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Use of the medicinal leech for salvage of venous congested microvascular free flaps of the head and neck

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Abstract

Objective: The objective of the study was to determine the utility of leech therapy in venous congested microvascular free flaps in which venous outflow could not be established or surgical revision was unsuccessful.

Methods: We conducted a retrospective review of all patients at a tertiary referral center from January 2002 to December 2008 who received leech therapy for a venous congested microvascular free flap in which venous outflow could not be established primarily or failed surgical revision.

Results: Six patients were identified. Leech therapy was required for a median of 9 days (4-14 days). The median lowest hemoglobin level per patient was 8.0 g/dL (5.4-9.3 g/dL). All patients (6/6, 100%) required blood transfusions during therapy. The median number of units of packed red blood cells transfused per patient was 13.5 U (4-29 U). All flaps (6/6, 100%) were successfully salvaged with leech therapy. There was one minor complication, observed as 2 episodes of syncope in the same patient, related to anemia. There were no cases of infection transmitted as a result of leech therapy.

Conclusions: Leech therapy can be used to successfully salvage venous congested microvascular free flaps in the absence of primary venous outflow. Leech therapy can be used safely and with little morbidity compared with other reports.

1. Introduction

The use of microvascular techniques allows for reconstruction of extensive defects of the head and neck that result from tumor resection, congenital deformities, and trauma. The success of microvascular free flaps has been reported to be as high as 95% to 98% [1]; however, these flaps continue to fail for a variety of reasons including arterial insufficiency, technical errors during harvest or inset, infection, and patient comorbidities, among others. The most frequently cited reason for failure of microvascular free flaps is compromise of venous outflow. Hidalgo and Jones [2] reviewed 150 consecutive microvascular free flaps and reported 11 cases of circulatory compromise, 8 of which were attributed to venous compromise. All 8 of the flaps showing evidence of venous compromise were salvaged with reexploration and revision of the anastomosis or thrombectomy.

Surgical exploration and revision of the venous anastomosis serve as the criterion standard for attempts at flap salvage secondary to venous compromise. In some cases, surgical exploration and revision are attempted and fail because of distal/multiple venous thromboses, whereas in other cases, surgical revision is not an option because of patient stability or the lack of a venous anastomosis to revise (ie, cases of traumatic avulsion). Nonsurgical options must be used in an effort to salvage these flaps. Nonsurgical options include bloodletting via stab incisions following injection of heparin [3], hyperbaric oxygen therapy [4,5], thrombolytics [6], mechanical leeching [7], and the use of the medicinal leech [8].

The medicinal leech (*Hirudo medicinalis*) is commonly used as a bridge to surgical revision of a compromised free

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flap, with studies showing significant improvement of perfusion of venous congested flaps following the application of medicinal leeches [9]. Less commonly, medicinal leeches are used as a total replacement for venous outflow until new venous channels can form. There are only a few reports in the literature describing the use of the medicinal leech as a replacement for venous outflow in microvascular free flaps of the head and neck, with the majority of these case reports focusing on the replantation of traumatically avulsed ears [10-15]. This report describes our experience using the medicinal leech for salvage of microvascular free flaps used in head and neck reconstruction that have an absent venous outflow or have failed surgical revision.

2. Materials and methods

This study was approved by the Mayo Clinic Institutional Review Board.

2.1. Patient population

A retrospective review of the medical record was conducted to identify all patients undergoing therapy with medicinal leeches for venous congestion following microvascular free flap reconstruction or replantation of traumatically avulsed tissue between January 2002 and December 2008 at our institution. Venous congestion was identified using multiple criteria including increasing edema, ecchymosis, brisk capillary refill, normal to elevated temperature, and brisk bleeding of dark blood following pin prick.

