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The evaluation of adenoid hypertrophy and obstruction grading based on rhinomanometry after nasal decongestant test in children

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Abstract. – OBJECTIVES: Adenoid hypertrophy (AH) is a very common problem in children. Nasal Fiberoptic Endoscopy (NFE) represents the gold standard method to diagnose AH. Rhinomanometry represents a valid diagnostic support. The aim of our study was to analyze the grade of nasal obstruction caused by AH, in a group of children, with rhinomanometry standard and after ND test versus NFE.

PATIENTS AND METHODS: Two hundred and eighty-four of 300 collaborative children, diagnosed as chronic oral breathers, were enrolled. All children underwent a complete physical examination, anterior active rhinomanometry and a second rhinomanometry after the administration of the nasal decongestant (ND) xylometazoline. All children were evaluated using Nasal Fiberoptic Endoscopy (NFE).

RESULTS: At rhinomanometry nasal obstrucion was found of grade 1 in 102 (35.9%) children, of grade 2 in 41 (14.4%), of grade 3 in 52 (18.3%), of grade 4 in 37 (13%) and of grade 5 in 52 (18.3%). Those patients were tested also with rhinomanometry after ND: grade 1 in 108 (38%) children, grade 2 in 52 (18.3%), grade 3 in 56 (19.7%), grade 4 in 23 (8.1%) and grade 5 in 45 (15.8%). At NFE: 83 (29.2%) patients presented a grade 0, 73 (28.7%) a grade 1, 51 (17.9%), 34 (11.9%) a grade 3 and 43 (15.1%) a grade 4. Comparing the grade of nasal obstruction in NFE and in RM after ND we found a great correlation for grade 1 and grade 5 (respectively 84.3% and 79,1%, $p < 0.001$) and low correlation for the others grades of obstruction. When compared to NFE, rhinomanometry test after ND had 81.1% sensitivity and 84.3% specificity. Operating Characteristic (ROC) curves were derived using data related to rhinomanometry vs NFE, and to Rhinomanometry after ND vs NFE.

CONCLUSIONS: Rhinomanometry after ND, compared to rmhinomanometry, is more specific and useful to evaluate nasal obstruction due to AH in children. RM after ND is a great tool to assess the severity of nasal obstruction. In fact, the minimum and maximum degrees of obstruction to the RM after ND correlate significantly ($p < 0.01$) with those of NFE.

Key Words:
Rhinomanometry, Nasal obstruction, Adenoid hypertrophy, Nasal Fiberoptic Endoscopy, Rhinomanometry after nasal decongestant.

Introduction

Nasal obstruction is a frequently encountered problem in the pediatric age group. It is a non specific symptom that has been associated with a variety of pathologies. However, the most ascertained recurrent cause of chronic nasal obstruction is attributable to adenoidal hypertrophy (AH)[1]. Therefore, chronic and severe nasal obstructions have to be carefully evaluated and treated as soon as possible. However, clinically diagnosing adenoidal obstruction is not easy[2]. Various methods of evaluating the real size of adenoids have been proposed: acoustic rhinomanometry, rhinomanometry, endoscopy and radiographic assessments[3,4].

Nasal Fiberoptic Endoscopy (NFE) is currently believed to be the most accurate method because it provides a direct view of the adenoid pad[3,5]. This is not only a reliable test, but it is also safe and well tolerated[6].

Rhinomanometry is simple and useful test for objective evaluation of nasal airway patency[7,8]. It is often used by clinicians to diagnose nasal obstruction and to follow up patients treated with medical and surgical procedures aimed to improve nasal patency[9,10].

The aim of our study was to analyze the grade of nasal obstruction caused by AH, in a group of children, with Rhinomanometry standard and after ND test versus NFE.

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Patients and Methods

A not randomized observational study was performed. At the Department of Pediatric Immunology and Allergology of Umberto I Polyclinic in Rome we selected 300 children aged 6 to 12 years (mean age 10.6 years) with upper airways obstructive symptoms from January 2008 to December 2011. Parents were asked to fill a validated questionnaire in order to define the condition of "chronic oral breather" as previously reported by the Brouillette et al guidelines revised by Carroll et al[11-13].

