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Leeching as Salvage Venous Drainage in Ear Reconstruction: Clinical Case and Review of Literature

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Background: Ear avulsion is a rare complication of different traumas, such as car accidents, human or animal bites and stab wounds, and can result in dramatic cosmetic consequences for the patient. Ear replantation, revascularization, and reattachment are the options offering best aesthetic results. But venous outflow insufficiency is responsible for a high rate of failures. Leeching is one the most efficient methods to relieve venous congestion. It has been used as an alternative venous outflow in case of severe impairment of the physiologic one.
Methods: We present a case of successful rescue of a congested reattached ear by leeching after subtotal avulsion, along with a review of the literature on cases of avulsed auricle reconstruction salvaged by hirudotherapy. Data were collected and analyzed to identify a best regimen to deal with venous congestion.
Results: More than 130 cases of avulsed auricle savage are described in the literature, in a fourth of which leech therapy was used in the management of venous congestion.
Discussion: In case of both venous outflow deficit or absence, leeches are a potentially successful option to correct the congestion while new veins reestablish normal physiology. The need for anticoagulant/antiaggregant therapy, antibiotics, and often blood transfusion are the main pitfalls of leeching.
Conclusion: Leeches can be considered a salvage method for ear replantation and reattachment in those cases that lack venous outflow in the presence of valid arterial inflow. *(Plast Reconstr Surg Glob Open 2018;6:e1820; doi: 10.1097/GOX.0000000000001820; Published online 5 November 2018.)*

INTRODUCTION

Ear avulsion is a rare dramatic event that can lead to severe deformity after different types of trauma such as car accidents, bites, and stab wounds. Reattachment of the avulsed ear offers the best aesthetic results.[1–3] In the absence of adequate perfusion or suitable vessels for microsurgical replantation/revascularization, alternative procedures can be used to attempt ear salvage such as composite grafting, the pocket-principle technique, or local flaps.[4–6]

Venous congestion due to thrombosis or insufficient venous connection is the most common complication responsible for the failure of ear revascularization and reattachment. In the presence of adequate arterial inflow, the presence of sufficient venous drainage should be assessed to prevent blood stasis and delayed necrosis. The avulsion mechanism of ear trauma often determines traction injuries to small ear vessels reducing the chances of identifying functioning veins or veins suitable for repair. Nonetheless, ear salvage should be attempted also in the lack of venous repair, as recently reported by Momeni et al.[7–14]

External venous decompression is a well-established approach to venous congestion. In ear salvage, it is advocated as alternative drainage until venous connections with the recipient bed develop.[15,16] Tissue milking, pin pricking, use of medicinal leeches, pharmacological leeching are common methods to drain the congested venous system of replanted tissues, often associated with systemic

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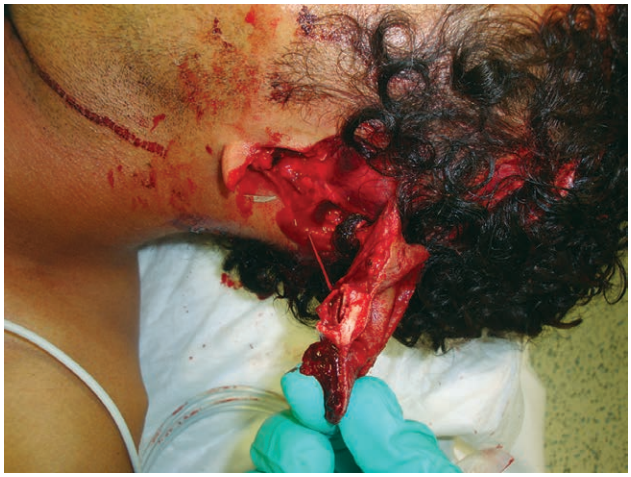

Fig. 1. Avulsion of the left ear.

Fig. 2. Intraoperatively the auricle developed venous congestion and leeching was started immediately after the surgery.

anticoagulant therapy.[17–19] Among those, leeching is one of the most commonly employed in congested ears salvage, and several successful cases are reported in the literature, but a clear consensus on the protocol of application to ear salvage is still lacking.

