MOUSE MODEL OF PECTORALIS FLAP ASCHEMIA

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♦ABSTRACT♦

Objective/Hypothesis: Ischemia and flap necrosis have long been feared complications of head and neck reconstructive surgery. Our aim was to create a pectoralis major flap ischemic model in mice to aid investigations of novel strategies to reduce flap ischemia. Here we report initial results from this effort.

Methods: Mice were allocated equally into groups receiving either traditional pectoralis major myocutaneous flap dissection or traditional dissection with constriction of the vascular pedicle. Pre-operative thoracic laser Doppler images were compared to those obtained 13-15 days post-operatively to evaluate change in flow.

Results: The mean change in flow in the region of interest was 130.10 +/- 23.56 SEM in the control group, and 116.63 +/- 8.31 SEM in the group with the constricted pedicle. T-test analysis revealed no significant difference in pre- and post-operative region of interest flow between the two groups (p = 0.32).

Conclusions: Despite constriction of the vascular pedicle in the 'ischemic' group, no statistically significant difference of flow could be demonstrated between the two groups. Our findings are consistent with the robust nature of the pectoralis major myocutaneous rotational flap, and highlight its resistance to ischemia. Additional effort will be needed to further constrict blood flow toward development of ischemic muscle flap model.

♦INTRODUCTION♦

- Advances in the field of head and neck reconstructive surgery have made it possible for patients to have extensive resection of invasive disease while being able to make a complete functional and cosmetically acceptable recovery.
- Microvascular free tissue transfer is arguably the greatest advancement in head and neck reconstructive surgery, offering surgeons the ability to use well vascularized tissue to recreate defects with excellent functional outcomes. However despite its advantages, free tissue transfer still has significant risks, of which flap failure is the most critical.
- Microvascular free tissue transfer has failure rates were traditional quoted at between 5-15%; however since refinement in surgical technique, advances in surgical technology, and increased surgical volumes, free tissue transfer is now successful in over 95% or cases.
- At present time no animal model exists that recreates tissue ischemia seen in head and neck reconstructive surgery. The paucity of an animal model makes investigation of flap survival difficult, hindering advancements in the prevention and treatment of flap ischemia.
- Due to the technically demanding nature of microvascular surgery we propose pilot mouse model investigation with the pectoralis major flap. The ischemia seen in a pectoralis major flap is similar to that of free tissue transfer, allowing extrapolation of findings in a pectoralis flap model to that of free flap.
- We aim to develop and refine a mouse model for ischemia in a pectoralis major muscle flap. We hypothesize that constriction of the pectoral branch originating from the thoracoacromial artery and prevention of collateral vascular in-growth from adjacent tissue, will induce ischemia verified by Doppler-documented decreased perfusion and histological characteristics of ischemia.

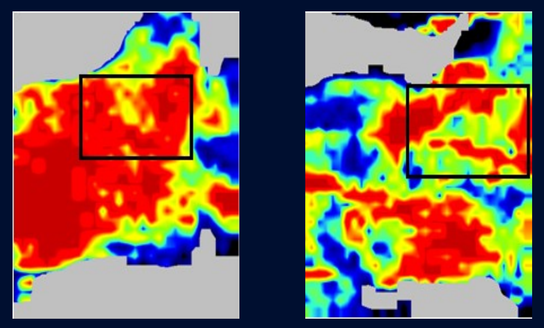

Figure 1 - A pre-operative (left) and post-operative day 14 (right) Doppler image of a control subject. Note the ROI highlighted in black.

