EFFECT OF ADENOTONSILLECTOMY ON PULMONARY ARTERIAL BLOOD PRESSURE IN CHILDREN WITH ADENOTONSILLAR HYPERTROPHY

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Abstract

Objective: the aim of this work was to determine the pulmonary artery systolic pressure (PASP) in children with hypertrophic tonsils and adenoid and to clarify whether tonsillectomy and adenoidectomy has any effect on (PASP) of these children. Another aim of this study is to find out whether the complications of adenotonsillar hypertrophy are reversible or not and to estimate the time needed for reversibility.

Material and methods: this study was carried out on thirty children with hypertrophied chronic adenotonsillitis causing chronic upper airway obstruction 19 males (63.3%), and 11 females (36.7%) with mean age 6.1±1.8. All patients were subjected to thorough history taking, full clinical examination, plain X-ray on soft tissue neck (lateral view) and chest X-ray (P-A view), and Echocardiography for assessment of (PASP). Adenoidectomy, tonsillectomy or both were carried out for all children. Postoperative evaluation for all patients by general, E.N.T. examination, and cardiac cases were followed by using echocardiography at intervals of one week and four months.

Results: this study showed small adenoid in 6 cases (20%) and large adenoid in 24 cases (80%) detected by plain X-ray soft tissue neck, but there is no cariomegally of all cases detected by chest X-ray. It showed also pulmonary hypertension in 8 children (26.7%) detected by echocardiography. There was significant correlation between the severity of snoring and sleep apnea in relation to pulmonary hypertension (P<0.01, P<0.05 respectively). Relief of upper airway obstruction was carried out by tonsillectomy, adenoidectomy or both. Snoring and apnea were disappeared in nearly all cases, and also Echocardiography showed improvement of pulmonary hypertension in 75% of cardiac cases one week postoperatively, and all cases were improved after four months postoperatively.

Conclusion: from this study we conclude that adenotonsillar hypertrophy causes higher PASP in children and adenotonsillectomy is an effective therapeutic measure in such patients.

INTRODUCTION

It has been previously reported that increased upper airway resistance resulting from hypertrophied tonsils and adenoid can cause intermittent airway obstruction, chronic alveolar hypoventilation, and even lead to severe cardiopulmonary complications like cor-pulmonale (9).

Many complications are caused by adenotonsillar hypertrophy including cardiovascular system deterioration as pulmonary hypertension, growth retardation, learning and cognitive deficits (9).

The main mechanism of pulmonary hypertension is hypoxia related pulmonary vasoconstriction; other contributing factors are hypercapnia induced pulmonary vasoconstriction and exaggerated negative intrathoracic pressure during obstructive episodes (9).

Otolaryngologists and pediatricians must know that obvious anamnesis of upper airway obstruction is sufficient to indicate surgical intervention. Adenotonsillar hypertrophy and upper airway obstruction takes the first order among the adenotonsillectomy indications (4).

Complications of adenotonsillar hypertrophy, especially cardiovascular ones, can be easily recognized using supplemental diagnostic modalities (5).

PATIENTS AND METHODS

This study included 30 patients, 19 males, and 11 females, there mean age 6.1±1.8 years. All patients were selected randomly from those referred to E.N.T clinic of Benha University Hospital during the period from June, 2005 to November 2005 with the following criteria:

a- Inclusion criteria:

1- Obstructive symptoms such as long lasting nocturnal snoring, sleep apnea, open mouth breathing, difficulty in swallowing and poor appetite.
2- Hypertrophied tonsils causing oropharyngeal airway obstruction. A standardized grading classification proposed previously was used for the clinical examination. According to that scale, grade 3 and 4 hypertrophied tonsils were included.
3- Adenoid hypertrophy causing nasal obstruction.

b- Exclusion criteria:
1- Presence of chronic chest disease or congenital heart diseases.
2- Other causes of nasal obstruction such as acute rhinitis, allergic rhinitis, septal derivation or anatomical deformities.