The study was approved by the local Scientific Ethics Committee and informed consent at enrolment was obtained by all parents. Exclusion criteria were craniofacial malformations, nasal infections during the last 2 weeks, deviated nasal septum and velopharyngeal insufficiency.

The study design is summarized in Figure 1.

From the analysis of the questionnaire administrated 284 patients were classified habitual snorers. One-hundred and sixty-eigth (59.1%) boys were included. Those patients were selected to underwent a complete physical examination, an anterior rhinoscopy, a NFE and an anterior active Rhinomanometry (Sibelmed Rinospir PRO 164, Barcelona, Spain). Occasional and non-snorers children were excluded.

To perform rhinomanometry patients were asked to wear a face mask, close their mouth and breathe only with the nose in accordance with the International Committee on Standardization of Rhinomanometry[9]. A retest was performed in all patients.

The results of rhinomanometry were considered related to nasal flows of 150 Pa and compared with pediatric reference values height-dependent reported in literature[14]. In accordance with Zapletal et al[14] the degree of nasal obstruction, based on rhinomanometry test values, was estimated as fraction of predicted values (p.v.) of rhinomanometric parameters: grade 1 corresponded to no obstruction (71-100% of p.v.); grade 2 to mild obstruction (57-70% of p.v.); grade 3 to moderate obstruction (43-56% of p.v.); grade 4 to severe obstruction (29-42% of p.v.) and grade 5 to very severe obstruction (less than 29% of p.v.). This method has been previously described[15].

Subjects were administered ND (xylometazoline chloridrate, 0.05%), 2 drops/nostril, with a 5-minute interval between them. The test was repeated after half an hour[16].

NFE was performed by an expert otorhinolaryngologist using a 2.7 mm diameter endoscope and the degree of AH was calculated using Cassano et al criteria[17].

Statistical Analysis

Statistical analyses was performed using SPSS (Statistical Package of Social Sciences, Chicago, IL, USA) software version 9.0. Two by two tables were used to calculate sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV), and grades correlation. We

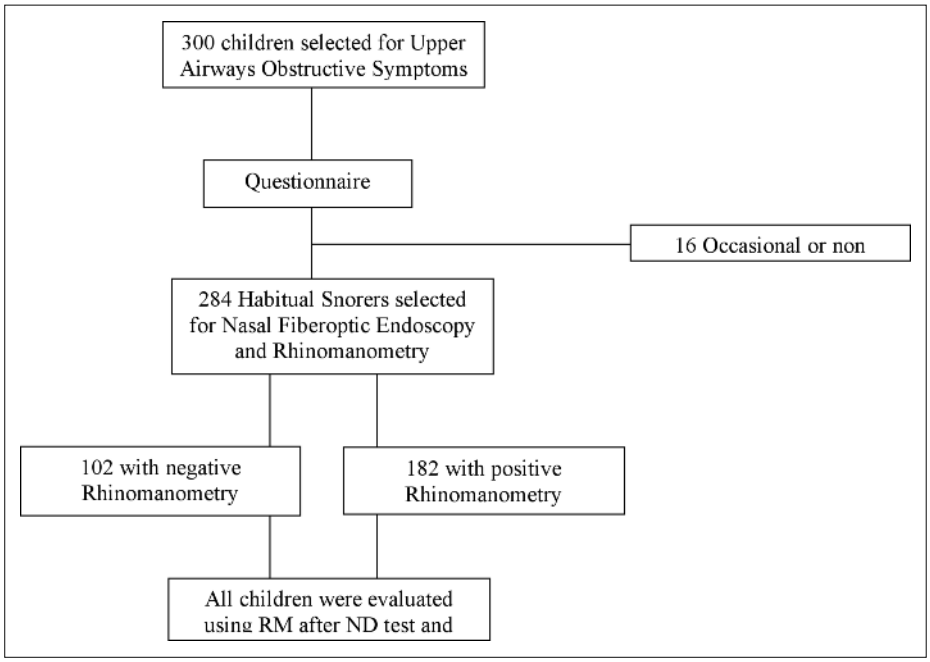


Figure 1. Study design.

