

# Histomorphological Changes in Hypertrophied Tonsils in Children

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## ABSTRACT

**Aim:** To study histomorphological changes in hypertrophied tonsils in children and to co-relate the extent of these changes to the tonsillar hypertrophy

**Methods:** Enlarged tonsils from thirty children with obstructive airway symptoms were obtained after tonsillectomy. Normal tonsils were obtained from 10 children's at autopsy

**Results:** In hypertrophied tonsils size, weight, epithelium and lymphoid compartment, all were affected. It was observed that there was an increase in thickness and keratinization of epithelium, increase in size of germinal centers, decrease in no of lymphoid follicles due to increase in size.

**Conclusion:** Hypertrophic changes are probably immunological response to exposure to different antigens in an exaggerated manner and obstructive symptoms may lead to complications, sometimes fatal. Measures should be devised to prevent or treat tonsillar hypertrophy.

**Keywords:** Tonsillar hypertrophy, tonsillectomy, lymphoid follicle.

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## INTRODUCTION

In America the most commonly performed surgical procedure in children is tonsillectomy with or without adenoidectomy, the commonest indication being size i.e., tonsillar hypertrophy and its complication (Cohen et al., 2007). According to another study, carried out at Children's Hospital Los Angeles (between 2002-2006), out of 2062 patients tonsillectomy was performed on 1017 patients. The average age of children on whom tonsillectomy was performed was 6.1 years and routine indications were upper airway obstruction, obstructive sleep apnea (OSA) and chronic infection. In 74.6% of specimens on histological diagnosis revealed hypertrophy. In the same study researchers commented that each year about 287,000 tonsillectomies with or without adenoidectomy are performed [Verma et al., 2009]. In 2002, in France, 75000 tonsillectomies were performed; major indication was tonsillar hypertrophy and of which 90% were in children. Now a days removing the tonsils especially in younger children is not due to infection only rather hypertrophy and its complications are the primary causes [Kurnatowski et al., 2006; Granzotto et al., 2010]

Tonsillar hypertrophy was observed in 11% school children in Turkey and adenotonsillar hypertrophy was observed 55.3% in school going children in Brazil (Kara et al., 2009; Salles et al., 2009). Generally tonsils start to hypertrophy or increase in size within the first three years of life, which is the period of highest immunological activity during childhood [Valera et al., 2003]. The palatine tonsils increase in size throughout childhood and tend to regress or involute at puberty, when the reactive lymphoid tissue begins to atrophy [Bannister et al., 2008; Baharuin et al., 2006]. This hypertrophy is not a disease but is due to increased immunological activity and is clinically known as tonsillar hypertrophy [Bannister et al., 2008]. In physiological hypertrophy, tonsils increase in size and weight with absence of both visible congestion on anterior pillars and cheesy discharge on pressing [Verma et al., 2009]. Tonsillar crypts contain dead and alive lymphocytes, desquamated epithelial cells and bacteria more than the normal tonsils (Ugras et al., 2008). Sometimes this increase is very rapid and develops serious symptoms and complications [Unkel et al., 2005]. It is no doubt that even moderate hypertrophy of the lymphoid tissue of the pharynx can cause an obstruction of this part of the airway and may alter the mode of breathing, hinder speech and swallowing and disturb sleep [Gryczynska et al., 1995].

Hypertrophied tonsils are characterized by enlarged lymphoid follicles with significant enlargement of germinal centers. The germinal centre is pale but not of uniform colour. It is darker towards the medulla, indicating the organization of

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the different types of the cells within it. These cells include the B-lymphocytes in their different stages of maturity. Mitotic figures of B cells indicate a hyperplastic condition of B lymphocytes in the germinal centres [Ugras *et al.*, 2008; Young *et al.*, 2006]. In addition to these B-lymphocytes follicular dendritic cells (the major antigen presenting cells of the follicles) and the tingible body macrophages are also present in the germinal centers. Tingible bodies are the macrophages which have phagocytosed the surrounding immature B-lymphocytes which were not effective in generating a high affinity antibody [Young *et al.*, 2006]. There is also sharp demarcation of germinal centers from mantle zone lymphocytes because in the mantle zone B-lymphocytes are arranged circumferentially with an onion skin pattern, and are of small sized and closely packed [Rosai and Ackmer, 2004]. According to some researches interfollicular area is reduced because of the enlarged lymphoid follicles in tonsillar hypertrophy and it is relatively increased in diseased tonsils [Korsrud, *et al.*, 1980] while others stated that the interfollicular area remains unaffected [Kumar *et al.*, 2010]

The lymphoid tissue of the tonsils is directly exposed to the outside environment through inspired air or by ingested food [Mitani *et al.*, 1990; Perry and Whyte, 1998]. Electron microscopic observations have demonstrated that the mature crypt epithelium is porous and allows the protrusion of lymphocytes through these pores that mediate the immune response [Iscsaon and Parikh, 2008]. It explains the functions of the palatine tonsils i.e. they sample the environmental antigens (which were inhaled or ingested) and participate in the initiation and maintenance of the local and systemic immune responses [Serpero *et al.*, 2009].

