Case Report
Cent Asian J Med Sci. 2021 Sep;7(3):298-303. https://doi.org/10.24079/CAJMS.2021.09.016

Central Asian Journal of Medical Sciences
CAJMS

Application of Leech Therapy After Replantation of Severed Distal Fingers

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Submitted: Jun 20, 2021
Revised: Jun 28, 2021
Accepted: August 5, 2021

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Objective: Prevention and treatment of venous crisis after reconstructive microsurgery is complicated and every clinician has concern about it. We present our clinical experience with blood-sucking leech therapy for replantation of severed fingers. **Methods:** Blood-sucking leech therapy was prescribed for venous crisis due to various causes from July 2019-2020 in 8 patients whose distal fingers were severed. **Results:** After clinical application, their venous congestion was relieved, all the affected fingers survived, and the curative effect was satisfactory. **Conclusion:** In venous crisis after the replantation of severed fingers, blood-sucking leech therapy has a significant effect which can successfully prevent finger death caused by congestion, reduce the rate of necrosis, and improve survival rate. It is worthy of applying in clinical practice.

Keywords: Finger Injuries, Microsurgery, Leeching, Hirudo Medicinalis,

Introduction

In finger replantation, the key to a successful operation lies in the anastomosis of arteries and veins and the reestablishment of blood circulation. If the arteries and veins are well anastomosed and repaired, the success rate of surgery can be greatly improved [1]. However, the anastomotic vessels of the severed fingers are small and often accompanied by serious injuries or even defects, so it is difficult to effectively anastomose the vessels which leads to blood circulation problems [2]. In particular, veins have a thin wall and poor elasticity, resulting in vascular crisis of reflux blockage and other events that occur from time to time [3].

To solve those problems, the commonly used treatments in the clinic include local heparin infusion, bloodletting shunt, negative pressure suction, compression, warm preservation, spasm relieving, anticoagulation, analgesia, and psychological nursing, but each of these approaches has its advantage and disadvantages [4, 5]. Every surgeon has concern and has discussed the problem of how to prevent and treat vascular crisis complications after replantation of severed fingers in order to realize the maximum benefit of replantation surgery [6].

The leech (Hirudo medicinalis) is a highly specialized annelid with a flat body shape [7]. Medical leech therapy is commonly used in Mongolian traditional medicine and recently applied in reconstructive microsurgery for decreasing venous congestion [8-10]. Therefore, we used blood-sucking leech therapy for 8 patients with venous crisis after replantation of a distal amputated finger. The venous congestion was relieved and all the affected fingers survived with satisfactory curative effect. In venous crisis after replantation of severed fingers, blood-sucking leech therapy has a significant effect, which can successfully prevent finger death caused by congestion, reduce the rate of necrosis, and improve the survival rate. Therefore, we present our clinical experience with blood-sucking leach therapy for replantation of severed fingers. This therapy will be elaborated and analyzed, hoping that this method can be a significant positive advantage when organically combined in clinical practice to enhance and improve the survival rate of replanted severed fingers.

Case Report

A total of 8 patients (5 males and 3 females) were treated with living blood-sucking leech therapy. The average age was 33.2 ± 14.4 years (age range 6-53). Among them, there were 3 cases of thumb disconnection, 2 cases of index finger disconnection, 1 case of a hand's middle and ring finger disconnection, and 2 cases of little finger disconnection. The cause of injuries and general information of patients are listed in Figure 1. All of these patients accepted interventional distal finger replantation surgery. From among these cases, we describe in detail a typical case following treatment by blood-sucking leech therapy.

Ethical statement

This study was approved by Ethics Committee of Mongolian National University of Medical Sciences on December, 2019.

As a typical case, a 36-year-old male was admitted to the hospital 5 hours after his left little finger was accidentally severed by a cutting machine during work. Physical examination of the left little finger showed that the wound edge was neat and that the distal interphalangeal joint was broken (Figure 1). Immediately, a little finger replantation was performed under emergency brachial plexus block anesthesia. The anastomosis

Table 1. The general information of injured patients treated by leech therapy.

