

Oto-endoscopic Versus Microscopic Ventilation Tube Placement In Children

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Abstract

Objectives: Within the last few years, oto-endoscopes have been in use for inserting transtympanic ventilation tubes. However, in terms of published studies, only a limited number have investigated the efficacy of endoscopic myringotomy and tube placement in children. The aim of this prospective study was to evaluate the feasibility of endoscopic ventilation tube insertion in children by comparing the duration and outcomes of endoscopic versus microscopic technique.

Method: The study included 39 children in total (22 boys and 17 girls) aged 2-10 years and diagnosed with chronic otitis media with effusion (COME). In Group A, ventilation tube insertion was performed using oto-endoscopy in 15 patients (29 ears). In Group B, ventilation tube

insertion was performed using surgical microscopy in 24 patients (44 ears).

Results: The mean operative time for the microscopic technique was significantly shorter than that of the endoscopic technique ($P < 0.05$). No serious perioperative complications related to the techniques used occurred.

Conclusions: In children, oto-endoscopic tube placement can be performed safely, but the duration of endoscopic tube placement is not shorter than that of microscopic tube placement.

Key words: Chronic otitis media with effusion; Oto-endoscope; Ventilation tube placement

1. Introduction

Ventilation tube insertion is a common childhood operation. Traditionally, the microscopic technique has been performed for insertion of a transtympanic ventilation tube in most types of middle ear surgery^[1]. Endoscopes have been used in otologic surgery since the 1990s and recent developments in endoscopic equipment have permitted an all-encompassing view of the anatomy of the middle ear, even in the presence of an anterior overhang^[2].

To date, there have been only 3 reports in the literature describing the use of the endoscope for insertion of a transtympanic ventilation tube^[3-5]. Martellucci *et al.* compared endoscopic ventilation tube insertion with microscopic surgery^[5]. However, in that study, surgery was confined to adult patients under local anaesthesia. To the best of our knowledge, there is no study that has systematically determined the impact of oto-endoscope usage for venti-

lation tube insertion in children with chronic otitis media with effusion (COME). The hypothesis being tested in this study was that endoscopic ventilation tube insertion does not significantly differ from microscopic techniques in terms of operative time and complications, and is suitable for use in children.

The aim of this prospective study was to evaluate the feasibility of endoscopic ventilation tube insertion in children by comparing outcomes from the endoscopic and microscopic techniques.

2. Methods

2.1. Subjects and study design

The study was designed as a prospective trial, and was conducted between April 2014 and April 2017 at Baskent

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University Hospital, Department of Otolaryngology Head and Neck Surgery. The study included a total of 39 children (22 boys and 17 girls) with a mean age of 5.2 ± 2 years (range, 2-10 years) who were diagnosed with COME. The outcomes of endoscopic and microscopic approaches were compared.

Patients with an examination finding of endotympanic effusion, type B tympanogram, and persistent conductive hearing loss for 3 months were considered positive for COME. The retraction pockets were graded according to Sade's classification and we included only grade 1 retraction pockets in the study. Informed consent for participation in the study was obtained from the parents or legal guardians of the children. Any patients with craniofacial anomalies, or recurrent COME, grade 2,3,4 retraction pockets or adhesive otitis media were excluded. Ethical approval for the study was granted by the Baskent University Institutional Review Board (Project no: KA14/119) and supported by the Baskent University Research Fund.

In Group A, ventilation tube insertion was performed with the oto-endoscope in 15 patients (29 ears) with a mean age of 5.7 ± 2.5 years (range, 2-10 years), whereas in Group B, ventilation tube insertion was performed with surgical microscope in 24 patients (44 ears) with a mean age of 5 ± 1.7 years (range, 3-9 years).

The operations were performed under general anaesthesia by two senior surgeons, who were highly experienced in endoscopic (H.S.E.) and microscopic (S.S.E.) ear surgery. The duration of surgery and anaesthesia, the vital parameters of oxygen saturation, heart rate and non-invasive blood pressure, all medications given during general anaesthesia, and any perioperative or postoperative complications of the procedure or anaesthesia were carefully recorded. In our surgical setting, following oral premedication in the day care unit, either inhalation induction or intravenous induction is administered within the operating room, although there is no completely standardised anaesthetic procedure applied in all cases of elective myringotomy and ventilation tube insertion.

