The Role of Sensation in Subjective and Objective Evaluation of Nasal Patency

S. Dipak · N. Prepageran · Siti Haslinda ·
AS. Atiya · R. Raman

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Abstract To assess if sensation of nasal mucosa affect the subjective sensation of nasal patency. This is a case control study with 50 patients, using 2% lignocaine as the active drug and normal saline as the placebo (2 groups of 25 patients each). Each subject had 2 ml of solution sprayed into the test nose. These subjects had no prior nasal symptoms, allergy or surgery. They were evaluated subjectively using Likert scale and objectively by acoustic rhinometry before and after lignocaine or normal saline. The patients in both normal saline and lignocaine groups demonstrated no significant change based upon Likert scale. The study also demonstrated the mean cross sectional area 1 (CSA1), mean cross sectional area 2 (CSA2), with mean Volume 1 and mean Volume 2, these results did not vary significantly in both groups with Acoustic Rhinometry. The analysis thus shows that the use of topical anesthetic spray on nasal mucosa produces no objective effect on nasal resistance or subjective sensation of altered nasal patency. Thus the study concludes that, tactile sensation of nasal mucosa does not play a role in the sensation of nasal obstruction.

Keywords Nasal patency · Rhinometry · Sensation

Introduction

Nasal patency may be considered to have two aspects; the resistance to airflow and sensation to airflow. It is the former

that has received the most attention from Rhinologist as it can be accurately measured and because obstructive lesions are clinically obvious. Conversely, it is the sensation of airflow that is important to the patient. If stimulation of the nerve endings in the nasal cavities cause an increased sensation of airflow, it would then seem reasonable to surmise that the converse is true, that anesthesia of these nerve endings would cause a sensation of nasal obstruction [1]. Patients with atrophic rhinitis suffer from a sensation of nasal obstruction in the presence of pathologically widened nasal cavities. This is said to be due to the destruction of the nasal mucosal nerve endings by the disease process [2]. This implies that tactile sensation plays a role in nasal patency, thus this study was undertaken to test this hypothesis.

Materials and Methods

A case control study was performed with lignocaine as the active drug to anesthetize the mucous membrane and normal saline as the placebo. Selection of subjects were, those who visited the Out-patient Clinic of the Department of Otorhinolaryngology, university malaya medical centre during the 6 month study period and met with the study criteria were selected for the study. The subjects were students, staff of the university and others. Half of the selected subjects were examined using 2% lignocaine as an active drug (labelled as bottle A) and the other half using normal saline (labelled as bottle B) after an informed consent. The inclusion criteria was adult patients whose age 18 years and above and had no prior nasal surgery. The exclusion criteria was (i) those who had history of nasal disease or symptoms of coryza in the past 4 weeks and (ii) those who were being treated for allergic rhinitis (on medication-antihistamines or steroid nasal spray).

S. Dipak · N. Prepageran (✉) · S. Haslinda ·
AS. Atiya · R. Raman
Department of Otorhinolaryngology, Faculty of Medicine,
University Malaya, 59100 Kuala Lumpur, Malaysia
e-mail: prepageran@yahoo.com

Each subject was informed about the nature of the study in terms of methodology, possible adverse effects and complications. After knowing and understanding all the possible advantages and disadvantages of the study, hence a consent was taken. The investigators and others with any knowledge of the project were excluded from the study.

Lignocaine was used for the study because it is not a potent vasoconstrictor, it acts rapidly and it is effectively absorbed from mucous membrane. Prior to the medication, the subjects were allowed 15 min to acclimatize to the laboratory surroundings and during this time complete a questionnaire. The questionnaire included relevant history of nasal disease, allergic rhinitis on medication, prior nasal surgery or recent history of coryza which could interfere with the study. Subjects were requested to choose the nose on either side with reasonably clear airway. Subjective assessment by means of Likert scale, a score range of 1–5; representing the condition of their nose at the start of the study before any exposure to the sprays. A score of 1 represented a totally clear nose and a score of 5 a totally blocked nose. Acoustic rhinometry was performed using Rhinoscans Acoustic Rhinometer. Acoustic measurements were performed during a breathing pause while the patients were in a sitting position. The angle of the incident acoustic wave was kept as close as possible to 45° to a line joining the base of the pyriform aperture of the nose to the tragus. Suitable nose piece was selected for each individual according to the size and shape of the nose and was coated with a thin layer of ointment to make an acoustically sound seal. The test nose was measured taking care to fit the nose piece tightly to the nostril without distorting the anatomy of the nose. Care was taken not to obstruct the nasal vestibule with ointment or deform the nose during testing [3]. All environmental parameters were kept as constant as possible during the period of the study (room temperature was $20 \pm 2^\circ\text{C}$). The test substance were administered by means of spray bottle (standardised nasal spray bottle), which was gently inserted into the test nose. The subject then administered two puffs and subsequently inhaled (2 ml lignocaine; 2% in sterile water or 2 ml of normal saline). Twenty minutes later the subject again made a subjective assessment of nasal sensation of airflow and acoustic rhinometry was repeated. Series of three measurements were performed on the test nose. The measurement were considered valid, if the three curves showed no deviation from each other from the nostril to the end of the notch, a divergence of maximally 20% from the middle curve at the posterior end of the curve and no crossover [4, 5].

