

## Acute postoperative infection with *Aeromonas hydrophila* after using medical leeches for treatment of venous congestion

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### Abstract

**Introduction** Venous convulsion after reconstructive microsurgery procedures is one major complication a surgeon has to deal with. Today, especially in the field of reconstructive microsurgery, medicinal leech therapy enjoys a renaissance. The potential risks such as infections associated with leech therapy are generally underestimated and not sufficiently discussed in literature.

**Method/patients** We present five male patients with an average age of 47 years. All patients suffered from a trauma incident, which had to be treated as an emergency. Three patients showed, postoperatively, a venous congestion after the reconstructive procedures. Another two patients with flap reconstruction and flap training developed venous problems after 12 and 14 days. In all five cases, the indication was given to use medical leeches (*Hirudo medicinalis*). In all the patients, a local infection of the injured extremity could be regarded after beginning with the leech treatment. The treatment duration with medical leeches for postoperative venous congestion was an average of 6 days.

**Results** The reconstructive procedures in all five cases were unfortunately unsuccessful as major local infections were observed. Microbiological analyses showed, in all cases, an infection with *Aeromonas hydrophila*.

**Conclusion** We recommend making a considered indication for leech therapy, to diagnose wound infections early and to think about prophylactic antibiotics in patients with leech application.

**Keywords** *Aeromonas hydrophila* · Postoperative infection after leech treatment · Leech infection · Venous convulsion

### Introduction

Today, especially in the field of reconstructive microsurgery, medical leeches (*Hirudo medicinalis*) are undergoing a medical renaissance. They are an important therapeutic option in the treatment of venous congestion of flaps. They are also important in replanted fingers in which arterial revascularization was performed. These patients often have insufficient venous drainage postoperatively and medical leeches provide a temporary relief to venous engorgement whilst venous drainage is re-established. Medical leeches have two different mechanisms of blood letting. The first mechanism is through passive bleeding after each leech bite; this accounts for the majority of the average blood meal volume for a leech. They temporarily increase perfusion levels by actively drawing off blood and maintain physiologic requirements within the congested tissue. Laser Doppler flowmetry could demonstrate a significant increase in superficial skin perfusion around the leech bite [9, 15]. Moreover, as the leech bite continues, it reduces congestion due to the anticoagulant effect of leech saliva, which contains thrombin inhibitor hirudin, apyrase, collagenase, hyaluronidase, factor Xa inhibitor and fibrinase I and II [7, 8, 14].

Besides positive effects of leech therapy, the most common complications associated with the use of leeches

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are anaemia and infection, with reported infectious incidences ranging from 2.4 to 20% [4, 5, 18, 21, 28]. *Aeromonas hydrophila*, a gram-negative rod, which lives symbiotically in the intestines of the leech, contributes to these infectious complications. Though the exact symbiotic relationship between leeches and the microbiotic rod is unknown, *Aeromonas hydrophila* contributes proteolytic enzymes for leech digestion [13, 14, 18].