The medical record was reviewed; and patient data were extracted including age, sex, indication for surgery, type of surgery, complications, additional procedures, and follow-up. Specifics of leech therapy were obtained from reviewing patients' medication administration record in addition to transfusion records and laboratory data. Operative reports were reviewed to extract the type and vessels used for venous and arterial anastomoses. Data are presented as median values (minimum-maximum) where appropriate.

2.2. Leech therapy

Medicinal leeches (*H medicinalis*) were obtained from Leeches USA Ltd (Westbury, NY; www.leechesusa.com) and are kept in a small but constant supply for emergency use. Leeches are stored in refrigerated (<20°C) distilled or bottled spring water with 2 g of *Hirudo* salt (Leeches USA Ltd) added to each gallon of water. The water is changed 3 times per week. Leeches are dispensed as needed to the floor where they are stored in refrigerated containers until use. Before application, any blood clots on the area to be treated are removed with dry 4 × 4 gauze. Alcohol swabs are avoided because they interfere with the leech latching onto the patient. The leech is grasped with gloves or a nontoothed forceps and placed on the area to be treated. If the leech is reluctant to attach, the flap can be pricked with a needle to induce bleeding that facilitates attachment of the leech. If the leech refuses to attach within 60 minutes, the prescribing physician is notified, as this may signify impaired arterial circulation. Once the leech attaches, it is allowed to feed and will generally detach once it has lost its blood supply or is fully distended (Fig. 1A). Leeches are monitored every 10 to 15 minutes to ensure that they remain at the site of attachment. Once detached, the leech is killed by placing it in 70% isopropyl alcohol and discarded. Blood clots over areas of previous bites are removed periodically to promote continued bleeding from the sites. Additional leeches are placed on the flap once the previous bite sites cease bleeding, which varies from 30 minutes to 4 to 5 hours. Free flaps are treated with leech therapy until sustained improvement of the venous congestion is noted, at which time leech therapy is gradually weaned over the course of 1 to 3 days unless the free flaps show signs of worsening venous congestion. All patients are placed on antibiotic prophylaxis for *Aeromonas hydrophila* for the duration of leech therapy. Patients' hemoglobin levels were monitored every 6 hours, and patients were transfused to maintain their hemoglobin at levels greater than 10.0 g/dL. The extent of leech therapy was individualized to each patient based on the response of the tissue being treated. Two leeches were attached to each flap initially and replaced approximately every hour after detachment. Flaps were monitored for signs of continued venous congestion or improvement, and leech therapy was adjusted accordingly.

Fig. 1. Venous congested microvascular free flap receiving leech therapy. (A) Patient 2 receiving leech therapy of the radial forearm free flap that had failed operative revision of the venous anastomosis. Note the partially engorged leech on the left (see also inset) with a newly attached leech on the right. (B) Complete salvage of the venous congested free flap is observed 5 weeks following leech therapy.

3. Results

Six patients received therapy with medicinal leeches to salvage a venous compromised microvascular free flap or

Table 1
Patient demographics

Patient #/ age/sex	Diagnosis	Location	Flap	Venous congestion	Lowest Hgb (g/dL)	RBC (U)	Length of stay (d)	Flap outcome
1/13/F	Traumatic avulsion	R upper lip	Replanted tissue	POD 1	5.4	29	11	Survival
2/64/M	SCC	R forehead and eyelid	RFFF	POD 3	8.9	11	14	Survival
3/66/M	SCC	R lower lip	RFFF	POD 2	8.6	4	8	Survival
4/66/M	SCC	Tongue	RFFF	POD 1	7.4	16	10	Survival
5/74/F	SCC	R lower lip/cheek	Parascapular	POD 1	7.1	20	14	Survival
6/78/M	SCC	L temple	ALT	POD 2	9.3	4	7	Superior 1/3 necrosis

SCC indicates squamous cell carcinoma; RFFF, radial forearm free flap; ALT, anterolateral thigh; POD, postoperative day.

