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ASSESSMENT OF OLFACTORY STATUS IN ALLERGIC AND NON – ALLERGIC RHINITIS PATIENTS

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Abstract : A study undertaken to assess the olfactory acuity in allergic (group I) and non- allergic rhinitis (group II) patients in comparison with age and sex matched controls (group III). Patients presenting with atleast three of the five cardinal symptoms of rhinitis i.e. rhinorrhoea, sneezing, itching, headache and nasal obstruction were grouped as non-infective rhinitis and further divided into allergic rhinitis (group I, n=20) and non-allergic rhinitis (group II, n=20) based on nasal smear cytology positivity or negativity for eosinophils respectively. Detailed Ear, Nose and Throat examination was carried out in both the groups and peripheral blood samples were analysed for total, differential leukocyte and absolute eosinophil counts using standard techniques. In all the three groups the olfactory thresholds for 5 odorants i.e. musk (M), formalin(F), camphor(C), asafoetida(A, 10% aqueous solution) and oil of peppermint (P, 20%) were evaluated for testing musky, pungent, camphorous, putrid and minty odours respectively by the method described by Elsberg and Levy for quantitative olfactometry. The results indicated elevation of olfactory thresholds (Δ%, calculated taking control values as 100%) for 4 or 5 odorants in group I and group II patients respectively as compared with controls (group I: Δ% for P-89.6%; M-116.4%; A-55.8%; $P<0.001$; C-73.1%; $P<0.02$; F-26.6% N.S.; group II: P-96.9%; M-99.3%, $P<0.01$ for both; A-66.8%; C-102.7%, $P<0.001$; F-42%, $P<0.05$). In the non allergic rhinitis group the magnitude of the olfactory loss was more severe except for the odorant musk.

Further interpretations as per gender based specificities revealed more severe olfactory loss in males of both the groups for the odorants peppermint and musk and moderately severe olfactory loss for formalin and camphor as compared to females. However, for the odorant asafoetida females showed greater olfactory loss than males in both the groups (Δ% 73.38% versus 52% in group I and 81.29% versus 69.7% in group II).

Key words : olfactory threshold, odorant, quantitative olfactometry, gender based specificities

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INTRODUCTION

Impact of non infective rhinitis on the sense of smell in the absence of other nasal abnormalities has not been studied extensively. Olfaction plays a major role in the perception of flavour and serves as a warning signal for spoiled foods and escaping gas. Patients become unaware of their own body odour and can become socially insecure (1). Dysfunction of smell or taste could be of considerable adverse consequence to individuals whose livelihood or safety depends on proper functioning of their senses of smell and taste (cooks, firemen etc). In contrast to the dysfunction in the paired organs of vision and hearing, bilateral loss of function must occur before the patient is aware of the problem (2). Chronic impairment of smell can affect an individual's sense of well being. Documentation of olfactory loss in controlled studies of allergic rhinitis patients in the absence of other nasal disease tends to be lacking (3).

The sense of smell is usually measured qualitatively by asking the patient to identify an easily recognizable substance by sniffing in which memory association and intelligence all play a role (4). Smell function may be assessed by the use of the University of Pennsylvania Smell Identification Test containing scratch and sniff patches of microencapsulated odorant. Hyposmia or decreased sense of smell cannot be measured qualitatively. Many attempts at quantitative clinical olfactometry have been discarded as inaccurate, cumbersome or too time consuming. Procedures such as odorant quantification using gas chromatography-olfactometry have been expensive, cumbersome and need expertise (5). Elseberg and Levy advocated a simple, reliable and satisfactory method for quantitative olfactometry (6).

The present study was conducted to assess the (1) olfactory status of allergic & non-allergic rhinitis patients using the above mentioned equipement as the studies on olfactory status of such patients are scanty. (2) To explore gender based variations in olfactory thresholds for various odorants in allergic & non-allergic rhinitis patients.

METHODS

Patients presenting with atleast three of five cardinal symptoms of rhinitis i.e. rhinorrhoea, sneezing, itching, headache and nasal obstruction were grouped as non infective rhinitis and divided into two groups. Group I (n=20) had nasal smear cytology positive for eosinophils with or without accompanying eosinophilia (Table I). Group II (n=20) were labelled as 'Positive controls'/non allergic rhinitis with nasal smear cytology negative for eosinophils. Asymptomatic age and sex matched controls constituted group III (n=18), also known as negative controls.

The mean age was around 27 years and the male: female ratio was 11 : 9 in group I and 9 : 11 in both groups II and III. The minimum level of education was matriculation in all the groups. Detailed family history, past history, characteristics of the incidence and duration of allergy/ illness, details of treatment taken were obtained in patients of allergic and non-allergic rhinitis (group I and II). Ear, nose

and throat examination was carried out in detail in both the groups. Peripheral blood samples were analysed for total, differential and absolute eosinophil counts using standard techniques. Nasal smear cytology was tested for positivity for eosinophils in both the groups using conventional staining techniques.

