

Review articles

Hirudotherapy in veterinary medicine

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ABSTRACT. The saliva of medicinal leeches, e.g., *Hirudo medicinalis* and *Hirudo verbana* commonly used in hirudotherapy, contains more than 100 bioactive substances with various therapeutic effects, including anticoagulant, vasodilator, thrombolytic, anti-inflammatory and anaesthetic properties. Recently, leeches have been used very successfully in veterinary medicine to treat many diseases of animals, especially dogs, cats and horses. The most common indications for the use of leeches are hip and elbow dysplasia, acute and chronic arthritis, diseases associated with inflammation of tendons, ligaments, and fascia, diseases of the vertebrae and the treatment of scars. Leech therapy is a painless procedure which takes an average of 30 to 120 minutes, the time being dependent on the size of the animal. All leeches used in medical procedures should originate only from certified biofarms. The maintenance of sterile conditions for the culture, transport and storage of medical leeches is very important to protect animals from microbial infections. Hirudotherapy is successfully used in veterinary medicine, especially when traditional treatment is not effective, the effects of treatment are too slow, or after surgery, when the tissues may be threatened by venous congestion.

Key words: leeches, veterinary leech therapy, hirudotherapy

Introduction

Leeches have been used in the treatment of certain diseases since ancient times. Hirudotherapy evolved over the years, reaching a peak of popularity in Europe between 1825 and 1850 [1]. For several years, there has been renewed interest in the use of leeches, especially in the treatment of congestive complications after plastic and reconstructive surgery [2,3]. Hirudotherapy is increasingly being used successfully in veterinary medicine, especially when traditional treatment is not effective, or the effects of treatment are too slow. The primary indication for leech therapy is the need to salvage tissues whose viability is threatened by venous congestion [4]. In Poland, although only a few clinics offer treatment with leeches, few pet owners are interested in this method of treatment. Often, hirudotherapy is undertaken when all other methods have failed, however, this safe and

effective form of treatment is expected to grow in popularity in veterinary medicine.

The biology of medicinal leeches

Leeches are segmented, hermaphroditic, blood-sucking, annelid worms which are permanent or temporary external parasites of numerous animals such as fish, amphibians, water birds and mammals, including humans. Medicinal leeches belongs to the order Arhynchobdellida, family Hirudinidae. Of the 650 species of leeches described in the world, only 15 are classified as medicinal leeches. In Europe, three species of leech, *Hirudo medicinalis*, *H. verbana* and *H. orientalis*, are present in natural environment, but only *H. medicinalis* is a legally protected species in this region. Currently, *H. verbana* is the species most commonly available from authorized commercial leech farms [5–7].

European medicinal leeches inhabit freshwater ponds with plentiful weed growth in temperate climates. It occupies the deciduous arboreal zone from Britain and southern Norway to the southern Urals, and probably as far as the Altai Mountains [6]. The medicinal leech has a cylindrical, dorsoventrally flattened body divided into 33 or 34 segments. Members of that group measure up to 20 cm in length, have 5 pairs of eyes on the head and look for their host by means of an olfactory system. Adult leeches have a large posterior sucker, which is used in crawling, and a smaller sucker at the head which encloses a mouth with three jaws. These jaws house small pores and gland cells through which the salivary material is released into the wound of the host [6]. The saliva secreted by the medicinal leech contains more than 100 bioactive substances, including hirudin, hyaluronidase, calin, destabilase, eglin and bdellin. The intestinal tract of leeches consists of an armed mouth, a pharynx and an oesophagus, with a crop, stomach, intestine and hindgut. After feeding, blood is stored in the lateral diverticula of the crop, which has 10 pairs of lateral pockets, crop ceca, and one pair of posterior crop ceca to provide additional storage space. During ingestion, the blood is mixed with anticoagulation secretions. Leeches can ingest an amount of blood approaching 10 times their own weight and may not require feeding for up to 1 year after their last meal [8]. The blood cells are concentrated by excreting plasma from the ingested blood. They can be stored for several months and digestions take place using the symbiotic bacteria living in the crop and intestine of leeches [9].

Complete embryonic development occurs within a cocoon, and is composed of two distinct life stages, cryptolarva and juvenile [10]. In the natural environment, the eggs in cocoons are deposited into the moist soil on the shore of inhabited ponds. After leaving the cocoon, the juvenile leeches must enter the water environment, where they grow up feeding on the blood of aquatic animals [10].

Leeches in medicine

Leeches have been successfully used in human and veterinary medicine because they produce a large number of therapeutic substances. One of the most important is hirudin, which is known for its strong antithrombotic properties. In 1950, Fritz Marquardt of Germany isolated a protein from *H. medicinalis* that he termed hirudin, and

demonstrated its thrombin inhibitor properties. Hirudin is still regarded as the most potent natural inhibitor of thrombin, thanks to its high affinity for the protein [2].

The active effect of hirudin is based on synergies with other components of leech saliva, such as antistasin and ghilanten, which are potent specific inhibitors of the blood coagulation Factor Xa [11]. Bdelein is a substance which exerts an anti-inflammatory influence by inhibiting the protease involved in the spread of inflammation. Hyaluronidase, an enzyme with antibiotic properties that degrades hyaluronic acid, facilitates the penetration and diffusion of pharmacologically-active substances into tissues. Other important substances produced by leeches may include substances that reduce blood viscosity and have anti-cancer properties. In addition, leeches produce a number of important neurotransmitters such as dopamine, serotonin, acetylcholine and enkephalin, which reduce the perception of pain by the patient and have a relaxation effect on the whole organism [10]. The spectrum of pharmacological activities of leech saliva is already vast, and other therapeutically active compounds are the focus of studies using recombinant DNA technology. Pharmaceutical companies are seeking to expand their repertoire of leech salivary components as anticoagulants [2].

