Emergent Reuse Leech Therapy: A Better Method

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The specter of venous congestion threatening the survival of pedicle flaps, free flaps, tissue replantations, and traumatized tissues continues to haunt surgeons.[1–7] To combat this menace, the medicinal leech, *Hirudo medicinalis*, remains in the surgeons' armamentarium to salvage many of these otherwise doomed tissues.[1–10] Since the signs and symptoms of venous congestion (cyanosis, rapid capillary refill, and tense turgor) often arise suddenly in the postoperative period, a requisite number of hungry therapeutic leeches is not always emergently available. Therapeutic maximization of a suboptimal number of leeches in this critical time period is essential. Even in the best of circumstances, obtaining fresh, hungry leeches from either of the U.S. distributors (both on the East Coast) requires 12 to 24 hours for delivery. Most hospitals do not maintain leech colonies because of their infrequent use. Because a fed leech remains satiated for up to 12 months,[11–14] we recently reported a method of stimulating sated leeches to immediately reattach and refeed by purging them of their blood meals with gentle finger pressure followed by immersion in a solution of Hirudisalt with serotonin 10 μM for 20 minutes.[15] This regimen achieved an immediate reattachment and refeed rate of 40 and 20 percent, respectively. With further investigation, we have developed a new methodology for emergent leech reuse that is more effective and less complicated than serotonin exposure in returning engorged leeches to their original hungry, therapeutic state.

Materials and Methods

Fasting leeches were obtained from Biopharm International (Charleston, S.C.). Adult Sprague-Dawley rats were anesthetized with pentobarbital and their abdomens depilated to be used as "patients." (No rat was exsanguinated by leeching.) After weighing each leech, it was placed on the patient's abdomen and allowed to attach and feed at will. Cessation of feeding was the point at which the leech voluntarily detached from the patient and began moving away.

The sated leech was reweighed and then purged by one of four methods: (1) making a small 1- to 2-mm midbody posterior incision into the crop (stomach) with the tip of a no. 11 scalpel blade and gently expressing the blood meal, (2) regurgitation by placement in hypertonic saline (3%), (3) gentle finger pressure emesis, or (4) regurgitation by exposure to wood ash (pH 14). The leeches were removed from the hypertonic saline or wood ash when they assumed a quiescent posture at the bottom of the beaker. Each purged leech was then replaced on the patient for subsequent reattachment and refeeding.

After the initial purging, each leech was given three attempts at reattachment and refeeding over 1 hour. Evidence of reattachment was the trifoil bite mark on the patient's abdomen. Refeeding was defined as reattachment followed by peristaltic movements and a gain in weight.

Leeches that refed were purged a second time via their same initial method and replaced

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on the patient's abdomen for a possible third feeding. Leeches that failed to reattach and/or refeed were placed in a bath of Hirudisalt with serotonin 10 μM for 20 minutes and then given another three attempts at reattachment and refeeding over 1 hour. Results were statistically analyzed by the Student-Newman-Keuls *t* test for analysis of variance.

Results

To simplify analysis, the results were divided into two groups: (1) those purged by posterior crop incision and (2) all other methods. Those purged by posterior crop incision averaged a first blood meal 247 percent (±12 percent) of their original weight. All 20 leeches (100 percent) purged by posterior crop incision reattached at least once within 1 hour. Of these, 15 (75 percent) refed, consuming, on average, a meal equal to 47 percent (±21 percent) of their original blood meal. After purging again, this time averaging 101 percent (±20 percent) of their second blood meal, 13 (87 percent) of these refed leeches reattached, with 6 (46 percent) of them refeeding.

The leeches reconsumed, on average, a meal equal to 27 percent (±31 percent) of their initial meal or 72 percent (±75 percent) of their second meal. Of the original 5 leeches that did not refeed and were subsequently exposed to serotonin 10 μM, all (100 percent) reattached, with 2 (40 percent) refeeding, consuming a meal 81.5 percent (±11.5 percent) of the initial meal.

