

Leech therapy for the treatment of venous congestion in digital re-plants and revascularizations

 Levent Horoz,  Mehmet Fevzi Çakmak

Department of Orthopedics and Traumatology, Faculty of Medicine, Kırşehir Ahi Evran University, Kırşehir, Turkey

Corresponding Author: Levent Horoz, dr.leventhoroz@gmail.com

Submit Date: 17/12/2022

Accept Date: 23/01/2023

ABSTRACT

Leech therapy was first used in Egypt around 1500 BC to treat a range of ailments from nosebleeds to gout. Medicinal leeches have been part of the therapeutic armamentarium of hand surgeons for more than 60 years. Venous congestion after digital replantation or revascularization threatens digit survival in the immediate postoperative period. External bloodletting, including leech therapy, provides a central role in salvage of the congested finger. Although there have been previous studies few published articles and no consensus guidelines have discussed the weaning of leeches in the postoperative period. Describing the initiation of leech therapy for digits experiencing venous insufficiency. Analyzing articles on treatment and follow-up after finger replantation published between 2000 and 2022 on the treatment of venous congestion after finger replantation and revascularization. We conducted a systematic review, taking into account the studies that applied leech therapy. The collected data revealed the relevant indications, treatment procedures, efficacy, adjuvant treatments, side effects. For this indication, the success rate of leech therapy ranged from 65 to 85% (83.7% in our series) according to the situations encountered. Optimal frequency of application ranged from 2 to 8 hours, while average overall duration ranged from 4 to 10 days. Antibiotic prophylaxis against *Aeromonas* is highly advisable. A ciprofloxacin and trimethoprim-sulfamethoxazole combination currently appears as the most relevant prophylactic antibiotherapy. Hirudotherapy is a reliable treatment in cases of patent venous insufficiency of only artery only digit replantation. Even though the relevant literature is highly heterogeneous, we have attempted to put forward a specific protocol bringing together dosage, delivery route, frequency of administration and appropriate prophylactic antibiotherapy.

Keywords: Leech therapy, digit replantation, digital amputation, hirudo therapy

INTRODUCTION

Venous congestion is the most common cause of failure after free tissue transplants and finger replantation's.¹ Medicinal leeches play an important role in providing venous drainage until angiogenesis develops.² During the medical leech therapy, hundreds of bioactive products are secreted into the surrounding tissue. Among them, hirudin, which is known as the most potent, prevents coagulation by inhibiting thrombin in the coagulation cascade. Other bioactive products released into the environment during leech therapy include acetylcholine, histamine-like peptide, and hyaluronidase. These provide tissue blood flow with a local vasodilator effect.³ While a single leech can suck up to 10 ml of blood, it allows the removal of venous blood up to 50 mm in the bitten area with passive bleeding during leech application.⁴ Leech therapy Helping to remove blood up to 48 hours after leech application provides an advantage in treatment until angiogenesis develops.⁵ It has been used successfully to prevent venous congestion that develops due to anastomoses that are prone to thrombosis.⁶ In cases of replantation without arterial circulation, finger losses take

up to 13 hours, while development of necrosis starts in 3 hours in free tissue transplantations and finger replantation without venous return.⁷ For this reason, it is important to provide venous return until angiogenesis develops in free tissue transplants and finger replantation. Hirudo therapy and leech applications were approved by the FDA in 2004 and leech was registered as a medical device. Although many benefits of leech application have been proven in free tissue transplantation and finger replantation with congestion, it has side effects. These include *Aeromonas* bacteria colonizing the leech digestive tract, blood transfusions due to bleeding disorders, anaphylaxis, and prolonged hospitalizations. Our aim is to share the experiences of leech applications in finger replantation cases.

