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Leech therapy: when once is not enough

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Venous congestion is a constant threat in the survival of free flaps, pedicled flaps, tissue replantations and traumatized tissue. Leech therapy has proved effective in salvaging much of these compromised tissues. To be effective, leeches must be both readily available and hungry, requirements not always easily met. Our investigation seeks to establish a means to return sated leeches to their previous unfed, hungry state for reuse.

Sated leeches were purged of their blood meals by placement in 3% hypertonic saline or by gentle finger pressure, then exposed to serotonin 0 μM (control), 10 μM, 30 μM or 90 μM for 20 min. Subsequent rebiting/refeeding was observed and analysed.

Leeches bathed in serotonin rebit or reattached at nearly four times the rate of unexposed leeches; 30% *vs* 8% respectively. Biting, however, is not refeeding. Overall, 41 leeches were treated with serotonin with four (10%) refeeding. Those that refed consumed a significantly smaller blood meal than the initial feeding; 50% ± 47% SD *vs* 348% ± 143% SD of original body weight. None of the control group refed.

As a method for routinely reusing leeches, serotonin bathing cannot be recommended. In the immediate postoperative period with the sudden emergence of venous congestion requiring leech therapy, but with an inadequate number available, this 1% refeed rate after 10 μM serotonin exposure could potentially determine the success or failure of the flap/replantation until fresh leeches are made available.

Key words: Leech, venous congestion, serotonin.

Introduction

Plastic surgeons are all too often caught in the struggle to save tissue from the menace of venous congestion. It is a constant threat in the survival of free flaps, pedicled flaps, tissue replantations, and traumatized tissue.[1-7] Because of this, the use of *Hirudo medicinalis* (medicinal leech) is undergoing a renaissance in modern medicine.[1-10] With its unique salivary properties of local anaesthesia, anticoagulation, vasodilation and a collagenase/hyaluronidase to promote local spread of these effects,[1,2,11-14] the leech is rejoining the surgeon's armamentarium in salvaging otherwise doomed tissue. While today's use of leeches in no way approaches the popularity it enjoyed during the 19th century, when seven million leeches were used in London in one year and over 32 million in France in a single year,[1,2,15-17] their recent surge in demand did lead to a crisis of accessibility in the early 1980s and placement of *Hirudo medicinalis* on the endangered species list in 1983.[1,2] To ensure their availability, leech farms have subsequently been established, particularly in Europe, to meet this increased use. As the signs and symptoms of venous congestion (cyanosis, rapid capillary refill, tense turgor) may arise suddenly in the postoperative period, a requisite number of leeches may not always be immediately available. For example, our closest supplier is on the East Coast with a minimum of 14 - 18 h delivery time to Los Angeles. This necessity for a ready supply of leeches recently arose at our institution. With a dearth of leeches in Southern California and most of the Western US, we were thus prompted to investigate ways in which to reuse available leeches until such time that additional leeches can be obtained.

A fed leech remains satiated for up to a year.[18-21] Lent and Dickinson demonstrated that bathing intact hungry leeches in serotonin significantly alters their feeding behaviour.[18,22] Leeches exposed to serotonin (30 μM for 20 min) significantly increased their biting activity in attempting to feed on warmed parafilm covered plates. The goal of our investigation was to not only have sated leeches rebite, but for them to also refeed, all in an animal model.

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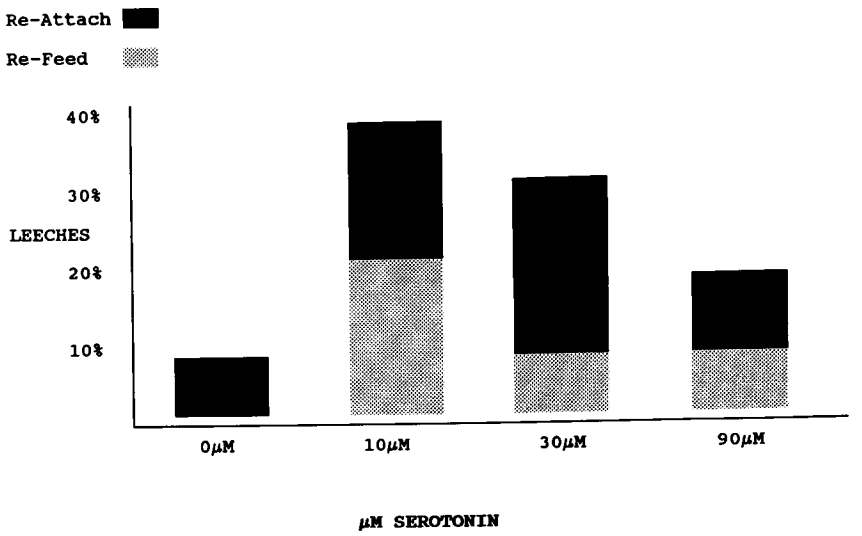

Figure 1. Serotonin bathing of leeches significantly increases reattachment activity ($P < 0.05$).

Materials and methods

Hungry leeches were obtained from Leeches USA, Ltd, Westbury, New York, USA. Adult Sprague – Dawley rats were anaesthetized 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 either placed in hypertonic saline (3%) to regurgitate or stripped of its meal by finger pressure. The leeches were removed from the hypertonic saline when they assumed a restful posture at the bottom of the beaker.

The purged leeches were dried, reweighed and placed in one of four solutions:

1. Hirudisalt™/distilled water (control)
2. Hirudisalt™/distilled water with serotonin 10 μM
3. Hirudisalt™/distilled water with serotonin 30 μM
4. Hirudisalt™/distilled water with serotonin 90 μM.