replanted tissue during the period studied (Table 1). There were 4 males and 2 females, with a median age of 66 years (13-78 years), identified for the study. Patient 1 suffered a dog bite leading to the avulsion of the right medial cheek, and the lateral and philtral subunits of the lip and the avulsed segment replanted (Fig. 2). Patient 2 presented with a basaloid squamous cell carcinoma of the right forehead and eyelid. He underwent excision of the lesion that consisted of a portion of the frontal bone followed by reconstruction with a radial forearm free flap (Fig. 1). Patient 3 presented with recurrent squamous cell carcinoma of the lower lip that was surgically excised and reconstructed with a radial forearm free flap. Patient 4 presented with a squamous cell carcinoma of the tongue for which he underwent a partial glossectomy with radial forearm free flap reconstruction. Patient 5 presented with a recurrent squamous cell carcinoma of the right lower lip and face and underwent excision of the lesion involving the lip and face, and partial mandibulectomy with reconstruction using an Estlander flap and parascapular osteomyocutaneous free flap. Patient 6 presented with recurrent squamous cell carcinoma of the temple that was excised and reconstructed with an anterolateral thigh free flap. Extraoral leeching was performed in 6 (100%) of 6 patients. In the case of patient 4, the patient's intraoral radial forearm free flap was able to be treated with leech therapy via the skin paddle placed in the neck for monitoring purposes.

Venous congestion was noted in 3 (50%) of 6 flaps on postoperative day 1, 2 (66.6%) of 6 flaps on postoperative day 2, and 1 (33.3%) of 6 flaps on postoperative day 3. Leech therapy was promptly initiated in all cases once venous congestion was noted, and appropriate cases were returned to the operating room for revision. Two (33.3%) of the 6 flaps developed arterial insufficiency and were taken urgently to the operating room for reexploration and revision of the arterial anastomoses. In both cases, the venous anastomoses were revised at the same time; however, the flaps continued to exhibit venous congestion postoperatively due to what was felt to be venous insufficiency or thrombosis of the perforating veins and/or microcirculation. One (16.7%) of the 6 flaps developed venous insufficiency on postoperative day 3. Leech therapy was initiated as a bridge to the operating room. At the time of reexploration, the venous anastomosis was found to be completely thrombosed; and despite thrombectomy and thrombolysis, the flap continued to suffer from venous congestion postoperatively. In another case, the venous pedicle was patent; and the venous congestion was primarily of the skin paddle and not the osseous portion of the flap. This was felt to be due to the poor perforators going to the skin at the time of harvest, making surgical revision of the anastomosis unlikely to be successful. It was elected to use leech therapy as the sole means of salvaging this flap. In the case of the other 2 flaps, there was an absent venous anastomosis, necessitating the use of leech therapy alone.

Leech therapy was required for a median of 9 days (4-14 days) per patient. The median number of leeches used per patient was 54 (25-350 leeches). The median lowest hemoglobin level recorded per patient was 8.0 g/dL (5.4-9.3 g/dL). All patients (6/6, 100%) required blood transfusions while receiving leech therapy. Patients required a median of 13.5 U of packed red blood cells (4-29 U). In

