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Medicinal leech therapy



New life for an ancient treatment

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WHEN MOST PEOPLE think of leeches, they think of sinister, slimy parasites that lurk in the water and drain the lifeblood out of anything that moves. But these little creatures live a double life. Because of their ability to suction blood, they've been applied for centuries for bloodletting, a practice once believed to heal many ailments. After falling out of favor in the 19th century, medicinal leech therapy, or hirudotherapy, was revived in the 1980s to treat venous congestion after surgery. (See *Leeches march through history.*)

In 2004, the FDA approved the marketing of commercial leeches as devices under the Food, Drug, and Cosmetic Act for skin grafts and reattachment surgery.¹ Hirudotherapy is also under investigation for various other uses, such as pain management.^{2,3} This article reviews the risks and benefits of hirudotherapy, details how to initiate and monitor this treatment, and explores potential future uses.

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Understanding leeches

More than 650 species of leeches have been identified around the world, with the largest measuring up to 45 cm (18 in). These segmented, amphibious, external parasites can latch onto a host for 15 minutes to an hour, ingesting 5 to 15 mL of blood. After feeding, they detach spontaneously.^{4,5}

Hirudo medicinalis is the species most frequently used in modern medicine because it has the deepest bite and the most extended postbite bleeding time. Dark brown to green in color, these leeches can be up to 25 cm (10 in) long.^{3,5-8} (See *Looking at leeches.*)

Leeches used for medicinal purposes are raised commercially under sterile conditions. Each leech is used once and then destroyed.¹⁰

Bioactive saliva

Leech saliva contains many bioactive ingredients that make it easier for the leech to feed and establishes the

usefulness of hirudotherapy in complementary medicine. The primary constituent is hirudin, an anticoagulant that binds to thrombin and prevents the conversion of fibrinogen to fibrin. The hirudin in leech saliva also has bacteriostatic and bactericidal actions.^{5,11} Other key substances include:

- calin and factor Xa inhibitors—two anticoagulants with different mechanisms of action—and destabilase, which dissolves fibrin and lyses thrombi. These substances work with hirudin to prevent blood from clotting in the wound for an average of 10 hours, which allows pooled blood to drain from areas of venous congestion. In addition, some constituents in the saliva have antiplatelet properties.
- acetylcholine, a histamine-like compound that acts as vasodilator, increasing blood flow to the site
- a morphine-like analgesic compound that makes each bite painless
- bdellins and eglins, which ensure a minimal inflammatory response to the bite
- hyaluronidase, which makes tissues more permeable and helps increase the absorption rate of these substances
- a collagenase, which reduces scar tissue density and adhesions.^{5,9-11}

All of these constituents, along with many other enzymes with similar effects, work together to enhance the therapeutic potential of modern-day leech therapy.

Relieving venous congestion

Hirudotherapy has been used primarily after microvascular and plastic surgeries to relieve venous congestion, which results from adequate arterial inflow but poor venous outflow. The continuous oozing that results from the leech bite offers a route for venous outflow.^{7,10}

Classic signs of venous outflow insufficiency include dusky bluish skin color, tissue edema, and warmth of the replanted tissue in the setting of a brisk capillary refill time (3 seconds or less).^{3,7} Venous congestion can occur after such plastic surgery procedures as digital replantation and flap surgeries.¹²

Tissue-flap transplantation, which involves the transfer of tissue from one area to another while maintaining the tissue's blood supply, has been shown to benefit from aggressive leech therapy.¹³ In one study, researchers assessed the effectiveness of leech therapy in flap surgeries of the head and neck with venous obstruction that couldn't be corrected

either surgically or pharmacologically.¹¹ Of the 450 patients who received flap surgeries of the head and neck, eight developed venous insufficiency. These patients were placed on leech therapy with regular evaluation, blood transfusions, and prophylactic antibiotics as needed. On average, 215 leeches were used for each patient. At the end of the study, all of the flaps survived.

In another case study, a 30-year-old woman had a flap of her scalp, including her hair, forehead, both eyebrows, and two-thirds of her right ear, severed completely from her cranium after an industrial blender caught her ponytail.⁵ Her scalp was replanted in the OR by anastomosing the arteries and veins. After surgery, her right ear developed signs of venous congestion, so the surgeon ordered leech therapy. The nurses applied leeches to the patient's right ear and contiguous scalp area three to four times a day for 3 days. Treatment was tapered as the poor venous outflow was corrected. In total, the patient received 8 days of leech therapy and fully recovered. Her hair began to grow back 1 month after the surgery.