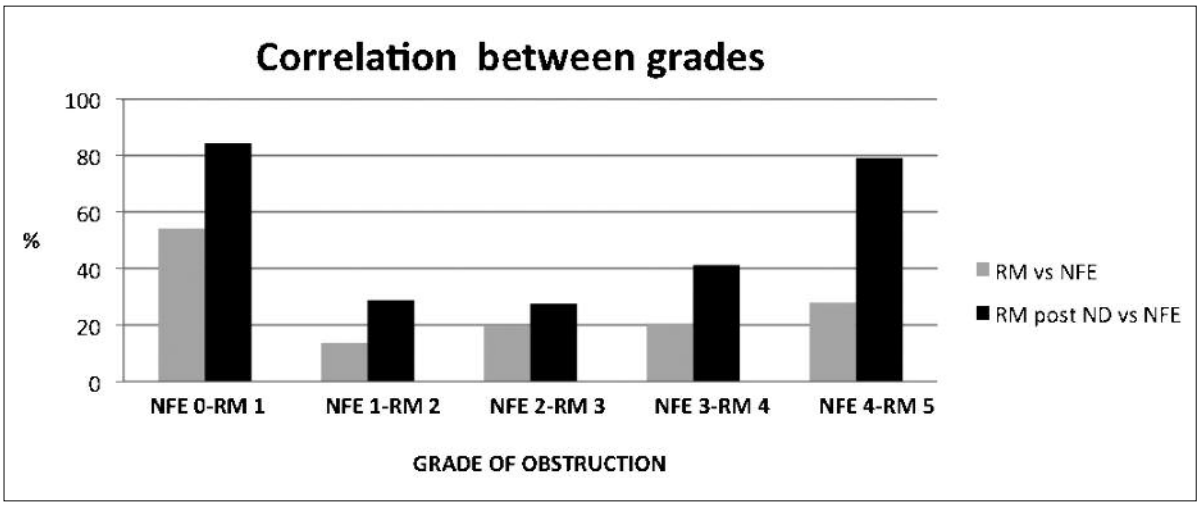


Figure 2. Correlation between the grade of nasal obstruction in RM, and in RM after ND with NFE.

plotted receiver-operator characteristics (ROC) curves for rhinomanometry and NFE, in order to quantify the accuracy of the tests. ROC curve, is a graphical plot of the sensitivity, or true positive rate, vs. false positive rate; it can also be represented by plotting the fraction of true positives out of the positives (TPR = true positive rate) vs. the fraction of false positives out of the negatives (FPR = false positive rate).

Results

According to questionnaire, of 300 patients 284 (94.6%) were classified as habitual snorers and 16 (5.4%) as occasional or non snorers.

The two hundred and eighty-four habitual snoring patients underwent rhinomanometry and the nasal obstruction found was of grade 1 in 102 (35.9%) children, of grade 2 in 41 (14.4%), of grade 3 in 52 (18.3%), of grade 4 in 37 (13%) and of grade 5 in 52 (18.3%).

Those patients were tested also with rhinomanometry after ND which confirmed the presence of nasal obstruction: grade 1 in 108 (38%) children, grade 2 in 52 (18.3%), grade 3 in 56 (19.7%), grade 4 in 23 (8.1%) and grade 5 in 45 (15.8%).

All patients included in the study underwent a NFE: 83 (29.2%) of them presented a grade 0, 73 (28.7%) presented a grade 1 of AH with an occlusion < 25%, 51 (17.9%) presented a grade 2 of AH with an occlusion between 25-50%, 34 (11.9%) presented a grade 3 of AH with an occlusion between 50-75% and 43 (15.1%) presented a grade 4 of AH with an occlusion between > 75%.