CASE REPORT

A 26-year-old man was involved in a car accident resulting in almost complete avulsion of the left ear associated with a wide laceration of the left tempo-parietal scalp (Fig. 1). He reached the operating theatre in 5 hours from the time of injury, where the ear was examined and recognized to have an effective arterial inflow (seen with microsurgical loupes and confirmed by a positive pin pricking test) provided through a small skin bridge. Refill was brisk, and an attempt to find suitable veins for anastomosis to increase blood outflow had no success. The ear was sutured to the scalp with 4-0 and 2-0 nylon sutures. No drains were positioned to maximize skin-to-skin contact.

Venous congestion was managed by starting leeching immediately after surgery (Fig. 2). Leeches were applied continuously for the first 4 postoperative days and changed every 4 hours, then the ear was monitored every 6 hours for 7 days, and leeches were reapplied in the presence of signs of venous congestion, with up to 3 leeches per day.

The patient was given ceftriaxone 1 g twice daily, 4,000 units of enoxaparin sodium s.c. and 325 mg of Aspirin oral per day for 2 weeks. Bloods were monitored, and 2 units of red blood cells were transfused. The patient was discharged to outpatient care 2 weeks after surgery (Fig. 3). At 3 years follow-up, the auricle maintained a satisfactory shape.

MATERIALS AND METHODS

The literature in the Medline database (Pubmed) was searched using combinations of key words ("ear replantation," "ear avulsion," "hirudotherapy," "hirudo medicinalis," "leech," "medicinal leech").

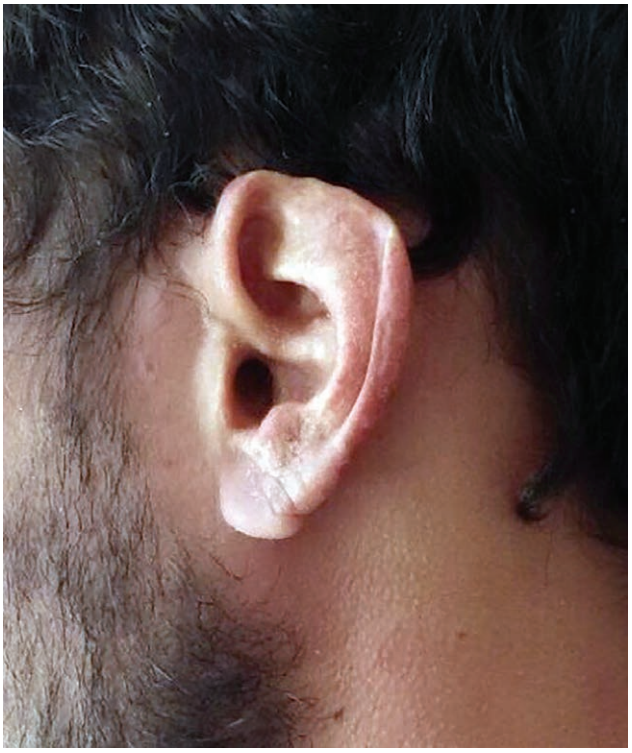

Fig. 3. Complete healing 3 years after the trauma.

Studies published in English describing ear salvage with leech therapy in total and subtotal amputations (> 80% of the surface of the auricle) were selected. Articles including only descriptive reports, historical articles, correspondence, editorials, and reviews were excluded.

Residual/reestablished perfusion, regiment of leech application, anticoagulant and antiaggregant therapy, blood transfusions, and antibiotics administered in successful cases and complications were analyzed.

RESULTS

We identified 131 cases of successful ear salvage reported in the literature from 1970 to 2016. Twelve cases were

excluded for unclear description of leeches use. Leeches were employed in 40 cases of 119.

In 4 of these cases, perfusion was conserved through an intact skin pedicle; it was reestablished by arterial microsurgical anastomosis in 22 cases and by an artero-venous anastomosis in 2 cases. As for venous drainage, it appeared to be intact in 3 cases and was repaired intraoperatively in 9 cases, with 2 venous anastomoses performed in 1 case. Sixteen amputated auricles lacked adequate veins.