The most common reason for failure of replantation and flap surgeries is venous insufficiency. Hirudotherapy is relatively effective in helping relieve venous congestion as collateral venous vessels are being formed. However, in the context of a surgical emergency that requires immediate treatment, such as forearm compartment syndrome, it's considered only if the venous insufficiency can't be surgically corrected or surgery is contraindicated.³

Contraindications

Hirudotherapy shouldn't be administered to patients who are immunocompromised, have inherited or acquired bleeding disorders, or experience arterial insufficiency due to the high risk of infection or extreme blood loss. Patients receiving hirudotherapy

Leeches march through history

One of the very first recorded uses of medicinal leeches was found in 15th century B.C. on the walls of Egyptian tombs. Leeches have also appeared in biblical proverbs, poems, and early medical literature throughout the world. Leech popularity peaked in the early 19th century, especially in France and Russia, where more than 130 million leeches were used every year. France went from exporting leeches in 1825 to importing over 33 million leeches in 1835.^{3,4,10,15,26} In one example, a Russian military surgeon used up to 200 leeches on one case.⁴

Leeches were used to heal a wide variety of ailments, including laryngitis, mental disorders, tuberculosis, and syphilis. However, their popularity began to wane later in the 19th century when French physician Pierre Charles Alexandre Louis used statistics to prove that leeching and bloodletting did more harm than good. Just like that, 2,000-year-old assumptions about the healing power of bloodletting fell into disrepute.^{2,4}

Even so, in 1884, strong scientific interest in these ancient healers led to the discovery of hirudin, an anticoagulant factor found in leech saliva.^{2,4} The 1980s marked the first time medicinal leeches were applied to treat venous congestion after surgery, a use that continues today.^{2,4,8,14,18}

Looking at leeches^{5,7-9}

Each leech has a sucker on either end to help keep it attached to the host while it feeds. The mouth is on the anterior, narrower end of the body. It's composed of three jaws, each containing 100 miniscule teeth arranged in a Y shape. After the leech detaches, it leaves an oozing bite wound.



are at risk for anemia and may require blood transfusions, so patients who can't accept blood transfusions should be excluded. Hirudotherapy is also contraindicated in patients who are medically unstable.^{7,10}

Potential risks

The most serious complication of hirudotherapy is **infection**.⁷ A Gram-negative bacillus, *Aeromonas hydrophila*, is present in the leech's digestive tract to help digest blood.^{14,15} About 88% of infections associated with hirudotherapy are associated with *A. hydrophila*.¹⁶ Other bacteria, such as *Serratia marcescens*, *A. sobria*, *Vibrio fluvialis*, and *A. veronii*, have been isolated from cultures.^{2,7,17} Leeches obtained from unapproved suppliers could be vectors of bloodborne illnesses such as hepatitis and HIV.³

Infections with *A. hydrophila* range from local infections affecting grafts or flaps, to skin loss, sepsis, and meningitis.^{3,17} The infection rate of patients who don't receive prophylactic antibiotics is 2.4% to 20%.³ In those who receive antibiotics prophylactically, the infection rate is approximately 4.1%.⁷ Conse-

quently, antibiotics are indicated during hirudotherapy.

The *Aeromonas* species produces beta-lactamase, so it's not sensitive to penicillins or first-generation cephalosporins. Suggested antibiotic coverage includes second- and third-generation cephalosporins, aminoglycosides, fluoroquinolones, and trimethoprim-sulfamethoxazole.^{2,3,7,12} Tetracyclines and chloramphenicol are also alternatives.^{3,7} However, resistance to ciprofloxacin and trimethoprim has been found in *A. hydrophila* isolates from patient specimens, so dual antibiotic prophylaxis therapy is suggested.^{6,16} Notify the healthcare provider (HCP) of any signs or symptoms of infection.

Excessive bleeding leading to **anemia** is associated with hirudotherapy. Bleeding can be controlled by applying topical thrombin or applying direct pressure to the bleeding site. Because a blood transfusion may be necessary, the patients should be informed of this possibility during the informed-consent process. Notify the HCP of increased bleeding times, any coagulation profile abnormality, or drops in hemoglobin or hematocrit.⁷

Allergic reactions, including anaphylaxis, have been reported. Teach the patient and caregivers to recognize and respond appropriately to signs and symptoms of an allergic reaction.⁷

Preparing for hirudotherapy

Because hirudotherapy is considered a complementary treatment, healthcare facilities may not have policies and procedures in place until practitioners begin to prescribe it. At that point, however, policies and procedures should be quickly developed to provide guidelines for the proper use and disposal of leeches and for the care of patients during and after therapy. Before initiating hirudotherapy, be sure to review and follow your facility's guidelines. For example, informed consent should be obtained and documented before hirudotherapy begins. Informed consent requires the HCP to give the patient a detailed explanation of the risks and benefits of this therapy, as well as any alternatives available.