In all the three groups the sense of smell was tested both qualitatively and quantitatively in each nostril for five odorants, namely musk, formalin, camphor, asafoetida (10% aqueous solution) and oil of peppermint (20%) for testing the musky, pungent, camphorous, putrid and minty odours respectively. The test was carried out at ordinary room temperature and pressure and the room was kept free from any odour. The test procedure was carried out as per the methodology described by Elsberg and Levy for quantitative olfactometry (Fig. 1a). All the patients and the controls were tested for each nostril separately for each of the odorant. The subject was asked to indicate (quantitative evaluation) as well as identify (qualitative aspect) the smell as soon as 1 ml air is injected as a blast through inlet tube into the flask, containing the odoriferous substance, having placed the inlet tube in the test nostril. If the patient is unable to indicate the smell, the same procedure is repeated increasing the amount of air by 1 ml each successive time at an interval of 30 seconds till the smell is indicated and/or identified. The olfactory threshold (ml) for each odorant is measured twice in each nostril and the mean of the readings is taken as the final olfactory threshold for that particular odorant. Olfactory threshold for each odorant is defined as the number of ml of air that had to be injected into each nostril before the indication and/or identification of the smell being tested. No patient was on any treatment for one week before the test.

RESULTS

Table Ia and Ib describe the sample characteristics for the allergic and the non allergic rhinitis patients. The mean age and the educational status were identical for both the groups. The mean absolute eosinophil counts in Group I and Group II patients were 658.3 ± 383 and 376.2 ± 304 respectively. The nasal smear cytology was positive for eosinophils in group I (n=20) and negative in group II (n=20) patients which was also the criterion for dividing

TABLE I(a) : Characteristic features of the sample consisting group I and group II patients.

	Group I (Positive cases, n=20)	*Group II (Positive controls, n=20)*
Age		
Mean	27.3	27.2
±SD	10.8	9.7
Sex		
Females	9	11
Males	11	9
Educational status		
Graduate	13	13
Matric	5	5
Housewife	2	2
Family history		
Positive	2	5
Incidence		
Seasonal	7	3
Perennial	10	16
Not relevant	3	1
Symptoms		
Rhinorrhea	20	19
Sneezing	18	20
Itching	13	16
Headache	9	12
Nasal Obstruction	14	19

TABLE I(b) : Characteristic features of the sample consisting group I and group II patients.

	Group I (Positive cases, n=20)	*Group II (Positive controls, n=20)*
ENT Examination		
DNS	4	–
PND	8	5
NAD	8	14
ITH	–	1
TLC (cells/cumm)		
Mean	8070	7635
±SD	2829	1860
AEC (cells/mm^3)		
Mean	658.3	376.2
±SD	383	304
Nasal Smear Cytology For Eosinophils	Positive	Negative
History of Allergy		
Dust	6	5
Cold	3	–
No reported allergy	11	14
Bronchial asthma	–	–
Strong smell	1	–
Duration of illness (in years)		
Mean	7.4	3.5

them into the respective groups. The ENT examination revealed Deviated Nasal Septum in 4 allergic rhinitis patients which was insignificant to cause nasal obstruction. Tables II & III and figure 1b describe comparison of olfactory thresholds of group I and II patients with asymptomatic controls (group III) for various odorants. The increase in olfactory thresholds (Δ%) in allergic and non allergic rhinitis patients was calculated taking control values as 100%. The tables also show the gender based values as well as common values. The results indicate significant elevation of olfactory thresholds for Peppermint, Asafoetida and Musk (P-89.6%; A-53.8%; M-116.4%, $P<0.001$) and Camphor (73.1%, $P<0.02$) in group I patients. Though the olfactory threshold increased for the pungent odour Formalin (F-26.6%), no

TABLE II : Comparison of olfactory thresholds (in ml) of patients of Allergic Rhinitis with asymptomatic control group for various odorants including gender based values.

Odorant	*Allergic Rhinitis group (mean ± SE, n=20)*			*Control group (mean ± SE, n=18)*			*P value*
	Common values	*F (n=9)*	*M (n=11)*	*Common values*	*F (n=7)*	*M (n=11)*	
Peppermint	3.13±0.36	2.37	3.75	1.65±0.14	1.89	1.5	<0.001
Formalin	2.95±1.18	2.39	3.41	2.33±0.14	2.28	2.36	NS
Camphor	3.81±0.41	3.64	3.95	2.2±0.18	2.25	2.18	<0.02
Asafoetida	2.54±0.19	2.41	2.66	1.63±0.1	1.39	1.75	<0.01
Musk	3.42±0.39	2.97	4.00	1.58±0.14	1.60	1.57	<0.001

TABLE III : Comparison of olfactory thresholds (in ml) of patients of Non-allergic Rhinitis (group II) with asymptomatic control group (group III) for various odorants including gender based values.

