Medical Leech therapy (Hiurdotherapy), benefits and side effects

Research project

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By

Sima Edris Mustafa

Supervised by

Dr. Shwan Khursheed Rahman

ERBIL-KURDISTAN

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SUPERVISOR CERTIFICATE

This research project has been written under my supervision and has been submitted for the award of the degree of BSc. in General Science with my approval as a supervisor.

Signature:

Name: **Dr. Shwan Khursheed Rahman**
Date: /4/2022

I confirm that all the requirements have been fulfilled.

Signature:

Name: **Assist. Prof. Dr. Kazhal Muhammed Sulaiman**
Head of the Department of Biology
Date: /4/2023

I confirm that all the requirements have been fulfilled

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DEDICATION

This work is dedicated to:

- ♥ The sake of Allah and my great teacher and messenger Mohammed (May Allah bless and grant him).
- ♥ The people who have supported me throughout my education. Thanks for making me see this adventure through to the end especially my Family
- ♥ My friends who encourage and support me.

ABSTRACT

Hiurdotherapy is a treatment using medicinal leeches. *Hirudo medicinalis*, have been used to treat patients for centuries. In the past, leeches have proved to be an effective treatment for a number of conditions including battle wound treatment. Currently leeches may be used to assist in the treatment of abscesses, arthritis, glaucoma, myasthenia gravis, thrombosis and some venous disorders. Medical leeches may also be used in plastic surgery and in some blood circulatory problems. During feeding, leeches secrete a complex mixture of different biologically and pharmacologically active substances into the wound. Hirudin is the prominent constituent of leech saliva. It is sometimes used to describe all the active constituents in the leech saliva. This paper outlines the potential information of leech therapy in current medical care in the World.

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INTRODUCTION

Medicinal leech therapy (MLT) or Hiurdotherapy is a kind of complementary and integrative treatment method applied with blood-sucking leeches. One or more leeches are attached to the skin of problematic area and the purpose is to gain potential utilities of leech saliva that is secreted while the leeches are feeding. MLT has been used for centuries and the term leech was provided from the word "laece" (physician). The first recorded applications were observed in ancient Eygpt (Whitaker et al., 2004). In addition, Chinese, Arabic, Anglo-Saxon, Ancient Greek, and Roman medical records have many references to MLT. In 17th century Europe, MLT reached its widest area of application.(Eldor et al., 1996) Since the 1900s, attention of medical professionals has decreased, but in the last 30 years, MLT has become an important part of much scientific research.(Cherniack and Cherniack, 2011)

Leeches live in fresh water and are segmented, hermaphrodite, carnivorous worms. They are sensitive to vibrations on the water, touch, light, heat, sound, and various chemicals. They are multisegmented, including "brain parts", and each segment has different organs such as ganglions and testicles. Two sucker parts work for creeping and adherence; the anterior one has three jaws including many teeth. They generally bite warm parts of the host and suck its blood with rhythmic contractions (Sig et al., 2017). Feeding usually takes almost 40 minutes and a leech digests 10–15 mL of blood per feeding. Digestion is achieved by many enzymes and mutual microorganisms such as *Aeromonas hydrophila* and *Pseudomonas hirudinia*.(Herlin et al., 2017)

MLT was previously tested and is widely used after plastic, reconstructive, and microsurgical applications, in cardiovascular diseases, deep vein thrombosis, postphlebitic syndrome, complications of diabetes mellitus, tinnitus, acute and chronic otitis, and in reducing the pain of osteoarthritis.(Abdualkader et al., 2013) There are more than 600 leech species, but *Hirudo medicinalis, Hirudo troctina, Hirudo nipponia, Hirudo quinquestriata, Poecilobdella granulosa, Hirudinaria javanica, Hirudinaria manillensis, Haementeria officinalis,*

and *Macrobdella decora* are the most frequently applied worldwide (Eldor et al., 1996).