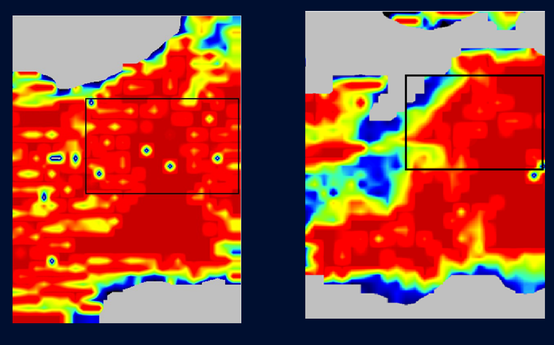

Figure 2 - A pre-operative (left) and post-operative day 14 (right) Doppler image of an experimental subject. Note the ROI highlighted in black.

♦METHODS♦

- This work was approved by IACUC
- Subjects were C57BL/6J female mice, 4-6 weeks old
- Measurements were made using laser Doppler imaging of the thorax with the Periscan™ PIM3 laser Doppler imager, and processed using Periscan™ PIM3 software at baseline and 13-15 days post-operative.
- Surgery consisted of mobilization of a pectoralis major flap under inhalation anesthesia
  - Control group - Pectoralis flap was raised and returned to native position over a silastic sheet
  - Experiment group - Pectoralis flap was raised and rotated 180 degrees to constrict the vascular pedicle
- Analysis of dependent variable consisted of comparison of whole thorax and Region of Interest flow between the control and experimental groups, this was done with t-test.

♦RESULTS♦

- **Pre-operative flow:**
  Control group - 211.29, 212.27, 268.69, and 371.92
  Experimental group - 386.01, 365.21, and 371.92*
- **Post-operative flow:**
  Control group - 287.28, 262.64, 199.48, and 238.61
  Experimental group - 262.60, 252.19, and 323.36
- **Mean change in flow:**
  Control group - 19.05 SEM of +/- 49.51
  Experimental group was 113.32 with an SEM of +/- 5.89
  Unpaired T-test analysis reveals no statistically significant difference, p=0.08.

- **Pre-operative flow to region of interest (ROI):**
  Control group - 444.77, 457.41, 313.41, and 496.78
  Experimental group - 433.59, 404.77, and 482.21
- **Post-operative flow to ROI:**
  Control group - 333.25, 328.26, 227.33, and 301.13
  Experimental group - 309.04, 304.75, and 356.88
- **Mean change in ROI flow:**
  Control group - 130.1 with a SEM of +/- 23.56
  Experimental group - 116.63 with a SEM of +/- 8.31. Unpaired T-test no statistically significant difference, p=0.33

*One of the experimental group mice was did not survive surgery and removed from the dataset.

♦DISCUSSION♦

- Microvascular free tissue transfer has transformed the field of head and neck reconstructive surgery. At present time, no animal model exists to recreate the tissue ischemia and flap necrosis seen in head and neck reconstructive practice. It was the aim of this pilot study to create an ischemic model in mice to aid investigations in novel strategies to reduce flap ischemia.
- Due to the technically demanding nature of microvascular surgery and the size of the subjects in mouse models, we elected to use a pectoralis major rotational flap as a surrogate for free tissue transfer.
- Despite a design intended to compromise the vascular supply of the experimental group, the pectoralis major flap used remained viable. There was no statistically significant difference between the control group and experimental group in Doppler flow.
- Lack of appreciable flap ischemia or reduction in flow highlights the robust nature of the pectoralis major flap.
- Our intension in future protocols is to use vascular clips to completely restrict flow through the vascular pedicle of the experimental group subjects.
- It seems that the rotation of the flap 180 degrees is insufficient to create appreciable ischemia in such a hearty flap.
- Future studies would need larger subject volumes to reach statistical significance. Using power analysis based on this preliminary data we will need 10 subjects for any measured time point post-surgically per group for a p-value of 0.05 and a power of 0.8

♦CONCLUSION♦

Despite constriction of the vascular pedicle in the 'ischemic' group, no statistically significant difference of flow could be demonstrated between the two groups. Our findings are consistent with the robust nature of the pectoralis major myocutaneous rotational flap, and highlight its resistance to ischemia. Additional effort will be needed to further constrict blood flow toward development of ischemic muscle flap model.