

PNIF measurement in a healthy French population. A prospective study about 234 patients*

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SUMMARY

Objective: A prospective study in a healthy French population to evaluate the normal range of PNIF.

Material and methods: In total, 234 subjects separated into 2 groups (group 1: patients with VAS ≥ 8 , $n = 151$ and group 2: patients with VAS < 8 , $n = 83$) have been prospectively enrolled in this study from September 2003 to April 2004. For all participants, nasal obstruction was evaluated through a VAS and two PNIF measurements.

Results: The mean PNIF measurements in group 1 and group 2 were 87.5 L/min and 84.7 L/min, respectively with a significant difference between male and female in both groups ($p < 0.0001$). The reproducibility in group 1 and group 2 was 5.1 L/min and 4.4 L/min respectively. A slight tendency to a reduction due to the age was observed except for patients over 60.

Conclusion: This study confirms that the technique of PNIF measurement is reliable and simple. The normal range of PNIF in a healthy French population has been determined although our results show lower values than previous published reports from other countries. However, it remains an attractive method for the follow-up and survey of patients complaining of nasal obstruction.

Key words: nasal obstruction, PNIF, visual analogical scale, healthy population, subjective evaluation

INTRODUCTION

Nasal obstruction is a common complaint of patients whose evaluation remains mostly subjective. However, sensation and measurement of nasal obstruction may be evaluated with different techniques: rhinomanometry, acoustic rhinometry, Visual Analogic Scale (VAS), questionnaire and PNIF (Peak Nasal Inspiratory Flow rate), etc. ^(1,2) A poor correlation between objective measurements and subjective sensation is frequently reported. Because of the large success of the measurement of expiratory respiratory peak flow in asthmatic patients, PNIF was presented by Youlten ⁽³⁾ and considered reproducible and reliable to analyze the subjective sensation of nasal patency in adults. Portable spirometers have been suggested for general practitioners to evaluate the PNIF as a routine and several studies ⁽⁴⁻⁷⁾ have demonstrated a good correlation between PNIF and the subjective sensation of nasal patency in adults. Taking into account, these previous publications, we conducted a prospective study to evaluate the normal range of PNIF in a healthy French population and compare these

results with previous studies concerning other populations.

MATERIALS AND METHODS

Patients

The study was conducted from September 2003 to April 2004. During this period, 234 subjects aged from 17 to 84 years were included after informed consent. Eligible patients were selected among people accompanying a patient for ENT problems in our department. They were free of any Upper Respiratory Infection (URI) in the last 6 weeks preceding the measurement, and had no history or previous consultations for chronic nasal obstruction or allergic problems. None had complaints of nasal obstruction and other nasal symptom at the period of the inclusion controlled by a standardized modified questionnaire elaborated from Meltzer's scoring system (JACI 1988). Patients with previous nasal surgery were excluded. All were non-asthmatic and presence of lung dysfunction was assessed using a doctor-administrated questionnaire.

Evaluation

For all patients selected after the questionnaire, the sensation of nasal respiratory comfort was additionally evaluated through a visual analogical scale (VAS) graduated from 0 (major discomfort) to 10 (no discomfort at all) just before to perform the measurements. For this study only two measurements has been applied according to the Starling-Schwanz' study⁽⁸⁾ and its suggestions for routine use of this spirometre. The measurement of PNIF was realized with a portable nasal spirometer (Clement Clarke international company, Harlow, Essex, UK) as follows: after five minutes of rest, the patient, in seated position, realized a maximal forced inspiration after a maximal expiration. The two measurements were carried out by trained residents. A one-minute interval was observed between two measurements. In case of a technical problem, an additional measurement was authorized. To improve the selection of the normal population, 2 groups of patients were established: first (group 1) whom VAS score was superior or equal to 8 and second (group 2) with VAS score inferior to 8. The mean value of PNIF was used for the statistical analysis.

Statistical analysis

All data were analyzed with STATview (SAS institute, Berkeley, CA, USA, version 5) and results were expressed as mean \pm standard deviation (SD). Data were compared using the Student's t test. A p-value < 0.05 was considered to be statistically significant.