Many studies have found that leeches have various bioactive molecules in their secretions. More than 20 molecules and their modes of action have been identified, but there are many more awaiting exploration. These molecules have analgesic, anti-inflammatory, platelet inhibitory, anticoagulant, and thrombin regulatory functions, as well as extracellular matrix degradative and antimicrobial effects.(Clarke, 2016, Das, 2014)

Hirudo medicinalis has widest therapeutic usage among the leeches, but worldwide, many different species were tested and studied. Then, The aim of the present report about Medicinal leech therapy (MLT) or hirudotherapy, an old technique, has been studied by many researchers for possible effects on various diseases such as inflammatory diseases, osteoarthritis, and after different surgeries.

HISTORY

The use of leeches in medicine dates as far back as 3,500 years ago, when they were used for bloodletting in ancient Egypt. Leech therapy is one of the oldest medical practices, having been practiced among the diverse ancient people, including the Mesopotamians, the Egyptians, the Greeks, the Mayans and the Aztecs. In Greece, Leech therapy was first introduced by a famous Unani physician, Hippocrates, also known as father of medicine. The popularity of this therapy was reinforced by the ideas of Roman philosopher Galen, who classified Leech therapy as a method of treatment and prevention of health. He believed that blood was the dominant humour and the one in most need of control. In order to maintain the balance of humours, a physician would either remove excess blood from the body or advise them any other treatment for evacuation of morbid humours. (Lone et al., 2011)(Sivachandran et al., 2015). Recently, the medical science has taken a leap to a stage beyond imagination.

The application of leech for therapeutic purposes has been described as leeching. In the ancient time, leeches were merely used as a tool for bloodletting. Bloodletting was basically conducted as a remedy for congested or inflamed parts of the body in condition of engorged haemorrhoids, swollen testicles, laryngitis, prolapsed rectum and inflamed vulva. The underlying concept of bloodletting was to remove vitiated blood to restore good health. Since bloodletting by venesection is a painful procedure, the usage of leech became the preferred alternative for the same. In addition, bloodletting using leech was not only painless, but it also limited the amount of blood loss compared to venesection[3].

According to Eldor et al.[3], Nicander of Colophon was the first medical practitioner who started the trend of using leeches for therapeutic purposes between 200-130 BC. Subsequently, the usage of leech was described in a work of the celebrated 2nd century by Galen, a physician. In addition to that, ancient artefacts like early Chinese writings, ancient Sanskrit, Persian and Arabic literature had also mentioned the utilization of leech for therapeutic purposes.

During the middle ages, leeches were not viewed as an important organism for therapy. However, in the 18th and 19th centuries, leeching was at its peak of popularity in Europe, thus, resulting in leeches becoming a major object of international trade. During the 19th century, it was reported that leech therapy was being practised in hospitals. According to the published report, Parisian hospitals used approximately 5-6 million leeches between 1829 and 1836 and managed to remove 84 150 kg of blood annually from treated patients. On the other hand, in 1832, St. Bartholomew's Hospital in London used 97 300 leeches for treatments. The successful application of leeches for medical treatments in hospitals led to an enormous increase in demand for leeches, particularly, H. medicinalis, in Europe.

As time progressed, medical practitioners around the world used leeches for the treatment of many diseases, ranging from various local aches, inflammatory processes to nephritis, laryngitis, eye disorders, brain

congestion as well as obesity and mental illnesses[3]. In the year 2004, U.S. Food and Drug Administration (FDA) had given the approval for the usage of *H. medicinalis* (a medicinal leech) as a medical device in clinical setting[4].

Shortly thereafter, in the year 2007, a controversy was raised regarding the identity of *H. medicinalis*. A study on the identification of leeches from the farms which cultivated them for medical purpose revealed that many of the farmed leeches were Hirudo verbena (Siddall et al., 2007).Since then, several studies were carried out and now, *Hirudo verbana* has also been given clearance by FDA to be used as a medical device The FDA clearance has again brought leeches to its peak of popularity globally. (Britton, 2016).