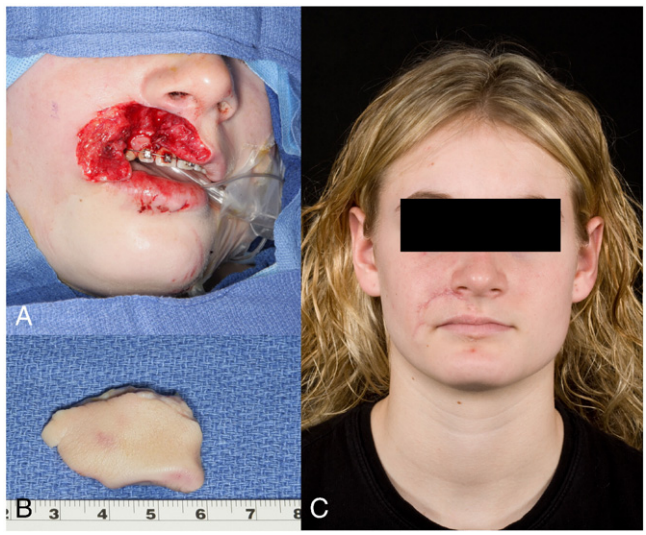

Fig. 2. Patient 1. (A) Intraoperative photograph showing the right cheek and upper lip defect secondary to a dog bite. (B) Avulsed tissue segment retrieved following dog bite. (C) Twenty-one months following replantation of the avulsed tissue segment and salvage of the venous congested flap with leech therapy. Patient received 2 triamcinolone acetonide injections, dermabrasion, and a scar revision to an area of hypertrophied scar during the follow-up period.

addition to packed red blood cells, one patient required additional blood products. Patient 1 required 2 U of platelets and 6 U of fresh frozen plasma. In all patients (6/6, 100%), the venous congested flap was able to be salvaged with leech therapy. Only 1 (16.7%) of 6 flaps went on to develop partial necrosis. Patient 6 developed necrosis of the superior third of his anterolateral thigh flap covering a defect of the left temple.

There was one minor complication as a result of leech therapy. Patient 5 experienced 2 episodes of syncope while receiving leech therapy that we believe was secondary to anemia. The patient's hemoglobin level at the time of the syncopal episodes was 7.1 and 7.4 g/dL, respectively. The patient was transfused to a hemoglobin level greater than 10 g/dL, which relieved her symptoms following both episodes. There were no infectious complications of leech therapy. Patient 1 received antibiotic prophylaxis in the form of meropenem and trimethoprim/sulfamethoxazole, patient 2 and patient 4 received levofloxacin and metronidazole, patient 3 and patient 5 received cefepime, and patient 6 received ciprofloxacin. All antibiotic treatment regimens were based on the recommendations of the Infectious Disease consult service.

4. Discussion

This study demonstrates that the medicinal leech can successfully salvage venous congested microvascular free flaps of the head and neck even after failure of surgical revision or in cases in which venous drainage could not be successfully established based on our treatment algorithm (Fig. 3). All 6 flaps treated with leech therapy in this study survived, with only one flap exhibiting partial necrosis, despite the lack of suitable venous outflow. Our results compare favorably with those of Chepeha et al [16] who reported salvage of 8 venous congested microvascular free flaps with leech therapy despite failure of surgical revision to reestablish venous outflow.

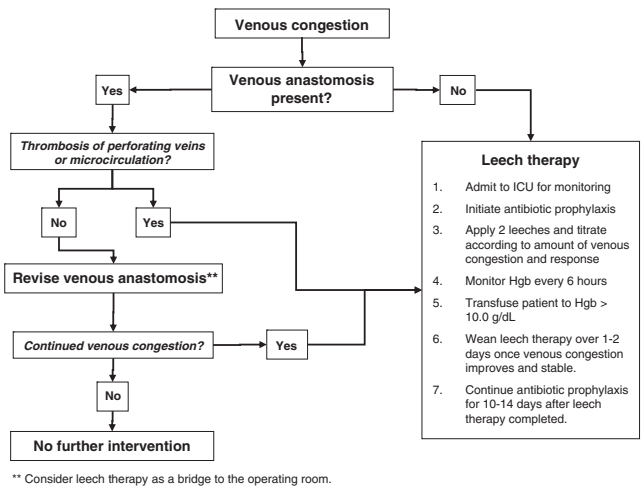

Fig. 3. Leech therapy treatment algorithm.

