

Model Research Essay

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Abstract

The emergence of leeches in modern medicine proves that they can be a useful treatment for many conditions. Bloodletting was practiced for millennia, with leeches being used for this purpose since the Stone Age. Leeches were misused until the discovery of germs. Leeches are now used in microsurgery to aid circulation. They have also been used in pain management for osteoarthritis. The chemicals in leech saliva are responsible for the advantageous clinical effects. There is some risk of infection when patients have weak immune systems and some physicians perceive too much risk in the treatment. A mechanical leech has been developed to emulate a leech.

The Use of Leeches in Modern Medicine

The results of a bad fall can be devastating to our bodies. Along with the bruises and cuts, there is a risk of infection. Joints could become swollen with infected blood that has to be drained. Now imagine living in an age where the best treatment is to apply a wriggling brown worm to the infected areas. But this era isn't the Middle Ages or Ancient Greece. It's the 21st century and the leech successfully removes the infected blood and reduces the signs of inflammation.

For most of us, the idea of using leeches is abhorrent, a treatment from an ignorant time. But the emergence of leeches in modern medicine has proven the importance of this ancient remedy. Leeches are being used in microsurgery; where modern methods cannot insure sufficient circulation through reattached limbs. They are being used in the treatment of ulcers, frostbite, cataracts and inflammations of the ear, nose and throat. Scientists have isolated enzymes and proteins in leech saliva that shows promise for the treatment of osteoarthritis (1).

The first documented use of leeches by medical practitioners is in an Ancient Egyptian wall painting. The painting (dated 1567-1308 B.C.) shows the use of leeches on a patient's head (4:79). There is evidence that leeches were used all over the world since the Stone Age (6: 93). In medieval England, leeches were linked with healing because of the etymology of the word. In Old English the word "lacnian" meant to heal and physicians were known as "leche" (2:46). Consequently, Middle Age physicians were known as leeches. These physicians had a penchant for bleeding their patients.

Bloodletting is the most common medical practice associated with ancient medicine (2:255). It is known as phlebotomy or venesection (2:246). The popularity of this treatment in the Middle Ages came about because of the Greek humoral theory; that a person's four bodily fluids governed a person's health. So good health could only be maintained if phlegm, yellow bile, black bile and blood were all balanced. To relieve illness, medieval physicians would try to remove blood from a patient who was deemed to have too much (2: 243). The methods physicians had available to them were cupping, cutting and leeches. In the Middle Ages, Leeches were used for "disorders as disparate as nephritis, obesity, and mental illness" (5). The use of leeches in medieval times was of greater benefit than cupping¹ because the amount of blood removed would be more "predictable" and of a

greater amount (6: 94). Although cutting the skin removed the most blood, it was also more dangerous.

The belief that blood was the cause of illnesses was not unique to the Middle Ages. 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 (6:94). He prescribed the use of as many as thirty leeches at one time, sometimes bleeding patients into unconsciousness (1). In France, physicians would prescribe leeches for patients even before seeing them (6:93). The practice of using leeches became so widespread that by the mid-18th century the leech nearly became extinct in Europe (5). Leeches were misused till 1850 when Pasteur's discovery of germs made germ theory the primary drive in medicine (1).

There are more than six hundred and fifty species of leeches (1). Only *Hirudo medicinalis* is used in medicine. *H. medicinalis* is brown with rounded sides and is "typically between two and four inches long, with disk like suction cups at either end of its body" (1). The poisonous species are identifiable by their green color, large heads and hair (6:95). They are known to cause fever, swelling, paralysis and malignant ulcers. *H. medicinalis* has evolved specialized mouthparts that allow it to feed on mammalian blood (1). At the center of its head sucker are three jaws, arranged in a Y-shaped pattern (1). Each jaw contains about a hundred teeth that penetrate the skin in a "sawing motion" (1).

The saliva of *H. medicinalis* contains a powerful anticoagulant, a vasodilator, a spreading factor, enzymes and an anesthetic. The anticoagulant² prevents blood from clotting (3). The vasodilator opens up blood vessels, helping to increase blood flow. An anesthetic is "pumped into [a] bite from minute ducts between its teeth" (1). This makes a leech bite painless. The spreading factor moves all the chemicals quickly into tissue farthest from the bite, "liquefying any hardening blood" (1). A hungry leech will only ingest "about two teaspoons of blood during a typical feeding" (1). A feeding usually takes 45 minutes and the leech will detach by itself or when sprinkled with salt (6).