MORPHOLOGY DESCRIPTION AND LIFE CYCLE OF LEECH

Leeches are segmented worms that live in a wide range of environments, including fresh water, salt water and on land. The are hermaphroditic and produce young from eggs stored in cocoons. Some leeches are carnivorous and swallow their prey whole, but most are parasitic, latching onto and moving across their hosts with two sucking discs positioned on either end of their bodies. Bloodsucking leeches release anesthetic chemicals, anticoagulants and antibiotics into their hosts so the bite isn't felt, the blood flows freely and there is little chance of infection. For some experiments, individuals for which the exact birthdate (defined here as the date of zygote deposition into cocoons on the parental venter) was known were reared in isolation from early stages of development in small petri dishes (35 or 50 mm diameter), with daily feeding and changes of water (1/100 dilution of artificial seawater; Salinity for Reefs, Aquavitro) at room temperature (21–23°C). For other experiments, groups of late stage embryos or early juveniles, from a clutch for which the exact birth date was known, were isolated and reared as freely breeding cohorts, maintained as above except for being transferred as adults to larger containers (0.5–1 liter capacity pyrex bowls). With rare exceptions, animals in both conditions were checked daily for reproductive activity and deaths. Cocoons were removed and embryos

enumerated as described elsewhere (Weisblat and Kuo, 2009); embryos were usually removed and counted within 24 hours of zygote deposition. In apparent contrast to the situation with *Hirudo* (Sawyer, 1986), essentially all the *Helobdella* zygotes developed normally except for those damaged during removal from the parent. On occasions where clutch deposition was not observed immediately, the date of laying was estimated from the stage of development attained when the clutch was removed(Iyer et al., 2019)

All leeches are hermaphrodites, meaning each one has both male and female reproductive organs. However, they do reproduce sexually--usually by intertwining their bodies together. One leech's male organ release a spermatophore, or a capsule that encloses sperm, which is then attached to the other leech. Once attached, the sperm exits the spermatophore and makes its way through the skin of the other leech. Once inside, it travels to the ovaries and fertilizes the eggs.

THE LIFE CYCLE STAGES:

EGGS

Eggs are considered ready to be laid when their colour turns brown and when they become clustered within the ovisacs. Each cluster presumably comprises the set of oocytes destined to be housed within a cocoon. Animals lay four to six cocoons per clutch, with each cocoon including 15–30 eggs. Accordingly, one clutch includes 60–180 eggs.

Un-cleaved eggs may be obtained from laid cocoons or directly from the ovisacs. Since development of the egg starts as soon as it leaves the ovisacs and takes a couple of hours to complete oviposition, eggs within a single cocoon develop asynchronously when laid naturally .(Fernández, 1980)

The characteristic social behaviour of leeches during the breeding season is also seen under laboratory conditions (Fernandez et al., 1987).

JUVENILES

Leeches are epimorphic, meaning they pass through the stages of growth without changing fundamentally. The juvenile that emerges from the cocoon has the same number of segments for its entire life unlike earthworms, which add segments as they grow. During the juvenile stage, leeches demonstrate two types of growth depending on their type.

Figure 1: Leech on Skin, during feeding

ADULTS

Leeches achieve adulthood either when they reach their critical body weight or once they reach sexual maturity, depending on the type. The average adult leech is typically between 15 and 30 mm long, however, leeches as long as 200 mm have been found in tropical regions. Leeches die after reproducing once or, in some cases, twice. Nevertheless, leeches may live for months or a year prior to reproduction and can also survive the same length of time in between feedings.

Figure 2: Anterior region, show the trunk filled

FOOD SOURCES

Leech species tend to be specific, attacking either fish, amphibians, reptiles, birds or mammals, with little overlap. Their food sources vary as widely as their habitats and distinct species. A leech that feeds primarily on water fowl, for example, can first attach to any part of the bird and make its way to the bird's head, where it attaches to feed either at the bird's eye or the inside of its nostril. (Campbell, Meg. 2023).

HIRUDOTHERAPY

Leeches absorb blood either through their proboscis which is used to puncture the skin or by bite. This is similar to a mosquito bite and is not painful due to the release of a histamine-like substance. Leech saliva also contains an anaesthetic so that patients do not feel the bite. In addition the saliva has a chemical preventing blood clotting. However, there may be occasions such as cold skin, smoking or age-related issues that may affect the anaesthetic qualities of a leech bite.