I- Pre-operative assessment: all patients underwent the following:
1- History taking and clinical examination:
(a) History was taken from the parents and they were asked about:
   • Number of recurrent acute attacks of adenotonsillitis in the last year.
   • Snoring, the parents were asked to grade the child’s snoring into one of three categories:
i- No snoring. ii- Intermittent snoring (during sleep only). iii- Continuous snoring (during sleep and wakefulness).
   • Night sleep disturbance and whether the child exerts an effort to breath (sleep apnea) or not.
   • History of chest and heart problems.
(b) Clinical examination:
   • ENT examination: was carried out for all patients with stress on:
     i- The nose: it was examined to exclude causes of obstruction other than adenoid such as deviated septum, allergy or polyps.
     ii- The oropharynx: it was inspected for detection of tonsillar size. Tonsillar hypertrophy was graded according to Suen and His Colleagues (6) into:
       - Grade 0: not visible.
       - Grade I: extending to the pillars i.e., within the tonsillar fosse.
       - Grade II: enlarged beyond the pillars but not meeting the uvula.
       - Grade III: meeting the uvula.
       - Grade IV: “Kissing” at the mid line.
   • Chest and heart examination: all patients were sent for chest and heart assessment for detection of cardiomegaly or pulmonary edema and to exclude lower airway pathology which can be a cause of cor-pulmonale.

2- Radiological examination:
   a- Lateral plain x-ray of the nasopharynx: lateral soft tissue plain x-ray of the post-nasal space and upper airway with slightly extended neck were performed for all cases. According to Hibbert (7), the lateral soft tissue radiographs of the nasopharynx were classified into three categories:
      i- Cases with normal airway and nasopharynx (i.e., no adenoid).
      ii- Cases with partial encroachment of the adenoid on the airway (i.e., adenoid partially attenuating the nasopharyngeal air column).
      iii- Cases with nearly complete attenuation of the nasopharyngeal airway by the adenoid.

b- Chest radiography: chest radiographs were taken in the postero-anterior in the erect position with deep inspiration.
   R + L
   CT = ______ T D
   CT = Cardiotoracic ratio. R = Maximal cardiac dimension to the right of the midline. L = Maximal cardiac dimension to the left of the midline. TD = Transverse dimension at the widest expansion of the bony chest according to (Anthony et al.) (8) cardiothoracic of 0.5 or less is considered within normal limit.

3- Echocardiography: It was carried out in the echocardiography Unit of Benha University Cardiology Department (hp Sonos, 2000 echocardiography), the children were sedated with chloral hydrate in a dose of 75-100 mg/Kg when needed.

The following modalities were used:
   • M-mode echocardiography (detects cardiac anatomy and dimensions).
   • Two-dimensional echocardiography (detects spatial relation of the cardiac structures).
   • Doppler and colored Doppler echocardiography (measures tricuspid valve flow through the cardiac wall and measures pressure gradient of the tricuspid regurge which helps to measure PASP by the following equation.

\[
PASP = PG \text{ of } TR + 10. \text{ Pulmonary hypertension is present if } PASP \text{ exceed } 30mm Hg.\]

PASP = Pulmonary Arterial Systolic Pressure. \(PG = Pressure \text{ Gradient's = Tricuspid Regurge.}\)

II- Operation: Adenotonsillectomy was carried out for all thirty cases at E.N.T department of Benha University.

III- Post-operative assessment: All cases were subjected to follow up for improvement of pre-operative symptoms and cases with cardiac problems were subjected to follow up by using echocardiography one week and 4 months post-operatively.
RESULTS

I- Pre-operative results: 30 cases were included in this study with recurrent attacks of acute adenotonsillitis, and sleep restless pattern, 19 males 63.3%, and 11 female 36.7%, their mean age 6.1±1.8 (table 1, 2).

Table (1): Age distribution of the study group.

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>$\bar{X} \pm SD$</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6.1 ± 1.8</td>
<td>4 –10</td>
</tr>
</tbody>
</table>

Table (2): Sex distribution of the study group.

<table>
<thead>
<tr>
<th>Sex</th>
<th>No</th>
<th>%</th>
<th>Z “test”</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td>19</td>
<td>63.3</td>
<td>1.46</td>
<td>&gt; 0.05</td>
</tr>
<tr>
<td>Females</td>
<td>11</td>
<td>36.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>30</td>
<td>100.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table (3): Grades of tonsillar hypertrophy among the study group.