Leech Therapy History

The first written evidence of leech practices was created by the Egyptians and dates back to 1500 BC. Its use for therapeutic purposes dates back to the civilizations of Greece, Rome and India around 500 AD.⁸ Later, it was popularized

among French surgeons and started to be used in 1970s to prevent venous congestion in free flaps.⁹ Their use after finger replantation and the first publications were published in the 1990s, and its use in cases that did not respond to medical treatment became popular.¹⁰

Leech Application Conditions and Current Evidence

As a result of the literature review, *Hirudo medicinalis* is used for the treatment of venous congestion (**Figure 1**). In some cases, *Hirudo verbana* and *Hirudo michaelsoni* were used for similar treatment modality.¹¹ The sizes of these leeches, which are used for medical purposes, vary between 3-5 cm and their weights vary between 2-3 grams (**Figure 2**).

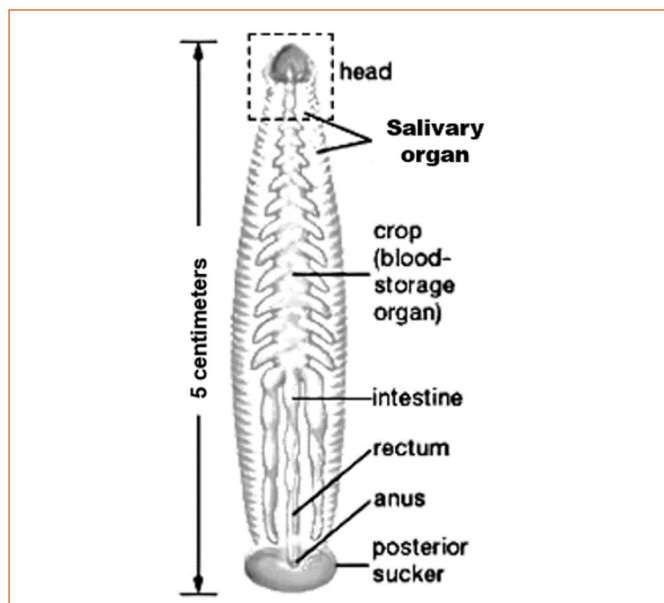


Figure 1. Leech application after finger replantation



Figure 2. *Hirudo medicinalis* morphology

There are suction organs at both ends of the leeches, and the suction process continues for about 15 minutes to 2 hours after the application. After the suction process is finished, it leaves the application area spontaneously. While bleeding in the application area continues for 6-8 hours, it decreases and disappears within 2 days.¹²

There is a general consensus on the use of antibiotic prophylaxis in patients given leech therapy for venous congestion. Appropriate antibiotic prophylaxis is applied together with treatment against *Aeromonas* species that are choline in the leech intestinal tract.¹³

2-3. The generation cephalosporin's, fluoroquinolones, trimethoprim-sulfamethoxazole, tetracycline and aminoglycosides can be used for prophylaxis. It should be started simultaneously with the treatment. After the examination of the samples taken from the leech tanks, 21 aeromonas species were found and 74.7% of them were sensitive to ciprofloxacin and 100% of them trimethoprim sulfamethoxazole. There are publications suggesting that antibiotic prophylaxis should be given just before the start of the application and to continue for 24 hours after the application. Another protocol advocates continuation of antibiotic prophylaxis for 2 weeks after administration.¹⁴ Benzodiazepins and narcotic analgesics are not recommended for the treatment of pain in patients treated with leeches. It has been observed that narcotic analgesics suppress leech activity.¹⁴ After the process, the leeches are killed in 70% ethanol and destroyed as medical waste. After wiping the application area with sterile sponge moistened with isotonic serum, it is recommended to leave it wet with a heparin dressing. In this way, the continuation of the hemorrhage should be ensured. In cases where venous system repair cannot be achieved after finger replantation or there is a risk of venous congestion, hirudo therapy can be started immediately after surgery. Hirudo therapy can be applied under systemic heparinization and aspirin therapy. If the leech is having trouble holding on, bleeding can be achieved by opening microholes on the skin with the help of a lancet, and leeches can be attached to these bleeding areas. Leeches should be changed at 2-hour intervals and clinical progression should be monitored. The clinician and the nurse must adapt to each situation by proposing first a "trial" interval of 2 to 6 hours according to congestion severity during the first 12 hours, and then a "maintenance" interval of 4 to 8 hours according to congestion reduction and blood color during bleeding. While measurement of the blood gases on the flap may be helpful, in our experience blood color and congestion should suffice. Nurses need to be trained for leech application.