In her article, "Leech therapy for pain and venous congestion," Nancy Walsh describes the effects after a leech bite by writing how: "local blood flow increases and anticoagulant effects continue for hours" (5). The most common side effect noted was slight itching at the site of leech application (5).

In the 1960s, surgeons "began taking advantage of the anticoagulant, vasodilatory, and anesthetic properties of leech saliva for wound healing" (5). In microsurgical procedures the reattachment of severed body parts (such as limbs, fingers or ears) takes place. The benefit of using leeches in microsurgery is that they reduce venous congestion; where veins in reattached body parts fail to connect properly (1). Blood does not drain out of veins and the excess blood accumulates. The result of venous congestion is that the sewn on body part turns blue and dies if circulation is not restored (1). The leeches remove the congested blood and the chemicals in the leech saliva maintain the flow of blood even after the leech has finished feasting. The anticoagulants ensure that circulation is maintained "through small veins that otherwise could not be kept from clotting" (5). Leeches create an "artificial circulation" for a patient; which is more effective than the modern technique of lancing "congested veins, or dripped anti-coagulants into the wound" (1). There have been many successful reattachments of "whole or partial avulsed ears, a particularly difficult surgical undertaking because of the lack of local venous capacity" (5).

Leech suppliers such as Biopharm and Leeches U.S.A, breed and sell leeches to hospitals. A leech can survive on a single meal for more than a year. A serious consequence of using leeches is the possibility of infection from the leech. A leech acts like "a dirty needle- that can walk" (1). So the need to dispose of the leech after its use is clear. Another hazard is *Aeromonas hydrophila*. This is a digestive enzyme found in a leech's gut, which can

cause septicemia in patients (5). Nancy Walsh describes how in one French hospital, "infections were seen in 5 of 122 patients treated with leeches in the hand surgery unit" (5). The enzyme is more harmful to "humans whose immune system is weak" (1). It is estimated that one in every two thousand patients contracts a bacterial infection from a leech (1). To minimize this risk antibiotics are frequently administered to patients before a leeching (1). At Biopharm the leeches are starved for 12 months before they are sold; this makes them more effective when they are used and reduces the bacteria present.

Despite the F.D.A. approving the leech as a medical device in 2003, their use in medicine is still not widespread. This is due to the negative perception of leeches by patients and the attitudes of doctors. Surgeons are the most likely to advocate their use while some physicians argue that "poor venous drainage in transplanted tissues" indicates a "surgeon's lack of skill in connecting veins," and balk at the "idea of ceding control of a patient's treatment to a slug" (1). Physicians fear that there will be less control over a patient's treatment and in one respect their fears are justified. Leeches have the tendency to squirm away, so when they are used, special care has to be taken to ensure that they do not roam freely. In the article "Bloodsuckers," Jon Colapinto describes how cotton wool has to be put into the patient's ear to make sure a leech does not enter during an ear treatment. Some patients are uncomfortable with the thought of leeches but they will pursue the treatment because the alternative is another surgery (1). The psychological ramifications for patients can be intense since leeches may have to be administered for many days in extreme venous congestion cases.

In 2001 researchers from Kliniken Essen-Mitte, Essen³, Germany reported on their study on the use of leeches in the treatment of osteoarthritis of the knee (5). In the published papers, the authors speculated that the anesthetic, anti-inflammatory enzymes and vasodilators in leech saliva could be relieving patient's pain (1). These chemicals penetrate deep into joints with the help of the spreading factors (1). The doctors "believe that their results have been too consistent to be ascribed entirely to a placebo effect" (1). There was no way to construct "a sham leech treatment" and "treatment blinding is not feasible" (5). So it is unclear whether their results are conclusive or due to a placebo effect.

Another medical advancement that has come about from leeches is the invention of a mechanical leech. In 2001, a team of researchers at the University of Wisconsin at Madison developed the device, which "resembles a small bottle attached to a suction cup" (5). The mechanical leech removes excess blood and delivers an anti-clotting drug.

Modern medicine uses leeches as both a cure and the bases for new technology. The benefits of using leech therapy come from their saliva. The saliva contains powerful chemicals such as anticoagulants and anesthetics. Leeches have been used in microsurgery to aid reattached body parts and in the treatment of pain. There is some risk in using leeches; vulnerable patients may develop infections. But the benefits of the treatment seem to outweigh the possible dangers.

