Avulsion of the Auricle in an Anticoagulated Patient: Is Leeching Contraindicated? A Review and a Case

Jens Mommsen, M.D., D.D.S.,¹ Javier Rodríguez-Fernández, M.D.,¹
Mario Mateos-Micas, M.D.,¹ Olga Vázquez-Bouso, M.D.,¹
Victor Gumbao-Grau, M.D.,¹ and Gabriel Forteza-Gonzalez, M.D., Ph.D.¹

ABSTRACT

Amputation of the auricle is a periodic occurrence leading to disfigurement if not treated properly. Venous stasis is a common complication in reattachments and requires decongestant and anticoagulant treatment. Today, leech therapy is the treatment of choice. Common problems are that it is not available everywhere and that it is usually contraindicated in anticoagulated patients. The peculiarities of leech therapy and the various aspects of surgical management are reviewed. A case of a partial amputation of the auricle in a patient under concomitant anticoagulation therapy with warfarin is presented. The amputated part was reattached in another hospital without microvascular anastomosis. The patient presented to our department with early signs of venous congestion. Leech therapy was started 35 hours after trauma, and the patient continued his anticoagulation therapy. With this treatment, 90% of the amputated part was rescued. The anticoagulation therapy of the patient may have played an important role in the first hours after reattachment, preventing capillary thrombosis and in consequence facilitating the minimal oxygenation necessary. The claim that anticoagulation therapy is a contraindication to leeching should be questioned in cases of reattachments in well-controllable locations without arterial anastomosis.

KEYWORDS: Leeches, leeching, leech therapy, trauma, amputation, ear, auricle, anticoagulation

Traumatic amputation or laceration of the auricle is a periodic occurrence often caused by human and canine bite injuries, followed by accidents.¹ Reattachment and microsurgical anastomosis of the vessels are considered state of the art. Reattachment without venous anastomosis can be justified due to the rapid revascularization, the capacity of the auricle to tolerate

hypoxia, and the efficacy of treating venous stasis by leeching. Reattachment without arterial anastomosis is usually successful in partial lacerations, where the irrigation via the capillaries of the remaining soft tissue bridge often is sufficient. In amputations, reattachment as a composite graft without anastomosis does not appear to be promising, yet it is a common task—"ut

¹Hospital Universitari Joan XXIII, Cirugía Maxilofacial, Tarragona, Spain.

Address for correspondence and reprint requests: Jens Mommsen, M.D., D.D.S., Hospital Universitari Joan XXIII, Cirugía Maxilofacial, C/ Doctor Mallafre Guasch, 4 Tarragona 43007, Spain (e-mail: dr.mommsen@gmail.com).

Craniomaxillofac Trauma Reconstruction 2011;4:61–68. Copyright

© 2011 by Thieme Medical Publishers, Inc., 333 Seventh Avenue, New York, NY 10001, USA. Tel: +1(212) 584-4662.

Received: July 29, 2010. Accepted after revision: November 19, 2010. Published online: May 13, 2011.

DOI: <http://dx.doi.org/10.1055/s-0031-1279668>.

ISSN 1943-3875.

aliquid fiat”—in nonspecialized hospitals. Due to the widespread unfamiliarity with leech therapy, some auricles that might have had sufficient capillary input are lost due to venous stasis.

Leech therapy generally is contraindicated in anticoagulated patients.² Nevertheless, we will encounter this condition more often in the next years due to the demographic evolution. We present a case of successful reattachment of a partial amputation of the upper left auricle followed by leech therapy in a patient with concomitant anticoagulation, and we review the different treatment possibilities.

CASE REPORT

The patient was a white male, 74-years-old, with a history of pulmonary embolism in 1999 due to a deep venous thrombosis in the right leg. At the time of the accident, he was under concomitant anticoagulation therapy with warfarin (alternating 5 mg/d and 3.75 mg/d, international normalized ratio 2 to 3).