<table>
<thead>
<tr>
<th>Tonsillar hypertrophy</th>
<th>No</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Grade I</td>
<td>4</td>
<td>13.3</td>
</tr>
<tr>
<td>Grade II</td>
<td>5</td>
<td>16.7</td>
</tr>
<tr>
<td>Grade III</td>
<td>10</td>
<td>33.3</td>
</tr>
<tr>
<td>Grade IV</td>
<td>11</td>
<td>36.7</td>
</tr>
<tr>
<td>Total</td>
<td>30</td>
<td>100</td>
</tr>
</tbody>
</table>

There were 4 cases with grade I (13.3%), 5 cases with grade II (16.7%), 10 cases with grade III (33.3%) and 11 cases with grade IV (36.7%). (table3).

Table (4): The nasopharyngeal soft tissue X-ray findings (lateral view) in the study group.

<table>
<thead>
<tr>
<th>Adenoid size</th>
<th>No</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>No adenoid (completely patient nasopharyngeal airway)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Small adenoid (partial attenuation of the nasopharyngeal airway)</td>
<td>6</td>
<td>20.0</td>
</tr>
<tr>
<td>Large adenoid (nearly complete attenuation of the nasopharyngeal airway)</td>
<td>24</td>
<td>80.0</td>
</tr>
<tr>
<td>Total</td>
<td>30</td>
<td>100</td>
</tr>
</tbody>
</table>

Also, the lateral nasopharyngeal soft tissue x-ray demonstrated 6 cases with partial attenuation of nasopharyngeal airway (20%), while 24 cases (80%) with nearly complete attenuation.(table 4).
Table (5): Distribution of the study group according to severity of snoring and pulmonary hypertension.

<table>
<thead>
<tr>
<th>Pulm. Hypertension</th>
<th>Snoring</th>
<th>Present</th>
<th>Absent</th>
<th>Total</th>
<th>Chi. Sq</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intermittent</td>
<td></td>
<td>4 (16%)</td>
<td>21 (84%)</td>
<td>25</td>
<td>5.76</td>
<td>P &lt; 0.01</td>
</tr>
<tr>
<td>Continuous</td>
<td></td>
<td>4 (80%)</td>
<td>1 (20%)</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>8 (26.7)</td>
<td>22 (73.3)</td>
<td>30</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table (5): shows that intermittent snoring was detected in 25 cases, 4 cases of them showed pulmonary hypertension, while continuous snoring was detected in 5 cases, also 4 cases of them showed pulmonary hypertension, and this correlation was statistically significant (P value < 0.01).

Table (6): Distribution of the study group according to apnea and pulmonary hypertension detected by echocardiography.

<table>
<thead>
<tr>
<th>Pulm. Hypertension</th>
<th>Apnea</th>
<th>Total</th>
<th>Present</th>
<th>Absent</th>
<th>Chi. Sq</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td></td>
<td>13</td>
<td>0 (0%)</td>
<td>13 (100%)</td>
<td>6.11</td>
<td>P &lt; 0.05</td>
</tr>
<tr>
<td>Present</td>
<td></td>
<td>17</td>
<td>8 (47.1%)</td>
<td>9 (52.9%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>30</td>
<td>8 (26.7)</td>
<td>22 (73.3)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Also there were 17 cases presented with sleep apnea in this study, while 13 cases presented without apnea. Only 8 cases out of 17 cases with apnea showed pulmonary hypertension, and this correlation was statistically significant (P value < 0.05).

II- Operative data: Adenoidectomy was carried out for 6 (20%) children, their tonsils were grade I - II. Adenotonsillectomy was carried out for 24 (80%) children who had adenoid and large tonsils (grade III – IV).

III- Post-operative follow up:

Table (7): Comparison between pre and post-operative symptoms among the study group.