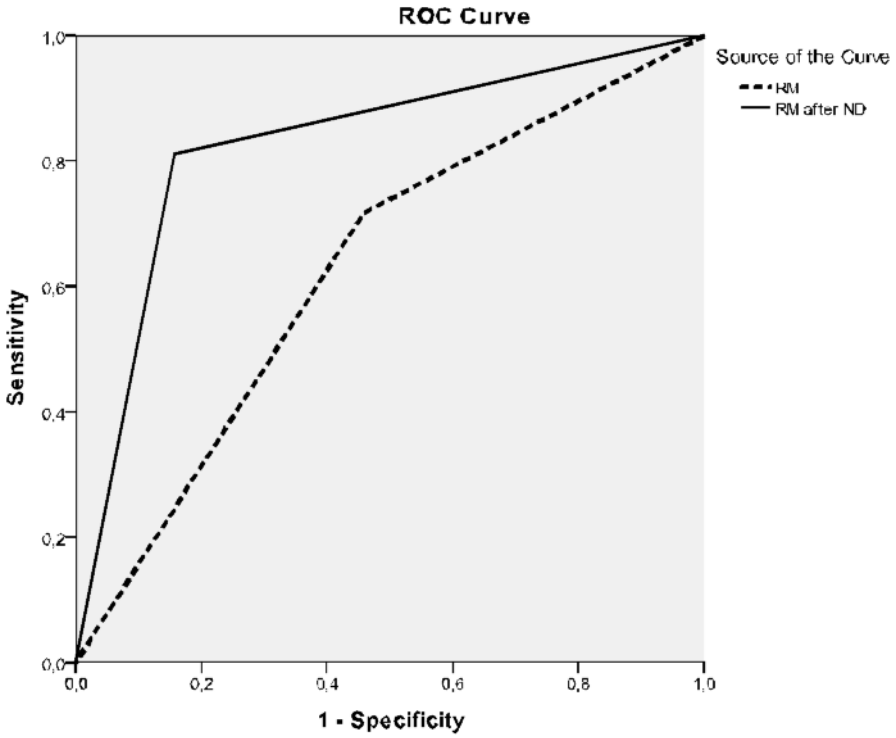
Furthermore, comparing the grade of nasal obstruction we found a great correlation for grade 1 in RM after ND and grade 0 in NFE and grade 5 in RM after ND and 4 grade in NFE (respectively 84.3% and 79.1%, $p < 0.001$) and low correlation for the others grade of obstruction. Whereas in basal RM the correlation with NFE, for the same grade of obstruction, was respectively 54.2% and 27.9% $p < 0.001$ (Figure 2).

In addition, comparing ROC curves for rhinomanometry and rhinomanometry after ND testing by NFE (Figure 3), we evidentiated that the area under curve (AUC) of RM is smaller than AUC of RM after ND testing (AUC difference -0.20; $p < 0.001$).

Discussion

The nasal symptoms are very common in pediatric population. Nasal obstruction during childhood is usually attributed to adenoid hypertrophy[18]. NFE currently represents the gold standard technique for the assessment of AH[17,19].

Ameli et al[20] studied a relationship between adenoid size an allergy in a pediatric population complaining of nasal obstruction using the nasal endoscopy. They showed that large adenoids may be associated with absence of allergy, whereas large turbinates may be associated with small adeoides. They suggest that nasal obstruction could not depend on adenoidal obstruction so the evaluation of the nose and the rhinophaynx is mandatory in each children and it should be performed by nasal endoscopy.



Test Result Variable(s)	Area	Std. error[a]	Asymptotic sig.[b]	Asymptotic 95% Confidence Interval	
				Lower bound	Upper bound
RM	.629	.037	.001	.556	.702
RM after ND	.827	.028	.000	.775	.885

Figure 3. ROC curves for Rhinomanometry and Rhinomanometry after ND testing by NFE.

Advantages related to rhinomanometry test are the functional assessment of the patient and the possibility of a simultaneous evaluation of both nostrils. At the same time, the prolonged time (20 to 30 minutes) needed for the evaluation of the patient and the inability of the test to identify the site of obstruction represents two major disadvantages[21].

