Permanent placement of ventilation tubes in the chinchilla

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Introduction

The use of long-term ventilation tubes in patients with chronic eustachian tube dysfunction is an accepted form of initial surgical treatment. Despite improvements in composition and design, early extrusion, occlusion, development of granulation tissue, and need for repeated procedures continue to be frequent problems encountered in the course of treatment. The use of titanium implants and hydroxyapatite bone cements in the middle ear have been extensively studied and found to be safe and effective. The purpose of this pilot study was to develop a novel technique for establishing permanent middle ear ventilation by incorporating the proven technologies of titanium implants and hydroxyapatite bone cement.

Methods and Materials

Heat cautery myringotomy was used to expose the middle ear space in both ears of five chinchillas. The mucosa along the medial wall of the hypotympanum was removed in preparation for the implant. Freshly mixed OtoMimix® hydroxyapatite bone cement was loaded into a 3cc syringe and allowed to set for two to three minutes in order to obtain the desired consistency. The cement was then slowly injected onto the hypotympanic wall using a 22-gauge angiocatheter needle. A titanium ventilation tube was then placed into the cement and allowed to set for five to six minutes. The tympanic membrane openings were allowed to heal spontaneously.

The ears were re-explored at four months and the integrity of the cemented tube was assessed clinically. At 10 months, three of five animals were re-explored and one animal was euthanized and the temporal bones were obtained for histopathology. Whole temporal bone sectioning was performed to assess for evidence of osseointegration at the site of bone cement application and at the titanium tube interface.

Results

All myringotomies closed spontaneously. The bone cement was well accepted by the middle ear, with no clinical or histologic evidence of inflammation, granulation, osteolysis, or redundant osteogenesis. The titanium tubes were securely fixed in place and the tube-bone cement complex was covered with healthy, vascularized mucosa. These findings were clinically evident at both four and 10 month re-exploration (Figures 1 and 2). Histologic examination in the 10 month specimen showed a composite of cancellous and cortical bone enveloping the medial flange of the titanium tube and evidence of osseointegration at the titanium tube-bone cement interface (figures 3 and 4).

Conclusions

The use of hydroxyapatite bone cement to permanently secure a titanium tube to the middle ear wall appears to have some promise as a technique for establishing long-term ventilation of the middle ear space. A prototype titanium tube is currently being developed for this purpose.

Bibliography