<table>
<thead>
<tr>
<th>Operation</th>
<th>Symptoms</th>
<th>Pre (n = 30)</th>
<th>Post (n = 30)</th>
<th>Z</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Snoring</td>
<td></td>
<td>30 (100%)</td>
<td>2 (6.7%)</td>
<td>4.95</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Mouth breathing during sleep</td>
<td></td>
<td>27 (90%)</td>
<td>5 (16.7%)</td>
<td>3.89</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Hyponasal voice</td>
<td></td>
<td>28 (93.3%)</td>
<td>0 (0%)</td>
<td>19.8</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Day time mouth breathing</td>
<td></td>
<td>22 (73.3%)</td>
<td>6 (20%)</td>
<td>3.02</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>Restless sleeping</td>
<td></td>
<td>20 (66.7%)</td>
<td>0 (0%)</td>
<td>6.33</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Day time somnolence</td>
<td></td>
<td>16 (53.3%)</td>
<td>0 (0%)</td>
<td>4.27</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Enuresis nocturna</td>
<td></td>
<td>6 (20%)</td>
<td>1 (3.4%)</td>
<td>2.01</td>
<td>&lt; 0.05</td>
</tr>
</tbody>
</table>

From table (7): the preoperative symptoms showed highly significant improvement 1 week postoperatively (P value < 0.001). Regarding to hyponasal voice, day time somnolence and restless sleeping, they disappeared in
all cases, while snoring and nocturnal enuresis disagreed in nearly all cases, but regarding to mouth breathing during sleep and day time mouth breathing disappeared in about 80% of cases.

Table (8): Pre and post-operative pulmonary hypertension detected by echocardiography.

<table>
<thead>
<tr>
<th>Pulmonary Hypertension</th>
<th>No.</th>
<th>%</th>
<th>Z test</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-operative</td>
<td>8</td>
<td>(26.7%)</td>
<td>Z&lt;sub&gt;1&lt;/sub&gt; = 2.02</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>Post-operative 1 week</td>
<td>2</td>
<td>(6.7%)</td>
<td>Z&lt;sub&gt;2&lt;/sub&gt; = 3.3</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>4 months</td>
<td>0</td>
<td>(0%)</td>
<td>Z&lt;sub&gt;3&lt;/sub&gt; = 1.96</td>
<td>&gt; 0.05</td>
</tr>
</tbody>
</table>

From table (8): there were 6 cases (6.7%) out of 8 cases detected with pulmonary hypertension preoperatively showed complete improvement 1 week postoperative and this was statistically significant (P value < 0.05), the remainder 2 cases showed complete improvement 4 months postoperative and this was highly statistically significant (P value < 0.001).

Table (9): Comparison between the mean of PASP of children who has pulmonary hypertension pre-operative and post-operative (one week and four months).

<table>
<thead>
<tr>
<th>Time</th>
<th>PASP</th>
<th>X ± SD</th>
<th>X ± SD of the difference</th>
<th>SE</th>
<th>Paired t-test</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-operative</td>
<td>34.21±6.7</td>
<td>15.04±5.44</td>
<td>1.92</td>
<td>T&lt;sub&gt;1&lt;/sub&gt; = 7.82</td>
<td>&lt; 0.001</td>
<td></td>
</tr>
<tr>
<td>Post-operative</td>
<td>19.17±5.6</td>
<td>18.0±11.8</td>
<td>4.17</td>
<td>T&lt;sub&gt;2&lt;/sub&gt; = 4.32</td>
<td>&lt; 0.001</td>
<td></td>
</tr>
<tr>
<td>4 months</td>
<td>16.21±7.59</td>
<td>2.96±3.9</td>
<td>1.38</td>
<td>T&lt;sub&gt;3&lt;/sub&gt; = 2.15</td>
<td>&lt; 0.05</td>
<td></td>
</tr>
</tbody>
</table>

Table (9): shows that the comparison between preoperative and one week postoperative PASP showed highly statistically significant decrease in the PASP, the mean value of preoperative PASP was (34.21 ± 6.7), and one week postoperative PASP was (19.17 ± 5.6) p value < 0.001, also the comparison between preoperative and 4 months postoperative PASP showed highly statistical significant decrease in the PASP the mean value of preoperative PASP was (34.21 ± 6.7), and 4 months postoperative PASP was (16.21 ± 7.59), p value < 0.001.

