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Transcervical ultrasonographic examination of palatine tonsil size and its correlation with age, gender and body-mass index in healthy children

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ABSTRACT

Objective: Our aim was to assess the palatine tonsil size with transcervical ultrasonography in healthy children and to analyze whether the palatine tonsil size is correlated with age, gender and body-mass index (BMI).

Methods: This series consisted of 680 healthy children (340 females, 340 males) who underwent transcervical ultrasonography for evaluation of palatine tonsil size. A total of seventeen age groups (range: 1−17 years) comprised of 40 children (20 females, 20 males) were constituted. Demographic data including gender, height, weight and BMI were noted. Correlation between baseline descriptive data and tonsil volume was investigated.

Results: The average age was 102.51 ± 59.24 months (range: 12 to 204) and body-mass index was 17.50 −5.16 kg/m2 (min: 12.4-max:25.8). The average tonsil volume was 1819.5−2023.5 mm^3 (min:601, max: 4007). The tonsil volume did not differ significantly between females and males ($p = 0.108$). However, there was a significant difference between tonsil volumes of various age groups ($p < 0.001$). Tonsil size seemed to be greater in parallel with advancement of age ($p < 0.001$) and increased BMI ($p < 0.001$).

Conclusion: Transcervical ultrasonography can be an accurate, safe, cheap, non-invasive and accessible measure for evaluation of the size of tonsils objectively. There were strongly positive correlations between age, BMI and palatine tonsil size in healthy children and variability with respect to descriptive characteristics must be considered during diagnostic procedures and preoperative evaluation.

Advances in knowledge: In our study, we suggest that transcervical ultrasonography can be an accurate, safe, cheap, non-invasive and accessible measure for evaluation of the size of tonsils. There were positive correlations between age, BMI and palatine tonsil size in healthy children.

1. Introduction

Tonsillar hypertrophy is a common cause of anxiety for parents and may be troublesome for general practitioners [1,2]. In patients suffering from recurrent tonsillitis, tonsil hypertrophy accompanies the clinical scene and size of the palatine tonsil is one of the important factors that lead to the obstruction of the airway [3]. Furthermore, preoperative subjective evaluation of the tonsil size may not always be consistent with the actual dimensions [4].

Tonsillectomy is usually performed to relieve the airway obstruction in patients with tonsillar hypertrophy and therefore, tonsil size can be a useful predictor for the success rate of surgery in these cases. Hence, a precise evaluation of palatine tonsils is necessary for achievement of satisfactory surgical outcomes after tonsillectomy performed for relief of upper airway obstruction [5]. The palatine tonsils accomplish their maximum size in early childhood and they tend to undergo an insidious atrophy after puberty [6]. The palatine tonsils can be readily observed in the oropharynx during oral examination. In some circumstances, evaluation of tonsil size can be challenging owing to the position and size of the tongue and tongue base [7]. Some techniques for measurement of the tonsils have been developed, although the most frequently used techniques are the clinical grading and lateral radiography. Clinical grading of tonsillar size is based on their transversal extension the midline [8]. The depth or vertical aspects, however, are not regarded in the physical examination. The limited value of tonsillar grading in children has become evident when the

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real size of the surgically removed tonsillar tissue has been compared with the clinical grading [5]. Nevertheless, controversies still exist about the value and/or significance of such measure methods and it must be remembered that the amount of the projection of the medial border of the tonsil into the pharynx may not necessarily reflect the true size of the organ.

On computerized tomography (CT) scans, the tonsils are difficult to distinguish from the anterior and posterior tonsillar pillars due to their similar attenuation coefficients. Similarly, on T1 weighted magnetic resonance (MR) images, the tonsils are difficult to differentiate from muscle tissue. On T2 weighted MR sequences, the tonsils have a high signal intensity than muscle because the lymphoid tissue and submucosal glands within the tonsils have a longer T2 relaxation time relative to the adjacent muscles [9]. Moreover, CT and MRI are expensive and may not be always available. In addition, CT is associated with remarkable radiation exposure. On the other hand, transcervical ultrasound may have a potential as a practical modality to measure the palatine tonsil size.

The aim of the present study was to evaluate the palatine tonsil size with transcervical ultrasonography in healthy children and to investigate whether the palatine tonsil size is correlated with age, gender and body-mass index.

2. Materials and methods

2.1. Study design

This cross-sectional study was performed in the pediatric radiology department of our tertiary care center between September 2015 and September 2016. The approval of local Institutional Review Board and written informed consent of every participant were obtained prior to the study.

