This treatment is found to be effective in thrombosed piles⁴¹.

18. Main complications in Corrective plastic surgery such as arterial and venous insufficiency caused by a vessel collapse or a vascular spasm are reported regularly in the area of anastomosed vessels. A retrospective evaluation of 148 patients who underwent medical leech therapy, in the case of local or pedicled flaps and some patients who had undergone reconstruction with microvascular flaps from 2005 and 2010, was conducted. The sample had the typical symptoms of venous congestions of their flaps, despite suture removal, relief of pressure on the flap, and the elimination of a hematoma beyond the flap after surgery. Medical leech therapy was used in these cases. The series has confirmed the excellent and predictable healing after medical leech therapy for local and microsurgical anastomosed flaps in the case of venous congestion⁴².
19. The present study was conducted to observe the effects the hemorheological properties after leech treatment. 23 patients (19 women and 4 men) with different diseases (cardiovascular and cerebral diseases, peripheral vascular disorders, etc.) was investigated before and after application of ten leeches on the lumbar region and one month after the

first measurement. Whole blood viscoelasticity, plasma viscosity, whole blood and plasma density and hematocrit were determined as hemorheological parameters. The results showed that the whole blood viscoelasticity is significantly decreased after leech treatment although no significant changes of hematocrit and plasma viscosity could be observed. The decrease of blood viscoelasticity values was even more marked after one month of treatment. They correlated well with changes in aggregation tendency and flexibility of the red blood cells (RBC). These results suggest, that leeching is not a hemodilution effect alone. Moreover, apart from rendering blood noncoagulable by acting as antithrombin, the salivary gland secretion of these animals can also have a lasting effect on the hemorheological properties⁴³.

20. The study had conducted to determine the effect of the thrombin inhibitor, hirudin, on the pathogenesis of murine antigen induced arthritis (AIA). AIA was induced by intra-articular injection of methylated bovine serum albumin in the knee joints of previously immunised mice. Hirudin (injected subcutaneously $3 \times 200 \mu\text{g}/\text{mouse}/\text{day}$) was given over 13 days, starting three days before arthritis onset, and its anticoagulant effect monitored by clotting times. Arthritis severity had evaluated by technetium-99m (^{99m}Tc) uptake in the knee joints and by histological scoring. In addition, intra-articular fibrin deposition was examined by immunohistochemistry, and synovial cytokine mRNA expression measured by RNase protection. Joint inflammation, measured by ^{99m}Tc uptake, had significantly reduced in hirudin treated mice at days 7 and 10 after arthritis onset. Histologically, synovial thickness had markedly decreased in hirudin treated

mice compared with untreated ones. By contrast, no difference in articular cartilage proteoglycan content was found between both groups. Intra-articular fibrin deposition and synovial interleukin 1 β mRNA levels, had slightly reduced (~20%) in arthritic joints from hirudin treated mice compared with untreated ones at day 10 of AIA. It had concluded that Hirudin reduces joint inflammation associated with AIA by fibrin-dependent and independent mechanisms⁴⁴.

21. Leech treatment generally does not cause changes in systemic coagulation profile. However, excessive leech use may result in bleeding diathesis and deranged prothrombin time, international normalized ratio and activated partial thromboplastin time requiring FFP and platelet transfusions. The wound of leech bite may be a source of infection so appropriate antibiotic coverage is recommended. The choice of regional anesthesia would depend upon the coagulation profile and the time of last leech therapy. Potential coagulopathy requiring blood product usage needs to be kept in mind in a cardiac surgical patient⁴⁵.
22. Antioxidants from natural sources have been arisen as prophylactic and therapeutic agents in many life threatening disorders such as cancer and cardiovascular diseases. Leech therapy has been used since the extreme old ages in a variety of abnormalities. The current study was executed to examine the antioxidant activity of the salivary gland secretion of the medicinal Malaysian leech using DPPH free radical scavenging activity method. Leech saliva extract (LSE) was collected from starved leeches after feeding them on the phagostimulatory solution of 0.001M arginine in 0.15 M sodium chloride. Total protein

concentration was 78.753 ± 2.406 μ g/ml. A series of different dilutions of LSE were mixed with DPPH in a methanolic medium and the changes in absorbance were measured at 516nm. Results showed that LSE expressed a free radical scavenging activity with IC₅₀ of 7.282 μ g/ml compared with 5.803 μ g/ml of L-ascorbic acid as a positive control. Therefore, this study revealed that the proteomic contents of LSE are promising natural antioxidants⁴⁶.