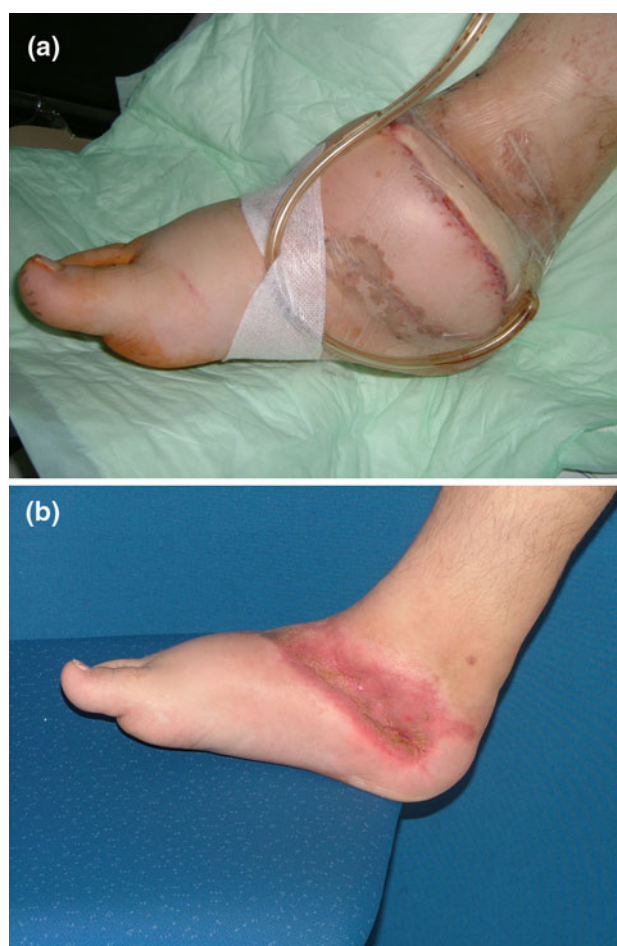
We report five cases of male patients with extremity defects and *Aeromonas hydrophila* infection after clinical use of leeches. We analysed consecutive patients with leech therapy and *Aeromonas hydrophila* infection in regards to trauma type, beginning of leech therapy and duration of leech therapy. Moreover, we want to underline that the potential risks of infections associated with leech therapy should be considered when considering leech therapy. These risks are generally underestimated and not sufficiently discussed in modern literature.

## Materials and methods

We present five male patients with an average age of 47 years. All patients suffered from a trauma incident, which was treated as an emergency. One patient suffered from a complex fracture of the distal lower extremity with tissue defect (Fig. 1a, b), two patients had amputations of the thumb, one patient suffered from an acute phlegmonous infection of the hand with lymphangitis and one patient showed a tissue defect with exposure of middle finger tendons after a saw accident. Three patients presented postoperatively with venous congestion after reconstructive procedures. The other two patients presented, 12 and 14 days after flap reconstruction and training, with venous congestion of the flap. In all five cases medical leech therapy was indicated. All patients developed a local infection of the injured extremity after leech treatment. These patients are summarized in Table 1. Data analysed include: description of injuries, operative procedures, complications, beginning of leech treatment, duration of leech use, time of recognition of the *Aeromonas* infection and management of the complicating infection.

## Results

The five patients summarized in Table 1 include infections ranging from minor wound drainage to severe myonecrosis. Two of the patients had leeches applied to a flap (venous free flap, sural flap) about 2 weeks after beginning with flap training, one patient with phlegmonous infection after incision and debridement (Fig. 2a, b) and the remaining two patients with complicated replantations. All



**Fig. 1** Patient suffered from a complex fracture of the distal lower extremity with tissue defect. **a** Reconstruction of the tissue defect with a free flap. **b** Result after postoperative infection with *Aeromonas hydrophila* and flap loss

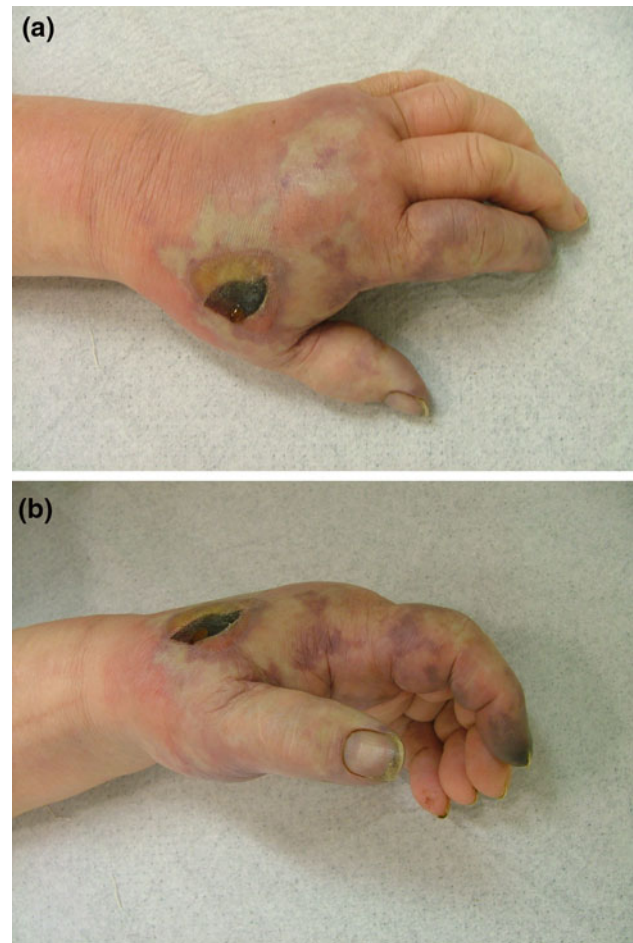
five patients were treated for venous congestion for an average of 6 days with medical leeches (*Hirudo medicinalis*). The reconstructive procedures in all five cases were unsuccessful as major local infections were observed. The onset of the infections was after 4–7 days. After that the leech treatment was stopped immediately and microbiological smears were taken. Microbiological analyses showed an infection with *Aeromonas hydrophila* in every case. Finally, the infections were cured with fluoroquinolone antibiotics. None of the patients were receiving adequate antibiotics when leeches were applied. Moreover, we observed a significant drop in haemoglobin levels during medicinal leech application in every patient.

