International Journal of Pediatric Otorhinolaryngology 78 (2014) 223–226

Contents lists available at ScienceDirect

International Journal of Pediatric Otorhinolaryngology

journal homepage: www.elsevier.com/locate/ijporl

Outcomes of tympanostomy tube placement in children with Down syndrome—A retrospective review

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ARTICLE INFO

Article history:
Received 15 September 2013
Received in revised form 16 October 2013
Accepted 19 October 2013
Available online 21 November 2013

Keywords:
Tympanostomy tubes
Down syndrome
Otitis
Complications

ABSTRACT

Objectives: Tympanostomy tubes are commonly used for treatment of chronic otitis media with effusion (COME) or recurrent acute otitis media (RAOM) in patients with Down syndrome, but hearing outcomes in this population have been mixed, and complications appear to be common. We aim to characterize outcomes and complications associated with tympanostomy tube placement in this population.
Methods: Retrospective review. All patients with Down syndrome presenting to a tertiary academic pediatric otolaryngology practice over a ten year period from 2002 to 2012 who received tympanostomy tubes for COME, RAOM, or hearing loss were reviewed.
Results: Long term follow up data was obtained in 102 patients, with average follow up 4.7 years. COME was the primary indication for tube placement in 100/102 (98%). Less than half of these patients (44%) initially failed their newborn hearing screen. Post operative hearing was found to be normal or near normal for the better hearing ear in 85/99 (85.9%), and normal to near normal in bilateral ears in 71/99 (71%). A majority (63.7%) of patients required two or more sets of tubes during the follow up period. Long term complications were common and were significantly increased if the patient required three or more sets of tubes, including chronic perforation (36.6% vs 8.2%, $p < 0.001$), atelectasis (29.3% vs 1.6%, $p < 0.0001$), and cholesteatoma (14.6% vs 0%, $p = 0.003$).
Conclusions: COME is a frequent problem in Down syndrome, and the majority of patients will require two or more sets of tubes during their childhood and achieve normal postoperative hearing. Long term complications of otitis media appear to be more common in this population and appear to correlate with increasing number of tubes placed. More investigation is required to determine optimal treatment strategies for COME in patients with Down syndrome.

1. Introduction

Down syndrome (DS) is the most common chromosomal abnormality among live births with a prevalence estimated to be 1.18 per 1000 [1,2]. In addition to the developmental and cardiovascular manifestations of DS, there is a high rate of otolaryngologic complications including, chronic otitis media with effusion (COME), adenotonsillar hypertrophy, obstructive sleep apnea and thyroid disease [3]. The higher prevalence of COME in the DS population is attributed to a combination of decreased lymphocyte function and craniofacial abnormalities, such as mid-face hypoplasia, prolonged Eustachian tube dysfunction, decreased cartilage density of the Eustachian tube predisposing collapse, and generalized hypotonia [4–6]. Together, these factors impair the ability of the middle ear to clear middle ear fluid and equalize pressure through the Eustachian tube. This predisposes the DS population to middle ear disease, and conductive hearing loss.

A majority of young children with DS have been found to have intermittent if not chronic middle ear fluid on routine exams, and this problem appears to persist even into late childhood and even adulthood, with potentially profound impacts on long term hearing outcomes [7–10]. Shott et al. found that 81% of DS children presenting with otitis media have some degree of hearing loss prior to treatment [11]. While DS children may also have sensorineural hearing loss or mixed hearing loss, studies have found that in DS children, 83–88% of hearing loss was conductive and, in one of the studies, 60% of this was attributed to chronic otitis media or perforations [12,13].

Management of COME and efficacy of pressure equalization (PE) tube placement in DS patients has been debated in the literature due to the frequent need for multiple PE tube placement, perception of increased complication rates, and controversy over

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http://dx.doi.org/10.1016/j.ijporl.2013.10.062

efficacy in resolving hearing loss. One retrospective study reported that up to 40% of DS patients had a persistent conductive hearing loss at 6 weeks after surgical management along with increased rates of recurrent effusions, otorrhea, perforation, and cholesteatoma [14]. A subsequent prospective study reported that DS children with COME who were treated by PE tube placement when indicated, had significant resolution of hearing loss, with only 2% showing persistent hearing loss at one year [11]. Complications of such treatment were not addressed in this study.

In order to address some of the remaining questions regarding PE tube outcomes in DS patients, our study was designed to review the natural history, including complications and hearing results, in a population of surgically treated DS children with COME.

2. Methods

Approval for this study was obtained via the Institutional Review Board at the Oregon Health and Sciences University (IRB # 00008114). Patient charts were obtained via a search of the electronic medical record database (Epic Systems, Madison, WI). All pediatric patients with diagnosis of Down syndrome presenting to the OHSU pediatric otolaryngology clinic over a ten year period (July 2002–July 2012) were reviewed. Patients were included if they were under the age of 18 and were assigned a diagnosis code of chronic otitis media, hearing loss, or recurrent acute otitis media. Exclusion criteria included follow up <12 months, no tympanostomy tube placement, or prior tube placement at another facility.