The duration of surgery was defined as the time elapsed from when the surgeon first received the ear speculum or endoscope until the ventilation tube was actually in place. Three kinds of operation (adenoidectomy and/or tonsillectomy and/or ventilation tube placement) were originally selected for timing of the technique, however, for the purposes of this study, only the period elapsed during ventilation tube placement was examined. Failed ventilation tube

placement and associated complications (tearing of the tympanic membrane, dropping of the tube in to the middle ear, laceration of the external ear canal and bleeding) were recorded for both methods to enhance the evaluation of suitability and safety of the procedure.

2.2. Surgical procedure

General anaesthesia was employed in each operation. The surgeons operated from a sitting position, with the patient supine and the head turned 30° towards the side of the non-operated ear. The main procedures were similar in both groups and were as follows: myringotomy in the antero-inferior quadrant with a sickle knife, aspiration of glue secretions from the middle ear, and the insertion of the Shepard grommet ventilation tube made of fluoroplastic (Shepard grommet ventilation tube; Medtronic I.D. 1.14, Inc. Minneapolis, USA) (Figure 1-4) by means of "alligator" microforceps. A rigid 0° endoscope of 2.7 mm diameter, 110 mm in length (Rigid 0° endoscope; Hopkins KARL STORZ, Tuttlingen, Germany) was used in the Group A operations. A surgical microscope (Surgical microscope; Carl Zeiss GmbH, Tutlingen, Germany) and 4 mm diameter ear speculum was employed for the Group B patients.

All patients were evaluated at follow-up in the 1st week and at monthly intervals thereafter until tube extrusion occurred.

2.3. Statistical analysis

Calculations were performed using the SPSS statistical software application (SPSS; Version 17.0; SSPS Inc., Chicago, IL). Outcomes were compared using the Mann-Whitney test. A value of $p < 0.05$ was considered statistically significant.

3. Results

The demographic parameters of the groups are listed in Table 1 and the results of the statistical analyses are summarised in Table 2. The mean operative time for the microscopic technique was briefer than that of the endoscopic technique at the level of statistical significance (266.90 seconds for Group A; 231.23 seconds for Group B. $p < 0.034$). In Group B, moderate bleeding during the procedure occurred in a single patient, who had a prominent anterior wall of the external auditory canal. The bleeding was controlled with the application of a 0.5mg/ml. epinephrine-soaked



Figure 1. Endoscopic view of the tympanic membrane.



Figure 2. Paracentesis image from the antero-inferior quadrant of the tympanic membrane (endoscopic view).



Figure 3. Aspiration of the glue-like material (Endoscopic view).

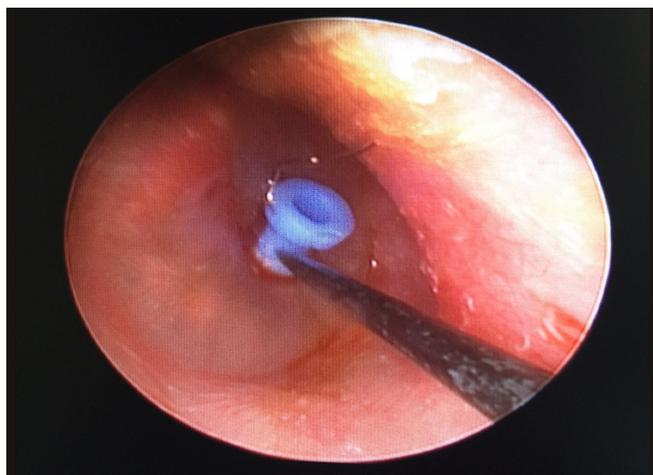


Figure 4. Ventilation tube placement (Endoscopic view).

cotton wad. No complications, such as tearing of the tympanic membrane or the surgeon dropping the tube in to the middle ear, occurred in either Group A and Group B. All of the ventilation tubes were successfully placed in both groups without recourse to changing surgical method.

4. Discussion

There have only been a limited number of reports that describe the use of the endoscope for insertion of ventilation tubes and which compare the use of endoscopic and microscopic techniques in patients with COME [3-6]. As a basic surgical principle, it is known that the duration of an operation is a risk factor. A lengthier operating time is associated with greater complications, both surgical and

medical [7, 8]. Moreover, a longer surgical duration also prolongs anaesthesia, which is known to contribute to the development of complications [9]. Thus, it was hypothesized that a decrease in time needed for surgery utilising the endoscopic technique would lead to a decrease in the quantity of medication required for general anaesthesia plus fewer complications. This hypothesis can be rejected as the results of the study demonstrate that the mean duration of surgery was significantly shorter in the microscopic group. However, the absence of perioperative or postoperative complications during the ventilation tube placement procedure using the oto-endoscope might also be noted.