By accidentally colliding with a radiator, he suffered an amputation of the upper third of his left auricle. With the amputated part wrapped in a napkin, the patient presented at the local hospital, where the staff of the emergency room reattached the amputated part 3 hours later as a composite flap without microsurgical anastomosis.

The patient received levofloxacin 500 mg and was discharged with the recommendation to present to a plastic surgeon for follow-up. The following day, he presented to our outpatient clinic. The reattached part presented an anemic aspect and, due to the time passed, further microsurgical measures were discarded. The patient was prescribed amoxicillin with clavulanic acid 1 g/8 h and was asked to continue his habitual prophylaxis with warfarin.

The next day (some 35 hours after the accident), the reattached part presented a livid coloring, indicative of venous congestion. Stab incisions produced scarce quantities of blood of dark color (Fig. 1).

The patient was admitted and leech therapy was initiated (*Hirudo medicinalis*, Biopharm LeechesTM, Hendy, South Wales, United Kingdom). Two leeches were applied and remained until reaching a volume indicative of sufficient ingestion (~20 minutes) before withdrawal. The decongestive effect was visible in the course of application (Fig. 2). During the following 48 hours, two leeches were applied every 8 hours. Post-treatment care to avoid early closure of the bites and to favor passive bleeding consisted of applying gauzes soaked in warm saline solution. The warfarin treatment was not suspended or substituted. Upon spontaneous bleeding and not showing signs of congestion, leeching was suspended temporarily during the third day. On the fourth day, epidermolysis began, forming a blister

Figure 1 Before leeching: The amputated part was reattached some 30 hours before. The livid color and the small amount of dark blood after stabbing are signs of congestion.

(Fig. 3). As it was accompanied by signs of congestion, leeching was reinitiated once every 24 hours, to the ninth day. The patient was dismissed that day showing partial necrosis of the epidermis of the reattached part (Fig. 4). The hemogram confirmed a light anemia (red corpuscles $3.69 \times 10^{12}/L$, hemoglobin 12.00 g/dL, hematocrit 35.2%) that did not require transfusion.

The patient was seen weekly and the auricle was almost completely epithelialized 44 days after the amputation (Fig. 5). Three months later, 90% of the

Figure 2 During leeching: One leech is still feeding. Another has been removed and the typical starlike bite can be seen. The lightening of the skin color indicates the immediate decongestive effect.

Figure 3 Fourth day of leeching: A blister formed, indicating epidermolysis.

amputated part had survived and the patient was satisfied with the final result (Fig. 6).

DISCUSSION

Surgical Management

Reattachment of amputated parts has always been a desire throughout human history. The New Testament

Figure 5 Forty-four days after trauma: Almost all of the necrotic skin has epithelialized.

(Lucas 22:47) relates the reattachment of Malchus' auricle by Jesus after its amputation by St. Peter.³ In the medical literature, the first reattachment of an auricle after an amputation as a result of a horse bite was described by Brown 1898.⁴ In 1966, Buncke and Schulz⁵

Figure 4 Ninth day of leeching: A necrosis of the distal skin of the amputated part occurred.

Figure 6 Three months after trauma: 90% of the amputated part survived.

described the microsurgical technique of reattaching auricles in rabbits, and Pennington et al described the first successful reattachment with microsurgery in humans in 1980.⁶

The auricle primarily consists of skin and cartilage, which, due to their low metabolism, show a higher resistance toward ischemia. Times of ischemia of 10, 18, and up to 33 hours have been described,^{3,7,8} a fact that plays an important role in survival as a composite flap.

Small defects of the auricle are esthetically well treated by performing a reductive otoplasty if localization and size permit it. In cases of larger lacerations or amputations, it is recommended to reattach the avulsed part.^{9,10} This also applies to bite injuries, disregarding the usual practice not to perform primary closure due to contamination and damage of the wound margins.

