PREOPERATIVE AND POSTOPERATIVE CARDIAC FUNCTIONS AND PULMONARY ARTERY PRESSURE IN PATIENTS UNDERGOING ADENOTONSILLECTOMY

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ABSTRACT

Objective: This study aimed to compared the pre- and postoperative pulmonary arterial pressures and changes in cardiac function using echocardiography and tissue Doppler ultrasonography in patients who underwent adenotonsillectomy due to adenotonsillar hypertrophy.

Methods: 25 pediatric patients who adenotonsillar hypertrophy diagnosed by physical examination, symptom scores and radiologic procedures. It was made echocardiography and tissue Doppler ultrasonography to patients before and after adenotonsillectomy 3rd months. In the postoperative 3rd month those patients were re-examined for cardiac functions and the findings were compared with the control group.

Results: In the study group there were significant decreases in the cardiac parameters especially in the pulmonary arterial pressure compared with the preoperative period. Pulmonary artery pressure values at baseline and at postoperative 3 months were significantly different (p=0.00 <0.05). Although postoperative right ventricular end-diastolic diameter decreased and was similar to the levels in the control group the amount of decrease was not significant (p 0.14 >0.05). Conclusions: In the cardiologic parameters only pulmonary artery pressure improve after adenotonsillectomy significantly statistical. Other cardiologic parameters improved but not significantly. However, further studies are required to confirm this finding.
KEYWORDS: Adenoidectomy, tonsillectomy, Hypertension, Pulmonary, Doppler Tissue Ultrasonography.

INTRODUCTION
Adenotonsillar diseases are among the most common conditions in pediatric ages currently, among which adenotonsillar hypertrophy is specifically common and may have a poor outcome when left untreated. Adenotonsillar hypertrophy includes most conditions that develop due to respiratory disorders in childhood. The symptoms of this entity most commonly develop at 2-5 years of age.\(^\text{[1,2]}\) It may lead to serious conditions such as craniofacial abnormalities, growth retardation, obstructive sleep apnea syndrome (OSAS), pulmonary hypertension and cor pulmonale.\(^\text{[3,4]}\)

Cardiopulmonary changes may develop secondary to the increasing airway resistance due to adenotonsillar hypertrophy. Although considerable postoperative improvement in cardiologic parameters, specifically pulmonary artery pressure, was reported, the number of combined studies regarding this issue is limited. This study compared the pre- and postoperative pulmonary arterial pressures and changes in cardiac function using echocardiography and tissue Doppler ultrasonography in patients who underwent adenotonsillectomy due to adenotonsillar hypertrophy.

MATERIALS AND METHODS
The study included 25 pediatric patients who presented to the Mustafa Kemal University Medical Faculty Otorhinolaryngology Head and Neck Surgery Department with adenotonsillar hypertrophy between January 2008 and June 2008. Adenotonsillar hypertrophy was confirmed with symptom scores, physical examination findings, clinical histories and radiologic examinations. It was asked for informed consent to all parents. Patients underwent echocardiography and tissue Doppler ultrasonography to measure the pulmonary artery pressure and cardiologic parameters. All echocardiographic and Doppler measurements performed by the same person. The patients didn’t receive any drugs which may influence cardiac function. It was cardiologic parameters were also measured at postoperative 3 months and the results were compared to those measured in 25 control cases. The control cases selected who have no cardiologic problems and airway obstruction due to adenotonsillary hypertrophy. It were excluded from the study who have cardiopulmonary problems, bleeding diathesis, airway and other infections diseases. It was excluded five patients due to cardiopulmonary problems.
Symptomatic patients with isolated adenoid, isolated tonsillar and adenotonsillar hypertrophy comprised the study group. Conditions such as septal deviation, allergic rhinitis, laryngeal pathologies that could lead to upper airway obstruction and serious sistemic diseases were excluded in the study patients.

