Correlation between tidal breathing flow volume loops and obstructive sleep apnea in young children with adenotonsillar hypertrophy

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**Background**: The availability and cost of polysomnography limit its use as a diagnostic test for obstructive sleep apnea (OSA). Tidal breathing flow volume (TBVF) loops can determine the site and severity of airway narrowing in infants and young children.

**Objective**: To determine whether the configurations of TBVF loops assessed during sleep correlated with OSA and its severity in young children with adenotonsillar hypertrophy (ATH).

**Methodology**: Retrospective study was performed in the patients aged ≤ 5 years who presented at King Chulalongkorn Memorial Hospital during 1999-2000 with ATH and suggestive symptoms for OSA. All patients had overnight 4-channel cardio-respiratory monitoring and TBVF loops assessment performed during sleep in the same admission. OSA/hypopnea index, lowest arterial oxygen saturation (SpO2) during sleep and TBVF loops parameters such as mid tidal expiratory flow rate/mid tidal inspiratory flow rate (Me/MI) ratio and peak tidal expiratory flow rate/tidal volume (PTEF/Vt) ratio were reviewed.

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Results: Twenty patients with the mean age of 4.0 ± 0.8 yrs (range 3-5 yrs) were reviewed. Median OSA/hypopnea index was 2.7/hr (range 0-19.8/hr). OSA was found in 16 patients (80%). The TBFV loops showed normal in 6, variable upper airway obstruction (UAO) in 9, and fixed UAO in 5 patients. In patients who had variable UAO, there was no correlation between Me/Mi and either OSA/hypopnea index (r=0.4; ns) or lowest SpO₂ during sleep (r= -0.3; ns). The number of the patients who had OSA was not different among those who had normal loops, variable UAO and fixed UAO (4, 9 and 3, respectively; ns). There was no difference in the number of those who had SpO₂ <92% during sleep among these 3 groups of patients (3, 7 and 2, respectively; ns).

Conclusion: The configuration of TBFV loops assessed during sleep did not correlate with the occurrence as well as the severity of OSA and could not predict OSA nor its severity. We speculate that the occurrence and the severity of OSA should depend on other factors rather than the size of upper airway during sleep alone.

Keywords: Obstructive sleep apnea, Tidal breathing flow-volume loops, Adenotonsillar hypertrophy.

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สุชาดา ศรีพิทยาราม, เธียรชัย ธรรมมาภิญ, นวลจันทร์ ปราบพาย, จันทนา หาญฤทธิกร, จิตรลดา ศิริจิตรวงษ์. ความสัมพันธ์ระหว่าง Tidal breathing flow volume loops กับการเกิดภาวะทางเดินหายใจอุดตันในขณะนอนหลับ (Obstructive sleep apnea) ในผู้ป่วยเด็กเล็กที่มีต้อทอนซิลและอะเดนอยด์โต. จุฬาลงกรณ์มหาวิทยาลัย 2547 เม.ย.; 48(4): 223 – 34

ปัจจัย/เหตุผลการทําวิจัย: การวิจัยข้อมูลภาวะทางเดินหายใจอุดตันในขณะนอนหลับ (OSA) ในผู้ป่วยเด็กโดยวิธี overnight polysomnography มีข้อจํากัดในเรื่องค่าใช้จ่ายที่สูงและเครื่องมือที่ใช้ยังไม่แพร่หลาย การตรวจดูสัญญาณของ tidal breathing flow volume (TBVF) loops เป็นวิธีที่ทําได้ง่ายในเด็กเล็ก ใช้ประกอบแนวทางและความรุนแรงของการสิ่งแวดล้อมทางเดินหายใจได้

