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MAIN ARTICLE

Role of spirometry in detection of nasal obstruction

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Abstract

Background: A subjective feeling of nasal airflow obstruction is a common symptom. An objective method for quantitative measurement of nasal airflow has long been desired. Rhinomanometry and acoustic rhinometry have been developed for anatomical and physiological evaluation of nasal obstruction. This study was designed to determine the usefulness of a portable spirometer in assessing upper airway obstruction.

Methods: One hundred and ninety-six patients were assessed with nasal inspiratory spirometry to determine nasal airflow. All patients also underwent paranasal sinus computed tomography to determine anatomical abnormalities. Spirometry was performed on each nostril separately.

Results: Sensitivity and specificity levels were high. This portable and easy to use device may be useful in respiratory assessment. Correlation between anatomical obstructions and subjects' complaints was statistically significant ($p < 0.001$), but no definite correlation between septal deviation severity and spirometric values was found.

Conclusion: Portable spirometry is an objective and useful method of evaluating nasal obstruction, but needs more investigation to establish a standardised test.

Key words: Nasal Obstruction; Diagnosis; Spirometry

Introduction

Nasal obstruction leads to increased resistance to nasal airflow.[1,2] One of the most common aetiologies of nasal obstruction is nasal septal deformity.[3] A subjective feeling of obstruction to nasal airflow is a common symptom associated with septal deviation.[2]

The discrepancy between nasal obstruction symptoms and clinical findings is reflected in the poor correlation between subjective nasal obstruction symptoms and objective measurements of nasal airflow.[4] Objective methods of measuring nasal function have been developed and established.[5] An objective measurement of the severity of septal deviation would help the surgeon to select appropriate patients for surgical treatment, and could also be used to assess the effectiveness of surgery.[2] Rhinomanometry and acoustic rhinometry are currently the best methods for objective assessment of nasal obstruction.[6] Many studies have investigated the usefulness of portable spirometers to assess the severity of septal deviation.[2] Recent reports have demonstrated the possibility of quantifying nasal airflow in terms of nasal partitioning ratio, determined by rhinomanometry and spirometry using a portable spirometer.[7] This method assesses inspiratory nasal airflow only, not expiratory airflow.

Materials and methods

Studies based on the nasal cycle are difficult because multiple measurements of nasal patency need to be made over many hours. There is a great need for a simple instrument that can be used for studies away from the clinical laboratory. The spirometer is recognised as being simple to use for both the investigator and the patient.

The present study applied the following exclusion criteria: allergic rhinitis, nasal valve collapse, conchae bullosa, polypoid turbinate and nasopharyngeal masses. These were identified from the clinical history and via clinical and paraclinical examinations, including paranasal computed tomography (CT) without contrast, which was performed in all patients to detect anatomical abnormalities.

A total of 196 subjects were enrolled in the study, after informed consent had been obtained. A clinical trial was designed and conducted, and data were analysed.

A Fukuda-STN 95 spirometer (Fukuda Denshi, Tokyo, Japan) was fitted with a nasal adaptor for each nasal passage during inspiration.

Before each measurement, patients were asked to blow their nose gently to clear any excess secretion and to ensure that the air within the nasal passages

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was at room temperature and a relatively constant humidity. Subjects were instructed not to smoke, drink alcohol or undertake any strenuous activity prior to testing. None of the subjects had taken any systemic nasal decongestants in the preceding 48 hours, or any regular medication.

Each nasal airway was locally vasoconstricted with lidocaine-adrenaline 1/100 000 soaked cotton. Nasal airflow was then measured whilst the other nostril was occluded with surgical tape or a pre-moulded nostril plug. The nasal piece was placed over each of the subject's nostrils so that the whole opening to the nasal passage was sealed in an airtight fashion. A calibrated and programmed spirometer was used to record predicted vital capacity. The subject was instructed to exhale their vital capacity through the mouth and then to inhale their inspiratory vital capacity through first the asymptomatic and then the symptomatic nostril. Subjects were asked to perform this procedure up to three times, and the mean of three inspiratory volume measurements was then calculated as a percentage mean of vital capacity, for each side. The inspired volume through the non-obstructed side (measured as a pre-test value) and the obstructed side (as a post-test value) was displayed on a monitor and the data recorded.