The reading taken were displayed as a series of 3 curves, the means of these were taken. The minimal cross sectional areas CSA1, CSA2, Vol1 and Vol2 of the nasal cavity determined.

CSA1: Minimal cross sectional area of nasal valve area.

CSA2: Minimal cross sectional area at anterior end of the medial turbinate and anterior one third of inferior turbinate.

Vol1: Volume of nasal space at nasal valve area.

Vol2: Volume of nasal space at anterior end of the medial turbinate and anterior one third of inferior turbinate.

All the variable obtained were coded and entered in SPSS of window version 12.0. Appropriate statistical analysis were performed using the same software and this includes independent *t*-test, paired *t*-test and pearson correlation to establish the relationship between subjective nasal sensation determined using Likert scale and Acoustic rhinometry measurements. Value of significant, $P < 0.05$, were considered statistically significant.

Results

There were 50 patients included in this study. Twenty five of them were examined using 2% lignocaine (lignocaine group) and another 25 patients were examined using normal saline (normal saline group). The age distribution of this group is from 19 to 56 years old with a mean age of 27.8 years and standard deviation of 7.642 years. The age distribution for all patients is showed in chart 1.

Among the lignocaine group, the study showed that there is no significance difference of mean CSA1 between pre and post lignocaine ($P = 0.382$). It also showed there is no significance difference of mean CSA2 between pre and post lignocaine ($P = 0.237$). Similar result were found among the normal saline group, in which there is no significance difference of mean CSA1 ($P = 0.280$) and mean

Chart 1 Patients age distribution

Table 1 Mean cross sectional area

	CSA1		CSA2	
	Pre	Post	Pre	Post
Lignocaine group	0.6540	0.6716	0.7488	0.8200
Normal saline group	0.6064	0.5876	0.8332	0.7824

Table 2 Mean volume of nasal space

	Vol1		Vol2	
	Pre	Post	Pre	Post
Lignocaine group	1.9224	2.0136	4.9236	5.3920
Normal saline group	1.8756	1.8720	5.8820	5.4488

CSA2 ($P = 0.408$) between pre and post normal saline (as shown in Table 1).

This study also compares the difference of mean CSA1 and CSA2 between the pre and post lignocaine and normal saline nasal sprays respectively. The result showed that for pre lignocaine and normal saline group, there is no significance difference of mean CSA1 ($P = 0.262$) and mean CSA2 ($P = 0.363$). In post lignocaine and normal saline group, there is no significance difference of mean CSA1 ($P = 0.052$) and mean CSA2 ($P = 0.736$) as shown in Table 1.

The study showed that there is no significance difference of mean volume of nasal space at nasal valve area between pre and post lignocaine ($P = 0.095$). There is also no significance difference of mean volume of nasal space at anterior end of the medial turbinate and anterior one third of the inferior turbinate between pre and post lignocaine ($P = 0.304$). There is also no significance difference of mean volume of nasal space at nasal valve area between pre and post normal saline group ($P = 0.95$). Beside that, similar results were found that there is no significance difference of mean volume of nasal space at anterior end of the medial turbinate and anterior one third of inferior turbinate between pre and post normal saline ($P = 0.467$) as shown in Table 2.

This study revealed that between the pre lignocaine and normal saline group, there is no significance difference of mean volume of nasal space at nasal valve area ($P = 0.644$). There is also no significance difference of mean of the lignocaine and normal saline group at anterior end of the medial turbinate and anterior one third of inferior turbinate ($P = 0.19$). At post, mean volume of nasal space at nasal valve area and mean volume of nasal space at anterior end of the medial turbinate and anterior one third of inferior turbinate also did not differ significantly at 5% of significance between the lignocaine and normal saline group ($P = 0.229$, $P = 0.554$) as shown in Table 2.

Table 3 Means of subjective nasal sensation assessment

	Pre	Post
Lignocaine group	1.84	1.92
Normal saline group	2.00	2.08

Table 4 Correlation coefficients (R) for subjective nasal sensation and acoustic rhinometry measurements

	CSA1	CSA2	Vol1	Vol2
Pre	−0.065	0.033	−0.191	0.133
Post	0.000	−0.042	−0.072	−0.088

Patients showed no subjective change in nasal sensation post lignocaine spray shown by Likert scale as shown in Table 3.