Lateral sinus x-rays, postero-anterior chest x-rays, electrocardiographic and echocardiographic parameters, and symptom scores of the study group were documented at baseline and postoperative 3 months. X-ray examinations done as regular examinations of the study protocol.

In the lateral nasopharynx x-ray the obstruction ratio of the adenoid vegetation in the study group was determined by the adenoid nasopharynx ratio (ANR) defined by Fukioka et al.[5]

Adenotonsillar hypertrophy was confirmed by the ANR defined by Fukioka et al., the tonsillar grading system developed by Freidman et al in 2003 and the preoperative symptom scores of the patients. ANR ≥0.85, grade 3 and 4 and symptom scores ≥3 were considered adenotonsillar hypertrophy.

Tonsillar hypertrophy was graded according to the grading system defined by Freidman et al. in 2003.[6] Among those with isolated tonsillar hypertrophy only patients with grade 3 and 4 hypertrophy were included in the study. Among patients with grade 2 tonsils, those with an ANR greater than 0.85 were included in the study. Eleven patients had grade 3 and 3 had grade 4 tonsillar hypertrophy. The remaining 10 patients were those with grade 2 tonsillar hypertropy and adenoid hypertrophy with an ANR greater than 0.85.

**Symptom Scoring**

The patients in the study group underwent pre- and postoperative symptom scoring.[7] Snoring, mouth breathing during the day and night, hyponasal speech, restless sleep, daytime sleepiness and nocturnal urinary incontinence were considered significant symptoms and forms were assessed accordingly. Parents were asked to reply to questions regarding the symptoms as “yes”, “no”, “always”, “frequently” “sometimes” and “never. “Always” and “frequently” answers were considered “yes” and “sometimes” and “never” answers were considered “no”. Questions answered “yes” scored 1 point and the maximum score was 7. Patients with a symptom score ≥3 were included in the study.
Surgical technique
Eleven patients underwent adenoidectomy, one tonsillectomy and 13 patients adenotonsillectomy. Cold surgery technique was used for adenoidectomy; for the tonsillectomy cases electrocotery was used in 3 cases, coblation in 1 and cold surgery in 10.

Echocardiography and Tissue Doppler Measurements
All patients in the study group underwent measurement with echocardiography at baseline and at postoperative 3 months. Pre- and postoperative electrocardiography was performed in all patients. Preoperative systolic and diastolic functions and pulmonary artery pressures were measured and noted. Patients with a pulmonary artery pressure ≥25 mm Hg were included in the study. The echocardiography panel measurements included the right ventricle end-diastolic diameter (RVED), interventricular septum (IVS), left atrial diameter (LAD), left ventricle end-diastole diameter, left ventricle end-systole diameter (LVESD), left ventricle ejection fraction (EF) and pulmonary artery pressure (PAP).

The tissue Doppler panel measurements included the following. For the left cardiac functions, peak mitral annular systolic velocity (Sm), peak early diastolic annular velocity (Em), peak late diastolic mitral annular velocity (Am), isovolumetric relaxation time (IVRT), isovolumetric contraction time (IVCT), myocardial performance index (MPI) were measured. For the right cardiac functions, peak tricuspid systolic velocity (Sm), peak early diastolic tricuspid annular velocity (Em), peak late diastolic tricuspid annular velocity (Am), isovolumetric relaxation time (IVRT), isovolumetric contraction time (IVCT), and myocardial performance index (MPI) were measured.

Statistical Analysis
Data obtained by clinical, radiologic, echocardiographic and Doppler ultrasonographic findings were analyzed with SPSS 11.0 package program. Frequency distribution and standard deviation of data were reported.