## Discussion

*Aeromonas hydrophila* is a member of the *Aeromonas* species, gram-negative facultative anaerobes. Studies,

**Table 1** Five patients with *Aeromonas hydrophila* infection after microsurgical procedure and leech treatment

Patient	Age	Trauma type	Reconstructive procedure	Complications leading to leech treatment	Antibiotics at the time of leech application	Beginning of leech use	Duration of leech use (days)	Post-application onset of infection (days)	Bacterial smear
1	43	Amputation of the thumb	Replantation of digitus 1 with vein graft interposition	Venous congestion	Spizel/clont	Postoperative day 1	5	5	<i>Aeromonas hydrophila</i> <i>Aeromonas veronii, sobria</i>
2	68	Phlegmoneous infection of the hand	Evacuation and debridement, skin transplantation	Venous congestion	Spizel	Postoperative day 2	4	4	<i>Aeromonas hydrophila</i>
3	35	Amputation of the thumb	Replantation of digitus 1	Venous congestion	None	Postoperative day 1	6	6	<i>Aeromonas hydrophila</i>
4	51	Complex saw trauma with tissue defect of the middle finger	Venous free flap	Venous congestion	Spizel/clont	Postoperative day 14	7	7	<i>Aeromonas hydrophila</i>
5	37	Complex fracture of the distal lower extremity with tissue defect	Sural flap	Venous congestion	Spizel/clont	Postoperative day 12	7	7	<i>Aeromonas hydrophila</i>

**Fig. 2** Patient with phlegmoneous infection after incision, debridement and following leech treatment because of postoperative venous congestion after the reconstructive procedures

which incubated leeches in solutions of antibiotics or 0.02% chlorhexidin, did not show any significant sterilization effect on the pathogenic organisms in the leech gut [20, 23]. Several studies [13, 22] described infections due to *Aeromonas hydrophila* as a complication of leech use in venous congestion of flaps and replantations. The severity ranges from mild cellulitis and trivial episodes of wound drainage to more serious infections with abscess, tissue necrosis, septicaemia and meningitis [2]. Review of previously published leech-related *Aeromonas hydrophila* infections and analysis of our patients showed several general characteristics (Table 2) [3, 10, 17, 21, 24, 26, 29]. There are two periods with the highest risk of *Aeromonas hydrophila* infection in leech therapy. The first is with acute onset, occurring within the first couple of days. The second is with delayed onset of 10 days or more after leech application. Lineaweaver et al. [18] as well as Ardehali et al. [2] analysed this phenomenon. They hypothesized that acute infection results from the bite of the leeches contaminating the wound. The delayed infections may