Charts were reviewed for newborn hearing screening test results, and hearing status was obtained both with pre operative audiograms and post operative audiograms. Standard post operative audiograms were typically obtained between 2 and 4 weeks post tube placement according to age and developmentally appropriate protocols, with follow up ABR testing for patients that would not condition to in-office audiometry. Postoperative OAE results were accepted in retrospect only if normal responses were achieved and follow up audiograms confirmed normal hearing at a later date with tubes in place.

Surgical data collected included the age of the patient at each tube placement, presence and type of effusion, and type of tubes placed. Follow up visits by both the otolaryngology service as well as pediatric audiology were reviewed and the extrusion date of each tube was recorded as the date of the first visit in which the tube was visualized to be completely free of the tympanic membrane. In cases in which audiometric measurements suggested tube extrusion but cerumen impaction made tube visualization difficult, and subsequent exam of ears under anesthesia confirmed extrusion, the original clinic date was documented as the date of extrusion.

Exam findings both from clinic visits and exams under anesthesia were recorded with regard to the presence of tympanosclerosis, retraction/atrophy, eardrum perforation, cholesteatoma, and chronic otorrhea. The charts were also reviewed for additional surgical procedures such as adenoidectomy, tympanoplasty, and mastoidectomy.

The Chi squared test or Fischer's exact test (two tailed) was used when appropriate to determine significance.

3. Results

A total of 221 patients were identified which met the inclusion criteria. A total of 119 were excluded, with reason for exclusion including no tympanostomy tubes placed (61, 51.3%), less than 12 months follow up (11, 9.2%), and history of tube placement or follow up at another facility (42, 35.3%). Additionally, 3 patients were excluded due to inability to place tubes due to EAC stenosis (3, 2.5%). A total of 102 patients were thus evaluated in this study. The median age at first tube placement was 18.8 months, and average number of tubes placed was 2.4, with mean follow up time of 4.7 years.

The primary indication for tube placement was chronic otitis media in 100/102 (98%) and recurrent acute otitis media in 2/100 (2%). All initial tubes placed were considered "short term" tubes (collar button, grommet, reuter bobbin, donaldson, armstrong, and titanium collar buttons). The median extrusion time was 10.7 months. Extrusion time did not vary significantly based on type of tube, diagnosis, or type of effusion at time of tube insertion.

Newborn hearing screening data was available in 89 of 102 (87.3%) of patients in the tube study group. Abnormal initial screens were present in 43 (48.3%), and repeat testing was performed in 37/43 of these patients, in which 4/37 were found to have normal hearing in both ears. This yielded a false positive rate for detection of hearing loss with initial newborn hearing screen of 10.8%. Overall passing for both ears was achieved in 50/89 (56%). Overall failing screens were documented one ear in 7/89 (9.0%), and both ears in 32 (36.0%).

Post operative hearing results were obtained in 99/102 patients after initial tube placement. The distribution of post operative audiogram modalities utilized for data analysis is outlined in Table 1. Post operative hearing was found to be normal or near normal for the best hearing ear in 85/99 (85.9%), and normal to near normal in bilateral ears in 71/99 (71%), with distribution of hearing outcomes outlined in Table 2. Only one patient was found to have bilateral profound hearing loss and was not a candidate for amplification. This patient did go on to receive cochlear implantation.

Table 1
Post operative audiograms were performed 2–4 weeks post tube placement according to age and development appropriate protocols, with repeat testing with ABR offered for patients which would not condition to office testing. VRA, visual response audiometry; ABR, auditory brainstem response; BOA, behavioral observation audiometry; PTA, pure tone audiometry; OAE, otoacoustic emissions; CPA, conditioned play audiometry.

Postoperative audiogram	*n*	%
VRA	63	63.6
ABR	27	27.3
BOA	3	3.0
PTA	3	3.0
OAE	2	2.0
CPA	1	1.0
Total	99	100.0

Table 2
Postoperative hearing results after first set of tympanostomy tubes, (a) best hearing ear and (b) worst hearing ear. Only one patient had bilateral profound hearing loss.

	n	%
(a) Postoperative HEARING: best ear		
Normal to near normal	85	85.9
mild	10	10.1
moderate	3	3.0
severe	0	0.0
profound	1	1.0
Total	99	100.0
(b) Postoperative HEARING (worst ear)		
Normal to near normal	71	71.7
mild	16	16.2
moderate	5	5.1
severe	2	2.0
profound	5	5.1
Total	99	100.0