Our series was comprised of 680 healthy children (340 females, 50%; 340 males, 50%) who underwent transcervical ultrasonography for evaluation of palatine tonsil size. A total of seventeen age groups (range: 1–17 years) consisting of 40 children (20 females, 20 males) were constituted. Demographic data including gender, height, weight and body-mass index (BMI) were noted.

Exclusion criteria consisted of a refusal to participate in the study, fever at the time of enrollment, children <3% or >97% of the growth chart, recurrent or chronic infection, tumor, trauma, surgery or any disease involving palatine tonsils.

2.2. Outcome parameters

Data gathered from every participant consisted of age (months), gender (male, female), body weight (kg), height (cm), BMI (kg/m^2) and tonsil volume (mm^3). Tonsil size was evaluated separately for right and left tonsils and the average volume was calculated.

2.3. Measurement of palatine tonsil size

Measurement of tonsil size was made by an operator with an experience of 5 years in pediatric radiology using the Aplio™ 500 (*Toshiba Medical Systems Co. Ltd., Otawara, Japan*) and linear 4.8–11.0 MHz transducer.

The patients were maintained in supine position with the neck extended and the head rotated away from the side under examination. After the mandibular angle was clearly identified, the ultrasound probe was placed transcutaneously in transverse and longitudinal planes below the angle of the lower jaw and above the hyoid bone (Figs. 1 and 2). This position provided a clear view of the tonsillar bed as a well-defined, hypoechoic structure lateral to the tongue and below the submandibular gland and superior constrictor muscle. Owing to its ellipsoid shape, the volume of the tonsil was estimated in mm^3 using the formula "0.52 × length × width × height".

2.4. Statistical analysis

Analysis of data was performed via IBM Statistical Package for Social Sciences (SPSS) Statistics 20 software (*IBM, Armonk, North Castle, New York, USA*). Normality of distribution for variables was tested via Kolmogorov-Smirnov test. Mann-Whitney U test was used to compare two independent groups, whereas Kruskal-Wallis test was performed for comparison of more than 2 independent groups. Correlation between variables was tested using Spearman's rho test. Quantitative variables were expressed as mean and standard deviation, or median and interquartile range. The confidence interval was 95% and p value less than 0.05 was considered as statistically significant.

3. Results

An overview of baseline descriptive data in our study population ($n = 680$) is shown in Table 1. The average age was 102.51 ± 59.24 months (range: 12 to 204) and body-mass index was 17.50–5.16 kg/m^2 (min: 12.4-max:25.8). The average tonsil volume was 1819.5–2023.5 mm^3 (min:601, max: 4007). The tonsil volume did not differ significantly between females and males ($p = 0.108$). In contrary, there was a significant difference between tonsil volumes of various age groups ($p < 0.001$) (Table 2).

Spearman's rho analysis demonstrated that there were strongly positive correlations between age, BMI and tonsil volume in the whole study population ($p < 0.001$) as well as female ($p < 0.001$) and male ($p < 0.001$) subgroups (Table 3).

The alteration of tonsil volume with advancement of age is shown in Fig. 3. The relationship between tonsil volume and BMI is demonstrated in Fig. 4. Accordingly, increases in age and BMI were associated with enlarged sizes of palatine tonsils.

4. Discussion

The objective of the present study was to assess the palatine tonsil size by means of transcervical ultrasonography and to investigate whether there is a correlation between the size of tonsil and baseline descriptives such as age, gender and BMI. We were able to image palatine tonsils sufficiently by means of ultrasound and we suggest that this method can be a cheap, safe, practical and reliable method to evaluate the palatine tonsil size in pediatric population. Our results demonstrated that size of palatine tonsils were correlated positively and strongly with age and BMI in both males and females.

Lateral neck radiographs have been used and their results displayed seem correlation with the degree of obstructive sleep apnea; however, they only provide a two-dimensional view of the tonsils and does not indicate the transverse extent of the organ [7,9–11]. Ultrasound is accurate, non-invasive, inexpensive and bedside tool can use to study the tonsils size, shape and appearance, can assess blood flow of the tonsil and expected to be useful in the diagnosis and therapy of palatine tonsillar disease [12]. Ultrasound is not currently utilized as a standard measure in the clinical evaluation of the oropharynx and palatine tonsils. However, recent data suggest that it can serve as a promising imaging modality for evaluating the base of the tongue and the palatine tonsils. Ultrasound is comparable and complementary to CT and MRI, which possess recognized limitations [13].

Currently-used imaging methods may sometimes fail to demonstrate the actual size of structures in oral cavity and oropharynx [14]. Ultrasound examination can be performed by