The reattachment with microsurgical connection of the blood vessels is state of the art.¹¹ Nevertheless, it is a challenging task to find and connect the auricular vessels due to their minuscule size (Fig. 7). It is not recommended to perform excessive searches for vessels to avoid further damage to the capillary bed. Due to the good blood supply of the auricle, it is sufficient to connect one single artery.¹²

Most problems are caused by the venous drainage. Some authors recommend multiple anastomosis,¹³ and others describe the difficulties to find adequate veins.^{2,7,11,14,15} Concannon and Puckett¹⁶ and De Chalain and Jones¹⁷ even discourage performing venous

microanastomosis in difficult cases due to the good results when treating venous congestion adequately.

If it is impossible to perform microsurgical anastomosis, the reattachment without it, like a composed flap, is recommended.^{9,12,16} It has a good prognosis in cases of partial lacerations due the ample ability of the remaining tissue bridge to nourish the auricle.¹² In amputations, reintegration as a composite flap is indicated only if microsurgical techniques are unavailable. It has advantages like its simplicity, short duration, and few additional scars, facilitating secondary reconstruction in case of failure.¹² The risk of failure is influenced by the size of the amputation. In surgically designed transplants from the auricle, a composite graft up to 15 mm has a success rate of 90%, and grafts more than 15 mm fail in 50%.¹⁸ In traumatic amputations, nevertheless, the laceration of the wound margins might lead to difficulties in revascularization and thus to minor success rates.

Contused and necrotic tissue should be debrided because revascularization—beginning in the subdermal plexus—cannot be effective within the necessary time if a barrier of compromised or necrotic tissue has to be passed. It may even be beneficial for revascularization to amplify the surface of nonepithelialized tissue by resection of retroauricular skin.^{9,14,16}

The metabolic needs can be lowered by cooling, which is recommended in transplants.¹⁹ Yet in cases of reduced arterial or venous flow, warm dressings are used to encourage vasodilatation.

An alternative to microsurgical reconstruction is the dermabrasion of the amputated part, its reattachment,

Figure 7 Arterial vascularization of the right auricle. The multiple anastomoses facilitate reinsertion as a composite flap. The reduction in diameter in the periphery makes microsurgery difficult in smaller amputations.

and its conservation in a retroauricular subcutaneous pouch.²⁰⁻²² This has proven successful in partial amputations from one-third to two-thirds of the auricle,⁷ although the esthetic result might be deficient as the cartilage can suffer morphological changes such as ossification and fibrous degeneration.²³

It is advised to carefully evaluate the indication of nonmicrosurgical techniques and to consider even a more time-consuming transport to a center with microsurgical experience.¹ The treatment should be considered "planned urgent" rather than as an emergency surgery.⁸

Venous Congestion

Venous congestion in reattached auricles is such a common situation that we have to accept it as being an accompanying symptom rather than seeing it as a complication.¹² A meta-analysis found venous problems in 10 of 14 cases with arterial and venous microsurgical anastomosis. Eight cases were treated appropriately (six with leeches and two with external decompression) and rescued. A case without treatment and another that was treated too late lost their auricle.¹⁶

In cases of venous stasis, the question is not whether to introduce leeching and anticoagulation, but rather when to do so.¹¹

Leech Therapy

At the present time, in many hospitals leech therapy has not yet become part of the standard armament of treating venous stasis. The lack of awareness of its possibilities and the concern of provoking an antediluvian image hinder its nationwide introduction, leading to the loss of some reattached auricles.

Leeching has a long history and was very popular in medieval times, whereas from the 19th century to the last quarter of the 20th century, few descriptions are found.²⁴ With the advances in plastic and reconstructive surgery, leeches again began to play an important therapeutic role in the 1960s, mainly in cases of venous stasis in flaps.