None of the leeches purged by hypertonic saline immersion regurgitation reattached or refed. A single leech purged by finger pressure emesis reattached (20 percent) but did not refeed. After exposure to serotonin, two (40 percent) of each saline and finger pressure group reattached, with neither of the hypertonic saline group refeeding, while both finger pressure–purged leeches refed, consuming a meal 38 percent (±29 percent) of original meal. None of those leeches that refed would reattach or refeed a third time. None of the wood ash–purged leeches reattached or refed even with serotonin exposure.

Discussion

Judicious leech therapy can prevent the loss of free and pedicle flaps, replantations, and traumatized tissues compromised from venous congestion.[1–10] Alternative methods to leech therapy such as topical heparin with partial nail removal have not always proven effective. The success of leech therapy is due only in part to the amount of blood the leech directly removes. Continued bleeding from the bite can result in a blood loss 10 times the amount of the initial feed, thus providing for the effective long-term decompression of the compromised tissue.[1–4,16,17] In our refeeding experiments after posterior crop incision, all meals (first, second, and third) resulted in wounds that continued to ooze blood for similar time periods and quantity to the initial bites. Even though the amount of these subsequent meals was less than the initial feed, 47 percent (±21 percent) and 27 percent (±31 percent), respectively, the long-term therapeutic goal of continued wound anticoagulation and decompression would most likely be achieved. Reattachment without refeeding, however, left only a superficial trifoil bite mark and no continued bleeding after release.

The ability of leeches to reattach and refeed is directly dependent on their method of purging. Wood ash and hypertonic saline exposure failed to stimulate refeeding even with serotonin. Of finger-stripped leeches, a 40 percent refeed rate was achieved, but only with serotonin. The best results were accomplished with the posterior crop–incised leeches with an immediate 75 percent refeed rate, increased to 85 percent with serotonin immersion (Fig. 1). For a second refeed (third feeding overall), only posterior crop–incised leeches provided this continual reuse, with a 46 percent rate of refeeding (Fig. 2). Finally, the amount of each blood meal was significantly greater after posterior crop incision than with any of the other purging methods, potentially maximizing the amount of anticoagulants injected into the bite wound (Table I).

In a clinical setting, optimal therapy would be from fresh hungry leeches used once and then discarded. To date, reapplying leeches has not been recommended due to the theoretical potential of transmission of infectious diseases. Reuse in the same patients, however, would obviate this risk. Leech bites can become infected with *Aeromonas hydrophilia*, an organism of the leeches' normal gut flora. Lineaweaver et al.[18,19] have reported excellent results in preventing *Aeromonas* infections by using peritherapeutic cefotaxime. However, if the available number of leeches required for therapy is