Figure 3Therapeutic Leech

MODE OF ACTION OF HIURDOTHERAPY

The mechanism of action appears to be the secretion of biologically active substances from the salivary glands of the leech onto living organisms. There are 100 different of bioactive materials in leech saliva. The most common found is hirudin, a substance which oppresses the process of blood clotting. Secretions from the leeches salivary glands also contain anti-inflammatory, bacteriostatic, and analgesic actions. These eliminate micro-circulation disorders and, restore the damaged vascular

ADVANTAGES OF LEECH THERAPY

Since ancient times, leeches were used to treat many illnesses and disease through bloodletting, a method where blood was drawn out in the hope that removing impure blood would heal the body. Believe it or not, leech therapy is

sometimes the best alternative in treating illnesses, and even surpasses pharmacological treatments. Because of its healing effects to the human body, this traditional method of curing diseases is still thriving today.

Treating Vascular Disease

It is in the leeches saliva that has been known to cure or prevent diseases. Their saliva has over 100 bioactive substances that are very beneficial. One such component is hirudin, which acts as an anticoagulation agent. Calin is another component that also inhibits blood coagulation. A component that dissolves fibrin clots as well as inhibits the formation of thrombus is the destabilase. Leech saliva also contains a Factor Xa inhibitor, and this compound restrains the coagulating effect of the coagulation Factor Xa. It also has hyaluronidase that enhances the viscosity of the interstitial fluid. For vasodilating effect, it has acetylcholine and histamine-like substances as well as carboxypeptidase A inhibitors. These three can increase blood flow by dilating constricted vessels. These are just some of the very useful components in leech saliva.

Patients with cardiovascular disease undergo leech therapy on different areas of their body than, lets say, patients with peripheral vascular disease. In each case leeches will promote better blood flow to the region.(Babenko et al., 2020)

Treating Cardiovascular Disease

Since the early days of the 20th century, people have been using leeches to treat cardiovascular diseases because of the Hirudin enzyme in the leeches saliva, a substance which has systemic anticoagulative effects. A physician would usually prescribe the use of leeches when a person suffered a stroke or heart attack. Also, Hirudin stimulates segmental reflex mechanisms and this contributes to the treatment of cardiovascular diseases.

Treating Alopecia and Baldness

Leech therapy is known to increase blood circulation, therefore when therapy is applied to thinning or bald areas, the increase of blood circulation helps enhance

the concentration and delivery of nutrients that assist in making hair follicles strong, thereby assisting in the promotion of hair growth.

People suffering alopecia caused by fungal infections or dandruff can also benefit through the antibacterial component in the leeches saliva, which helps combat fungal infections.

Treating Arthritis

There are approximately 600 species of leeches known worldwide and only 15 species are considered as medicinal leeches and used for arthritis and other treatments.

The arthritic joint is first cleansed before medicinal leeches are placed on specific areas relating to the problem. This is a simple and natural process and feels similar to experiencing a mosquito bite as leeches release a natural anesthetic. The Leech has a natural process that removes infected blood and at the same time, releases therapeutic components and enzymes from its saliva, allowing these components and enzymes to work their wonders in reducing inflammation and pain in the joint.

Medicinal leeches remain attached to the patient for approximately one hour [times can vary] before they automatically disengage. Through the entire process, patients feel relaxed. The area is then cleansed and dressed.