Notes

¹ Cupping involved making a small cut in the flesh and then pressing a heated glass or metal cup on the wound. This made a vacuum as it sealed against the broken skin. (2:255)

² "In 1884, John Berry Haycraft, a British physiologist, had identified in *Hirudo medicinalis*'s saliva a powerful anti coagulant the first natural anti-clotting substance ever discovered. It was purified in the mid-nineteen-fifties by Fritz Markwardt, a German scientist, and cloned in 1986. (A drug called hirudin, made from the anti-coagulant,

is used to treat patients recovering from heart attacks.)" (1)

³ The principal author of the studies is Andreas Michalsen, a German internist and cardiologist, he is aided by Gustav Dobos. "Michalsen and Dobos designed a small experiment involving sixteen patients. Ten were leeches; six used a topical gel. The control group experienced little improvement, but the leeches reported "rapid relief--and remained free of knee pain at an examination twenty-eight days later" (1)

Annotated Bibliography

1. Colapinto, J. (2005, July 25). BLOODSUCKERS. *The New Yorker*, 81(21): 72.

This article dealt with Biopharm; a leech-breeding farm. It was very informative on the practices at these farms, such as how leeches are applied, bred, stored. The article focused on the Sawyers who own and manage the farm but it also gave historical information about the use of leeches. It explained that only one species of leech "Hirudo medicinalis" is suitable for medicinal purposes. The article was very useful and had no drawbacks.

2. Newman, P. B. (2001). *Daily Life in the Middle Ages*. North Carolina: McFarland.

This book covered all aspects of daily life in the Middle Ages. The source had a lot of history on bloodletting. This source explained that medieval physicians were known as leeches because of the origin of the word. In Old English "lacnian" meant "to heal" and in Middle English "leche" means healer. The source went into the different methods of bloodletting (phlebotomy) and explained why bloodletting was prevalent. The book was a general source so it lacked specific information on how leeches function.

3. Shinkman, R. (2000, October 16th). "Worms and squirms; Maggots, leeches making a comeback in modern medicine," *Modern Healthcare*. 30. 54.

This article explained how maggots and leeches are being used in medicine. They are no longer seen as just an archaic medical treatment. The source described how there is a wider acceptance of leeches by surgeons but other physicians are not as trusting. The source explains how physicians think there is less control when using leeches than if modern practices are used. The source went into more detail about the ramifications of using maggots but it was still very useful.

4. Thorwald, J. (1962). *Science and Secrets of Early Medicine*. London: Thames.

This source covered the medical procedures undertaken throughout the world since the time of Ancient Egypt. The book had a few pages on the use of leeches. The author suggested that the Egyptians were the first to document the practice of bloodletting. It used evidence based on papyrus scrolls and wall paintings. One showed a patient having a leech applied to his face from a bowl on the floor. The source described how leeches were used in the Late Hellenistic period. Leeches were applied "to spots on the body which contained an excess of blood or juices," they were then left there till they fell off (79). The source lacked any more elaboration on the practice of using leeches in other cultures.

- Walsh N (2004, January 1). "Leech therapy for pain and venous congestion. (Alternative medicine: an evidence-based approach)," *Family Practice News*, 34(1). 25.

This source dealt with the effects of leeches on the body. Leeches are used in surgery and pain control because of the saliva of *Hirudo medicinalis*. The source was very useful because it dealt with both the history of use and the modern practices. It also explained how researchers developed a mechanical leech. "The device delivers an anti-clotting drug and removes blood as desired." The source was useful because it showed how modern medicine was using the leech as a model for modern technology. It also explained the risks of using leeches. There were no drawbacks to the source.

- Zaidi, S. M. A., Zafar S., Aslam, M., Bari, A., Nasir, A. (2006). "Applications of Leeches in Medicine - A review," In M.Z. Abdin, & Y. P. Abrol (Eds.), *Traditional Systems of Medicine* (pp. 93 -97). New Deli: Narosa.

This source explained how leeches were used since the Stone Age and how much they were trusted as a cure. Physicians in France ordered leeches to be administered to patients before even seeing them. The practice of using leeches declined after 1850. In the 20th century it has made a comeback. They are being used now in microsurgery and to relieve "venous congestion." The saliva in leeches has both an anticoagulant and an anesthetic. This source was very informative and had no drawbacks.

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