The *Hirudo medicinalis* has three jaws with 60 rigid, thin, sharp teeth, each of which has a secretory opening.²⁵ The secretions consist of anticoagulants such as hirudin (a potent inhibitor of thrombin), antiaggregating substances like calin, vasoactive substances like histamine, proteases such as collagenases and hyaluronidases, and anesthetics.^{2,26} This cocktail not only facilitates the puncture of the skin and ingestion of blood but also increases the capillary flow by vasodilatation and thrombolysis and prolongs passive bleeding after withdrawal of the leech.^{24,27}

A study with skin flaps in pigs found that between 1 and 5 mL of blood was ingested by one leech, with an

average of 2.45 mL. The passive bleeding after withdrawal of the leech lasted up to more than 4 hours.²⁶ In our anticoagulated patient, the quantities seemed to have been higher and the times of passive bleeding under application of warm saline-soaked gauzes were longer. Additionally, the size of the area of reperfusion was evaluated.²⁶ A 16-mm average diameter of increased perfusion was measured. Outside that area, the effect was smaller, making it advisable to apply one leech every 15 to 20 mm.

Leeching should continue until revascularization is sufficient, which takes about a week (4 to 10 days).^{14,26} In our case, it took 9 days, though the suspension of leeching during the third day and the low frequency of application possibly prolonged the time necessary for revascularization.

Control of the therapeutic effect on the ear's perfusion is made clinically, observing color, temperature, and capillary refill. Attempts to objectify the perfusion by using a dye (fluorescein) have been described.¹¹ Yet, because visual inspection is a very simple, reliable, and effective way to control the efficacy of leeching, other more laborious methods are preferably applied when objectivity is required for scientific studies.

The drawbacks of leeching are the time and the personnel needed to perform leech therapy.²⁶ In difficult cases, it may be necessary to apply leeches every 4 hours at first, reducing frequency during the course. In our case, nurses volunteered to apply and monitor the leeches. In other hospitals, the nursing staff does not consider leeching to be part of their duty. An article in *The American Journal of Nursing*, on the other hand, states that "nurses may be expected to participate in this therapy" and offers guidelines for the nursing staff.²⁸ Given the problems of time and staff, delegating the monitoring of the leech to the family of the patient might be considered, in cases of good acceptance and interest.

Complications of leeching are migration of the leech to healthy tissue, infection, and hemorrhage.² The tendency of the leech to search for healthier tissue and its instinct to hide after feeding require vigilance during the whole time of application. *Aeromonas hydrophila*, a gram-negative germ located in the gut of the leech, is the main cause of infections. Antibiotic prophylaxis must be given. Several antibiotics are recommended: third-generation cephalosporins, aminoglycosides, tetracyclines, and ciprofloxacin.^{2,29}

Hemorrhage and Anticoagulation

The loss of blood can reach a pathological value. Anticoagulated patients or patients with coagulopathies are usually not considered to be candidates for leeching.² However, recommendations are contradictory: on one hand, it is advised not to treat these patients, and on the

other hand, it is widely recommended to prescribe anti-coagulants during leeching in healthy patients.^{7,10–12,30} Our patient was under anticoagulation with warfarin (international normalized ratio 2.2), and as the area of leeching was easily accessible for control and as less bleeding has to be expected in composite flaps because no arterial input is present, we decided to start leeching and continue his medication.

A control blood count on the ninth day showed mild anemia, but no blood transfusion was required. Steffen et al¹ reviewed publications of 37 cases of microsurgical reattachment of the auricle and found that 20 cases (54%) required blood transfusions, demonstrating the risk of critical blood loss if an arterial anastomosis is present. The risk of having to receive a transfusion has to be discussed with the patient before leeching. A patient who refuses transfusion (for religious reasons, for example) might not be a candidate for leech therapy.