Leeches were applied immediately after surgery in 12 cases of 16 with absent venous outflow and in 2 cases of 3 with intact skin pedicle and adequate arterial perfusion. Only 2 cases of 8 with 1 or 2 venous anastomoses required early leeching. The leeching regimen was changed from regularly intermittent to tapered on venous congestion 2–5 days after surgery (mean of 3.8 days) in 20 cases. Only in 2 cases the authors preferred to taper leeches application on venous congestion from the beginning. In 7 cases, the application regimen was not reported.

The number of leeches used by different authors was highly variable, ranging from 1 leech per day to as many as 1 every hour. The time interval between applications was differed similarly.

The duration of leech therapy ranged from 3 to 17 days (mean, 8.5 days). In cases with absent venous drainage, the application of leeches was continuous for a mean of 5.2 days, and then tapered basing on signs of vascular congestion.

In addition to leech therapy, the majority of patients received either a regimen of double anticoagulation or an association of anticoagulant and antiaggregant. Two patients received dextran and oral aspirin, 7 patients received heparin and oral aspirin, 5 patients received dextran, heparin, and oral aspirin. Ten patients received a monotherapy of dextran, heparin, or warfarin. In 2 cases, the type of anticoagulant is not reported, and in 1 case, no anticoagulant therapy was administered. Adjunctive therapy was equally highly variable and included intraoperative boluses of heparin, verapamil, postoperative oral buflomedil or prostaglandin, warming blanket, and warm room.

Twenty cases of 29 patients required blood transfusions (with a mean of 5.37 packed red blood cells units per patient). Twenty-five patients received antibiotic prophylaxis, which was specified in 14 reports; no infective complications are described (Table 1).

DISCUSSION

The auricle has no functional relevance, but it is a major element in defining face appearance, and its loss often has a significant psychological impact on the individual. Any attempt should be made to achieve the best possible preservation of its shape in case of partial or total ear avulsions. Either with a conserved or reestablished perfusion, insufficient venous drainage is the main factor leading to failure. Some authors believe that a vein to vein repair, or sometimes an artery to vein fistula, is mandatory for the replantation/revascularization of the auricle and that only an efficient physiologic drainage guarantees success.[5,7,20,21] On the contrary, many cases are reported of successful ear replantation despite absent venous drainage.[16,22–27] Momeni et al.[11] recently confirmed the role of alternative venous decongestion methods in ear salvage, reaffirming once again the importance of attempting ear salvage even with artery only anastomosis.[28]

Flushing or soaking with heparin sodium solution, subcutaneous heparin injection, daily punctures, and multiple stab wounds are classic techniques employed in reconstructive microsurgery, but they are anecdotal in ear reconstruction.

Medicinal leeching is described by many authors for secondary auricle salvage in cases of vein thrombosis after anastomosis.[10,17,23,29–31] But it is also proposed as a primary alternative when microsurgical anastomosis is not feasible.[8,15,22,32–37]

The saliva of leeches contains vasodilators (histamine-like products), inhibitors of platelet aggregation (calian, apyrase, saratin), anticoagulants (hirudin), permeability factors (hyaluronidase) and proteinase inhibitors (bdellin, egline). Together with the active ingestion of blood by the leech, each bite increases and prolongs bleeding after detachment.[10,38,39]

Anticoagulant and antiaggregant agents can be administered systemically in addition to leeches to maintain blood flow and prevent thrombosis. This was the case in the majority of reports analyzed, suggesting the administration of at least a combination of low molecular weight heparin and 325 mg of aspirin daily. Dextran or other agents were also introduced by some authors (Table 1).

Peripheral artery disease, severe immunocompromised status, and history of allergic reactions to leeches are absolute contraindications.[40] A chronic anticoagulant therapy represents a relative contraindication.[35] In any case, the general conditions of the patient must be taken into account, because leeching implies blood loss, which in some patients is better avoided.[32]

Leech-borne infections have an incidence between 2.4% and 36.2%, and along with exsanguination is the main complication of leech therapy. This should be discussed with the patient before starting application as part of consenting.