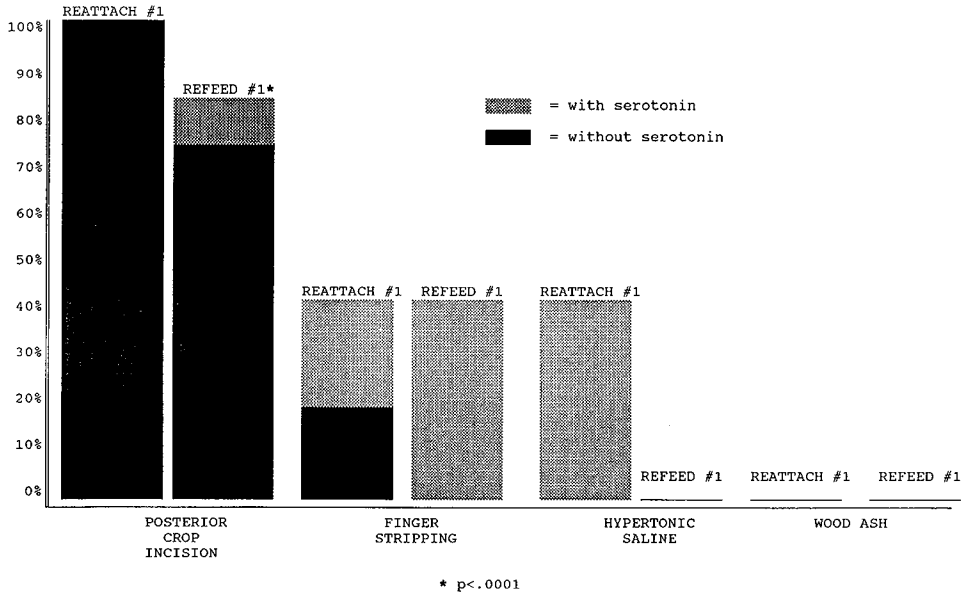

FIG. 1. Posterior crop incision is the most effective method of purging sated leeches for subsequent immediate reattachment and refeeding.

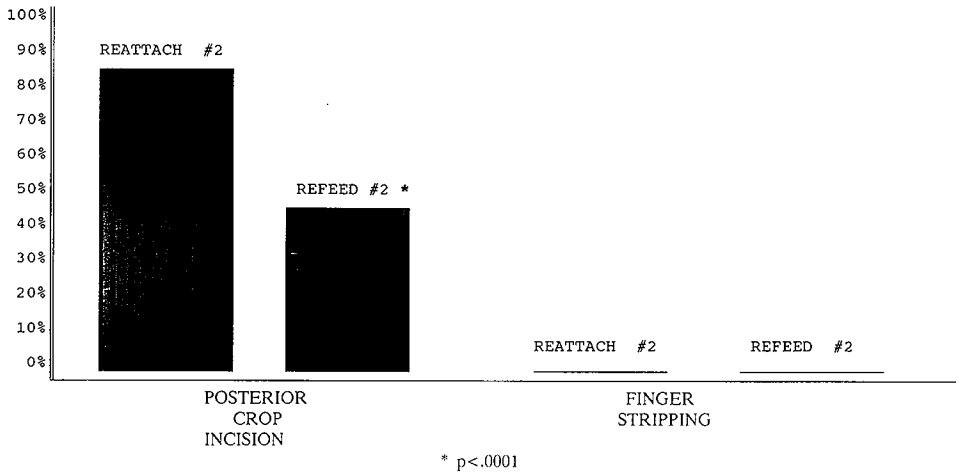

FIG. 2. Posterior crop incision is the only method found to allow repetitive leech purging, reattachment, and refeeding.

inadequate, the necessity of reusing the original leeches arises. With 75 percent of our posterior crop–incised leeches feeding a second time and 46 percent a third, emergent reuse of leeches could be used to successfully relieve tissues of venous congestion until the fresh "troops" arrive.

SUMMARY

Tissues threatened by venous congestion often can be saved by timely leech therapy. Methods to restimulate sated leeches, particularly emergently, are only poorly described in the nineteenth-century literature. Sated leeches were purged of their blood meals by (1) posterior crop incision, (2) hypertonic saline (3 percent) immersion, (3) gentle finger pressure emesis, or (4) wood ash exposure. Their ability to reattach and refeed with or without serotonin stimulation was evaluated.

All 20 leeches (100 percent) purged by posterior crop incision reattached, with 75 percent refeeding. After purging again, 87 percent of these refed leeches reattached, with 46 percent refeeding for a third time. Those leeches which did not initially refeed were exposed to serotonin 10 μM with 100 percent reattaching and 40 percent refeeding.

None of the leeches purged by hypertonic saline immersion regurgitation reattached or

TABLE I

Posterior Crop Incision–Purged Leeches Will Consume Larger and Repetitive Meals for Greater Decompression of Venous Congestion

	Refeeding (% of Original Meal)	
	1	2
Posterior crop incision	47% (±21%)	27% (±31%)
Finger pressure emesis	33% (±29%)	0%
Hypertonic saline	0%	N.A.
Wood ash	0%	N.A.

refed. A single leech purged by finger pressure emesis reattached (20 percent) but did not refeed. After exposure to serotonin, two (40 percent) of each saline and finger pressure group reattached, with neither of the hypertonic saline group refeeding, while both finger pressure–purged leeches refed, consuming a meal 38 percent (±29 percent) of original meal. None of those leeches which refed would reattach or refeed a third time. None of the wood ash–purged leeches reattached or refed even with serotonin exposure.

