Relationship Between Tympanic Membrane Perforations and Retained Ventilation Tubes

P. Todd Nichols, MD; Hassan H. Ramadan, MD; Mark K. Wax, MD; Robert D. Santrock, MD

Objectives: To determine the effects of prolonged ventilation tube retention on tympanic membrane healing and the efficacy of patching procedures used concomitantly at the time of tube removal.

Design: Retrospective chart review.

Setting: Tertiary referral academic institution.

Patients: Seventy-six patients aged 12 years and younger, with a total of 99 ears identified from January 1989 to December 1994. All patients underwent ventilation tube removal for prolonged tube retention or infection unresponsive to medical management. A minimum of 6 months of follow-up was required for inclusion.

Intervention: Ventilation tube removal under general anesthesia, with or without concomitant patching.

Outcome Measures: All medical charts were reviewed for age, sex, indications for tube removal, tube retention time, type of patch used (if any), type of tube, outcome after removal, other medical problems, and previous surgical history.

Results: The perforation rate was significantly higher in children with tubes retained beyond 36 months (P = .02). History of previous adenoidectomy predicted poor outcome, with a rate of 47% vs 17% in patients with no such history (P = .002). Patching did not improve healing. No other patient factors significantly influenced the perforation rate.

Conclusions: Ventilation tube retention longer than 36 months resulted in an increased perforation rate after surgical removal. Paper patching at the time of tube removal does not improve healing. Prospective studies are needed to confirm these findings and to determine the efficacy of other patching techniques.


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HE PLACEMENT of ventilation tubes in the management of chronic otitis media has been described since 1954, when Armstrong1 reported their successful use in the treatment of chronic secretory otitis media. The complications associated with ventilation tubes are now accepted as possible consequences of the treatment of chronic otitis media and eustachian tube dysfunction. These range from acute complications, such as otorrhea and early tube extrusion, to late sequelae, including tympanic membrane atrophy, tympanosclerosis, cholesteatoma, and persistent perforation.2 The management of perforations was described in the literature even before the advent of ventilation tubes. In 1947, Dunlap and Schuknecht3 used cautery of the perforation edges, followed by the daily instillation of urea to improve healing. A technique for patch myringoplasty was then described by Juers4 in 1958; it used marginal eversion and a piece of cottonoid to act as a surface for epithelial migration. This method is similar to that used today by many surgeons at the time of ventilation tube removal.

The rate of tympanic membrane perforation in spontaneously extruded tubes ranges from less than 1% to 4%.2,5,6 When tubes are removed surgically, the resultant perforation rate increases significantly.7,8 Because of this increase, concomitant patching has been advocated at the time of tube removal. Studies examining the efficacy of patching have shown mixed results.2,7,9,10 Appropriate indications for tube removal are even more nebulous. These indications have traditionally included prolonged tube retention in the asymptomatic patient, as well as chronic otorrhoea and infection that is unresponsive to medical management. However, no study has documented a specific

From the Departments of Otolaryngology–Head and Neck Surgery (Drs Nichols and Ramadan), West Virginia University (Dr Santrock), Morgantown, and State University of New York at Buffalo (Dr Wax).
PATIENTS AND METHODS

The medical charts of all patients undergoing ventilation tube removal at West Virginia University Hospital, Morgantown, from January 1989 to December 1994 were reviewed. Patients younger than 13 years with a minimum of 6 months of follow-up were included. Tubes were removed because of prolonged retention and/or chronic infection and otitis media, unresponsive to medical therapy. All removals were performed with the patient under general anesthesia on an outpatient basis. Surgical technique, in most instances, involved removal of the tube under direct microscopy by means of a straight pick or alligator forceps. The resultant tympanic membrane edges were freshened, and a patch was placed at the discretion of the operating surgeon. The patched ears were kept dry, while antibiotic drops were used when no patch was placed. Patients were initially seen 1 month postoperatively, then at 3- to 4-month intervals. Data collected included age, sex, reason for tube removal, tube retention time, type of patch used, type of tube, outcome, medical problems, and history of an adenoidectomy. Statistical analysis was performed with $\chi^2$, test of proportions, and logistic regression analysis.

RESULTS

Seventy-six children met the inclusion criteria. Of these, 45 were male and 31 were female. The mean age was 4.75 years (range, 1-12 years). A total of 99 ears were identified in this population.