Aeromonas spp., Pseudomonas spp. and Vibrio spp. can cause localized cellulitis, meningitis, and septic shock, occurring from 24 hours to 26 days after leeching. In addition, leeches are potential vectors of blood-borne diseases, including HIV and hepatitis viruses. Proper management of the leeches to avoid cross-contamination between patients is mandatory.

Aeromonas hydrophilia, a facultative Gram-negative rod that colonizes leech gut, is the major cause of infectious complications after leeching. It contributes to blood digestion and decontaminated leeches are less effective. Infection can be prevented by antibiotic prophylaxis with ciprofloxacin 250 mg twice daily as first-line therapy; alternatively, trimethoprim/sulfamethoxazole or a third-generation cephalosporin should be considered.[41–43]

Blood loss is an intrinsic consequence of the use of leech therapy. Hematocrit and blood count should be monitored closely, and RBC transfusions should be promptly administered.[6,14,35,44,45]

Table 1. Leech Therapy Regimens in Successful Cases of Ear Salvage

Reference	Arterial Inflow	Venous Outflow	Timing of Application	Regimen of Leeches Application
Current case	Intact (skin pedicle)	Absent	Immediately	Continuously and changed every 4 hours till POD 4, then based on signs of venous congestion for the first week
Mendenhall et al.[28]	Arterial anastomosis	Absent	8 h after surgery (immediately ordered)	2 Leeches every 2 h for the first 2–3 d, then gradually decreased
Momeni et al.[34]	A –V anastomosis	Absent	Immediately	2–3 h initially, then tapered till POD 10
Sullivan and Taylor[37]	Arterial anastomosis	Absent	Immediately	2 Leeches every 2 h, tapering every 3–4 d till POD 17 (doubling every 3–4 d the duration of time between each application)
Senchenkov and Jacobson[31]	Arterial anastomosis	2 Venous anastomoses	POD 2	Based on signs of venous congestion till POD 11
Dadaci et al.[12]	Arterial anastomosis	Absent	½ h PO	-Once every 4 h till POD 3 -Once every 6 h till POD 7 -Once every 12 h till POD 10 -Then once every 2 d till POD 16
Mommsen et al.[35]	Absent	Absent	POD 1 + POD 3 after temporary suspension	2 Leeches continuously till POD 2, then applied every 8 h and suspended in the POD 3. Then reapplied till POD 9
Hussey and Kelly[13]	Arterial anastomosis	Absent	Immediately	Regularly till POD 12
Talbi et al.[26]	Arterial anastomosis	Absent	Immediately	Replaced every 2 h at the beginning then every 6–8 h till POD 8
Jung et al.[44]	Arterial anastomosis	Absent	Immediately	Stab wounds and 2 leeches
Kim et al.[33]	Arterial anastomosis	Absent	2 h PO	Intermittent and tapered till POD 7
Trovato and Agarwal[8]	Arterial anastomosis	Absent	Immediately	3 Leeches every 4 h till POD 3, then every 6 h till POD 9
Komorowska-Timek and Hardesty[30]	Intact (skin pedicle)	Intact (skin pedicle)	Immediately for postoperative congestion	Every 4 h, then tapered till POD 5
O'Toole et al.[36]	Arterial anastomosis	Absent	Immediately	Continuously at first, then tapered till POD 7
Hullett et al.[10]	Intact (skin pedicle)	Intact (skin pedicle)	POD 1	Twice a day till POD 3 then based on signs of venous congestion
James et al.[32]	Arterial anastomosis	Absent	Immediately	Continuously based on signs of venous congestion for the first week
Frodel et al[9]	Intact (skin pedicle)	Intact (skin pedicle)	Immediately	Replaced every 6–8 h till POD 2
Cho and Ahn[23]	Arterial anastomosis	Absent	POD 3	Initially every 3 h, then tapered based on signs of venous congestion till POD 7
Zamboni et al.[27]	A –V anastomosis	Absent	Immediately	Every 4–6 h till POD 7
Concannon and Puckett[15]	Arterial anastomosis	Absent	Immediately	Leech every 2 h and then based on signs of venous congestion till needed
Nath et al.[19]	Arterial anastomosis	Absent	Immediately	Discontinued
Finical et al.[2]	Arterial anastomosis	Venous anastomosis	Early PO	Till POD 3
Kind et al.[29]	Arterial anastomosis	Venous anastomosis	Several hours PO	NA
	Arterial anastomosis	Venous anastomosis	14 h PO	NA
	Arterial anastomosis	Venous anastomosis	Few hours PO	NA
	Arterial anastomosis	Venous anastomosis	NA	NA
Funk et al.[14]	Arterial anastomosis	Venous anastomosis	1 h PO	1–3 times a day till POD 5 based on signs of venous congestion till needed
Rapaport et al.[45]	Arterial anastomosis	Venous anastomosis	36 h PO	Changed every 4 h till the POD 7 then tapered over the following week
Mutimer et al.[3]	Arterial anastomosis	Venous anastomosis	POD 5	Till POD 7