Following the distribution analysis of data, comparisons between groups (preoperative, postoperative 3 months and the control group) were run by the Mann-Whitney U test. Wilcoxon rank test was used for in-group comparisons. A p value of 0.05 was considered statistically significant. The Ethics Committee of the MKU Medical Faculty approved the study protocol.
RESULTS
The ages of the patient and the control groups were between 4 and 12 years (7.52±2.12) and 3 and 12 years (6.92±2.54), respectively and the difference was not statistically significant. The study group comprised 10 male (40%) and 15 female (60%) patients and the control group included 15 male (60%) and 10 female (40%) cases.

Eleven patients (44%) underwent adenoidectomy for pure adenoid vegetation, 1 (4%) tonsillectomy for tonsillar hypertrophy and 13 (52%) adenotonsillectomy for adenotonsillar hypertrophy.

There was no abnormal finding in routine blood analyses, electrocardiographic examinations and postero-anterior chest x-rays at baseline and at postoperative 3 months. Symptom scores at postoperative 3 months were significantly lower compared to baseline (p=0.00 <0.05).

The ANR was 0.86 in 6 patients, 0.87 in 4, 0.88 in 4, 0.89 in 4, 0.90 in 4, 0.91 in 1, and 0.93 in 1. The ANR was 0.71 in one case but the patient had grade 4 tonsils and underwent isolated tonsillectomy.

Pulmonary artery pressures of the patients at baseline and postoperative 3 months were 25-33 mm Hg (28.72 ±2.39, p <0.05) and 6-24 mm Hg (16.32±4.11, p <0.05), respectively. Pulmonary artery pressures at postoperative 3 months were 5-18 mm Hg (10.24±3.49) closer to baseline values. Pulmonary artery pressure values at baseline and at postoperative 3 months were significantly different (p=0.00 <0.05).

Echocardiographic and Tissue Doppler Results
Although postoperative right ventricular end-diastolic diameter decreased and was similar to the levels in the control group the amount of decrease was not significant(p≤0.14>0.05). At postoperative 3 months IVS, LAD, LVED measurements were lower but not significant compared to baseline (p >0.05). The increase in LVESD was also insignificant (p=0.65>0.05) and similar to measurements of the control group (2.11±0.33). While the increase in LVEF was clinically favorable, it was not significant (p=0.26 >0.05).

The PAP levels of the control group were similar to those of the study group at postoperative 3 months and the difference was not significant (p >0.05). Echocardiographic findings were shown in the Table 1.
Left Ventricular Tissue Doppler Results
The increase in SmEm, Em/Am and ET and the decrease in Am, IVRT, IVCT, and MPI were favorable but not significant (p >0.05). Besides, left ventricular tissue Doppler results at postoperative 3 months and those of the control group were similar and were not significant (p >0.05).

Right Ventricular Tissue Doppler Results
The increase in Sm, Em and Em/Am, the decrease in Am and the reduction in the measurements of IVRT, IVCT, ET, and MPI were not significant despite being clinically favorable (p >0.05). Besides, the results at postoperative 3 months and those of the control group were similar and were not significant (p >0.05).

DISCUSSION
Adenotonsillar hypertrophies are the most common childhood diseases. Most problems that develop in patients with adenotonsillar hypertrophy are due to airway obstruction. Adenotonsillar hypertrophies and the degree of related obstruction may be measured using different techniques. Different studies reported various techniques such as history, physical examination, lateral sinus x-ray, arterial oxygen saturation measurement using oxymetry monitor and symptom scoring described by Brouilette et al.\textsuperscript{[7-10]}

While selecting our patients we considered their histories as mentioned by their parents, symptom histories and related symptom scoring, endoscopy supplemented physical examination (grade 3, grade 4 tonsils) and adenoid-nasopharynx ratio (ANR ≥0.85) in the lateral sinus x-ray described by Fujioka et al.