Other contraindications are arterial insufficiency, immune system disorders, and allergy.²

There is consensus in the literature that the patient should be anticoagulated systemically in cases of ear reattachment. But there is no consensus on what type of anticoagulant to use. Heparin, aspirin, warfarin, prostaglandin E, dextran, and combinations have been used.^{7,8,10–12,30} Because our patient was taking warfarin for 10 years, we decided he should continue with his usual dose without adding other anticoagulants or anti-aggregants. Curiously, anticoagulation is not part of the protocol in composite grafts from the auricle (e.g., to the ala of the nose). Anticoagulation should even be discontinued preoperatively because of the risk of hematoma.¹⁹

There are few alternatives if leeching is not possible or does not show the desired result. Various skin incisions and injections of heparin have been tried or a stab incision in the lobe with a gauze drainage, but the consensus is that leeching is the preferred method.^{2,12,15} Mechanical devices have been tested to substitute leeches.³¹ The amount of blood drained was superior of that ingested by leeches (sevenfold), but no studies have been published to date showing their clinical usefulness.

CONCLUSION

The case presented is singular because of its circumstances. The patient was correctly treated surgically in another hospital but discharged without further consideration of possible complications. He presented to our clinic and with a delay of 36 hours from injury, we started leech therapy. Supposedly, the patient's anticoagulant therapy with warfarin could have played an important role in the survival of the amputated part during the first 36 hours without leech therapy, preventing capillary thrombosis and in consequence

facilitating the minimal oxygenation necessary. Leeching was performed during 9 days and resulted in a good outcome of 90% survival of the amputation. An increased frequency of leeching might have prevented epidermolysis and necrosis of 10% of the amputated part.

However, leech therapy is time- and staff-consuming, and in many hospitals a controversy exists between doctors and nurses about who should be assigned. This, the lack of knowledge about its beneficial effects, and the fear of provoking a medieval impression—especially among nonmedical decision makers—still prevents the use of leeches in all major hospitals. Nonetheless, it is important to consider some disadvantages of leech therapy, such as prolonged hospital stay, bleeding with the possible need for blood transfusion, and a certain risk of infection.

The demographic evolution will lead to more and more patients with ongoing anticoagulation who might need leeching. That should make us reconsider that in locations that can be easily controlled, an ongoing anticoagulation therapy should be no contraindication for leech therapy in reattached amputations. Caution is advised where patent arterial anastomoses are present.

REFERENCES

1. Steffen A, Katzbach R, Klaiber S. A comparison of ear reattachment methods: a review of 25 years since Pennington. *Plast Reconstr Surg* 2006;118:1358–1364
2. Hullett JS, Spinnato GG, Ziccardi V. Treatment of an ear laceration with adjunctive leech therapy: a case report. *J Oral Maxillofac Surg* 2007;65:2112–2114
3. Weerda H. *Surgery of the Auricle, Tumors-Trauma-Defects-Abnormalities*. Georg Thieme Verlag KG Stuttgart New York: Thieme Medical Publishers; 2007:29–30
4. Brown WJ. Extraordinary case of horse bite; the external ear completely bitten off and successfully replaced. *Lancet* 1898;1:1533–1534
5. Buncke HJ Jr, Schulz WP. Total ear reimplantation in the rabbit utilizing microminature vascular anastomoses. *Br J Plast Surg* 1966;19:15–22
6. Pennington DG, Lai MF, Pelly AD. Successful replantation of a completely avulsed ear by microvascular anastomosis. *Plast Reconstr Surg* 1980;65:820–823
7. Talbi M, Stussi JD, Meley M. Microsurgical replantation of a totally amputated ear without venous repair. *J Reconstr Microsurg* 2001;17:417–420
8. Shelley OP, Villafane O, Watson SB. Successful partial ear replantation after prolonged ischaemia time. *Br J Plast Surg* 2000;53:76–77
9. Godwin Y, Allison K, Waters R. Reconstruction of a large defect of the ear using a composite graft following a human bite injury. *Br J Plast Surg* 1999;52:152–154
10. Jeng SF, Wei FC, Noordhoff MS. Replantation of amputated facial tissues with microvascular anastomosis. *Microsurgery* 1994;15:327–333
11. Trovato MJ, Agarwal JP. Successful replantation of the ear as a venous flap. *Ann Plast Surg* 2008;61:164–168