Recently, several authors have proposed the advantages of the endoscopic approach over the operating microscope

Table 1. Demographic measurements, according to surgical procedure and time point.

Approach	Patient	Mean Age	Sex M/F	Unilateral	Bilateral	Adenoidectomy	A+T
Endoscopic	15	5,7	7M 8F	1	14	-	8
Microscopic	24	5	15M 9F	4	20	1	14

Table 2. Statistical analysis

Approach	Ear	Mean Duration (seconds)	SD	Min. (seconds)	Max. (Seconds)	Z	P value*
Endoscope	29	266,90	74,07	150	420	-2,125	0,034
Microscope	44	231,23	161,12	60	720		

SD: standard deviation, * Wilcoxon signed rank test. Min: minimum, Max: maximum

in ear surgery [6,10,11]. Bakshi [12] suggested that a tortuous ear canal or the presence of osteoma may present a particularly challenging anatomical condition when using an endoscope. However, the same challenge would be presented to both surgical techniques considered in our research. Our experience suggests that endoscopes can easily bypass any overhang in the external auditory canal or tortuosity which does not require any actual manipulation of the ear or head of the patient. In addition, the anterior recess and retraction pockets can be easily visualised with oto-endoscopes. Unless the diameter of the external ear canal is narrower than the oto-endoscope, it can always be used, and, indeed, this technique allows the surgeon to better visualise otherwise hidden places than use of a microscope would allow. If the diameter of the external ear canal is <4 mm, such a situation creates difficulties for both techniques [13]. Patients with a narrow external auditory canal, such as in Down's syndrome, were not included in the present study.

Endoscopes with different diameters (2.7, 3 and 4 mm) are available. Wullstein used "ototypanoscope" from the company Storz with a diameter of 2,7 mm intraoperatively in 1984. In recent years 3 mm diameter oto-endoscopes are preferred to obtain better image quality [14]. In the current study, the smaller (2.7 mm diameter x 140 mm length) oto-endoscope was used without any problems in the paediatric age group. Despite the small diameter of the oto-endoscope, it provides excellent resolution, intense light and higher magnification of the view than is obtainable with a microscope. Thus, the endoscopic procedure facilitates tutoring for young surgeons and for their tutors. According to the literature, a major limitation of endoscopic ear surgery is bleeding because of the one-handed technique and blood contaminating the endoscopic view [5,12]. In contrast, the main reason for bleeding in the current

study was seen to be the forced insertion of the ear speculum and traumatic use of the instruments due to the inadequate view afforded by the microscope. Moderate bleeding in the microscope technique group was due to laceration of the canal skin and this was controlled within a few minutes by the application of a cotton wad soaked with epinephrine 1/1000. No bleeding occurred during the endoscopic ear surgery in the current series.

Some authors have considered the fact that the endoscope leaves only one hand free to be a limitation for ear surgery [13,15]. Similarly, however, in microscopic tube placement, unless the speculum holder is chosen, surgeons have to hold the ear speculum with one hand and thus have only one hand free to perform the procedure. The disadvantages of endoscope use have been summarized as: left arm fatigue, loss of depth perception and a potentially long learning curve for the surgeon through needing adaptation to a newer technique [11,13,15]. Although it may be granted that the use of the oto-endoscope does indeed require a learning period, most otolaryngology surgeons are in fact already familiar with endoscope use from their work in rhinology. This experience usually makes the handling of an endoscope for ventilation tube placement in patients with COME relatively straightforward. The mean duration of ventilation tube placement was significantly shorter in the microscopic group, but the wide range of values for operative duration in Group B arose from a single case of haemorrhage during the procedure in an individual who had a prominent anterior wall of the external auditory canal (Table 2). Although the results seem to nullify the original hypothesis (i.e. that the techniques are virtually interchangeable), this finding should be further supported in additional studies including greater numbers of patients before being fully accepted. A limitation of the study was

that challenging cases, including craniofacial anomalies, and those with a narrow external auditory canal, were not included. Further experience of endoscope usage in such difficult cases should be collected. The 2.7 mm diameter endoscope might lead to reduced image quality and it may be a reason for the surgery being more prolonged than with the microscopic method. Therefore, these results will require further investigation in studies about ventilation tube placement that use 3 mm diameter oto-endoscopes.

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5. Conclusion

Ventilation tube placement can be safely performed in children using an oto-endoscope under general anaesthesia without perioperative or postoperative complications. The duration of tube placement is not shorter for the endoscopic technique than that involving the microscopic technique.

Conflict of Interest: The authors declare that they have no conflict of interest.

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