**Table 2** Previously reported *Aeromonas hydrophila* after microsurgical procedures and leech treatment

Author	Procedure	Complications leading to leech application	Antibiotics at the time of leech application	Post-application onset of infection	Journal
Dickson et al. [6]	Rectus abdominis flap for breast reconstruction	Venous congestion	NA	Day 12	Br Med J
Mercer et al. [21]	Forehead flap	NA	NA	Day 26	Br Med J
	Crossfinger flap			Day 2	
	Hand replant			Day 11	
	Instep flap of foot			Day 4	
	Latissimus dorsi flap			Day 1	
Jean and Nicolau [12]	Revascularization hand			Day 7	Second International Conference of Leech Scientists, Ottawa, Canada
	Revascularization hand	Venous congestion	NA	Day 10	
	Scapular flap	Venous congestion	NA	Day 5	
Lucht et al. [19]	Radial arm flap	NA	NA	Day 11	J Hosp Infect
Snowder et al. [25]	Digit replantation, subtotal hand replantation, gastrocnemius flap, rectus myocutaneous flap for breast reconstruction	Arterial and venous congestion	Cefazolin	Day 1–21	J Clin Microbiol
Lineaweaver et al. [17]					Ann Plast Surg
De Chalain et al. [5]	Pedicled latissimus dorsi flap for breast reconstruction	Occlusion of pedicle	Cephazolin, clindamycin,	NA	J Reconstr Microsurg
	Scalp and ear avulsion	NA	Cefazolin, augmentin	NA	

**Table 3** Tips and tricks in using leeches

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Wash the area with soap and water and rinse it with distilled water or warm heparinized saline
Take the leech wearing gloves, forceps can injure the leech
Use a syringe to direct the leech to the site: remove the plunger, place the leech in the barrel and invert it, holding the open end in place until the leech attaches
Improvement of attachment:
Place a drop of glucose or sucrose
Prick the skin with a sterile needle until a drop of fresh blood appears
Prevent migration:
Wrap a gauze around the treatment area
Use an occlusive dressing with a small hole in the centre for leech attachment
Use of plastic cups
Keep the temperature of the area at or above 86°F (30°C) with slightly warm room temperature or a wrapped light blanket

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result from *Aeromonas* colonization of necrotic tissue or eschar with later invasion of surrounding tissue. Here, ischaemic muscle may be especially susceptible to *Aeromonas* infections [16]. Among our five cases, we identified patients with an acute infectious onset, with an average of 5.8 days.

Prevention of delayed infections: diagnostic evaluation, indication and time of ischaemia

According to cases with delayed infections after leech treatment, a well-considered indication for leech therapy is necessary. First it is important to know the characteristic features of venous congestion: (1) livid discoloration, (2) fast capillary refill, (3) normal or high temperature, and (4) dark red blood flow after injection [11, 13]. Reasons for venous congestion can be oedema of the flap, haematoma, pedicle torsion or any other pressure to the venous pedicle. The clinician should determine, before leech therapy, that he is treating an inoperable venous occlusion in tissue that has a functioning arterial circulation. The application of leech therapy in cases with arterial compromise or undefined circulatory disruption probably will not contribute to tissue survival and may only create a potential port of bacterial entry. Also a possible antibiotic application has no use due to insufficient perfusion to deliver antibiotics to the tissue and leech. Lee et al. [15] ligated the venous drainage of bilateral epigastric flaps in rats and treat the subsequent venous congestion of one flap with leeches after 3 h. After 6 h, they released the venous ligation. They have reported necrosis rates of 41 versus 72% with/without leeches. It is essential to diagnose the problems with venous drainage early and reliably to prevent ischaemic and necrotic tissue from high risk of leech infection. Quantitative fluorometry may be a reliable method to analyse this parameter [1].

Furthermore, this risk of *Aeromonas hydrophila* infection increases if there is a long time between trauma and

anastomosis because of the resulting tissue damage and necrosis. The time of ischaemia was not documented and so we could not make any conclusions in our five cases.

Prevention of acute infections: preparation, attachment and removal of the leeches

To prevent acute infection, Yantis et al. [30] recommend to wash the area with soap and water and rinse it with distilled water or warm heparinized saline [14, 28, 30] before attaching the leech. Disinfection with alcohol should be avoided, since it makes leech attachment difficult [14]. Removal of the leeches should be without force. Force could cause the teeth to be left in the patient and become the source of infection. The use of alcohol, saline or vinegar on a pad is recommended. But large amounts of these materials are noxious to the leech and may cause it to regurgitate into the bite site with high infection risk. In addition, guidelines and tricks for a localized use of leeches should be observed (Table 3) especially to preserve the surrounding area [30].

