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Prevalence of pressure equalization tube placement and hearing loss in children with down syndrome

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ABSTRACT

Objective: To determine the prevalence of pressure equalization tube (PET) placement and hearing loss in children with Down syndrome (DS).
Material and methods: We evaluated 90 DS children births between 1 and 11 years old and compared to 90 children without DS paired in sex and age. Medical records were analyzed consecutively. Were collected data about proceedings PET placement, age of the patient at each PET, adenoidectomy, tonsillectomy and results for audiometry and tympanometry.
Results: Among the 90 patients with DS, 49 (54.4%) were male, median age of 58 months (15–143 months). In this group, 75 PET were placed in 26/90 children (28.9%) mostly between 3 and 5 years old. In 10/26 (38.5%) was necessary PET replaced. When compared to the control group- 6/90 (6.7%)- children with DS presented OR = 13.7 (95% CI 4.0–47.3) times more likely to use PET. Adenoidectomy and tonsillectomy (44.4% and 42.2% respectively) were significantly more frequent in DS group. The prevalence of hearing loss was 32.1% in the right ear and 26.9% in the left ear. Type B timpanometry was found in more than half of the patients with DS.
Conclusion: We found a 13-fold higher risk of PET in DS children, especially between the ages of 3–5 years. The high prevalence of hearing loss and PET placement in patients with DS reinforcing the importance of early and regular follow-up for hearing screening in this population, mostly in preschool-aged children.

1. Introduction

Down syndrome (DS) is the most prevalent chromosomal anomaly in the general population, with a live birth prevalence of 1 in 700 births in worldwide [1]. Although there is a wide spectrum of medical complications among individuals with DS, ear, nose and throat (ENT) disorders such as chronic respiratory infections and conductive hearing loss by chronic otitis media with effusion (COME) are common due to craniofacial malformations. These malformations are usually short and patent external Eustachian tube, external auditory meatus and tracheobronchial muscles hypotonia, compromising mucous discharge and favoring the appearance of otitis. Some authors described prevalence of these hearing disorders in patients with DS ranging between 63 and 90% [2].

COME is characterized by chronic presence of secretion in the middle ear cavity, with a tympanic membrane full of fluids and without any signs of acute inflammation, which persists for at least eight weeks. It is one of the most frequent diseases in childhood, the most common cause of hearing loss and indication of surgical procedure in children, representing enormous socioeconomic impact [3]. Since the introduction of pressure equalization tubes (PET) by Armstrong in 1954, myringotomy with PET placement was consolidated as an effective form of treatment for otitis media with effusion [4].

Hearing loss is one of the many health issues that is underestimated or not prioritized in individuals with learning disabilities. Thus, children with DS should have their hearing tested

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regularly in order to ensure children's development and learning abilities, especially in speech, language and social skills [5].

In the present study, we analyzed data obtained from Brazilian children with DS aimed to establish the prevalence of hearing loss and PET placement in this population. Additionally, we verified the incidence of adenoidectomy and tonsillectomy, results of audiometric and tympanometry distributed in age groups.

2. Material and methods

Approval from Ethics Committee of the Paraná Evangelical Beneficent Society was obtained to access patient medical record. A retrospective chart review evaluated 180 children, carried out with the analysis of 90 medical records of DS patients and 90 records of patients without DS (control group). All DS children have their periodic visits at the clinic of "Reviver Down" association, which is a regional reference center in care to DS people. In this place, patients receive free multidisciplinary support to treat their health problems, including follow-up with general pediatricians and otorhinolaryngologist specialists. At this center, we reviewed medical records consecutively, considering the inclusion and exclusion criteria described below. The healthy control group consisted of children being seen in routine consultations in a private practice and who had no diagnosis of severe or chronic disease. They were paired in age and gender with patients group.

We included children with DS confirmed by karyotype, births between August 2003 and September 2014 attended in this clinical center. Patients with age between 1 and 11 years 11 months and 29 days old were distributed in three ages groups: *early childhood* (1–2 years 11 months and 29 days); *preschool-aged children* (3–5 years 11 months 29 days) and *school-aged children* (6–11 years 11 months and 29 days), with 30 children in each subgroup. All DS patients and controls had collected data including sex, age, known risk factors associated with hearing loss such as breastfeeding, scholar and neonatal intensive care unit (NICU) period.