วัตถุประสงค์: เพื่อหาความสัมพันธ์ระหว่างสัญญาณของ TBVF loops กับอาการของ OSA และความรุนแรงของการณ์ในผู้ป่วยเด็กเล็กที่มีอาการนอน การนอนหลับโดยวิธี overnight 4-channel cardio-respiratory monitoring และ TBVF loops ขณะนอนหลับที่โรงพยาบาลจุฬาลงกรณ์ในปีพ.ศ. 2542-2543 ค่า OSA/hypopnea index, ค่าความล้าปอดของออกซิเจนในเลือดแดง (SpO₂) ขณะนอนหลับ และค่าที่วัดได้จาก TBVF loops ในขณะนอนหลับ ได้แก่ mid tidal expiratory flow rate/mid tidal inspiratory flow rate (Me/MI) ratio และ peak tidal expiratory flow rate/tidal volume (PTEF/VI) ratio ได้จากผู้ป่วยที่มี

วัสดุและวิธีการ: เป็นการศึกษาแบบบ่อยหลังในผู้ป่วยเด็กอายุไม่เกิน 5 ปีที่มีต้อทอนซิล/อะเดนอยด์โตและสงสัยภาวะ OSA และเข้ารับการตรวจการนอนหลับโดยวิธี overnight 4-channel cardio-respiratory monitoring และ TBVF loops ขณะนอนหลับที่โรงพยาบาลจุฬาลงกรณ์ในปีพ.ศ. 2542-2543 ค่า OSA/hypopnea index, ค่าความล้าปอดของออกซิเจนในเลือดแดง (SpO₂) ขณะนอนหลับ และค่าที่วัดได้จาก TBVF loops ในขณะนอนหลับ ได้แก่ mid tidal expiratory flow rate/mid tidal inspiratory flow rate (Me/MI) ratio และ peak tidal expiratory flow rate/tidal volume (PTEF/VI) ratio ได้จากผู้ป่วยที่มี

ผลการศึกษา: ผู้ป่วย 20 ราย อายุ 3-5 ปี (อายุเฉลี่ย 4.0 ± 0.8 ปี) ได้รับการศึกษาค่า OSA/hypopnea index อยู่ระหว่าง 0-19.8ช่อง (เฉลี่ย 2.7ช่อง) ผู้ป่วย 16 ราย (ร้อยละ 80) มี OSA ผลการตรวจ TBVF loops พบลักษณะปกตินู่ 6 ราย, variable upper airway obstruction (UAO) 9 รายและ fixed UAO 5 ราย จำนวนผู้ป่วยที่มี OSA ไม่แตกต่างกันระหว่างกลุ่มที่มี loop ปกติ (ค่า OSA 4 ราย) กับอีกกลุ่มที่มี variable UAO (ค่า OSA 9 ราย) และกลุ่มที่มี fixed
UAO (มี OSA 3 ราย) นอกจากนี้ ยังไม่พบความแตกต่างอย่างมีนัยสำคัญทางสถิติของจำนวนผู้ป่วยที่มีค่า $SpO_2$ ต่ำกว่าร้อยละ 92 เมื่อเปรียบเทียบระหว่าง 3 กลุ่มดังกล่าว (จำนวนผู้ป่วยที่มีค่า $SpO_2$ ต่ำกว่าร้อยละ 92 ในแต่ละกลุ่มเท่ากับ 3, 7 และ 2 รายตามลำดับ) ในกลุ่มที่มี variable UAO พบว่า ไม่มีความสัมพันธ์ระหว่างค่า $Me: Mi$ ratio กับ OSA index ($r = 0.4; ns$) หรือค่า $SpO_2$ ($r = -0.3; ns$)

สรุป:
ลักษณะของ TBFV loops ไม่ส่งผลกับการเกิด OSA หรือความรุนแรงของ OSA การเกิด OSA ในเด็กอาจเกี่ยวข้องกับปัจจัยอื่น ๆ นอกจากนี้ไปจากการตัวแปรของทางเดินหายใจในขณะนอนหลับ การสูญเสียของ TBFV loop ไม่ช่วยทำนายภาวะ OSA ในผู้ป่วยเหล่านี้