**Figure (1):** Nasopharyngeal soft tissue X-ray (Lateral view) shows nearly complete attenuation of nasopharyngeal airway (large adenoid). **(Case No. 5)**

**Figure (2):** Chest x-ray of another case shows normal CT ratio. **(Case No. 5)**
DISCUSSION

According to (Luke et al.) (10), hypoxia has 2 effects on cardiopulmonary system. Firstly, it leads to pulmonary vasoconstriction, an increase in m PAP and right ventricular after-load, finally causing right ventricular hypertrophy and right ventricular heart failure; secondly, it causes pulmonary edema by increasing capillary permeability. As regards sleep apnea, the parents of thirty snorer children were asked about sleep disturbance and whether their children exert efforts in breathing or not. Based on the facts previously reported by (Attal et al.) (11), who stated that diagnosis of sleep apnea can be achieved by clinical history.

Moreover, (Brouillette et al.) (12) stated that difficulty in breathing during sleep observed by parents strongly suggests that the child has OSA. In this study, it was found that 17 (56.7%) out of thirty snorer children had sleep apnea. These results agreed with those of (Yilmaz et al.) (1) who found that sleep apnea in 31 (59%) out of 52 children and also agreed with (Richardson et al) (13) who found sleep apnea in 60% of their cases with adenotonsillar hypertrophy. However, our results (56.7%) were higher than those of (Ischizuka and Kakuta) (14) who reported it in 40-45% of children with adenotonsillar hypertrophy as the cause of snoring and
their results were supported by the use of polysomnography. The difference between our results and results of (Ishizuka and Kakuta)\(^{(14)}\) may be due to the subjective assessment of apnea by parents as they may wrongly note the presence or absence of apneic episodes when the child is asleep, also there is one limitation of this study as we could not mange to perform a polysomnography (the gold standard for diagnosis of OSA). However, (Carroll et al)\(^{(15)}\) reported that snoring cannot be reliably distinguished from childhood obstructive sleep apnea by clinical history alone.

In this study, nearly all cases (93.3%) with snoring and sleep apnea improved after relief of obstructed upper airway either by adenoidectomy, tonsillectomy or both. This results is in accordance with that (Eliaschar et al)\(^{(16)}\) who observed improvement of snoring and apnea in 11 (78.6%) out of 14 children after adenotonsillectomy. Regarding to hyposonal voice, there were not much higher to cause any changes in restless sleeping and day time somnolence. Cardiopulmonary system that is detectable on chest x-ray, disappeared after relief of upper airway obstruction. But mouth breathing during sleep and day time mouth breathing had disappeared in only 83% and 80% of cases respectively. These results are similar to the results of (Miman et al)\(^{(19)}\). In a majority of patients with adenotonsillar hypertrophy, we see very mild symptoms or no symptoms at all related to the cardiopulmonary system, but symptomless chronic changes may slowly occur in these children. Therefore, it is wise to monitor these patients by an easy, noninvasive cost effective method; this can easily be done by monitoring mPAP of these children with Doppler echocardiography. As regards, the cardiopulmonary complications, echocardiography showed pulmonary hypertension in 8 (26.7%) children out of 30 of the study group. These results are less than (Yilmaz et al)\(^{(1)}\) who detected 27 (51%) out of 62 children, this difference may be due to the fact that duration of symptoms suggesting upper airway obstruction weren’t enough to produce pulmonary hypertension in addition to number of cases in this study is nearly half number of their study. In this study, 8 (47.1%) out of 17 children who gave history of sleep apnea developed pulmonary hypertension and the correlation between apnea and pulmonary hypertension was statistically significant (P value < 0.05). This result is in accordance with the results of (Sofer et al)\(^{(17)}\), who found no abnormalities in the chest x-ray of our patients.

**Limitations of the work**

- Inability to perform a polysomnography which is the gold standard for diagnosis of OSA.
- Small number of cases included in this study.