Maintenance and care

Leeches used in the treatment of humans and animals should originate from specialized leech breeding farms, which are certified for medical purposes. Collecting leeches from their natural environment is absolutely forbidden, as they may be contaminated by viruses, bacteria, fungi, and even parasites [9,10]. It cannot be guaranteed that the leeches collected from the natural environment had not previously fed on the blood of infected animals. After transport from breeding farms, only healthy, vital animals should be chosen. The leeches should be mobile, flexible and responsive to the touch of the therapist. They should be stored in lockable glass or ceramic vessels with non-chlorinated water which should be changed weekly in winter and twice a week in summer. Water volume area per animal should not be less than 0.7 liters, with typically 10–15 leeches being held in a large jar [11]. Animals must be maintained without feeding at a temperature from 4 to 13°C.

Hirudotherapeutic procedure

Leeches have an extremely wide range of applications in veterinary medicine. The most common patients are dogs, cats and horses [12], but even farm animals could also be treated with leeches [13]. Hirudotherapeutic treatments should be performed by skilled hirudotherapists. The patients receive one to seven treatment sessions, depending on the disease entity being treated. The number of leeches applied during one treatment session depends on the species of the patient, its size and its individual characteristics. Usually one leech is applied per 10 kg of body mass of an animal, while 5 to 15 leeches are used per animal in the case of horses. The therapist places the leeches on the affected sites (Fig. 1), whereupon the leech pierces the skin of the host with its 3 sharp jaws, which leave a Y-shaped wound [14]. As the leech saliva also contains an anaesthetic which prevents the animal from feeling the bite, the animals appear to remain calm [3]. The leech must stay on the skin until it has reached satiety, which generally takes 30–60 minutes in dogs and cats and 40–120 minutes in horses [15]. When the leech falls off, bleeding continues from the site of the bite, which is part of the therapy. Such bleeding should not be inhibited for a few hours, resulting in the loss of 50 ml of blood. After the cessation of bleeding, a therapist treats the area with bandages [5].

Indications and contraindications

The use of leeches in veterinary medicine has the same indications as in human medicine. The presence of venous congestion and blood clots especially after surgery, orthopedic trauma, limb amputation and castration of males, as well as cases



Fig. 1. The therapist place the leech on the affected site of poorly healing wounds are the indications for the use of leeches in animals [12].

The salvage of tissue flaps whose viability is threatened by venous congestion is the primary indication for leeching. For the Dermatology surgeon, leech therapy can be useful in cases in which cutaneous flaps may be lost because of venous outflow obstruction [4]. In animals, veterinary leech therapy (VLT) may be also used in dysplasia, inflammatory conditions or injuries of, *inter alia*, tendons, fascia or vertebrae. Table 1 presents a list of diseases in various animal species for which the use of hirudotherapy is indicated. Hemophilia and blood clotting problems are absolute contraindications for hirudotherapeutic intervention [16], as well as anaemia, acute infections, diseases that cause immunosuppression, pregnancy, bleeding disorders, cancer of the skin and fungal skin diseases.

Unfortunately, VLT is not without risks. *Aeromonas veronii* bv. *sobria*, a Gram-negative bacterial species, is known to live symbiotically in the digestive tract of *H. medicinalis*, producing enzymes which allow the digestion of blood meals.

Table 1. The most important indications for veterinary hirudotherapy

| Dogs | Cats | Horses |
|--|--|--|
| <ul style="list-style-type: none"> – postoperative wound – spinal osteoarthritis – discopathies – cauda equina syndrome – hip and elbow dysplasia – neuritis – eczema of the ear – poor wound healing – post-surgical scars – tendinitis – tenosynovitis – mastitis | <ul style="list-style-type: none"> – postoperative wound – discopathies – eczema – abscesses – strained ligament – dysplasia of the knee – inflammation of the knee – neuritis – mastitis | <ul style="list-style-type: none"> – mud fever – laminitis – tendinitis – tenosynovitis – ataxias – myositis – spinal osteoarthritis – arthritis in the shoulder joint |

This organism has been noted in 88% of reported surgical site infections after human medical leech therapy, presumably from the transmission of *A. veronii* bv. *sobria* from the leech digestive tract [4,9,17]. Recent genetic studies have shown that bacterial infection initially diagnosed as caused by *A. hydrophila* were in fact caused by *A. veronii* bv. *sobria* [9]. Some authors suggest the risk of infection may be decreased by dipping leeches in 0.02% chlorhexidine hydrochloride for 10 to 15 seconds before application to the wound, or by applying prophylactic parenteral antibiotics to the animal before leech application [4]. In very rare cases, local irritation of skin or anaphylaxis may be observed in veterinary leech therapy.

The potential benefits of hirudotherapy far outweigh the risks associated with infection of wounds. The results of therapy are fast and bring tangible benefits to patients. Treatment using leeches is relatively cheap and safe, and often turns out to be the best solution when conventional treatments fail.

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