RESULTS

In total, 234 subjects ranging from 17 to 84 years old were initially included according to the result of the questionnaire. Two PNIF measurements were performed for 97% of all patients, while additional proceedings were necessary in the remaining 3% (Table 1).

According to our criteria for selection, 2 patients groups were established with group 1 including patients with a VAS score equal or over 8 ($n = 151$) and group 2 including patients with a VAS score inferior to 8 ($n = 83$). The mean PNIF value for group 1 was 87.5 L/min and the difference PNIF2 - PNIF 1 was 5.1 L/min. The results of the remaining patients in group 2 ($n = 83$) for the mean PNIF and the difference PNIF2 - PNIF 1 were 84.7 L/min and 4.4 L/min, respectively (Tables 2.1 and 2.2).

The range of PNIF depending of the age is presented in Table 3. A slight tendency but not significant to a reduction due to the age has been observed except for patients over 60.

Table 2.1. Mean PNIF value (L/min) and difference PNIF 2 - PNIF 1 for patients of group 1 with VAS ≥ 8 ($n=151$) and for patients of group 2 with VAS < 8 ($n=83$).

	VAS ≥ 8 n=151	VAS < 8 n=83	p
Mean PNIF (L/min)	87.5 \pm 38.3	84.7 \pm 34.5	< 0.001
Total			
Mean PNIF (L/min)	n=59	n=42	
Men	100.3 \pm 43.6	96.6 \pm 38	< 0.001
Mean PNIF (L/min)	n=92	n=41	
Women	79.3 \pm 32.2	72.5 \pm 25.7	< 0.001
PNIF 2 - PNIF 1 (L/min)	n=151	n=83	
Total	5.1 \pm 25.3	4.4 \pm 21.5	0.05
PNIF 2 - PNIF 1 (L/min)	n=59	n=42	
Men	8.5 \pm 30.6	6.8 \pm 25.7	0.97
PNIF 2 - PNIF 1 (L/min)	n=92	n=41	
Women	2.3 \pm 21.1	2 \pm 16.1	0.001

Table 2.2. Mean PNIF value (L/min) and difference PNIF 2 - PNIF 1 between men and women (L/min) in group 1 with VAS ≥ 8 ($n = 151$) and in group 2 with VAS < 8 ($n = 83$).

VAS	Mean PNIF (L/min)	p	PNIF 2 - PNIF 1 (L/min)	p
VAS ≥ 8				
Men (n=59)	100.3 \pm 43.6		8.5 \pm 30.6	
Women (n=92)	79.3 \pm 32.2	$p < 0.0009$	2.3 \pm 21.1	$p = 0.19$
Total (n=151)	87.5 \pm 38.3		5.1 \pm 25.3	
VAS < 8				
Men (n = 42)	96.6 \pm 38.0		6.8 \pm 25.7	
Women (n = 41)	72.5 \pm 25.7	$p < 0.001$	2 \pm 16.1	$p = 0.3$
Total (n= 83)	84.7 \pm 34.5		4.4 \pm 21.5	

DISCUSSION

Measurement of nasal inspiratory flow has been performed in several studies including patients complaining of nasal obstruction⁽⁹⁾ but few studies have investigated the normal range of PNIF in healthy populations. As to the best of our knowledge no one has ever performed such a study in France, we decided to evaluate a normal population for this technique. In a previous publication, we have confirmed the convenience and repeatability of the technique⁽¹⁰⁾ with this instrumentation and the training effect observed after the first measurement which is globally always lower than the second. The mean difference found between the two measurements in the same patient (PNIF2 - PNIF1) in this study has been considered acceptable compared to previous studies^(6,8). As in

Table 1. Correlation between VAS and PNIF in total population ($n = 234$).

VAS	1	2	3	4	5	6	7	8	9	10
Mean PNIF L/min	30	65	71.2 +/- 23.2	71.2 +/- 37.8	88.2 +/- 30.7	108.5 +/- 48.2	80 +/- 25.9	86.4 +/- 32.2	85.1 +/- 38.9	89.8 +/- 41.7
Number of patients	1	1	10	6	20	15	30	41	42	68

Table 3. Correlation between mean PNIF and age in total population and in group 1 with VAS ≥ 8 .