In addition, we collected data about proceedings PET placement, including age of the patient at each PET, surgery for removal of adeno-tonsillar hypertrophy, other ENT surgeries. Only DS patients had results for audiometry and tympanometry. In case of more than one audiology exam being available, the last one was selected. All audiological exams were performed by speech therapists and interpreted by an otorhinolaryngologist. Hearing threshold of 24 dB was regarded as normal and hearing loss was defined as mild (25–40 dB), moderate (41–70 dB), severe (70–90 dB) and profound (more than 90 dB), describes by Davis and Silverman in 1970. The tympanograms were classified as: Type A, B or C (Jerger Classification) [6]. Type B tympanogram with normal canal volume was considered as conclusive evidence of fluid in the middle ear space [6,7].

Patients younger than 1 year of age or 12 years old or older, clinical records with less than 3 visits or lost to follow-up patients, with indefinite karyotype, with another associated genetic abnormality, with neurological or psychiatric alterations that could impede audiologic exams were excluded.

2.1. Statistical analysis

Obtained data were organized in frequency and contingency tables. Association studies were done through Chi squared test, Fisher exact test, Mann Whitney and unpaired t tests. Central tendency was expressed in median and interquartile range (IQR) in non-parametrical data and mean and standard deviation (SD) in parametric data, using the Graph Pad Prism 6.0 (GraphPad software Inc., La Jolla, CA, USA). A $p < 0.05$ were considered statistically significant.

3. Results

A total of 180 children were included in our study and their characteristics are shown in Table 1. Among the 90 patients with DS, 49 (54.4%) were male, with a median of 58 months, ranging from 15 months to 143 months. Known risk factors to promote infection and hearing loss such as less breastfeeding time, longer period in NICU and children at school were found in the DS group and compared to controls.

Among the 90 patients with DS, a total of 75 PET were placed in 26 children (prevalence of 28.9%), in all ages as observed in Table 2. In 10 (38.5%) of these 26 children was necessary the PET replaced and among these, five (50%) was required to insert PET for a third time. When compared to the control group (6 PET placed in three individuals) children with DS presented OR = 13.7 (95% CI 4.0–47.3) times more likely to use PET. Among these 75 PET placements, 38 were placed in right ears and 37 in left ears. In addition, patients between 3 and 5 years (preschool-aged children) had the highest incidence of placements PET as shown in Fig. 1 and Table 2.

Regarding ENT surgical procedures, adenoidectomy was performed in 40/90 (44.4%) patients with DS and in 15.6% of controls group ($p < 0.001$; OR = 4.4 CI = 2.1–8.7). Tonsillectomy was necessary in 38/90 (42.2%) DS children and in 14/90 (15.6%) [$p < 0.001$; OR = 3.9; CI = 1.9–8.8] of control group, distributed according to age groups (Table 2). Children with SD aged 3–5 years (preschool-aged) had significantly higher prevalence of PET, adenoidectomy and tonsillectomy as visualized in Table 2. Septoplasty was necessary in two cases, cleft palate correction in 2 cases and surgery for blocked tear duct in one case.

In DS group, hearing loss was observed in 32.1% of right ears and 26.9% in left ears, based on 25 children with hearing loss: mild, moderate, severe or profound by audiometry report (Table 3). Due to insufficient clinical data, it was not possible to perform the classification in conductive and sensorineural among patients with hearing loss. In the control group, it was not possible to perform the audiological tests.

Type B tympanogram was found in more than half of the ears submitted to the timpanometry, a common finding of COME (Table 3).

4. Discussion

In this study, we aim to provide more accurate data about hearing loss and ENT affections to doctors, parents and caregivers of Brazilian DS children. The high incidence of hearing impairment, about 75%, is outdated according to a revision published by

Table 1
Clinical and demographic data of children with Down Syndrome (DS) and controls.

	DS (%) n = 90	Controls (%) n = 90
Sex[a]		
Boys	41(45.9)	57(63.3)
Girls	49(54.4)	33(36.7)
Age[a](in months)		
Early childhood (n = 30)	28.9	26.1
Preschool-aged children (n = 30)	57	63.4
School-aged children (n = 30)	107.9	117.4
Breastfeeding[a]	71(78.9)	87(96.7)
Scholar[b]	78(86.7)	65(72.2)
NICU[c]	19(21.1)	1(1.1)

[a] p = 0.003– Fisher Exact test.
[b] p = 0.02– Fisher Exact test.
[c] p = 0.000015 – Fisher Exact test.
[a] Similar sex and age distribution between cases and controls due to matching.