The study revealed that for post lignocaine and normal saline groups, there is no linear relationship between the subjective nasal sensation with mean of minimal cross sectional area at nasal valve area ($r = 0.00$) but there is a very weak negative linear relationship (almost no relationship) with mean of minimal cross sectional area at anterior end of the medial turbinate and anterior one third of inferior turbinate, volume of nasal at nasal valve area as well as at anterior end of the medial turbinate and anterior one third of inferior turbinate. Although there is a weak relationship, this relationship is not significant at 0.05 levels as shown in Table 4.

Discussion

Nasal obstruction is one of the most common symptom encountered in otorhinolaryngological practice. Considerable attention has been paid to quantify the degree of nasal obstruction in term of nasal resistance to airflow [6]. The fact that nasal anesthesia had been reported to increase the sensation of nasal airflow appear to be an unexpected and paradoxical finding [1]. Camphor, eucalyptus and menthol are traditionally believed to be used in the symptomatic treatment of nasal congestion and their use extends back over 100 years. Despite the popularity of these compounds and their long usage as nasal decongestants there has been little research of their effects on the nose. Previous works [7, 8] has shown that the vapors of volatile oils: menthol, camphor and eucalyptus increases the nasal airflow without altering objective nasal resistance. If stimulation of nasal mucosa nerve endings leads to an increase sensation of nasal airflow, is the converse true, that anesthesia of the nasal mucosa leads to a sensation of nasal obstruction?

Jones et al. [1], showed local anesthesia (lignocaine) had no objective effect on nasal resistance to airflow but there

was a subjective sensation of improved nasal patency following its topical application. This fact that nasal anesthesia increased the sensation of nasal airflow appeared to be unexpected and paradoxical finding [1]. Eccles et al. [9] found that topical anesthesia (Lignocaine) caused decrease sensation of airflow and also reported that the subjects had their nose felt more blocked as a result of the anesthetic spray.

Its well known that following application of cocaine to the nose there occurs an increase in the sensation of nasal airflow. In this case, the local anesthetic also acts as a powerful vasoconstrictor causing a great reduction in the volume of the nasal erectile tissue [10]. In present we can investigate the effects of these substance on nasal resistance to airflow using standard rhinometric techniques (Acoustic rhinometry, AR). The use of AR is an objective method of measuring the minimal cross sectional area (CSA) at different points in the nasal cavity and also by measuring the volume of the nasal cavity (Vol). Hence the efficacy of each treatment modality can be assessed objectively.

This present study aim to determine these parameters as measured by AR correlating with the patients subjective sensation of nasal obstruction determined using Likert scale. The data produce graphs that display the area in three different valleys (nasal valve, inferior turbinate and nasopharynx). These waves are measurable as minimal cross sectional area 1, 2 and 3 (CSA 1, CSA 2 and CSA 3). Acoustic rhinometry is a non-invasive procedure requiring little cooperation from the patient [11]. Recommendations for standard operating procedure in clinical use of AR was described by Hilberg and Pedersen [12]. Clinical application of AR is used as a reliable method to show the dimensional changes of the nasal cavity in pre and post surgical states or in the use to measure outcomes of nasal decongestants and allergic treatment [13]. According to Grymer [14]; the minimal CSA 1 which frequently corresponded to nasal valve area, gives clinicians valuable information for documentation and diagnosis of nasal obstruction. Cross sectional area 2 was found to be very helpful in estimating the degree of nasal congestion. Cross sectional area 2 corresponds roughly to the anterior end of middle and anterior one third of inferior turbinate where most nasal erectile tissue is present [15].

The measurement of nasal resistance to airflow is gradually becoming an accepted clinical investigation in clinical rhinology. However, the patient attending the clinic with nasal obstruction is complaining of a sensation. This is not necessarily the same as an objective, measurable increase in nasal resistance.

The patients in both normal saline and lignocaine groups demonstrated no significant change based upon Likert scale after the study. The study has shown that in the normal

saline group, 76% (19) had no change in nasal sensation, 8% (2) felt clearer and 16% (4) had blocked sensation. Among the lignocaine group, the study found that 52% (13) had no change in nasal sensation, 28% (7) felt clearer and 20% (5) had blocked sensation. There was no significant difference between pre and post normal saline Likert scale.

The mean CSA1 and CSA2 with Vol1 and Vol2 did not vary significantly in both groups. The study also demonstrate no statistically significant relationship between the change in pre and post patient symptom score (Likert scale) and the change in pre and post CSA1 and CSA2 as measured by AR in both groups.

The analysis thus shows that the use of topical anesthetic spray on nasal mucosa produces no objective effect on nasal resistance or subjective sensation of altered nasal patency. Thus the study concludes that, tactile sensation of nasal mucosa does not play a role in the sensation of nasal obstruction.

Conclusion

The analysis thus shows that the use of topical anesthetic spray on nasal mucosa produces no objective effect on nasal resistance or subjective sensation of altered nasal patency. Thus the study concludes that, tactile sensation of nasal mucosa does not play a role in the sensation of nasal obstruction.

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