Length of Treatment

In order to end leech therapy, the development of venous channels and completion of angiogenesis are required. Considering the development of angiogenesis, the development of venous channels in the tissue that has been repaired begins on the 2nd day. In another histological study on free tissue flaps with arterial flow, it was observed that venous capillaries developed on the 3rd day after repair.¹⁵ There are large case series showing that the time required for venous angiogenesis after finger replantation is 5 days.^{2,16} For this reason, it is recommended to continue leech therapy for 5 days after replantation. Again, it is recommended that the decision to terminate the treatment should be made by considering factors such as soft tissue blood supply, temperature and color. Another factor affecting the duration of treatment and the number of leeches to be applied is the level of amputation. Longer-term treatments are recommended because of the increase in tissue volume that will develop venous congestion in amputations from the proximal level. Leech applications were found to be successful for 10-12 days in amputations from Zone 1 and more proximal.^{16,17} Another factor affecting angiogenesis is the age of the patient, and 48 hours of leech therapy was found to be sufficient in fingertip amputations in children under 10 years of age, and this period reaches 7 days in the older age group.¹⁸

External Bleeding Methods in Digit Replantation's

Multiple techniques have been described to satisfy outflow from artery-only replants. These include puncturing, scrubbing or lacerating the replant to promote bleeding; repairing both digital arteries; and creating a cutaneous-venous fistula, chemical leeching (local subcutaneous heparin), milking massage.¹⁹⁻²⁴ Success rates of these methods vary between 60-100%. The paraungal stab bleeding method showed the lowest success. Other methods have shown similar success.

Contraindications

Contraindications for leech application include arterial insufficiency, bleeding disorders, hematological malignancies, sepsis, HIV infection, decompensated hepatobiliary disease, leech intolerance. It is not recommended for vasoactive drug users, lactating and pregnant women.

Treatment Success

The success rate in finger replantation cases with only artery repair, especially in zone 1 and distal cases, varies between %60.9-90.^{2,16,18}

CONCLUSION

Hirudo therapy, leech therapy is a successful method that can be used to prevent venous congestion in cases where venous repair cannot be performed or the repair is thought to be unsuccessful. Prophylactic antibiotics are strongly recommended. Close follow-up of the patient is recommended in terms of side effects that may develop during the application.