After 20 min in solution, the leeches were dried and replaced on to the patient's abdomen. A disinterest in refeeding was indicated by aversive movements such as repeatedly crawling off the patient immediately after being placed there or refusing to bite even when the patient's skin was lanced with a #11 scalpel blade to create a small drop of fresh blood.

The leeches that did rebite and/or refeed attached immediately upon being placed upon the patient. Evidence of reattachment was the trifoil bite mark on the patient's abdomen. Actual refeeding was reattachment followed by peristaltic movements and a gain in weight.

The strip/serotonin 30 μM regimen was also performed on clinically obtained sated leeches used in an attempt to salvage a thumb replantation.

Results

The hungry leeches consumed an initial blood meal of 348% ± 143% SD of their body weight. Purging the leech of its blood meal was much more effective by finger stripping than hypertonic saline regurgitation, 93% ± 7% SD *vs* 57% ± 24% SD respectively.

One leech out of 12 (8%) in the control group reattached but did not refeed. In the 10 μM group, 40% of the leeches reattached (4 out of 10), but only half of these (20% of the group) actually refed. Of the refeeders, a single leech reconsumed 125% of its post-purge weight. A second leech that reattached consumed only 3% of its post-purge weight. In the 30μM group, 31% reattached (5 out of 16) with only one of these reconsuming a blood meal, 50% of his post-purge weight. The 90 μM group had 20% reattachment (3 out

of 15) but with only a single leech refeeding 20% of its post-purge weight.

Overall, 41 leeches were treated with serotonin with only four (10%) refeeding. Of these four, there was equal representation of two leeches each from the regurgitory groups. They consumed 50% ± 47% of their post-purge weights.

Four leeches were obtained from the clinical setting of a thumb replantation at the interphalangeal level in a four year old child. These four leeches consumed 264% ± 66% of their original body weight. Regurgitation with finger pressure released 84% ± 5% of the blood meals. All were bathed in 30 μM serotonin for 20 min. Only one of the four (25%) leeches reattached, but it did not refeed.

Discussion

To date, reapplying leeches has not been recommended due to the theoretical potential of transmission of infectious diseases.[1,2,6,21,23] We could find no reported cases of a communicable disease ascribed to cross-contamination from a leech in the literature. In fact, there are only rare reports of infectious complications from leech therapy at all.[1,3,7,23-25]

There is substantial documentation of the attempted reuse of sated leeches during their heyday of the 19th century, by placing the fed leeches into weak salt or vinegar solution,[8,9,14,26-28] or wood ashes,[29] the leech was made to regurgitate. Alternatively, the leech was 'stripped' of its blood meal by gentle finger pressure.[14,26-28,30] Leeches thus emptied were then reapplied to the patient for refeeding. The success or failure of these treated leeches refeeding was not reported. However, purged leeches were not considered as healthy as fresh leeches and were kept separate.

Our data confirms that leeches can be made to regurgitate their blood meals by placing them in saline (3%) or stripping them with finger pressure. Those placed in hypertonic saline regurgitated an average of 57% ± 24% of their blood meal while stripping them removed 93% ± 7% of the consumed blood. This difference had no bearing on the leeches' immediate future biting or feeding behaviour. Also, our purged leeches did not respond to feeding stimuli as would healthy, hungry leeches.

Our data also confirms the work of Lent and Dickinson that leeches bathed in serotonin rebit or reattached at over three times the rate of unexposed leeches; 30% *vs* 8% SD respectively ($P < 0.05$). Biting, however, is not refeeding. Even though none of the control leeches refed, only 10% of the serotonin bathed leeches reconsumed a blood meal. There is no significant connection between reattaching or refeeding and the original size of the leech, the size of the meal, the amount or method of regurgitation. Preliminary studies using wood ash as a purgative and different time intervals of serotonin bath exposure showed similar results. Leeches also did not refeed after phlebotomy or post-exposure to dilute vinegar.

The possibility of the leeches being partially anaesthetized from, or sensitized to, the pentobarbitol in the consumed blood cannot be ruled out. The purged leeches, however, displayed no obvious signs or symptoms of narcotic intoxication such as lethargy or a decreased responsiveness to painful stimuli.

When non-narcotic containing blood was consumed, i.e. the thumb replantation of our clinical source of sated leeches, the reattachment and refeed results were the same as in the laboratory animal model. One out of the four (25%) clinical leeches immediately reattached, but it failed to demonstrate peristalsis or to have gained weight after detaching.

There were no complications from using the leeches in the four year old described. The child viewed the entire procedure as a game with new toys. The initially squeamish parents were won over by their son's delight at the sight of the 'wiggling worms' and the significantly increased attention they received from the nursing and house staff. Similar experiences have been reported from other hospitals that use leeches.[2,3,4,10,31]

Bathing purged leeches in serotonin concentrations of between 10 and 90 μM significantly increased their reattachment activity, but our goal of stimulating leeches to refeed immediately after purging them of their blood meals was of dubious success. Only 10% of our serotonized leeches refed, and they consumed a significantly smaller blood meal than the initial feeding. The most promising results were achieved in those immersed in 10 μM serotonin, with a refeeding incidence of 20%. Studies are ongoing to further identify specific serotonin concentrations and exposure times to both increase the immediate incidence, and maximize the blood meal, of binged and purged leeches. As a method for routinely reusing leeches, however, serotonin bathing cannot be recommended. Nevertheless in the immediate postoperative period, with the sudden emergence of venous congestion requiring leech therapy but with an inadequate number available, this 20% refeed rate could potentially determine the success or failure of the flap/replantation until fresh leeches are made available.

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