Successive hypercapnia and hypoxia results with respiratory acidosis and this in turn causes vasodilation of the pulmonary artery, which ends up with cardiac hypertrophy. Long-term pulmonary artery hypertension causes dilation of the right ventricle, cardiac insufficiency and cor pulmonale.\textsuperscript{[11,12]} Long-term upper airway obstruction and secondary hypoxia and hypercapnia increase pulmonary vascular resistance.\textsuperscript{[3,13,14]} This in turn causes alveolar hypoventilation, right ventricular dilation, congestive heart failure and eventually cor pulmonale.\textsuperscript{[15-17]} High pulmonary artery pressure in patients with adenotonsillar hypertrophy is a significant factor in the cardiac morbidity of this condition.
Noninvasive techniques such as electrocardiography and Doppler echocardiography can be used to detect pulmonary artery pressure, cardiac hypertrophy, dilation and other pathologies.

Görür et al. followed-up patients with adenotonsillar hypertrophy for 8 months and reported that while adenotonsillar hypertrophy caused right and left ventricular dilation, adenotonsillectomy improved unfavorable cardiac changes and OSAS symptoms and that echocardiographic findings returned to normal after the operation.\cite{8} We made symptom scores and symptoms scores decreased after operation.\cite{7} It wasn’t made polysomnography. It may be good and more exact results for effect of adenotonsillectomy.

Duman D et al. measured right and left ventricular functions with Doppler ultrasonography at baseline and at postoperative 6 months. The assessment of PAP, and right and left ventricular MPI revealed significant improvement.\cite{18} A number of studies suggested that the MPI could be a good parameter to show right ventricular functions in patients with adenotonsillar hypertrophy. Besides, MPI was suggested to correlate well with invasive and noninvasive methods to assess right ventricular functions.\cite{19,20}

Our study is different from other studies regarding its combined design. We assessed all parameters that were individually assessed in other studies. We did tissue Doppler measurements at baseline and at postoperative 3 months in the study group and in the control subjects. Doppler Tissue Imaging (DTI) is a novel and popular echocardiographic technique used to determine myocardial velocity during cardiac circulation.\cite{21} Although tissue Doppler technique is not commonly used in routine clinical practice, it is useful to assess overall or regional ventricular systolic and diastolic functions.

Doppler Tissue Imaging technique was first described in 1989, is a modified form of conventional pulsed Doppler and provides the assessment of cardiac functions by analyzing myocardial velocities.\cite{22}

In the conventional Doppler technique, while the flow rate of high-rate low-amplitude blood circulating in the heart can be determined, low-rate and high-amplitude wall movements are filtered. In the tissue Doppler imaging technique, this filtration is minimized and gain kontrol is lowered until the blood flow signals disappear to allow the imaging of high-amplitude low-rate myocardial movements.\cite{23} Thus, the tissue Doppler imaging allowed more detailed and objective cardiologic measurements in our study.
Echocardiographic measurements in the patient group revealed favorable changes in the right and left ventricular parameters at postoperative 3 months compared to baseline levels; however, other parameters did not show any change. The most important change was the favorable and significant change in PAP, which was reflected in the clinical picture of the patients and the improvement in symptom scores. These changes were similar to those in other studies.\[8,9,10,18,24\]

The global assessment of the right and left ventricle with the tissue Doppler revealed improvement in almost all parameters (especially MPI and E/A). Although the improvements were not statistically significant, they had a favorable effect on cardiac functions and the clinical condition of the patients.

Other clinical studies of similar design have reported regression in adenotonsillar hypertrophy associated OSAS, cardiologic and other clinical symptoms and improvement—either significant or insignificant—in cardiac parameters after adenoidectomy, tonsillectomy and adenotonsillectomy.\[10,25,26\]

In conclusion, cardiopulmonary changes occur secondary to increasing airway resistance due to adenotonsillary hypertrophy. Echocardiography and Doppler echocardiography are effective noninvasive techniques to measure such changes. Cardiologic parameters, especially the pulmonary artery pressure, improve significantly after adenotonsillectomy. However, Studies which are further and long term follow up studies and are required to confirm this finding.

Conflict of Interest: None
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This study has no financial support from any sources.

REFERENCES