**CONCLUSION**

Pulmonary hypertension must be considered in our mind during management of adenotonsillar hypertrophy. Doppler echocardiography may help the surgeon for decision making for adenotonsillectomy and appeared to be an important modality for follow up of the patients post-operatively.

**REFERENCES**


الملخص العربي

لما لا شك فيه أن ضيق التنفس المزمن عند الأطفال يعد الأكثر انتشاراً، ويتسبب في ارتفاع ضغط الدم في الشريان الرئوي وفشل في وظيفة القلب، كما أن تضخم اللوزتين واللحمية يعتبر أكبر سبب معروف لانسداد الجهاز التنفسى العلوي عند الأطفال.

يعتبر الهدف من هذه الدراسة هو قياس ضغط الدم في الشريان الرئوي في الأطفال الذين يعانون من تضخم اللحمية واللوزتين، ولإيضاح إذا ما كان استئصال اللحمية واللوزتين له تأثير على ضغط الدم في الشريان الرئوي لهؤلاء الأطفال وأيضاً تهدف هذه الدراسة إلى معرفة ما إذا كانت المشاكل المتصلة على تضخم اللحمية واللوزتين بما فيها ارتفاع ضغط الدم في الشريان الرئوي يمكن أن تتحسن باستئصال اللحمية واللوزتين وما الوقت اللازم لهذا التحسن التام؟

اشتملت هذه الدراسة على ثلاثين طفلاً يعانون من الشخير وقد تم إجراء الآتي لهم:

1- إجراءات ما قبل الجراحة:
   - أخذ التاريخ المرضي الكامل.
   - الفحص العام للمريض.
   - الفحص الكامل للأنف والأذن والحنجرة.
   - أشعة عادية على الرقبة (وضع جانبي).
   - أشعة عادية على الصدر.
   - التحاليل الطبية اللازمة لعملية استئصال اللوزتين.

2- الجراحة: تم إجراء جراحة استئصال للحمية أو اللوزتين أو كليهما لجميع الحالات.

3- إجراءات ما بعد الجراحة: تم إجراء فحص إكلينيكي عام وتمت متابعة الحالات التي وجد بها اضطرابات في القلب باستخدام الموجات فوق الصوتية على القلب بعد أسبوع واحد وأربعة أشهر من إجراء الجراحة.

وقد أعطت نتائج الدراسة الآتي:

- بالنسبة للأشعة العادية على الرقبة، تبين وجود 6 حالات (20%) لديهم لحمية صغيرة، 24 حالة (80%) لديهم لحمية كبيرة.

- بالنسبة للأشعة العادية على القلب، أوضحت عدم وجود حالات بها تضخم في عضلة القلب. وبالنسبة للأشعة فوق الصوتية على القلب، فقد أوضحت ارتفاع ضغط الدم في الشريان الرئوي في ثمان حالات (%26.7).

وبعد إزالة سبب الانسداد في المجاري الهوائية بواسطة استئصال اللحمية أو اللوزتين أو كلاهما، اختفت نوبات الشخير وتوقف التنفس تقريباً في كل الحالات وأوضحت الموجات فوق الصوتية على القلب تحسن ضغط الدم في الشريان الرئوي في 75% من الحالات التي كانت تراقب من ارتفاع ضغط الدم في الشريان الرئوي في خلال أسبوع واحد بعد العملية، وبحلول الشهر الرابع حدث تحسن في بقية الحالات.

من خلال هذه الدراسة، نستطيع أن نستنتج أن تضخم اللحمية واللوزتين من الأسباب التي تؤدي إلى ارتفاع ضغط الدم في الشريان الرئوي، وأن استئصال أحدهما أو كلاهما يعتبر من الطرق العلاجية المؤثرة لـ هلءات الأطفال. ومن وجهة نظرنا نستطيع أن نقول أن الموجات فوق الصوتية على القلب من الطرق الرخيصة والعملية لتقييم الأطفال الذين يعانون من تضخم اللحمية واللوزتين التي تساعد أطباء الآلت الزن وآلذن لاتخاذ قرار باستئصالهما وأيضاً تعتبر مهمة لمتابعة هؤلاء الأطفال بعد العملية.