ETHICAL DECLARATIONS

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

REFERENCES

- Sammer DM. Management of complications with flap procedures and replantation. *Hand Clin.* 2015;31(2):339-344. doi:10.1016/j.hcl.2015.01.008
- Lee ZH, Cohen JM, Daar D, Anzai L, Hacquebord J, Thanik V. Quantifying outcomes for leech therapy in digit revascularization and replantation. *J Hand Surg Eur Vol.* 2019;44(4):414-418. doi:10.1177/1753193418823595
- Singh AP. Medicinal leech therapy (hirudotherapy): a brief overview. *Complement Ther Clin Pract.* 2010;16(4):213-215. doi:10.1016/j.ctcp.2009.11.005
- Pickrell BB, Daly MC, Freniere B, Higgins JP, Safa B, Eberlin KR. Leech Therapy Following Digital Replantation and Revascularization. *J Hand Surg Am.* 2020;45(7):638-643. doi:10.1016/j.jhsa.2020.03.026
- Whitaker IS, Cheung CK, Chahal CA, Karoo RO, Gulati A, Foo IT. By what mechanism do leeches help to salvage ischaemic tissues? A review. *Br J Oral Maxillofac Surg.* 2005;43(2):155-160. doi:10.1016/j.bjoms.2004.09.012
- Mumcuoglu KY. Recommendations for the use of leeches in reconstructive plastic surgery. *Evid Based Complement Alternat Med.* 2014;2014:205929. doi:10.1155/2014/205929
- Vural E, Key JM. Complications, salvage, and enhancement of local flaps in facial reconstruction. *Otolaryngol Clin North Am.* 2001;34(4):739-vi. doi:10.1016/s0030-6665(05)70016-5
- Rolleston JD. François-Joseph-Victor Broussais 1772 to 1832: his life and doctrines. *Proc R Soc Med.* 1959;22:405. doi:10.1177/003591573903200501
- François Joseph Victor Broussais (1772-1838). System of physiological medicine. *JAMA.* 1969;209(10):1523.
- Foucher G, Norris RW. Distal and very distal digital replantations. *Br J Plast Surg.* 1992;45(3):199-203. doi:10.1016/0007-1226(92)90076-a
- Siddall ME, Min GS, Fontanella FM, Phillips AJ, Watson SC. Bacterial symbiont and salivary peptide evolution in the context of leech phylogeny. *Parasitology.* 2011;138(13):1815-1827. doi:10.1017/S0031182011000539
- Houschyar KS, Momeni A, Maan ZN, et al. Medical leech therapy in plastic reconstructive surgery. *Wien Med Wochenschr.* 2015;165(19-20):419-425. doi:10.1007/s10354-015-0382-5
- Mumcuoglu KY, Huberman L, Cohen R, et al. Elimination of symbiotic *Aeromonas* spp. from the intestinal tract of the medicinal leech, *Hirudo medicinalis*, using ciprofloxacin feeding. *Clin Microbiol Infect.* 2010;16(6):563-567. doi:10.1111/j.1469-0691.2009.02868.x
- Chepeha DB, Nussenbaum B, Bradford CR, Teknos TN. Leech therapy for patients with surgically unsalvageable venous obstruction after revascularized free tissue transfer. *Arch Otolaryngol Head Neck Surg.* 2002;128(8):960-965. doi:10.1001/archotol.128.8.960
- Pérez M, Sancho J, Ferrer C, García O, Barret JP. Management of flap venous congestion: the role of heparin local subcutaneous injection. *J Plast Reconstr Aesthet Surg.* 2014;67(1):48-55. doi:10.1016/j.bjps.2013.09.003
- Han SK, Chung HS, Kim WK. The timing of neovascularization in fingertip replantation by external bleeding. *Plast Reconstr Surg.* 2002;110(4):1042-1046. doi:10.1097/01.PRS.0000021447.75209.0A
- Akyürek M, Safak T, Keçik A. Fingertip replantation at or distal to the nail base: use of the technique of artery-only anastomosis. *Ann Plast Surg.* 2001;46(6):605-612. doi:10.1097/00000637-200106000-00006
- Streit L, Dvořák Z, Novák O, Stiborová S, Veselý J. The use of medicinal leeches in fingertip replantation without venous anastomosis - case report of a 4-year-old patient. *Acta Chir Plast.* 2014;56(1-2):23-26.
- Patradul A, Ngarmukos C, Parkpian V. Distal digital replantations and revascularizations. 237 digits in 192 patients. *J Hand Surg Br.* 1998;23(5):578-582. doi:10.1016/s0266-7681(98)80005-3
- Han SK, Lee BI, Kim WK. Topical and systemic anticoagulation in the treatment of absent or compromised venous outflow in replanted fingertips. *J Hand Surg Am.* 2000;25(4):659-667. doi:10.1053/jhsu.2000.6920
- Zhang X, Wen S, Wang B, Wang Q, Li C, Zhu H. Reconstruction of circulation in the fingertip without vein repair in zone I replantation. *J Hand Surg Am.* 2008;33(9):1597-1601. doi:10.1016/j.jhsa.2008.05.005
- Sebastin SJ, Chung KC. A systematic review of the outcomes of replantation of distal digital amputation. *Plast Reconstr Surg.* 2011;128(3):723-737. doi:10.1097/PRS.0b013e318221dc83
- Ito H, Sasaki K, Morioka K, Nozaki M. Fingertip amputation salvage on arterial anastomosis alone: an investigation of its limitations. *Ann Plast Surg.* 2010;65(3):302-305. doi:10.1097/SAP.0b013e3181cc0021
- Yokoyama T, Hosaka Y, Takagi S. The place of chemical leeching with heparin in digital replantation: subcutaneous calcium heparin for patients not treatable with systemic heparin. *Plast Reconstr Surg.* 2007;119(4):1284-1293. doi:10.1097/01.prs.0000254496.02314.3e