Age	Gender	Location of injured fingers	Cause of injury	Duration of a leech applied (hours)
6	Man	Thumb	Machine cutting	18h
32	Man	Thumb	Chainsaw injury	30h
53	Woman	Thumb	Rope cutting	20h
46	Man	Indicator finger	Rock hitting	14h
37	Woman	Indicator finger	Kitchen knife cutting	32h
36	Man	Little finger	Machine cutting	27h
39	Man	Middle finger	Machine cutting	14h
		Ring finger		8h
11	Woman	Little finger	Squeezed by door	10h

Figure 1-4. The treatment process is shown in sequence. 1). Preoperative status of the distal joint of the little finger. 2). Immediate situation after replantation of the finger. 3). Application of a living leeches for treat a vein crisis. 4). The reexamination of 6 weeks after the operation.

ratio of artery and vein was 1:2 (Figure 2).

The surgery took 4 hours and in about 26 hours after the operation on the next day, the skin color of the affected finger changed from ruddy to dark red or purple. This finger was swollen and highly tense. The capillaries filled quickly, and the finger-tip blood letting test was dark purple. It was diagnosed as venous vascular crisis and reflux disorder.

After discussion with colleagues and seeking the consent of the patient and his family, we decided to apply living blood-sucking leech treatment (Figure 3). At the starting point, it was applied 6 times per day and each time for 4 hours. After two days, the venous congestion of the affected finger improved, therefore leech treatment was changed to 4 times per day and each time for 6 hours. After 3 days of treatment, this was changed again to 2 times per day once every 12 hours. After a total of 7 days of treatment, blood-sucking leech therapy was stopped since extravasation of blood in the affected fingers had significantly subsided, the color of finger pulp became rosy, temperature, tension, and capillary filling speed of the finger pulp had significantly improved (Figure 4).

During the treatment, psychological support was provided to all the patients, all changes on affected fingers were closely observed, and the treatment strictly followed aseptic methods. Meanwhile, antibiotics were routinely administered, vital signs were monitored, and dressings were exchanged before and after treatment. No symptoms such as wound infection occurred during the whole process. The suture was removed 14 days later and the patient was discharged from the hospital 6 weeks later. After 3 months, when the patient revisited, the functional and sensory recovery of the severed finger was good, and the therapeutic effect was satisfactory. The 8 patients mentioned in Table 1 were successfully and effectively treated by blood-sucking leech therapy for venous crisis by the same principles as described in this typical case.

Discussion

With the improvement of microsurgical techniques, the survival rate of replantation of severed fingers is improving. The expected rate of finger replantation is dependent on anastomosis of arteries and veins to re-establish blood circulation [2, 6]. However, various factors will influence the results such as the patient's general condition, preoperative influencing factors including local injury mechanisms, amputation plane, treatment time after injury, and preservation methods [6]. Postoperative influencing factors include environment, body position, diet, psychology, and other factors such as anti-infection, anti-spasm, anticoagulation medication, and other symptomatic treatments [11]. Therefore, problems in any of these factors may lead to postoperative vascular crisis, especially in the high incidence period 72 hours after the operation [5]. So, after finger replantation, it is an urgent task to avoid these influential factors and at the same time solve the vascular crisis [2].

Vascular crisis can be divided into arterial, venous, and

complex vascular crisis. The judgment is mainly based on the clinical manifestations of skin temperature, skin color, the tension of the finger, capillary filling time, and fingertip bloodletting experiment [12]. Vascular crisis of the affected finger must be identified as either insufficiency of arterial blood supply or venous reflux disorder before blood-sucking leech therapy. Artery blood supply deficiency is an absolute contraindication for leech treatment [9]. Infection is the main complication in the treatment of living leeches [13]. Aeromonas hydrophila infection is one of the most common types, therefore, it is necessary to take preventive measures against infection and strictly follow the principles of aseptic surgery [14]. Before treatment, the leeches can be soaked in 0.02% chlorhexidine or gentamicin solution for disinfection [9]. Patients should be given prophylactic antibiotics, such as third generation cephalosporin and ciprofloxacin, and avoid taking immunosuppressants before the blood-sucking leech therapy [8, 10].