ASA, acetylsalicylic acid; LMW, low molecular weight; NA, nonapplicable; NK, not known; N, no; PO, postoperatively; POD, postoperative day; PRBC, packed red blood cells; sc, subcutaneous; Y, yes.

Anticoagulant and Antiplatelet Therapy Associated	PRBCs T ransfusion	Antibiotic Prophylaxis	Leech-borne Infections	Adjunctive Therapies
SC 4,000 IU/d of LMWH and 325 mg/d of ASA orally	2 units	Y	N	NA
Heparin drip, 81 mg ASA os	6 units	Y	N	NA
IV dextran 40 at a rate of 25 cc/h	10 units	Y	N	NA
LMWH, ASA orally	N	Y	N	Heparin locally
Heparin, dextran-40, ASA orally, Clopidogrel	Y	N	N	Warm room, hyperbaric oxygen
IV 5,000 IU of heparin every 8 h, IV dextran 40 (500 ml/8 h) and 300 mg/d of ASA orally	N	Y	N	NA
Warfarin INR range 2–3	N	Y	N	NA
IV 1000 IU heparin hourly	6	Y	N	Warm room
20,000 UI/d of heparin, 160 mg/d ASA orally	5	Y	N	400 mg/d Buflomedil orally
Dextran 500 ml/d, 100 mg/d of ASA orally	N	N	N	Prostaglandin E1, 225 mg/d dipyridamole
5,000 IU of heparin by continuous intravenous drip for 7 d, lower molecular weight dextran 500 cc by continuous intravenous drip for 5 d, lipo-prostaglandin E1 (alpros- tadil-lipo) 10 lg by continuous intravenous drip for 7 d, and aspirin 300 mg orally for 14 d.	2	N	N	Topical vasodilator, soaked gauze, warm room, side heat lamp and a warming blanket
IV dextran 40 (25 mL/h)	2	N	N	NA
Dextran 40 and ASA orally	N	Y	N	Hyperbaric oxygen twice daily
IV heparin infusion and 150 mg/d ASA orally	Y	Y	N	Verapamil and phenoxybenzamine were applied directly to the vessels to correct spasm, and heparin was used to flush the vessel ends' lumens during their repair
N	N	Y	N	NA
Y	Y	NA	NA	NA
N	N	Y	N	NA
300 mg/d ASA orally, 500 cc/d IV LMW dextran for 5 d, 15,000 U/d of heparin	N	N	N	100 mg/d Chlorpromazine orally for 7 d, 25 mg bid of morphine sulfate for 3 d
10 d of heparin and switch to Coumadin	4	NA	NA	5,000 IU Heparin bolus intraoperatively and hyperbaric oxygen at 2 atmosphere for 90 min twice a day
LMW Dextran 15 cc/h	3	N	N	1,000 IU Heparin bolus intraoperatively
Heparin with a PTT between 2 and 2½	7	Y	N	Stab incisions and heparin soaked telfa gauze
Heparin and ASA till POD 7	5	N	N	NA
IV dextran 40 at a rate of 25 cc/h + ASA orally + heparin	8	NA	NA	NA
IV dextran 40 at a rate of 25 cc/h + heparin after congestion	2	NA	NA	NA
500 units/h of low dose heparin was begun after congestion + Coumadin for 6 weeks	12	NA	NA	Thrombolytic urokinase after arterial congestion
1,200 units/h of low dose heparin was begun intraoperatively + 325 mg/d of ASA orally	2	NA	NA	NA
IV dextran 40 at a rate of 25 cc/h, heparin and 10 grains daily of ASA orally	Y	Y	N	5,000 IU bolus intraoperatively
Heparin	10	N	N	NA
One bolus of 5000 UI of heparin	N	N	N	NA