Cole et al[22] reported that rhinomanometry can confirm the site and measure the severity of obstruction. Situations in which objective measurements are particularly useful are: allergy, history unreliable (children), nasal obstruction and mouth-breathing. In fact symptoms of nasal obstruction are poorly correlated with objective findings; however the variability is subjective.

The grading system presented by Sanjay et al[23] incorporates the relationship of the adenoid to the torus tubaris (Eustachian tube orifice), vomer (posterior nasalseptum), and soft palate. Specifically grade 1 adenoids are non-obstructive and do not contact any of the previously mentioned anatomic subsites. Subsequently, grade 2, 3, and 4 adenoids contact the torus tubaris, vomer, and soft palate (atrest) respectively.

Our study follows Cassano et al[17] criteria: grade 1 corresponded to free choanal opening (< 25%); grade 2 to adenoids occluding the upper half of the choanal opening (50%), without tubarian ostium involvement; grade 3 to adenoids occluding 75% of the choanal opening, with par-

tial Eustachian tube involvement; grade 4 to adenoids completely occluding the choanal opening associated with an unevaluable tubarian ostium.

In literature there are no correlation between adenoid hypertrophy obstruction grade in NFE and RM after ND. In our 284 patients instead we found a significant correlation between the degree of obstruction of the lower and higher grade the both techniques.

In 2007, Mittenzwey et al[24] suggested xylometazoline to treat nasal mucosa congestion.

According to Straszek et al[25] the inhalation of xylometazoline is associated to nasal dilation and free of major side effects in children.

Since treatment depends on obstruction degree, rhinomanometry after ND could represent a useful test for clinicians to choose the correct treatment and to avoid unnecessary adenomectomies in children.

Conclusions

The present study demonstrates that rhinomanometry test taken after the administration of a topic nasal decongestant is a valid technique for the assessment of AH in children, especially if associated to nasal fiberoptic endoscopy.

Rhinomanometry after ND, compared to rhinomanometry, is more specific and useful to evaluate nasal obstruction.

Also on the basis of the results obtained we can say that RM after ND is a great tool to assess the severity of nasal obstruction. In fact, the minimum and maximum degrees of obstruction to the RM after ND correlate significantly ($p < 0.01$) with those of NFE, which remains the gold standard for the evaluation of AH. This data allows us to state that RM after ND can be a valuable tool to diagnose and monitor the AH.

These two techniques represent a valid tool for clinicians to decide the most appropriate treatment, based on the degree of nasal obstruction.

Conflict of Interest

The Authors declare that there are no conflicts of interest.