Although the exact pathophysiological mechanisms of lymphoid tissue hypertrophy of upper airway are not known, previous works by researchers have shown enhanced release of potent proinflammatory mediators, such as TNF-alpha, IL-6, IL-8 and other cytokines are responsible for both the local and systemic inflammatory processes elicited by the presence of upper airway obstruction. These cytokines will result in the recruitment of lymphocytes and macrophages which in turn play a vital role in the host immune response to inflammation and infection. By comparing with recurrent infection this local inflammation is enhanced in obstructive sleep apnea. In this context, it can be speculated that in the patients with OSA concentrations of cytokines are elevated as compared to respiratory infection. This may reciprocally reflect that in OSA there is

more pronounced cell proliferative processes [Pang and Wang *et al.*, 2003].

Research related with the comparison of histological changes in chronic tonsillitis and tonsillar hypertrophy, especially in the lymphoid follicles was carried out in 2003 by Pang and Wang. They found that histologically tonsillar hypertrophy is characterized by an enlargement of lymphoid follicles as compared to recurrent tonsillitis, indicating a hyperplastic condition of lymphoid cells in the germinal centres [Dark and carr, 2010].

Healthy tonsils offer better immune protection and become more enlarged according to their demand for more immunity. Diseased tonsils are associated with decreased antigen transport, decreased antibody production above baseline levels, and chronic bacterial infection, and so these are less effective at serving their immune functions [Bonuck *et al.*, 2006].

A number of studies based on bacteriology, size, symptoms and complications due to enlarged tonsils and recurrent tonsillar infection have been carried out, but none of these studies emphasize the both gross features as well as histological changes in hypertrophied tonsils (reactive hyperplasia). Therefore it was required to analyze the histomorphological changes in different compartments of hypertrophied tonsils in children aged 4-10 years undergoing tonsillectomy and correlate them with obstructive symptoms. Lymphoid compartments, (like lymphoid follicles, germinal centres, interfollicular areas and surface epithelium) most affected will be identified so that these could be selectively targeted in order to avoid obstructive hypertrophy and subsequent fatal complications.

Insufficient weight and height gain in children with tonsillar hypertrophy is well documented because children with hypertrophied tonsils have poor appetite and dysphagia [Sen and Aycicek, 2010].

Abnormal nocturnal growth hormone secretion and impaired growth hormone action results from the abnormal sleep pattern. Since growth hormone is to be released while sleeping and obstructive tonsillar hypertrophy (OTH) is related with disturbed sleep. Retardation of growth in OTH may be the result of suppressed plasma ghrelin and serum insulin like growth factor-1 (ILGF-1). Ghrelin is a peptide hormone, which stimulates secretion of growth hormone. Ghrelin is transferred to the target tissues via blood after secreting from the placenta in the fetus and from the stomach and intestines in post natal life [Valera *et al.*, 2006].

Most of the facial growth occurs during childhood and shows two growth peaks. The first growth peak is between 5 and 10 years of age i.e.,

during the change from the primary to the permanent dentition and the second between 10 and 15 years [Valera *et al.*, 2003]. Since tonsillar growth affects the craniofacial growth from 3-7 years of age, most of the obstructive symptoms are observed during this period [Cheng *et al.*, 1988]. The effects of hypertrophied tonsils and or adenoids on craniofacial growth include elongated face, short upper lip, overcrowded upper teeth, small pinched nose, hypoplastic maxilla and mandible and high arched palate [Naibogulu *et al.*, 2008].

Enlargement of tonsils is one of the major causes of respiratory obstruction leading to mouth breathing, which then results in muscular, functional and dentofacial alterations. These alterations in turn may affect the mechanism of phonation, mastication and swallowing [Drake *et al.*, 2010]. Respiratory obstruction becomes more marked at night while the patient is sleeping due to relaxation of oropharyngeal musculature. This obstruction in breathing results in paradoxical respiratory efforts, hypercarbia (increase in CO<sub>2</sub> concentration in body) and often hypoxemia (decrease in O<sub>2</sub> level). These two factors i.e., hypoxemia and hypercarbia cause respiratory acidosis, which is a potent mediator of pulmonary vasoconstriction [Agrawal and Wang 2009]. Prolonged obstruction may lead to cor pulmonale, pulmonary congestion and hypertension. Pulmonary hypertension leads to the vicious circle of cardiovascular complications including right heart failure and even death. The symptoms, signs and possible complications depend upon the type and gravity of the obstructive sleep apnea, growth retardation, facial and chest deformation and cardiovascular diseases [Flaitz *et al.*, 2009].

Pediatric follicular lymphoma is a variant of follicular lymphoma with a good prognosis. In this class children show good response to less aggressive therapy and a better survival rate than adults. Follicular lymphoma must be distinguished from reactive hyperplasia of tonsil which it may mimic [Olofsson *et al.*, 1997].