The average tube retention time was 2.8 years (range, 2 months to 10.4 years). Forty-two ears were managed with tube removal only (no patch), while 57 were patched at the time of tube removal, with the use of paper in 49, fat in 6, and an absorbable gelatin sponge in 2. The tube retention time differed between the 2 groups, with an average of 2.5 years in the healed group and 3.9 years in the perforated group. The overall perforation rate was 28%: 30% in the patch group and 26% in the no-patch group (Table). The use of a paper patch at the time of tube removal was associated with a perforation rate of 29%. Use of the absorbable gelatin sponge or fat myringoplasty at the time of removal resulted in a perforation rate of 0% and 50%, respectively. The perforation rate by tube type varied as follows: Paparella, 16%; Reuter bobbin, 23%; Sheehy, 43%; and T-tube, 35%. For children with a history of less than 3 sets of tubes, the perforation rate was 24% vs 42% in those with 3 or more sets. Those patients with no history of adenoidectomy had a perforation rate of 17%, while those with a previous adenoidectomy had a perforation rate of 47%. There were no differences in healing with regard to age, sex, or the presence of concomitant medical problems. Only 2 patients with healed tympanic membranes required ventilation tube replacement.

COMMENT

Myringotomy with tube insertion is one of the most common procedures performed in the United States. Numerous studies are available regarding the indications for ventilation tube insertion; however, few studies have addressed the indications for their removal. In 1993, Solomon et al retrospectively examined the natural course of tympanic membrane perforation associated with surgically removed ventilation tubes. They noted a perforation rate of 10.3% when no patch was used. Hekkenberg and Smitheringale then prospectively showed a reduction in this rate to 4.5% by using an absorbable gelatin sponge or absorbable gelatin film patches at the time of removal. In 1992, Courteney-Harris et al also prospectively noted a statistically significant difference in healing when they used Silastic sheeting after T-tube removal. They recommended routine patching when T-tubes are removed. Baldwin and Loftin described a technique that used absorbable gelatin film as a patch and showed only a 6% perforation rate, but they had no control group for comparison. None of these studies addressed indications for tube removal. In contrast, Pribitkin et al looked retrospectively at paper patching when removing ventilation tubes and showed no difference in healing with the use of paper patching, except in the subset of children with a history of more than 3 sets of tubes. They also looked at tube retention time as a variable, but found no influence on healing. However, their patient data were not stratified beyond 24 months.
Traditional indications for ventilation tube removal have focused on the issues of chronic otorrhea associated with a patent and intact tube, as well as the tube that has been in “too long.” Intuitively it would seem that prolonged tube retention time would result in a higher perforation rate after removal, but no study has documented a difference or suggested an appropriate time beyond which removal is indicated. Our initial results demonstrated a statistically significant increase in perforation rate in children whose tubes remained in place beyond 24 months ($P = .05$). Also significant was the influence of adenoidectomy on healing. Patients with a history of adenoidectomy had a much higher perforation rate than those with no such history ($P = .01$). One possible explanation is that patients who require adenoidectomy have inherently worse eustachian tube function or middle ear disease, leading to a poor outcome after tube removal.

Because of the significance of previous adenoidectomy and tube retention time in our study, regression analysis was performed to control for the influence of one on the other, as well as for all other factors on these 2 important variables. After controlling for previous adenoidectomy and all other variables, we found that the true threshold for tube removal was significant at 36 months ($P = .02$) and that 24 months was confounded by the other variables. Previous adenoidectomy remained highly significant, even when controlling for all other influences ($P = .002$). Age, sex, the number of previous tubes placed, the type of tube used, whether a patch was used, and concomitant medical problems did not significantly influence the perforation rate. For some of these variables, however, the sample size was small, which may explain the lack of difference between the groups.

**CONCLUSIONS**

Prolonged ventilation tube retention beyond 36 months resulted in an increased perforation rate after surgical removal. Previous adenoidectomy appears to predict a significantly worse outcome by an unknown mechanism. No other factors appeared to influence healing after ventilation tube removal. Routine paper patching does not appear to improve healing in this population. A prospective study is needed to confirm these findings and to further define the role of patching when ventilation tubes are removed.

Accepted for publication October 22, 1997.

Presented at the Annual Meeting of the Southern Section of the American Laryngological, Rhinological, and Otological Society Inc, Captiva Island, Fla, January 17, 1997; winner of the 1997 G. Slaughter Fitzhugh Resident Research Award (Second Place), Southern Section of the American Laryngological, Rhinological, and Otological Society Inc.

We thank Jeanette Morency for her technical support in the preparation of the manuscript.

Reprints: Hassan H. Ramadan, MD, Department of Otolaryngology–Head and Neck Surgery, West Virginia University, PO Box 9200, Morgantown, WV 26506-9200.

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