Radiofrequency Volumetric Tissue Reduction of the Inferior Turbinate in a Sheep Model
Kiran Kakarala MD1,4, William C. Faquin MD PhD2, Michael J. Cunningham MD1,4
1Department of Otolaryngology, Massachusetts Eye and Ear Infirmary, Boston, MA
2Department of Pathology, Massachusetts General Hospital, Boston, MA
3Department of Otolaryngology, Children’s Hospital, Boston, MA
4Department of Otolaryngology, Boston Medical School, Boston, MA

ABSTRACT

Educational Objective: At the conclusion of this presentation, the participants should be familiar with the comparative tissue effects of four energy based techniques for inferior turbinate reduction as demonstrated in a sheep model.

Objectives:
1. Validate the sheep model of endoscopic nasal surgery, including description of sheep acoustic rhinometry findings.
2. Compare immediate and early postoperative histopathologic effects of four endoscopic techniques for turbinate reduction using a sheep model.

Methods:
1. Three radiofrequency devices (one monopolar and two bipolar) were compared to monopolar electrocautery in a sheep model of inferior turbinate reduction. Procedures were performed according to device manufacturer guidelines using standard endoscopic instruments.
2. Normative acoustic rhinometry data was obtained for the sheep model both before and after decongestion.
3. Histopathologic analysis of turbinate specimens was performed immediately postoperatively and at postoperative day 21.

RESULTS

Turbinate reduction was performed on seven sheep, one procedure on each side, yielding 14 turbinate specimens.

Acoustic rhinometry was validated in the sheep model, demonstrating increased nasal volumes following medical decongestion and surgical turbinate reduction.

Submucosal destruction of glands and venous sinusoids and replacement with fibrosis was demonstrated as a common mechanism of action for all devices. Initial epithelial disruption was also documented; squamous metaplasia and normal respiratory epithelial regeneration was seen variably between devices at postoperative day 21.

CONCLUSIONS
The sheep model is feasible for the study of endoscopic nasal procedures. Acoustic rhinometry yields reproducible measurements of nasal cross sectional area and volume in sheep, both at baseline and status post medical and surgical mucosal reduction.

Electrosurgical devices effect turbinate reduction via coagulation of venous sinusoids and mucous glands and induction of submucosal fibrosis.

All devices cause immediate and early (21 days) mucosal disruption and squamous metaplasia.

Radiofrequency devices may have benefits in terms of preservation of normal nasal mucosal respiratory epithelium compared to monopolar electrocautery.

METHODS AND MATERIALS

This study was approved by the Institutional Animal Care and Use Committee of the Massachusetts Eye and Ear Infirmary. Procedures followed United States federal guidelines for the care and treatment of experimental animals.

Seven one-year-old sheep formed the study population. General endotracheal anesthesia and postoperative care was performed following established protocols.

The radiofrequency devices used in this study included two bipolar and one monopolar device. The bipolar devices were the Coblator II with ReFlex Ultra 45 handpiece (ArthroCare ENT, Austin, TX) and the CelonLab ENT (Celon AG, Teltow, Germany). The monopolar device was the Somnoplasty G3 Workstation with Turbine handpiece (Gyrus ACM, Bartlett, TN). The monopolar electrocautery device used was the Force FX with handswitching pencil (E2515) and needle electrode (E1552) (Valleylab, Boulder, CO).

Procedures were performed according to device manufacturer guidelines. One procedure was performed on each side of the nose, yielding 14 turbinate specimens. Ten specimens were harvested at POD 0 and four specimens were harvested at POD 21. Acoustic rhinometry data was obtained pre and post-procedure.

Specimens were serially sectioned perpendicular to the long axis of the turbinate and slides stained with hematoxylin and eosin (H&E). Slides were reviewed by a pathologist blinded to the surgical procedure. Qualitative comparison between techniques with respect to immediate and early submucosal and mucosal tissue effects was performed.

RESULTS (cont.)

The sheep model is useful for study of the histopathologic effects of endonasal procedures. Standard endoscopic instruments and acoustic rhinometry can be used in this model with reproducible results.

DISCLOSURE

Funding for this study was provided by ArthroCare and Gyrus.

CONTACT
Kiran Kakarala MD
Massachusetts Eye and Ear Infirmary
243 Charles Street
Boston, Massachusetts 02114
Email: kiran_kakarala@meei.harvard.edu

REFERENCES