12. Steffen A. Die Verletzung der Ohrmuschel—eine retrospektive Analyse von Ursachen und Behandlungskonzepten [Doctoral dissertation] University of Lübeck; 2004. Available at: <http://www.students.informatik.uni-luebeck.de/zhb/ediss172.pdf>. Accessed 08, May 2011
13. Mutimer KL, Banis JC, Upton J. Microsurgical reattachment of totally amputated ears. *Plast Reconstr Surg* 1987;79:535–541
14. Akyürek M, Safak T, Keçik A. Microsurgical ear replantation without venous repair: failure of development of venous channels despite patency of arterial anastomosis for 14 days. *Ann Plast Surg* 2001;46:439–442; discussion 442–443
15. Nath RK, Kraemer BA, Azizzadeh A. Complete ear replantation without venous anastomosis. *Microsurgery* 1998;18:282–285
16. Concannon MJ, Puckett CL. Microsurgical replantation of an ear in a child without venous repair. *Plast Reconstr Surg* 1998;102:2088–2093; discussion 2094–2096
17. de Chalaïn T, Jones G. Replantation of the avulsed pinna: 100 percent survival with a single arterial anastomosis and substitution of leeches for a venous anastomosis. *Plast Reconstr Surg* 1995;95:1275–1279
18. Haug MD, Rieger UM, Witt P, Gubisch W. Managing the ear as a donor site for composite graft in nasal reconstruction: update on technical refinements and donor site morbidity in 110 cases. *Ann Plast Surg* 2009;63:171–175
19. Adams C, Ratner D. Composite and free cartilage grafting. *Dermatol Clin* 2005;23:129–140; vii
20. Mladick RA, Horton CE, Adamson JE, Cohen BI. The pocket principle: a new technique for the reattachment of a severed ear part. *Plast Reconstr Surg* 1971;48:219–223
21. Baudet J, Tramond P, Goumain A. A new technic for the reimplantation of a completely severed auricle. *Ann Chir Plast* 1972;17:67–72
22. Pribaz JJ, Crespo LD, Orgill DP, Pousti TJ, Bartlett RA. Ear replantation without microsurgery. *Plast Reconstr Surg* 1997;99:1868–1872
23. Staudenmaier R, Aigner J, Hözl J, et al. Subcutaneous preservation of an amputated auricle. Morphological changes. *Laryngorhinootologie* 2000;79:233–238
24. Frodel JL Jr, Barth P, Wagner J. Salvage of partial facial soft tissue avulsions with medicinal leeches. *Otolaryngol Head Neck Surg* 2004;131:934–939
25. Orevi M, Eldor A, Giguzin I, Rigbi M. Jaw anatomy of the blood-sucking leeches, *Hirudinea Limnatis nilotica* and *Hirudo medicinalis*, and its relationship to their feeding habits. *J Zool Lond* 2000;250:121–127
26. Conforti ML, Connor NP, Heisey DM, Hartig GK. Evaluation of performance characteristics of the medicinal leech (*Hirudo medicinalis*) for the treatment of venous congestion. *Plast Reconstr Surg* 2002;109:228–235
27. Mateos Micas M, García Díez E, Forteza González G. Sanguijuelas medicinales: utilidad en microcirugía. A propósito de un caso. *Rev Esp Cir Oral Maxilofac* 2001;23:90–94
28. Yantis MA, O'Toole KN, Ring P. Leech therapy. *Am J Nurs* 2009;109:36–42; quiz 43
29. Kalbermatten DF, Rieger UM, Uike K, et al. 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* 2007;39:108–111
30. Kim KS, Kim ES, Hwang JH, Lee SY. Microsurgical replantation of a partial helix of the ear. *Microsurgery* 2009;29:548–551
31. Conforti ML, Connor NP, Heisey DM, Vanderby R, Kunz D, Hartig GK. Development of a mechanical device to replace medicinal leech (*Hirudo medicinalis*) for treatment of venous congestion. *J Rehabil Res Dev* 2002;39:497–504