Patients and their families are likely to have questions and concerns about hirudotherapy, so be prepared to respond. For example, tell them how

long the prescribed therapy will last, how many leeches will be used, and where they will be placed. Reinforce information about why it was prescribed for the patient. Assure them that therapy is painless and that medicinal leeches are FDA-approved.¹⁸ Prepare them for the possibility that a leech may migrate off the attachment site during therapy, and tell them to alert a nurse if this occurs.

Perform a thorough patient assessment before initiating therapy. To ensure appropriate use of hirudotherapy, nurses must be able to differentiate venous insufficiency from arterial insufficiency. Arterial insufficiency, a contraindication for hirudotherapy, is manifested by pale tissue that's cool to the touch with slow or absent capillary refill.⁷

When performing medication reconciliation, determine if the patient is taking nutritional supplements, vitamins, or medications that could increase the risk of bleeding (such as nonsteroidal anti-inflammatory drugs) or suppress the patient's immune system (such as steroids). Be sure to ask specifically about herbal products and dietary supplements because some substances, such as ginkgo biloba and ginseng, can increase the risk of hemorrhage. Teach the patient to avoid caffeine and smoking before starting therapy to reduce the risk of vasoconstriction.⁷

When participating in hirudotherapy, follow these general guidelines along with hospital policy and procedure and instructions from the prescriber and the approved leech distributor.

• **Leech storage and care.** Leeches should be stored in an approved storage container with fluids from an approved distributor. After a container has been dispensed from the pharmacy for patient use, it should be kept covered with a perforated lid or gauze to allow ventilation. Be sure to secure a gauze covering with tape or a rubber band to prevent leeches

from escaping. Store the container in a refrigerator or any other cool, dark place where the temperature is no higher than 15° C (59° F), or as otherwise directed by the distributor. Unused leeches don't need to be fed, but the container fluid should be changed at least twice a week or as directed by the distributor.¹⁹

• **Site preparation.** Wash the attachment area with soap and water, then thoroughly rinse with distilled, non-chlorinated water to remove any traces of soap or topical medications that could discourage leech attachment.

Next, create a barrier to prevent leeches from migrating during treatment. Cut a small hole in the middle of a gauze square or a clear occlusive wound dressing and place it on the treatment area with the hole over the desired attachment site. This discourages leeches from moving off the attachment site to surrounding skin.

A plastic cup with the bottom cut off can also be used to "corral" leeches, depending on the attachment site.^{7,20}

• **Application.** Adhere to standard precautions and don gloves. Using a damp gauze sponge, gently grasp a leech between your fingers and remove it from the container. Grasping it with a gauze sponge prevents it from attaching itself to the glove.

Avoid using forceps, which can injure the leech. Direct the head toward the attachment site exposed by the hole in the barrier dressing. One distributor recommends applying the smallest leeches first because they're likely to be hungrier and eager to attach.²⁰

If a leech won't latch on, place a drop of glucose or sucrose on the desired spot before directing the leech there. Or, prick the skin to produce a drop of blood, which also encourages attachment.^{6,14,20}

• **Leech migration.** Generally, leeches remain on the attachment site until they're fully distended—typically 30 to 60 minutes if the site is congested with blood. They then drop off spontaneously. If an undis-

tended leech migrates, this may indicate arterial insufficiency; reassess the wound and notify the HCP.²⁰

• **Monitoring during therapy.**

Assess the attachment site every 15 minutes to make sure a leech hasn't migrated or detached.

Every 2 to 4 hours, remove clots by cleaning the site with a gauze sponge soaked in saline.¹⁰ Encourage continued oozing by wiping the site with a gauze sponge soaked in 100 U/mL heparin.¹⁰ Assess skin temperature every 3 hours to monitor the effectiveness of treatment. Venous congestion causes warmth; if the skin begins to feel cooler, this suggests that the therapy is effective.

Perform a detailed skin assessment of the site every 4 hours and watch for signs of infection. Estimate and document blood loss. Also document the duration and site(s) of attachment.⁷

• **Leech detachment.** Don't remove feeding leeches; wait for them to detach spontaneously. Place detached leeches in a labeled container provided for this purpose to prevent use on another patient. Treat the entire container as biohazardous waste and dispose of it according to facility policy and distributor guidelines. Never reuse a leech or return used leeches to the pharmacy.