The best method of purging leeches of their blood meals for emergent reuse is by posterior crop incision. Additional refeeding behavior can be achieved by immersion in serotonin 10 μM for 20 minutes.

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REFERENCES

1. Rao, P., Bailie, F. B., and Bailey, B. N. Leechmania in microsurgery. *Practitioner* 229: 901, 1985.
2. Kraemer, B. A., Korber, K. E., Aquino, T. I., et al. Uses of leeches in plastic and reconstructive surgery: A review. *J. Reconstr. Microsurg.* 4: 381, 1988.
3. Batchelor, A. G., Davison, P., and Sully, L. The salvage of congested skin flaps by the application of leeches. *Br. J. Plast. Surg.* 34: 358, 1984.
4. Brody, G. A., Maloney, W. J., and Hentz, V. R. Digit replantation applying the leech *Hirudo medicinalis*. *Clin. Orthop.* 245: 133, 1989.
5. Lim, C. L. Successful transfer of "free" microvascular superficial temporal artery flap with no obvious venous drainage and use of leeches for reducing venous congestion: A case report. *Microsurgery* 7: 87, 1986.
6. Gugen, J. E. The use and husbandry of leeches in plastic surgery units: A survey. *Br. Assoc. Leech Sci. Leech Newsletter*, no. 3, 1988.
7. Dergranc, M., and Zdravic, F. Venous congestion of flaps treated by application of leeches. *Br. J. Plast. Surg.* 13: 187, 1961.
8. Foucher, G., Henderson, H. P., Maneau, M., et al. Distal digital replantation: One of the best indications for microsurgery. *Int. J. Microsurg.* 3: 205, 1981.
9. Henderson, H. P., Matti, B., Laing, A. G., et al. Avulsion of the scalp treated by microvascular repair: The use of leeches for postoperative decongestion. *Br. J. Plast. Surg.* 36: 235, 1983.
10. Makin, C. A., and Edwards, L. Application of leeches to reduce swelling after reconstructive surgery. *Br. J. Urol.* 59: 189, 1987.
11. Lent, C. M., and Dickinson, M. H. The neurobiology of feeding in leeches. *Sci. Am.* 258: 98, 1988.
12. Lent, C. M., and Dickinson, M. H. On the termination of ingestive behaviour by the medicinal leech. *J. Exp. Biol.* 131: 1, 1987.
13. Dickinson, M. H., and Lent, C. M. Feeding behaviour of the medicinal leech, *Hirudo medicinalis*. *J. Comp. Physiol. (A)* 154: 449, 1984.
14. Green, C., and Gilby, J. A. The medicinal leech. *J. R. Soc. Health* 103: 42, 1983.
15. West, B. R., Nichter, L. S., and Halpern, D. Leech therapy: When once is not enough. *Blood Coag. Fibrinol.* 2: 197, 1991.
16. Giacometti, L. Leeching in the twentieth century. *Am. J. Cardiol.* 60: 1128, 1987.
17. Adams, S. L. The emergency management of a medicinal leech bite. *Ann. Emerg. Med.* 18: 316, 1989.
18. Lineaweaver, W. C., Hill, M. K., Buncke, G. M., et al. *Aeromonas hydrophila* infections following use of medicinal leeches in replantation and flap surgery. *Ann. Plast. Surg.* 29: 238, 1992.
19. Lineaweaver, W. C., Furnas, H., Follansbee, S., et al. Postprandial *Aeromonas hydrophila* cultures and antibiotic levels of enteric aspirates from medicinal leeches applied to patients receiving antibiotics. *Ann. Plast. Surg.* 29: 245, 1992.