คำสำคัญ:
ภาวะจุดกันของทางเดินหายใจในขณะนอนหลับ, tidal breathing flow volume loop, ภาวะสัมพันธ์เรียงและระดับออกซิเดซิต
Obstructive sleep apnea (OSA) can be found in children of all ages, especially those in the preschool period when there is a substantial growth of the adenoid and tonsils.\(^1\) Definite demographic data of OSA in children has not yet been well established. The prevalence of OSA in children varies from 0-10.3 % with the prevalence of 0.7 % among Thai school-age children.\(^2\) The disease is characterized by recurrent episodes of partial or complete upper airway obstruction occurring during sleep.\(^3\) It has been believed that a combination of structural and neuromotor defects contributes to the narrowing of the upper airway during sleep in OSA patients.\(^1\)

Tidal breathing flow volume (TBFV) loops can determine the site of airway obstruction in infants and children.\(^4\) Several studies demonstrated the characteristic signs of extrathoracic airway obstruction and limitation in flow volume loops of OSA in adults.\(^5\) However, many studies revealed low sensitivity and specificity of the tests in screening for OSA.\(^6\) All of these studies were performed while the patients were awake and in non-tidal breathing maneuver which might not represent the real status of upper airway patency during sleep or when OSA occurs. Evaluation of TBFV loops during sleep should provide useful information regarding the size of the upper airway that may be useful for the prediction of OSA, especially in young children who may not well tolerate the standard monitoring of overnight 16-channel polysomnography (PSG).

The aim of our study was to determine if there was a correlation between the configuration of TBFV loops and the occurrence as well as the severity of OSA in young children with adenotonsilar hypertrophy and snoring.

**Material and Method**

We retrospectively reviewed 20 patients, aged ≤ 5 years who presented with snoring and adenotonsillar hypertrophy as well as suggestive symptoms for OSA such as difficult or stop breathing during sleep, restless sleep, failure to thrive and poor school performance. All patients were admitted during 1999-2000 at King Chulalongkorn Memorial Hospital for an overnight 4-channel cardio-respiratory monitoring and had TBFV loops assessed during sleep in the following morning. Patients with neuromuscular or craniofacial disorders predisposed to OSA as well as those who had other causes of airway obstruction were excluded from the review. Tonsillar hypertrophy was defined when the patient demonstrated at least 3+ size of both tonsils. All patients had adenoid hypertrophy diagnosed by the x-rays of the lateral nasopharynx which were reviewed by the radiologists.

**Laboratory studies**

Each patient had an overnight 4-channel cardio-respiratory monitoring performed by using Sleep I/T\(^\text{®}\) (CNS, Inc. Chanhassen, MN) at the hospital. The monitored parameters included, namely:

- nasal and oral airflow measured by using the thermisters
- chest and abdominal wall movements
- arterial oxygen saturation (SpO\(_2\)) including pulse waveforms
- electrocardiogram

The total sleep times were 6-8 hours. Parents or caregivers were allowed to stay with the patients throughout the study nights. The sleep onset and sleep termination were clinically observed by the parents or caregivers. Movement artifacts were noted when
the patients demonstrated irregularities of chest/abdominal movement signals in addition to the irregularities of the pulse waveform signals, which were confirmed by the observations of the parents or caregivers.

The cardio-respiratory monitoring was scored by attending pediatric pulmonologists. An obstructive apnea event was defined when the patient demonstrated an absence of oro-nasal airflow signal lasting longer than 2 respiratory cycles times without a reduction of respiratory effort. An obstructive hypopnea event was defined when the patient demonstrated a 50 % or greater decrease in the amplitude of oro-nasal airflow signal lasting longer than 2 respiratory cycles times without a reduction of respiratory effort. Obstructive sleep apnea was diagnosed when the patients demonstrated OSA/hypopnea events greater than 1 per hour of total sleep time (OSA/hypopnea index >1/hour), either with or without desaturation. Desaturation event was defined when the SpO₂ was lower than 92 %.