Prophylactic antibiotics

For patients with eschars or open wounds and leech use, clinical inspection (at least every 15 min) and a prophylactic antibiotic therapy may prevent acute infection with *Aeromonas hydrophila* and also solve the problem of late infections by preventing bacterial colonization of necrotic tissue [3, 27]. *Aeromonas hydrophila* is resistant against penicillin and some studies also show resistance against first generation cephalosporins. The resistance against third generation cephalosporins like cefoxitin is variable [10]. In the literature, Knobloch et al. [14] recommend a prophylactic antibiotic therapy with fluoroquinolone antibiotics like ciprofloxacin 500 mg three times for 7 days. Other studies recommend double coverage (two antibiotics) during therapy and single coverage (one antibiotic) for

2 weeks afterwards [30]. Cases with established infections are treated with third generation cephalosporins, tetracycline, trimethoprim, fluoroquinolones or aminoglycosides [2, 18, 20]. On the other side, Lineawear et al. [18] described in 1988 that prophylactic antibiotics disrupt leech digestion by eliminating the enteric *Aeromonas hydrophila* and minimize the leech therapy effects. In our study, none of the patients were receiving adequate antibiotics when leeches were applied. Finally, the infections were cured with fluoroquinolone antibiotics but the reconstructive procedures in all five cases were unsuccessful. Based on our series and previous studies, surgeons should consider prophylactic antibiotics during leech therapy to prevent infections in difficult cases, despite concerns for decreased leech efficacy.

In conclusion, the use of medical leeches (*Hirudo medicinalis*) for the treatment of postoperative venous congestion in the field of reconstructive microsurgery is a standard tool with high risk of acute and delayed infection with *Aeromonas hydrophila*. In the future, tissue engineering strategies with angiogenesis options might be utilized for treatment or prevention of postoperative venous congestion replacing leech treatment [30].