Data were then analysed statistically using the chi-square test.

Results and analysis

A total of 196 pre-evaluated subjects were enrolled. None had undergone previous contrast paranasal sinus CT investigation. The group comprised 93 females (47.4 per cent) and 103 males (52.6 per cent) in the age range 12–70 years. Eighty-one individuals had asymptomatic nasal blockage while 115 individuals had symptomatic nasal blockage (Table I). The sensitivity and specificity of inspiratory rhinospirometry for nasal obstruction were 91.3 and 90.4 per cent, respectively, with positive and negative predictive values of 93.7 and 86.7 per cent, respectively.

Discussion

Nasal obstruction may be caused by structural abnormalities, mucosal disease or a combination of both. All increase resistance to nasal airflow. Nasal septal deformity is one of the most common disorders causing subjective nasal obstruction.[3]

The ability to objectively measure nasal ventilatory dysfunction would be useful to guide the appropriate choice of management.[8] Many methods have been developed for measuring nasal function.[9] Although nasal airflow asymmetry has been expressed as a nasal partitioning ratio,[7,10] rhinomanometry and rhinometry methods are capable of objectively measuring nasal obstruction as a complementary process that assesses nasal function and nasal geometry.[6]

The present study was designed to investigate an additional method of quantitative assessment of nasal septal deviation. Rhinospirometry, also known as reciprocal spirometry, is a rapid, effective, comfortable and relatively simple screening diagnostic method for measurement of airflow and evaluation of a patient's ability to breathe, which correlates significantly with clinical findings.[5] A decrease in inspired volume on the non-obstructed side, as a consequence of turbinate hypertrophy, may be diminished by local vasoconstriction.

- **Portable spirometry may be useful for evaluation of nasal obstruction**
- **It is quick, independent, easy to use and requires no complex calculations**
- **It assesses reciprocal vital capacity, for inspiration only**
- **Results correlate significantly with patients' symptoms**

In the present study, the sensitivity and specificity of rhinospirometry in detecting nasal obstruction were 91.3 and 90.4 per cent, respectively. It can be concluded that, alongside other methods, rhinospirometry may have diagnostic value in evaluating nasal obstruction.[8] This measurement method may have considerable advantages for studying the severity of nasal septal deviation, since it is quick, independent, easy to use and does not require complex calculations.[7] This method is purely inspiratory rather than expiratory, and demonstrates reciprocal vital capacity in accordance with the patient's complaints. The percentage of airflow obstruction on the obstructed side, in comparison with the non-obstructed side, is measurable and interpretable.

However, further investigations are required to improve the test procedure and to establish a standardised method, with appropriate computer software.

Conclusion

Rhinospirometry is a relatively simple screening diagnostic method. It permits objective measurement of nasal airflow and evaluation of a patient's nasal breathing ability, with acceptable correlation with clinical

TABLE I
COMPUTED TOMOGRAPHY *VS* RHINOSPIROMETRY RESULTS

CT diagnosis	Rhinospirometry diagnosis (pts; *n* (%))		Total pts (*n* (%))
	Correct*	Incorrect*	
Obstructed	105 (54)	10 (5)	115 (59)
Normal	72 (36.5)	9 (4.5)	81 (41)
Total	177 (90.5)	19 (9.5)	196 (100)

*Compared with computed tomography (CT) diagnosis. Pts = patients

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findings. This study shows that rhinospirometry constitutes an objective, simple and practical method of assessing the amount of asymmetry of nasal airflow, which can serve as an indicator facilitating patient selection, evaluation and prognosis, regarding nasal septal deviation surgery.

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