Leech (Hirudo), Latin name Whitmania pigra Whitman, belong to the Annelida (Hirudinea in Annelida) leech family [7]. An anticoagulant substance was extracted from Hirudo Medicinails in the 1950s by German scientist F.Malwardt. This anticoagulant differs from the mechanism of traditional antithrombotic drugs such as heparin and aspirin and is the most effective direct thrombin inhibitor found to date. It is named "Hirudin" [15, 16]. A large number of pharmacological experiments have confirmed that hirudin is the most effective and safest natural specific thrombin inhibitor known at present [17]. Hirudin is an animal source anticoagulant [18]. Its pharmacological effects are listed as follows; (1) an anticoagulant effect. Hirudin acts selectivity and specificity in the inhibition of thrombin. It only inhibits thrombin in the coagulation system without interfering with body fluids or cytokines, and its inhibitory effect does not require the participation of other blood coagulation factors or plasma components, nor is it affected by platelet factor 4 (PF4) or histidine-rich glycoprotein (HRG) [19]. (2) Anti-platelet aggregation. After the combination of hirudin and thrombin, the activation of thrombin in platelets causes the binding of thrombin to platelets to weakened. The release of platelets stimulated by thrombin is also inhibited and platelet aggregation is inhibited. (3) Antithrombotic effect. Blood clotting induced by thrombin is the main mechanism of endovascular thrombosis [20]. Hirudin cannot only combine with free thrombin in plasma, but also can neutralize thrombin bound to fibrin, so, it can directly dissolve thrombus and prevent the formation and extension of various kinds of thrombus [21]. (4) Besides, it relieves vasospasm, promotes neovascularization, improves blood circulation, reduces inflammation and lipid deposition in the blood vessel wall. It is an antioxidant, scavenges radicals, and so on. In June 2004, medical leech synthetic hirudin were officially approved by the Food Drug Administration (FDA) of the United States, allowing it to be publicly marketed and used in some clinical treatments with indications [22].

The principle of living blood-sucking leech therapy for venous crisis: (1) In recent years, leeches are used in microvascular surgery (replantation) and reconstruction surgery (flap transplantation) to reduce postoperative venous congestion due to structural injury [9, 23, 24]. Through the blood-thirsty habits of leeches to suck blood in venous congested tissue, a "vein output short circuit" is formed, effectively relieving swelling, reducing tension, and promoting blood reflux. (2) Leeches inject saliva containing active substances such as hirudin into the tissue while sucking up the extravasated blood, and further increase blood circulation through anticoagulation, antithrombosis, and fibrinolysis [17]. (3) As the leech's saliva contains different analgesics, anesthetics, and compounds similar to histamine, these effective substances have the effect of significantly reducing pain, and thus play a role in preventing vasospasm [20]. (4) At the same time, the saliva of leeches contains a protein called instability enzyme, which has the activity of lysozyme. It destroyes some components in the cell [25], has a broad spectrum of antibacterial activity, and resists gram-negative and positive bacteria.

The following points should be paid attention to when the therapy is applied clinically. (1) This therapy is mainly applicable to early postoperative venous circulation disorders. (2) Insufficient arterial blood supply is an absolute contraindication for blood-sucking leech therapy. (3) During the treatment, regular blood tests, coagulation function, tests for infection, and other tests should be conducted. Other diseases should be excluded, and symptomatic treatment should be given. (4) Psychological support before treatment must be provided to make patients fully prepared. (5) Infection prevention measures should be taken before treatment, and aseptic surgical principles should be strictly observed during treatment. (6) Pay attention to protecting the surrounding normal tissues during treatment to avoid damage. (7) After the treatment, actively disinfect the sucked wound, and change the wound dressing regularly. (8)

Antibiotics should be used to prevent infection before and after treatment. (9) Closely observe the blood supply and adjust the treatment plan at any time as needed [9, 10].

Through active blood-sucking and the anticoagulant effect of hirudin in its residual saliva, living leeches can timely solve the blood stagnation in tissues and maintain an increased amount of nutrient blood flow, thus improving the circulatory status while waiting for the replanted finger to establish new venous access to survive [8]. Although blood-sucking leech therapy cannot truly replace the role of venous blood vessels, they can reduce the impact of congestion on the retransplanted tissue, to gain time for the body to reestablish the blood supply system [23].

Conclusion

This case report describes 8 cases of blood-sucking leech therapy in replantation of severed fingers. Blood-sucking leech therapy in venous crisis after the replantation of severed fingers has a profound effect. It successfully saves dying fingers caused by congestion, reduces the rate of necrosis, and improves the survival rate of replantation, which is remarkably beneficial in clinical practice application.

Conflict of Interest

The authors have no conflicts of interest to declare.

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