## References

- Anthony JP, Lineaweaver WC, Davis JW Jr, Buncke HJ (1989) Quantitative fluorimetric effects of leeching on a replanted ear. *Microsurgery* 10(3):167–169
- Ardehali B, Hand K, Nduka C, Holmes A, Wood S (2006) Delayed leech-borne infection with *Aeromonas hydrophila* in escharotic flap wound. *J Plast Reconstr Aesthet Surg* 59(1):94–95
- Braga A, Lineaweaver WC, Whitney TM, Follansbee S, Buncke HJ (1990) Sensitivities of *Aeromonas hydrophila* cultured from medicinal leeches to oral antibiotics. *J Reconstr Microsurg* 6(2):135–137
- Dabb RW, Malone JM, Leverett LC (1992) The use of medicinal leeches in the salvage of flaps with venous congestion. *Ann Plast Surg* 29(3):250–256
- de Chalain TM (1996) Exploring the use of the medicinal leech: a clinical risk-benefit analysis. *J Reconstr Microsurg* 12(3):165–172
- Dickson WA, Boothman P, Hare K (1984) An unusual source of hospital wound infection. *Br Med J (Clin Res Ed)* 289(6460):1727–1728
- Foucher G, Norris RW (1992) Distal and very distal digital replantations. *Br J Plast Surg* 45(3):199–203
- Hartig GK, Connor NP, Heisey DM, Conforti ML (2003) Comparing a mechanical device with medicinal leeches for treating venous congestion. *Otolaryngol Head Neck Surg* 129(5):556–564
- Hayden RE, Phillips JG, McLear PW (1988) Leeches. Objective monitoring of altered perfusion in congested flaps. *Arch Otolaryngol Head Neck Surg* 114(12):1395–1399
- Hermansdorfer J, Lineaweaver W, Follansbee S, Valauri FA, Buncke HJ (1988) Antibiotic sensitivities of *Aeromonas hydrophila* cultured from medicinal leeches. *Br J Plast Surg* 41(6):649–651
- Hjortdal VE, Hansen ES, Hauge E (1992) Myocutaneous flap ischemia: flow dynamics following venous and arterial obstruction. *Plast Reconstr Surg* 89(6):1083–1091
- Jean A, Nicolau MH (1988) Leeches in post-surgical repair: septic risk. In: Second international conference of leech scientists, Ottawa, Canada, 23–25 June 1998
- Kalbermatten DF, Rieger UM, Uike K et al (2007) Infection with *Aeromonas hydrophila* after use of leeches (*Hirudo medicinalis*) in a free microvascular osteo-(myo-)cutaneous flap—suggestions for successful management. *Handchir Mikrochir Plast Chir* 39(2):108–111
- Knobloch K, Gohritz A, Busch K, Spies M, Vogt PM (2007) *Hirudo medicinalis*-leech applications in plastic and reconstructive microsurgery—a literature review. *Handchir Mikrochir Plast Chir* 39(2):103–107
- Lee C, Mehran RJ, Lessard ML, Kerrigan CL (1992) Leeches: controlled trial in venous compromised rat epigastric flaps. *Br J Plast Surg* 45(3):235–238
- Lineaweaver WC, Follansbee S, Hing DN (1988) Cefotaxime-sensitive *Aeromonas hydrophila* infection in a revascularized foot. *Ann Plast Surg* 20(4):322–325
- Lineaweaver WC, Furnas H, Follansbee S et al (1992) Postprandial *Aeromonas hydrophila* cultures and antibiotic levels of enteric aspirates from medicinal leeches applied to patients receiving antibiotics. *Ann Plast Surg* 29(3):245–249
- Lineaweaver WC, Hill MK, Buncke GM et al (1992) *Aeromonas hydrophila* infections following use of medicinal leeches in replantation and flap surgery. *Ann Plast Surg* 29(3):238–244
- Lucht F, Aubert G, Seguin P, Tissot-Guerraz F, Relave M (1988) Postoperative skin-flap decongestion, leeches and *Aeromonas hydrophila*. *J Hosp Infect* 11(1):92–93
- Mackay DR, Manders EK, Saggars GC, Banducci DR, Prinsloo J, Klugman K (1999) *Aeromonas* species isolated from medicinal leeches. *Ann Plast Surg* 42(3):275–279
- Mercer NS, Beere DM, Bornemisza AJ, Thomas P (1987) Medical leeches as sources of wound infection. *Br Med J (Clin Res Ed)* 294(6577):937
- Ouderkirk JP, Bekhor D, Turett GS, Murali R (2004) *Aeromonas* meningitis complicating medicinal leech therapy. *Clin Infect Dis* 38(4):e36–e37
- Sartor C, Limouzin-Perotti F, Legre R et al (2002) Nosocomial infections with *Aeromonas hydrophila* from Leeches. *Clin Infect Dis* 35(1):E1–E5
- Semel JD, Trenholme G (1990) *Aeromonas hydrophila* water-associated traumatic wound infections: a review. *J Trauma* 30(3):324–327
- Snowder DP, Ruef C, Kuritza AP, Edberg SC (1989) *Aeromonas hydrophila* infection associated with the use of medicinal leeches. *J Clin Microbiol* 27(6):1421–1422
- Thomas SB, Unglaub F, Dragu A, Gessner A, Horch RE (2009) An unusual case of gonococcal arthritis of the finger. *Arch Orthop Trauma Surg* 129(10):1335–1338
- Unglaub F, Loos B, Schwarz S, Kneser U, Dragu A, Horch RE (2009) Phlegmonous-infection in first degree Dupuytren's disease. *Arch Orthop Trauma Surg* 129(4):445–448
- Whitaker IS, Izadi D, Oliver DW, Monteath G, Butler PE (2004) *Hirudo medicinalis* and the plastic surgeon. *Br J Plast Surg* 57(4):348–353
- Whitlock MR, O'Hare PM, Sanders R, Morrow NC (1983) The medicinal leech and its use in plastic surgery: a possible cause for infection. *Br J Plast Surg* 36(2):240–244
- Yantis MA, O'Toole KN, Ring P (2009) Leech therapy. *Am J Nurs* 109(4):36–42 (quiz 43)