References

1) Bitar MA, Birjawi G, Youssef M, Fuleihan N. How frequent is adenoid obstruction? Impact on the diagnostic approach. Pediatr Int 2009; 51: 478-483.
2) Marchisio P, Torretta S, Capaccio P, Esposito S, Dusi E, Nazzari E, Torretta N. Clinical assessment of adenoidal obstruction based on the nasal obstruction index is no longer useful in children. Otolaryngol Head Neck Surg 2010; 142: 237-241.
3) Lertsburapa K, Schroeder JW and Sullivan C. Assessment of adenoidal size: a comparison of lateral radiographic measurements, radiologist assessment, and nasal endoscopy. Int J Pediatr Otolaryngol 2010; 74: 1281-1285.
4) Ameli F, Brocchetti F, Tosca MA, Signori A, Ciprandi G. Adenoidal hypertrophy and allergic rhinitis: Is there an inverse relationship? Am J Rhinol Allergy 2013; 27: 5-10.
5) Kindermann CA, Roithmann R, Lubianca Neto JF. Sensitivity and specificity of nasal flexible fiberoptic endoscopy in the diagnosis of adenoid hypertrophy in children. Int J Pediatr Otorhinolaryngol 2008; 72: 63-67.
6) Cassano P, Gelardi M. Fiberendoscopic assessment of rhinonopharyngeal obstruction due to adenoidal hypertrophy. Medico e Bambino 2000; 19: 239-244.
7) Kern EB. Standardization of rhinomanometry. Rhinology 1977; 15: 115-119.
8) Kobayashi R, Miyazaki S, Karaki M, Kobayashi E, Karaki R, Akiyama K, Matsubara A, Mori N. Measurement of nasal resistance by rhinomanometry in 892 Japanese elementary school children. Auris Nasus Larynx 2011; 38: 73-76.
9) Clement PA. Committee report on standardization of rhinomanometry. Rhinology 1984; 22: 151-155.
10) André RF, Vuyk HD, Ahmed A, Graamans K, Nolst Trenité GJ. Correlation between subjective and objective evaluation of the nasal airway. A systematic review of the highest level of evidence. Clin Otolaryngol 2009; 34: 518-525.
11) Brouilette R, Hanson D, David R, Klemka L, Szatkowski A, Fernbach S, Hunt C. A diagnostic approach to suspected obstructive sleep apnea in children. J Pediatr 1984; 105: 10-14.
12) Brouillette RT, Fernbach SK, Hunt CE. Obstructive sleep apnea in infants and children. J Pediatr 1982; 100: 31-40.
13) Carroll JL, McColley SA, Marcus CL, Curtis S, Loughlin GM. Inability of clinical history to distinguish primary snoring from obstructive sleep apnea syndrome in children. Chest 1995; 108: 610-618.
14) Zapletal A, Chalupová J. Nasal airflow and resistance measured by active anterior rhinomanometry in healthy children and adolescents. Pediatr Pulmonol 2002; 33: 174-180.
15) Zicari AM, Magliulo G, Rugiano A, Ragusa G, Celani C, Carbone MP, Occasi F, Duse M. The role of rhinomanometry after nasal decongestant test in the assessment of adenoid hypertrophy in children. Int J Pediatr Otorhinolaryngol 2012; 76: 352-356.

16) Clement PA, Gordts F. Standardisation Committee on Objective Assessment of the Nasal Airway, IRS, and ERS. Consensus report on acoustic rhinometry and rhinomanometry. Rhinology 2005; 43: 169-179.

17) Cassano P, Gelardi M, Cassano M, Fiorella ML, Fiorella R. Adenoid tissue rhinopharyngeal obstruction grading based on fiberendoscopic findings: a novel approach to therapeutic management. Int J Pediatr Otorhinolaryngol 2003; 67: 1303-1309.

18) Wang DY, Bernheim N, Kaufman L, Clement P. Assessment of adenoid size in children by fibreoptic examination. Clin Otolaryngol Allied Sci 1997; 22: 172-177.

19) Cho JH, Lee DH, Lee NS, Won YS, Yoon HR, Suh BD. Size assessment of adenoid and nasopharyngeal airway by acoustic rhinometry in children. J Laryngol Otol 1999; 113: 899-905.

20) Ameli F, Brocchetti F, Tosca MA, Signori A, Ciprandi G. Adenoidal hypertrophy and allergic rhinitis: is there an inverse relationship? Am J Rhinol Allergy 2013; 27: e5-10.

21) Corey JP. Acoustic rhinometry: should we be using it? Curr Opin Otolaryngol Head Neck Surg 2006; 14: 29-34.

22) Cole P, Fenton RS. Contemporary rhinomanometry. J Otolaryngol 2006; 35: 83-87.

23) Parikh SR, Coronel M, Lee JJ, Brown SM. Validation of a new grading system for endoscopic examination of adenoid hypertrophy. Otolaryngol Head Neck Surg 2006; 135: 684-687.

24) Mittenzwey H, Wüstenberg EG, Leupold W. Optical rhinometry: application on children and adolescents for nasal provocation tests. Pediatr Allergy Immunol 2007; 18: 372-377.

25) Straszek SP, Schlünssen V, Sigsgaard T, Pedersen OF. Reference values for acoustic rhinometry in decongested school children and adults: the most sensitive measurement for change in nasal patency. Rhinology 2007; 45: 36-39.