Introduction

Objective: Assess early changes in tissue oxygenation in a pedicled fasciocutaneous flap using a rat model.

Overview: Local flaps are a mainstay in facial reconstructive efforts. They are used to treat a variety of cosmetic and functional deficits. Flap failure due to tissue ischemia can be costly and time consuming event. Early recognition of tissue compromise may lead to better outcomes in recovery attempts.

Currently, the standard of care for monitoring of local tissue flaps is based on clinical assessment for signs of congestion, ischemia, or other. We developed a reproducible rat model using auto-controlled, bilateral abdominal fasciocutaneous advancement flaps (BEAFAF). The pedicle for the BEAFAF is the inferior epigastric artery. We used this model to identify markers in the early post-operative timeframe (1-2 days) which can accurately predict the future fate of the flap.

Methods

Forty-five 1 year old, male, Sprague-Dawley rats were used. An overview of the experiment design is shown below. (Figure 1). Bilateral fasciocutaneous flaps were designed on shaved and prepped rat abdomens as shown below. (Figure 2) The pedicle (inferior epigastric artery) was identified and spared. The contralateral pedicle was isolated and clipped. The distal end was removed, creating a tissue defect. Flaps were then advanced bilaterally and closed with absorbable suture.

Tissue oxygenation patterns on post-op day 2 correlated with subsequent flap necrosis or survival. In flaps developing visible necrosis by gross examination on day 7, there was an average decrease of tissue oxygenation levels of 29%. In flaps which ultimately survived, there was an average increase in tissue oxygenation levels of 26%.

Results

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Discussion

Flaps are a frequently used method of reconstruction in otolaryngology patients. While they can be used to successfully obviate a devastating functional and cosmetic defect, flap failure can be equally devastating. Failure often results in many more clinic and/or surgical visits. Additional operative procedures for both debridement and reconstruction are often required. Early identification of flap compromise may allow for faster intervention and subsequent flap rescue.

The bilateral design of this flap model allows each rat to serve as its own control, eliminating inter-rat variability. Although this experiment clipped the pedicle artery and vein, this model could easily be modified to replicate venous congestion or arterial occlusion only.

Successful study of vascular compromise requires an easily reproducible model, which we created. This can be used in future studies to assess pharmacologic agents which may effect flap rescue. It may also be used to better understand both intrinsic and extrinsic properties which may affect flap outcomes.

Conclusions

- Bilateral epigastric artery pedicled fasciocutaneous advancement flaps (BEAFAF) in a rat model provide a reliable and repeatable model for assessment of ischemic tissue insult.
- Early post-operative changes in tissue oxygenation may serve as a predictor of future tissue fate.

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