Current therapeutic usage of leech Therapy

Modern days with the revival of leech application, this method of treatment in practiced on hypertension, angina pectoris, myocardial infarction, heart disease, wrinkles, dark spots and panda eyes (dark colour under the eyes), Herpes Zoster, boils, alopecia (type of baldness), diseases caused by thrombosis and embolism, migraine, paralysis induced by brain thrombosis, infantile cerebral palsy, seizures, Schizophrenia, depression, Arthrosis, arthritis, rheumatism, muscle strain, tendovaginitis and tendinitis periorbital hematoma, glaucoma, eye inflammation such as chorioretinitis, conjunctivitis, keratitis and schleritis, sudden hearing loss, tinnitus, otitis media, gum diseases, endometriosis, hepatitis, foot ulcers in diabetes mellitus and sport injuries such as Golfer's elbow.

Further leech therapy is also used in detoxification of the body, promotion of health and beauty, for mental physical relaxation, for brain cells rejuvenation and better synapses of neurons, to enhance memory power (dementia and Alzheimer's), to improve blood circulation and digestion, for tissue revitalization and for prevention and lowering the risks of heart attack or stroke.

Though there are many claims for extraordinary success, many of them claims are not supported by scientific proof. However the author is of the

opinion that we should not off handedly reject or blindly accept all these claims.

Leech therapy in Siddha medicine: Some physicians practicing Siddha medicine, have

various beliefs⁴⁷. They believe that leeches should not applied on certain parts of the body on some days of the month. It is given in the table below-

Thithi (Day after New Moon)	Part of the body
1 Moon Day	Piradhamai (Great toe)
11 Moon Day	Thuthiyai (Sole of foot)
111 Moon Day	Thirithigai (Knee joint)
1V Moon Day	Chathurthi (Thigh)
V Moon Day	Panchami (Generative organs)
V1 Moon Day	Shasti (Umbilical region)
V11 Moon Day	Sapthami (Breast)
V111 Moon Day	Ashtami (Hands)
1X Moon Day	Navami (Neck)
X Moon Day	Dhasami (Female generative organ)
X1 Moon Day	Ekathasi (Tongue)
X11 Moon Day	Thuvathasi (Fore head)
X111 Moon Day	Thirayothasi (Eye lid)
X1V Moon Day	Chathurthasi (Nape)
XV Full moon day	Asy-pooranam (Head)

Further, these physicians are of the opinion that at a time no more than 4-6 leeches should be placed on the body, at a time. It is also

mentioned that in treatment of various diseases, leeches should be applied to different parts of the body.

Disease	Parts of the body
Swelling due to injury, boils and abscesses	Affected sites
Uncontrolled Vomiting	Fonticulus gutturis
Intractable headache	Forehead
Headache due to blockage of blood in piles	Anus region
Headache caused by Menopause	Thigh
Stomach pain due to dysentery	Anus region
Liver enlargement	Liver
Whooping cough in children	Middle of the back
Chronic swelling of the joints	Joints
Pain in eyes and eye brows with watering	1.25 cm away from the lateral angle of the eye

Discussion

Application of leeches (jalukacharana) removes not only blood from the body but also injects biologically active substances which help to manage various ailments. According to Ayurvedic view diseases are occurred by vitiation of dosha. Vitiated dosha can get accumulated in srotas (physiological channels), cause blockages and may lead to diseases. Jalukacharana is one of the oldest methods used in purification of the body by removing deeply seated toxins and pacifying vitiated dosha.

A healthy cell gets sick when it is deprived of needed oxygen and nutrition, and is unable to remove toxins accumulated during metabolism. Biologically active substances in leech saliva help the cells to absorb necessary nutrition and eliminate toxins. Therefore, many diseases could be treated with leech application. It is useful in treating a number of cardiovascular diseases: hypertension, atherosclerosis, hypercoagulation, stenocardia, myocardial infarctions, varicose veins, arterial blood flow disorders in lower limbs and their complications, such as trophic lesions and oedemas and also haemorrhoids. It is also helpful in managing gynaecological disorders: reduce various inflammation processes in the uterus and its adnexa, ovarian cysts, endometriosis, climacteric syndrome, various adhesions in the pelvis, and even in cases of frigidity, infertility and mastopathy. The application of leeches is successful in treating

prostate and scrotal diseases, erectile dysfunctions, bladder and urinary tract inflammations. Good results can be achieved using leeches to treat headaches of various origins, including migraine. Neurologists should consider leech therapy in the treatment of neuritis, neuralgia, radiculitis, spinal disorders (disc hernias), brain atherosclerosis, pre-stroke conditions and stroke.

Since substances contained in leech saliva can lower blood sugar levels and improve pancreatic function, leeches can be effectively used in the integrated treatment of diabetes and its complications

Applications of leeches (jalukacharana) have reported improvements in sleep quality, mood, work capacity and increased energy levels. When a leech is applied to biologically active areas of the human body, the bite itself gives a positive effect similar to reflexotherapy.

Conclusion

Applications of leeches (jalukacharana) described under bloodletting therapy (raktamokshana) of panchakarma in Ayurveda and Sri Lankan traditional medicine, is one of the very effective treatment modality for treating disorders in cardio vascular, respiratory, gastro intestinal, integumentary, genitor urinary, nervous, locomotor and endocrine systems.

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