Flow (L/min)

(PTEF = peak tidal expiratory flow rate, Me = Mid tidal expiratory flow rate, Mi = mid tidal inspiratory flow rate, Vt = tidal volume)

**Figure 1.** Normal tidal breathing flow volume loop (16)

The TBFV loops were assessed during sleep on the following day by a pulmonary lab technician who blinded to the results of the overnight 4-channel cardio-respiratory monitoring. The TBFV loops were obtained by using the Pediatric Pulmonary Function Cart (Sensormedics 2600®; Yorba Linda, CA). Chloral hydrate (50 mg/kg/dose) was given if the patients

Normal loop : Me/Mi = 0.7-1.5, PTEF/Vt = 1.0 – 4.0

Variable UAO : Me/Mi >1.5, PTEF/Vt = 1.0 – 4.0

Fixed UAO : Me/Mi = 0.7-1.5, PTEF/Vt < 1.0

(PTEF = peak tidal expiratory flow rate, Me = Mid tidal expiratory flow rate, Mi = mid tidal inspiratory flow rate, UAO = Upper airway obstruction, Vt = tidal volume)

**Figure 2.** Characteristic of each type of tidal breathing flow volume loops (16)
could not sleep by themselves. Four acceptable TBFV loops (complete loop with less than 15% of tidal volume variation) were selected. Tidal volume (Vt), peak tidal expiratory flow rate (PTEF), mid tidal expiratory flow rate (Me) and mid tidal inspiratory flow rate (Mi) were measured and analyzed from the selected loops (Figure 1). The patients were classified into 3 groups (normal loop, variable upper airway obstruction [UAO] and fixed UAO) basing upon the configuration of the loops (Figure 2) and the following criteria:165

- Normal loop : Me/Mi = 0.7 - 1.5 and PTEF/Vt = 1.0 - 4.0
- Variable UAO : Me/Mi > 1.5 and PTEF/Vt = 1.0 - 4.0
- Fixed UAO : Me/Mi = 0.7 - 1.5 and PTEF/Vt < 1.0

The following data were collected:
- Demographic data including ages and genders
- The lowest SpO₂ recorded during sleep
- OSA/hypopnea index
- The Me/Mi ratio and the PTEF/Vt ratio

Statistical analysis

Comparisons of ages and gender distribution among the 3 groups of patients (normal loops, variable UAO and fixed UAO) were made by using Anova test and Fischer Exact test, respectively. The correlation between Me/Mi ratio and OSA/hypopnea index as well as the lowest SpO₂ during sleep were assessed by using Pearson correlation. The number of patients who had OSA as well as the number of patients who had desaturation during sleep were compared among the 3 groups of patients by using Fischer Exact test. The p value < 0.05 was considered for a statistical significance.

The study protocol was approved by the Ethics Committee for Human Research Study of the hospital.

Results

Twenty patients, aged 4.0 ± 0.8 years (ranged 3-5 years; 25% female) were reviewed. The data of the studied patients (demographic data, TBFV loops parameters, OSA/hypopnea index and lowest SpO₂ observed during sleep) were shown in Table 1. The OSA/hypopnea index ranged between 0-19.8/hour (median 2.7/hour). There were 16 patients (80%) who had OSA/hypopnea index > 1/hour and 12 patients (60%) who had significant desaturation (SpO₂ < 92%) during sleep. Six of twenty (30%) patients had normal TBFV loops while nine (45%) had variable UAO, and five (25%) had fixed UAO. The mean ages of those who had normal TBFV loop, variable UAO and fixed UAO were 4.3 ± 0.9, 3.9 ± 0.6, and 3.7 ± 0.8 years, respectively. The percentages of female gender were 33, 22, and 20%, respectively. Among these 3 groups of patients, there was no difference in the mean age, gender distribution, the number of patients who had OSA, and the number of patients who had significant desaturation during sleep (Table 2).