Leech therapy has previously been reported as a substitute for venous outflow in replanted tissues of the head and neck, most commonly the avulsed ear. Concannnon and Puckett [12] reported the case of replantation of an ear without reestablishing venous outflow that was successfully salvaged following 12 days of leech therapy. Cho and Ahn [11] reported a similar case of an avulsed ear replanted without venous outflow that was successfully salvaged after 6 days of leech therapy. Others have reported success treating facial soft tissue avulsions with leech therapy. Crawford and Hagerty [17] reported a case in which an avulsion of the upper lip was successfully treated with microvascular arterial reanastomosis and leech therapy as a replacement for venous outflow. Frodel et al [18] reported the salvage of partially avulsed tissue from the nose, scalp, lip, and ear in 4 patients using leech therapy.

Unfortunately, not all venous congested tissues can be salvaged with leech therapy. Akyurek et al [10] reported the replantation of an 80% avulsion injury of the ear without reestablishing venous outflow. The flap was treated aggressively with leech therapy for 14 days but showed no evidence of ingrowth of new venous channels and subsequently necrosed once leech therapy was discontinued. Miller et al [19] reported 3 cases of avulsion injuries or amputations of the nose that were replanted and treated with leech therapy. The authors observed partial loss of the avulsed tissue in all 3 cases requiring revision surgery; however, it was noted that the resulting deformity was significantly better than if no replantation had been attempted.

Leech therapy is not without risks and complications. Chepeha et al [16] observed significant morbidity from leech therapy in their study including 5 cases of intensive care unit psychosis, 4 cases of prerenal azotemia, 1 case of congestive heart failure, 1 case of pneumonia, 1 case of decubitus ulcer, and 1 case of wound infection that was not associated with *A hydrophila*. The morbidity associated with leech therapy in our study was significantly lower, with only one minor complication observed. One patient suffered from 2 episodes of syncope due to anemia from leech therapy. This illustrates the importance of checking patients' hemoglobin level frequently and transfusing appropriately. Some authors advocate checking hemoglobin levels every 4 hours, whereas others advocate checks daily. This must be tailored to each individual patient and how aggressive the patient's flap must be leeched in an attempt to salvage it. It is our policy to check hemoglobin levels every 6 hours and transfuse patients to maintain a hemoglobin level greater than 10.0 g/dL. Despite drawing frequent hemoglobin levels, 3 patients developed anemia to levels less than 8 g/dL, suggesting that more frequent hemoglobin levels should be drawn during the most intense periods of leech therapy.

Infection is one worrisome complication of leech therapy. *A hydrophila* is a gram-negative rod that is a commensal organism in the enteric tract of the medicinal leech. Lineaweaver et al [20] reported 18 cases of *A hydrophila* infection following leech therapy that ranged

from wound infection to life-threatening sepsis. The episodes of infection observed by Lineaweaver et al [20] occurred as early as 24 hours after the application of leeches to as far out as 10 days after cessation of leech therapy and were felt to be due to colonization of necrotic tissue. The authors recommended administering prophylactic antibiotics to all patients receiving leech therapy and only treating tissues with a viable arterial supply and no evidence of necrotic tissue that could be colonized. There were no infectious complications observed in our study, which we attribute to all patients receiving prophylactic antibiotics at the initiation of leech therapy and all tissues exhibiting good arterial supply without evidence of necrotic tissues at the time of leech therapy.

The drawbacks of this study include its retrospective nature and small patient population. The success of microvascular techniques and the low rate of flap failure make reports of larger series of patients treated with leech therapy difficult. Although Fig. 3 outlines our treatment algorithm for venous congestion, the heterogeneity of free flaps used in head and neck reconstruction and individual patient circumstances require that leech therapy be individualized both in quantity and in duration according to the severity of venous congestion on presentation and temporal response of the tissue to therapy.

Based on the results of this study and others, leech therapy serves as a viable option for attempts to salvage microvascular free flaps and replanted tissue exhibiting venous congestion in which surgical revision has failed or venous outflow was never successfully established. Surgical revision remains the criterion standard for treating venous congestion; however, microvascular surgeons should keep the medicinal leech in their armamentarium for treating refractory cases.

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