Total population (n = 234)				
Age (Years)	Number	Mean PNIF (L/min)	Mean PNIF Min - Max	Mean PNIF SD (L/min)
17-29	37	95.9	35-165	34.9
30-39	43	95	30-185	40.3
40-49	62	85.3	30-275	39.3
50-59	35	69.2	37.5-120	25.2
> 60	57	86	30-200	36.3
Group 1 with VAS ≥ 8 (n = 151)				
17-29	21	100.9	37.5-165	37.5
30-39	32	96.9	30-175	38.6
40-49	46	85.8	30-275	41.8
50-59	20	68.1	37.5-110	24.7
≥ 60	32	84	30-200	36.6

these studies, the value of PNIF2 is the highest which confirms a probable learning curve of the technique by the patient. Some studies suggest more measurements to increase the validity of the results but the Starling-Schwanz's study⁽⁸⁾ found no significant difference between the second and the third reading. Concerning the selection of the normal population, it is confirmed through our study that a single questionnaire is not sufficient and that additional methods are necessary to improve the quality of the selected people. The double subjective evaluation with questionnaire and VAS was decided to increase the quality of selection of a population as normal as possible for nasal patency. The additional evaluation with VAS has permitted to select more obviously our healthy population in which only patients with a nasal VAS score over or equal to 8 were incorporated. The difference between mean PNIF value in patients of group 1 and group 2 is not important probably due the small size of each group. Further studies with larger groups are probably necessary to show a significant difference. With this methodology (maximal forced inspiration), our results are inferior for males and females to previous studies performed on English or Finnish populations with the same portable peak flow meter^(11,12) (Table 4). PNIF is highly effort dependent but optimal attention was paid to obtain a good cooperation of the patient and to deliver correct information. On the other hand, our results are not so far to Peynegre's study⁽¹³⁾, comparing the effect of a topical vasoconstrictor in a French population suffering from nasal

obstruction during common cold. The mean PNIF found after 15 min was 105.75 ± 43 L/min (median 100) and could be considered as the best result in a selected French population. Although all parameters for the technique are similar to previous studies, no explanations have been found to support these differences, which confirm the necessity of further studies in different populations and larger groups. However these data are the first to reference a normal French population, and could be considered for future studies evaluating the efficacy of specific treatments or drugs in pathological groups complaining of nasal obstruction. Nevertheless, the absence of a significant correlation between VAS and PNIF in our study confirms that the sensation of nasal congestion is extremely complex including sensation of humidity, pressure, thermal receptors, secretion, dryness and local irritation of the nose. The sensation of nasal congestion is not limited to a single sensation of reduction of nasal airflow⁽⁴⁾. Habituation may probably also play a role in the evaluation by EVA of the sensation of nasal obstruction. However, as previously reported, PNIF is a single procedure, reliable and well adapted for general practice and self survey of the patients. It may be applied for study in large populations with regard to its accessibility, but is not always correlated with subjective evaluation of nasal discomfort.

CONCLUSION

The normal range of PNIF in a healthy French population appears in our study inferior to previous reports. At this moment, no explanation can be suggested. However, PNIF measurement is a reliable and simple technique for evaluation of maximal inspiratory nasal flow especially for self-evaluation of patients suffering to nasal obstruction. Nevertheless, like anterior rhinomanometry, it can not be considered sufficient to analyze the sensation of nasal discomfort of breathing which represents a more complex situation.

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Table 4. Comparison of PNIF value in previous studies.

	Ottaviano ⁽¹⁰⁾	Klossek	Blomgren ⁽⁹⁾
Number of subject	n = 137 Male n = 60 Female n = 77	n = 151 Male n = 59 Female n = 92	n = 100 Male n = 50 Female n = 50
Mean age (years)	Global: nd Male: 43.3 ± 22.1 Female: 40.2 ± 18.6	Global: 46 ± 15 Male: 49.6 ± 16.1 Female: 43.7 ± 14	Global: 21 to 60 Mean: 39
Mean PNIF 2 value (L/min)	Male: 142 ± 46.8 Female: 119.2 ± 36.6	Male: 104.6 ± 54.8 Female: 80.8 ± 33.4	Male: 145 (58-233) Female: 128 (44-211)

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