All of those who had variable UAO had OSA. Seven of them (78%) had significant desaturation. The Me/Mi ratio did not correlate with either OSA/hypopnea index (r = 0.4; ns) or lowest SpO₂ observed during sleep (r = -0.3; ns).
Table 1. Demographic data, TBFV loop parameters, OSA/hypopnea index and lowest SpO₂ observed during sleep of the studied patients.

<table>
<thead>
<tr>
<th>Patients No.</th>
<th>Age (yrs)</th>
<th>Gender</th>
<th>Me/Mi</th>
<th>PTEF/Vt</th>
<th>Type of TBFV Loop</th>
<th>Lowest SpO₂ (%)</th>
<th>OSA/hypopnea index (hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>male</td>
<td>1.6</td>
<td>1.6</td>
<td>Variable UAO</td>
<td>80</td>
<td>6.8</td>
</tr>
<tr>
<td>2</td>
<td>4.5</td>
<td>male</td>
<td>2.1</td>
<td>1.4</td>
<td>Variable UAO</td>
<td>88</td>
<td>1.2</td>
</tr>
<tr>
<td>3</td>
<td>3.5</td>
<td>female</td>
<td>1.2</td>
<td>1.5</td>
<td>Normal</td>
<td>90</td>
<td>6.1</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>male</td>
<td>1.3</td>
<td>1.4</td>
<td>Normal</td>
<td>92</td>
<td>0.2</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>male</td>
<td>1.1</td>
<td>1.1</td>
<td>Normal</td>
<td>93</td>
<td>1.9</td>
</tr>
<tr>
<td>6</td>
<td>3</td>
<td>male</td>
<td>0.9</td>
<td>0.8</td>
<td>Fixed UAO</td>
<td>95</td>
<td>0.5</td>
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<td>7</td>
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<td>1.0</td>
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<td>94</td>
<td>1.1</td>
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<td>8</td>
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<td>1.7</td>
<td>1.2</td>
<td>Variable UAO</td>
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<tr>
<td>9</td>
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<td>1.3</td>
<td>1.2</td>
<td>Normal</td>
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<td>Normal</td>
<td>80</td>
<td>6.6</td>
</tr>
<tr>
<td>11</td>
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<td>1.5</td>
<td>Normal</td>
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<td>0.9</td>
<td>Fixed UAO</td>
<td>88</td>
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<td>13</td>
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<td>0.8</td>
<td>Fixed UAO</td>
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<td>Variable UAO</td>
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<td>8</td>
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<td>Variable UAO</td>
<td>77</td>
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<td>17</td>
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<td>1.4</td>
<td>Variable UAO</td>
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<td>4.3</td>
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<td>Variable UAO</td>
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<td>Variable UAO</td>
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<tr>
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<td>male</td>
<td>0.9</td>
<td>0.9</td>
<td>Fixed UAO</td>
<td>80</td>
<td>5.2</td>
</tr>
</tbody>
</table>

(Me/Mi = Mid tidal expiratory flow rate/mid tidal inspiratory flow rate ratio, OSA = Obstructive sleep apnea, PTEF/Vt = Peak tidal expiratory flow rate/tidal volume ratio, SpO₂ = Arterial oxygen saturation, TBFV = Tidal breathing flow volume, UAO = Upper airway obstruction)

Table 2. Comparison of the number of patients with OSA and the number of patients with desaturation during sleep among the 3 groups of patients (normal loop, variable UAO and fixed UAO).

<table>
<thead>
<tr>
<th></th>
<th>Normal loop (n=6)</th>
<th>Variable UAO (n=9)</th>
<th>Fixed UAO (n=5)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of patients with OSA</td>
<td>4 (67%)</td>
<td>9 (100%)</td>
<td>3 (60%)</td>
<td>ns</td>
</tr>
<tr>
<td>No. of patients with SpO₂ &lt; 92%</td>
<td>3 (50%)</td>
<td>7 (78%)</td>
<td>2 (40%)</td>
<td>ns</td>
</tr>
</tbody>
</table>