If a leech doesn't detach naturally after an extended period, this suggests arterial insufficiency and the leech should be removed. However, don't pull it off forcibly; doing so could cause small phlegmons—diffuse inflammation due to infection with the formation of exudate or pus—which may become sources of infection.^{2,7,8,21} Apply saline, alcohol, or vinegar on a pad and gently stroke the leech with it to encourage detachment.^{7,8,21}

• **Monitoring after therapy.** Assess the attachment site for continuous oozing every 1 to 2 hours after leech detachment. Wipe blood from the site with gauze moistened with heparin every 2 hours to remove clots so you

can see the site clearly. Also perform neurovascular assessments, document skin color every 2 hours, and assess for infection. Monitor hemoglobin and hematocrit levels and administer blood transfusions if prescribed.

Therapies under investigation

Hirudotherapy is generally accepted as a medically necessary option for treating poor venous drainage in surgical flaps and replanted body parts. Other uses discussed here are considered investigational or experimental at present and may not be covered by insurers.

Osteoarthritis of the knee.

Several studies have evaluated the usefulness of leeches as an alternative therapy for pain and/or local inflammation associated with osteoarthritis of the knee.

- Michalsen et al. conducted a trial involving 51 patients who were randomized into either the experimental group or the control group.²¹ The experimental group received a single treatment of four to six leeches applied locally, and the control group received a 28-day topical diclofenac cream regimen. Results showed that pain, joint function, and stiffness were better controlled in the experimental group than the control group at 1 week after initiation of their respective therapies. Overall quality of life was more improved in the experimental group than the control group by day 28.
- Andereya et al. conducted a study involving 113 patients randomized into three groups: a single treatment group, a double treatment group, and a control group.²² All patients were blinded to the treatment they were receiving by use of a screen that obstructed their view of the treated area. The single treatment group received one treatment of four leeches placed locally around the joint. The double treatment group received this treatment in addition to another application 4 weeks later. The control group received a placebo therapy that simu-



If an undistended leech migrates, this may indicate arterial insufficiency; reassess the wound.

lated hirudotherapy with a needle prick and wet gauze, which was formed in the size and shape of a leech. The results of this study supported the use of hirudotherapy to ease joint pain: The treatment groups had a reduction in pain medication requirements. Patients in the double treatment group had the greatest improvement in joint stiffness and activities of daily living.

- A case study by Teut and Warning illustrated that leech therapy was effective in treating osteoarthritis knee pain in an 87-year-old woman with severe knee pain associated with osteoarthritis who presented to the ED suffering from adverse reactions to fentanyl therapy.¹¹ She was admitted to the hospital and treated with leeches, physiotherapy, phytotherapy, and metamizol. Under this regimen of complementary treatments, the patient experienced reduced pain and improvements

in activities of daily living; she also regained her ability to walk.

Soft tissue hematomas. *Macroglossia*, or widespread lingual edema, most frequently results from seizure-related activity or injuries to the lower face caused by blunt or penetrating trauma.³ Nontraumatic causes are associated with the prone position assumed in cleft palate repair and spinal surgery. Hirudotherapy has been successful in the management of traumatic macroglossia, resulting in edema resolution with only minor leeching puncture marks remaining on the tongue.

Sialadenitis is a chronic inflammation of the salivary glands.^{11,23} Sialadenitis may be caused by calculi obstruction of salivary flow, leading to inflammation. Inflammation of the gland in the absence of a stone may be due to an autoimmune process and is known as a benign lymphoepithelial lesion. This condition may also be associated with Sjögren syndrome, a chronic inflammatory disorder that impairs lacrimal and salivary gland function.^{11,24} In one study involving 39 patients, hirudotherapy was shown to improve the clinical status for most patients with chronic sialadenitis. No improvement was noted in patients with inflammation of the parotid gland associated with Sjögren syndrome after treatment with leeches.¹¹

Cancer pain. Patients with advanced cancer typically report pain that's moderate to severe in intensity.²⁵ Conventional pain management includes opioid and nonopioid medications, spinal analgesics, local anesthetic blocks, neuroablative blocks, ablative surgery, radiotherapy, and adjuvant medications. Even though hirudotherapy has been used for pain treatment for centuries, little research has been done on use of leeches to manage cancer pain.²⁵

Seeing beauty in the beasts

Patients and staff alike may have some apprehension and anxiety

when encountering hirudotherapy for the first time. However, as this simple and relatively inexpensive treatment becomes more widely used, the therapeutic benefits of these little creatures will outweigh their less-than-desirable appearance. ■

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The authors and planners have disclosed that they have no potential conflicts of interest, financial or otherwise.

DOI-10.1097/01.NURSE.0000472561.41030.2d

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