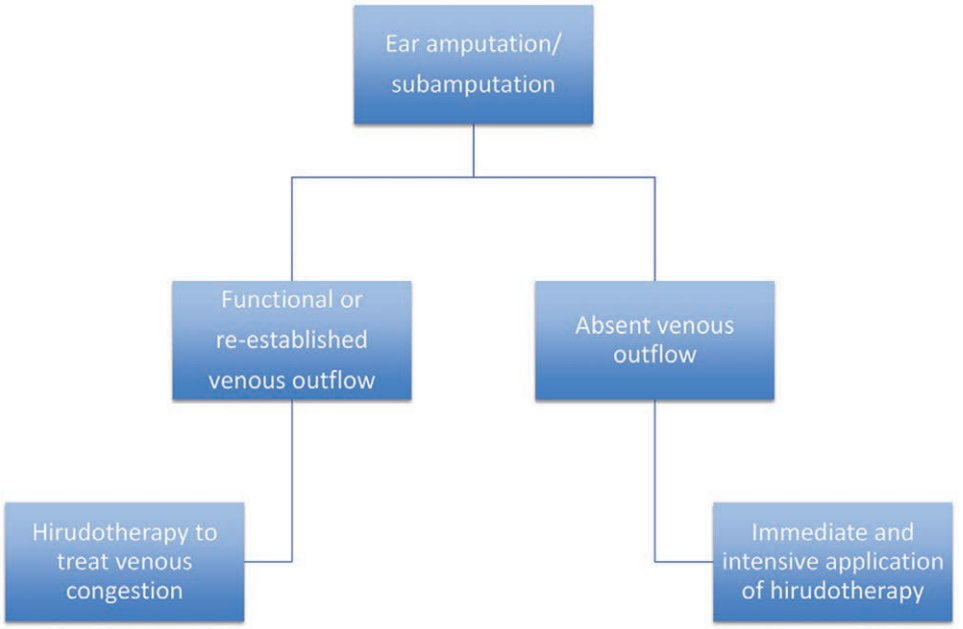

Fig. 4. Comparison of different conditions of venous congestion.

Scarring at leech biting sites is sometimes described. No significant scars were noticeable in the case we treated at 3 years follow-up, neither it was reported in other cases.

Intensive nursing and medical assistance and often a prolonged hospital stay are commonly necessary in patients treated with leech therapy. It is a time and staff-consuming therapy.[10]

A clear consensus on the application regimen has not been reached yet. A difficulty in defining a universal protocol for leech application is that each patient and tissue flap will require and respond differently based on the anatomy, severity of injury, mass of tissue, arterial inflow, metabolic activity, speed of neovascularization with development of new venous connections.[37] Basing on the literature, we believe it could be useful to consider 2 different scenarios in leech therapy regimens for salvaged ears. In cases of present postoperative venous drainage, leeches should be applied at need to relieve the venous congestion that may eventually arise if the venous drainage is insufficient when blood pressure rises or tissues swell up. In cases of absent venous outflow, an immediate and continuous application of leeches can replace the absent venous drainage of the amputated auricle. In this scenario (Table 1), leeches should be intensively applied over the first days while allowing new venous connections to develop. After a mean of 5 days, the application regimen can be tapered based on signs of venous congestion, thus reducing the burden to the patient and staff and limiting blood loss (Fig. 4).

Main limits to defining the role of leech therapy in avulsed ears salvage are the low number and at the same time variety of cases reported, along with the lack of reports on unsuccessful cases or of control cases in which alternative methods to relieve venous congestion are compared with hirudotherapy.

CONCLUSIONS

Leeching has the potential to move favorably the balance in attempts to salvage avulsed ears and should be a tool available and considered when such cases present.

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