(OSA = Obstructive sleep apnea, SpO₂ = Arterial oxygen saturation, TBFV = Tidal breathing flow volume, UAO = Upper airway obstruction)
Discussion

Tidal breathing flow volume loop can be used for evaluating the upper airway function in children. The site of the UAO can be determined by the characteristic of the loops and Me/Mi ratio. Normal children demonstrate oval-shape flow volume loops during tidal breathing while those who have extrathoracic UAO demonstrate a relatively decrease of inspiratory flow rate and increase of Me/Mi ratio. If the obstruction is more severe, the expiratory flow rate can also be affected, resulting in fixed loop pattern. This implies that the configuration of TBFV loop may be useful for determining the severity of airway obstruction.

In our study, most of the patients had TBFV loops that were suggestive for variable UAO. All of them had OSA. We could not demonstrate the correlation between Me/Mi ratio and OSA severity. This may be explained by the variation of the patients' ability in creating the driving pressure across the narrowing airway. Some children might be able to increase the driving pressure with consequently increasing the inspiratory flow rate during the tidal breath and then minimizing the flow limitation.

Only 25% of our patients demonstrated fixed UAO. We could not demonstrate the correlation between the configuration of the loops and the occurrence as well as the severity of OSA in our patients. Despite no statistical significance, the proportions of the patients who had OSA and desaturation in the fixed UAO group were less than those in variable obstruction group (60% vs 100%). This implied that not only the size of the upper airway during sleep, but also other factors determined the occurrence and severity of OSA in children. Subtle decrease of hypercapnic ventilatory drive has been reported in some OSA children. Further studies regarding the ventilatory drive in OSA children are still needed.

Despite being a gold standard for diagnosing OSA, the overnight, attended 16-channel PSG has several limitations that limit its use especially in developing countries. Besides the high cost of the test, other factors that limit its use in children include the time consuming and the complexity of the monitoring system that may not be well tolerated by young children. Therefore, other techniques of cardio-respiratory monitoring have been studied in order to substitute PSG. Morielli et al reported that the accuracy of determining sleep and wakefulness in children by using cardio-respiratory and videotape recording at home was comparable with EEG monitoring using in PSG. Other unattended, abbreviated cardio-respiratory monitoring such as nap study, overnight pulse oximetry and home videotaping have been reported to be useful for detecting OSA in children and adults despite having some limitations with their high false negative rates. The guidelines of the American Thoracic Society and the American Academy of Pediatrics suggested that the positive results of the unattended, abbreviated cardio-respiratory monitoring may be helpful and adequate for determining OSA in otherwise healthy children.

In our study, we did not use the overnight, attended 16-channel PSG as a diagnostic tool for OSA because of the high expense of the test, the shortage of the number of sleep-lab personnel, and poor patients' compliance. Most small children could not provide a good compliance with the
electrodes applied on their heads for monitoring electroencephalogram, electromyogram and electro-occulogram during full PSG. Therefore, we decided to use the overnight 4-channel cardio-respiratory monitoring for diagnosing OSA in our patients. Their sleep onset and sleep termination were determined by the parents or caregivers who were familiar with the sleep pattern of the patients. Movement artifacts were carefully noted by observing the oximetry waveform, heart rate variability and parents or caregivers’ observations. By carefully scoring, we believed that this monitoring system could provide good information for diagnosing OSA in our patients.

Conclusion

We found no correlation between the configuration of TBFV loops assessed during sleep and the occurrence as well as the severity of OSA in young children with adenotonsillar hypertrophy. The configuration of TBFV loops performed during sleep could not predict the occurrence and severity of OSA in these children. We speculate that not only the size of the upper airway during sleep but also other factors contribute to the occurrence and severity of OSA in young children with adenotonsillar hypertrophy.

References


10. Haponik EF, Bleecker ER, Allen RP, Smith PL,


polysomnography in the diagnosis of sleep apnea syndrome. Am J Respir Crit Care Med 2000 Sep; 162(3 Pt 1): 814 - 8