## MATERIALS AND METHODS

It was a descriptive study and conducted in the Department of Anatomy, King Edward Medical University, Lahore. Non hypertrophic tonsils from autopsies of ten children were collected from Department of Forensic Medicine, King Edward Medical University, Lahore. These were categorized as Group A (control group). Thirty samples were collected from children who were diagnosed with obstructive tonsillar hypertrophy (after a detailed history taken on a proforma). They underwent

tonsillectomy at the Department of ENT Unit-II Mayo Hospital Lahore (15 children), Department of ENT Services Hospital Lahore (6 children) and Department of ENT Sir Ganga Ram Hospital Lahore (9 children). These were categorized as Group B. Prior to autopsy or surgery a written informed consent was obtained from the guardians or parents.

**Inclusion criteria:** For the children undergoing tonsillectomies for hypertrophied tonsils, age range was 4-10 years (male and female children), with history of obstructive symptoms. For autopsies dead bodies of children both male and female of age 4-10 years received within 12 hours of death. The following gross and histological parameters were observed:

**Gross examination:** The tonsils were examined for the following features:

Colour and Surface. Weight (grams) measured on an electronic weighing scale. Size (centimeters) measured by vernier caliper.

**Microscopic examination:** The measurements were made by means of an oculometer at magnification of 10x objective. The sections were examined for the following parameters.

- Epithelium (type, thickness, keratinization)
- Number of the follicles at magnification of 10x objective/LPF

Three random readings of three respective fields per slide of the above mentioned parameters of the tissues were taken under low power (10x objective) and mean was taken.

**Statistical analysis:** Data were entered and analyzed using SPSS 13 version. All qualitative data was presented in form of multiple bar charts with respect to study groups. Quantitative data was presented in the form of mean  $\pm$  S.D along with its minimum and maximum value. Chi-square test of association was used for the comparison of qualitative data in all study groups. Mann-Whitney U Test was applied for the comparison of quantitative data in both study groups. A p-value less or equal to 0.05 was taken as significant.

## DISCUSSION

In this study normal tonsils (Group A) were compared with hypertrophied tonsils (Group B) in children of 4-10 years of age. It was observed that there was no change in colour and absence of congestion, pustules and ulcer formation on the hypertrophied tonsils. However the weight and size of the tonsils were significantly increased in group B as compared with group A (Fig. 1 and 2).

In present study the mean weight of enlarged tonsils was  $3.41 \pm 0.43$  gm and mean age was 7 years. Alatas and Baba in their research in 2008 reported the mean weight of enlarged tonsils in children was  $4.09 \pm 0.94$  gm, but the mean age of children in their study group was  $13.9 \pm 4.01$  years [Gorfien *et al.*, 1999]. The epithelium was stratified squamous keratinized in 50% cases of group B (fig. 4 and 6), while in 50% cases it was stratified squamous non-keratinized (fig. 4 and 8). Keratinization of epithelium was the feature associated with tonsillar hypertrophy. It is known as oral frictional hyperkeratosis [Gorfien *et al.*, 1999]. The surface epithelium in hypertrophied tonsils was thickened as compared to the normal tonsils. It was  $70.32 \pm 6.49$   $\mu$ m thick in group A while in group B it was  $165.65 \pm 35.98$   $\mu$ m (fig. 3 and 5).

This increase in thickness of surface epithelium is a result of constant physical irritation of the tonsillar surface [Rappaport]

The parenchyma of Group B palatine tonsils showed enlarged lymphoid follicles with only 1-2 follicles visible under low power field i.e.  $2.11 \pm 0.90$ /LPF, whereas in normal tissues the average number of follicles was  $5.00 \pm 0.94$ /LPF. It was concluded that the size of follicles was significantly increased in group B tonsils ( $p < 0.000$ , fig. 7). This increase in the size of lymphoid follicles is because of increase in lymphoid elements, especially the B-lymphocytes which are the major cells forming lymphoid follicles. The average size of germinal center in this study was  $29786.42 \pm 20328.15$   $\mu$ m in group A and  $345891.77 \pm 179255.61$   $\mu$ m in group B (Fig. 9). This shows that the size of germinal centers was significantly increased in the hypertrophied tonsils. This finding was also consistent with the previous research carried out by Gorfien *et al.* who used image analysis to measure germinal centre size and found that there is a significant increase in germinal centre area in hypertrophied tonsils from patient with tonsillar hypertrophy or recurrent tonsillitis compared with normal ones<sup>36</sup>.

## CONCLUSION

Immunopathogenesis of tonsillar hypertrophy is, at least partly, related to latent bacterial infection<sup>37</sup>. Probably this latent low dose continuous bacterial stimulation was the cause of tonsillar hypertrophy and hyperplasia, prolonged obstructive tonsillar hypertrophy, especially in young children, had many complications and may prove fatal. Immunomodulation is required in the form of some vaccine or drug to control hypertrophy and hyperplasia of tonsils.

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