All cases are individual, but on average, medicinal leech therapy is usually repeated if necessary every 6 to 8 months. Improvement in joint pain and inflammation will be noticed the following day after Therapy. Not only is it a safe way to treat arthritis, but it has been a universal treatment for centuries. (Asutkar and Varshney, 2018)

Treating Diabetes

Therapeutic Benefits for Diabetics

One of the most important substances recognised in leech salivary glands is Hirudin, a substance that suppresses the blood clotting mechanism. If you

remember, it was mentioned earlier that Diabetes patients have viscous [thick] blood, which creates a higher risk of developing blood clots. Development and dislodgment of clots into the general circulation poses serious threat. (Abdualkader et al., 2013)

Treating Kidney Diseases

It has been found that leech therapy can significantly help individuals to have healthier kidneys. Since kidneys can be damaged by the effects of diabetes, one of which is an increase in the viscosity of the blood, the enzymes found in leechï¿½s saliva (particularly the anticoagulation enzymes) can help prevent coagulation of the blood or thickening of the blood's consistency. Another important enzyme that reduces the stress on the filtering function of the kidneys is the enzymes that help dissolve blood clots. To promote good blood flow or circulation, blood vessels are dilated by the histamine-like enzymes. All these enzymes work together to help the kidneys receive good blood circulation, thus, aiding the kidney to properly filter toxins and waste materials from the body.

If there is any inflammation of the kidneys that impedes its filtering action, leech therapy can prove to be beneficial through the anti-inflammatory compounds in the leechï¿½s saliva. Other benefits of leech therapy include the antibacterial effect that helps kidneys fight off infection.

Treating Migraines

Pain is somewhat relieved when circulation to the particularly painful area is improved and the same principle holds true with migraines and this is where leeches come im handy.

There is a theory that suggests migraines are caused by tiny blood clots that are formed in the heart, which then travel to the brain and these blood clots disrupt the flow of blood to the brain and thus cause the typical symptoms of migraine like the one-sided head-ache, photophobia, and nausea.

As you may already know, there is a substance found in leeches called Hirudin. This substance is an anticoagulant, causing blood to become more

diluted, thus allowing it to flow easier and faster. Hirudin can dissolve those little clots that have formed by converting fibrinogen to fibrin. (Mehdi,2010)

DISADVANTAGE OF LEECH THERAPY

Allergic reactions and excessive bleeding are other potential drawbacks to using medicinal leeches. Although it is normal and therapeutic for blood to continue to ooze from the bite for one to two days after treatment, in some cases bleeding can become excessive. If a patient's blood count gets too low, a blood transfusion may be required.

Allergic responses to leeches have also been reported. Itching and rash are common signs, although anaphylaxis is also possible. Some patients may experience minimal scarring at the bite site. In light of these potential complications, hemophiliacs and patients who are immunocompromised or taking a drug or vitamin that increases the risk of excessive bleeding should be cautious about undergoing leeching.

Once a leech has finished feeding and falls off, there are three legal ways to dispose of it depending on the country. The leech can be returned to a retirement pool, or it can be killed by freezing or immersion in alcohol. Common practice in the United States is to kill the used medicinal leech. Dead medicinal leeches are potentially infectious and should be treated like hazardous waste material. Releasing live medicinal leeches into the wild is a potential violation of drug, environmental protection, and hazardous waste laws.

Patients may be hesitant or squeamish about leeching due to the nature of the treatment. This unease is often abated once the patient is educated about leeches and the procedure. For most patients, leeching is a noninvasive and painless way to stimulate blood circulation after certain types of surgeries (C. K. Lanz, 2023).

PAIN MANAGEMENT

Leeches are used in pain syndromes of various origins. The pain relief is rapid and sometimes long-lasting There are reports on successfully leech therapy in severe cancer pain Studies in osteoarthritis argue for symptomatic improvement

by leech therapy by analgesic and anti-inflammatory effects An open trial in 32 patients with osteoarthritis leech therapy improved pain, stiffness and movement of joints In a randomized trial with 52 patients with either leech therapy or transcutaneous electrical nerve stimulation (TENS) their osteoarthritis of the knee responded significantly better to leeches. That was in particular relevant in pain reduction and improvement.

Figure 4: using leech after surgery

CONCLUSIONS

Medical leech therapy is an effective treatment modality in plastic and reconstructive surgery for flap salvage, in the treatment of hematomas, post-phlebitis syndrome, and possibly for chronic wounds. There is very limited experience for other diseases. The most important adverse effect is the risk of leech-borne infection with Aeromonas spp. Prophylactic antibiosis can decrease this risk factor. The risk of anemia warrants hemoglobin control.

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