Odorant	*Non-Allergic Rhinitis group (mean ± SE, n=20)*			*Control group (mean ± SE, n=18)*			*P value*
	Common values	*F (n=11)*	*M (n=9)*	*Common values*	*F (n=7)*	*M (n=11)*	
Peppermint	3.25±0.43	2.95	3.61	1.65±0.14	1.89	1.5	<0.01
Formalin	3.31±0.36	3.2	3.77	2.33±0.14	2.28	2.36	<0.05
Camphor	4.46±0.5	4.36	4.58	2.20±0.18	2.25	2.18	<0.001
Asafoetida	2.72±0.21	2.52	2.97	1.61±0.1	1.39	1.75	<0.001
Musk	3.15±0.41	2.25	4.25	1.58±0.14	1.60	1.57	<0.01

TABLE IV: Increase in olfactory thresholds (Δ%) in Allergic and Non-allergic Rhinitis group patients (control values taken as 100%) indicating gender based specifities.

	Allergic Rhinitis group			*Non-allergic Rhinitis group*		
	Common (n=20)	*Females (n=9)*	*Males (n=11)*	*Common (n=20)*	*Females (n=11)*	*Males (n=9)*
P	89.6%	25%	150%	96.9%	56%	140.6%
F	26.6%	4.8%	44.4%	42%	40.3%	59.7%
C	73.1%	61.7%	81.19%	102.7%	93.77%	110%
A	55.8%	73.38%	52%	66.8%	81.29%	69.7%
M	116.4%	85.6%	154.7%	99.3%	40.6%	170.7%

P = Peppermint; F = Formalin; C = Camphor; A = Asafoetida; M = Musk

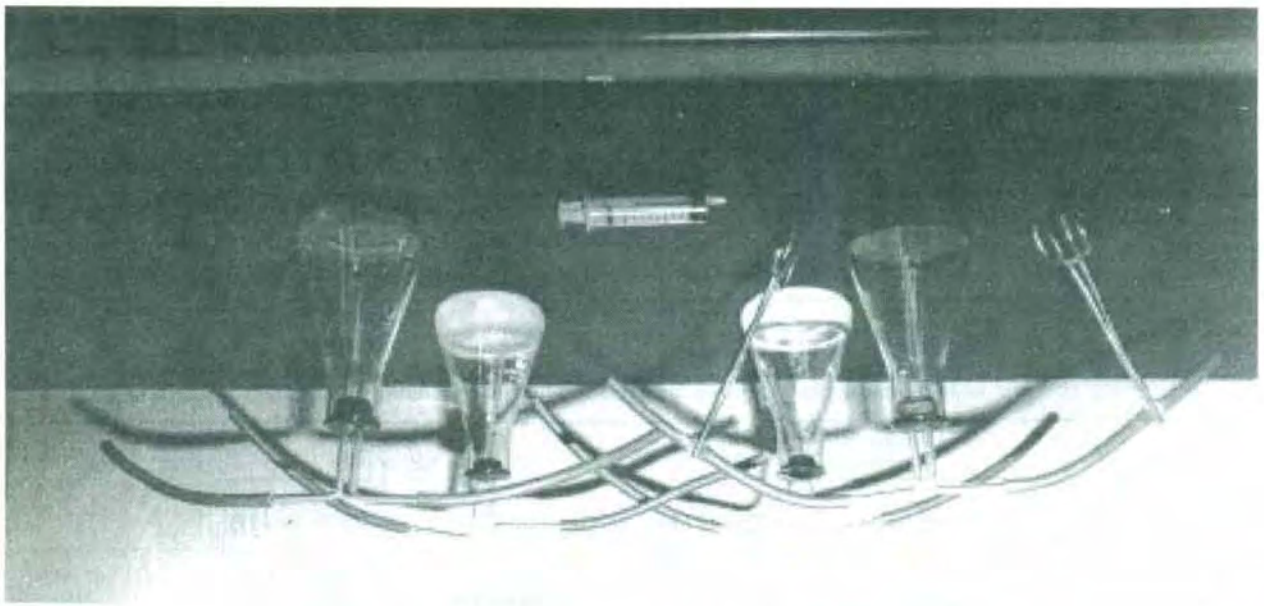

Fig. 1a: Elseberg and Levy olfactometer

significance could be attached to this finding. In group II, i.e.non allergic rhinitis patients there was significant elevation in the olfactory thresholds for Peppermint and Musk (P-96.9%; M-99.3%, P<0.01), Camphor and Asafoetida (C-102.7%; A-66.8%, P<0.001) and also for Formalin (F-42%, P<0.05). Increase in olfactory thresholds, both common and gender based values are indicated in Table IV and Figs. 2 & 3. In both the groups males showed greater olfactory loss as compared to females for the odorants Peppermint, Formalin, Camphor and Musk with severe olfactory loss (Δ%) in males for the odorants Peppermint and Musk (P:150% & 140%; M:154.7% & 170.7% in group I and II respectively) as compared to females (P:25%

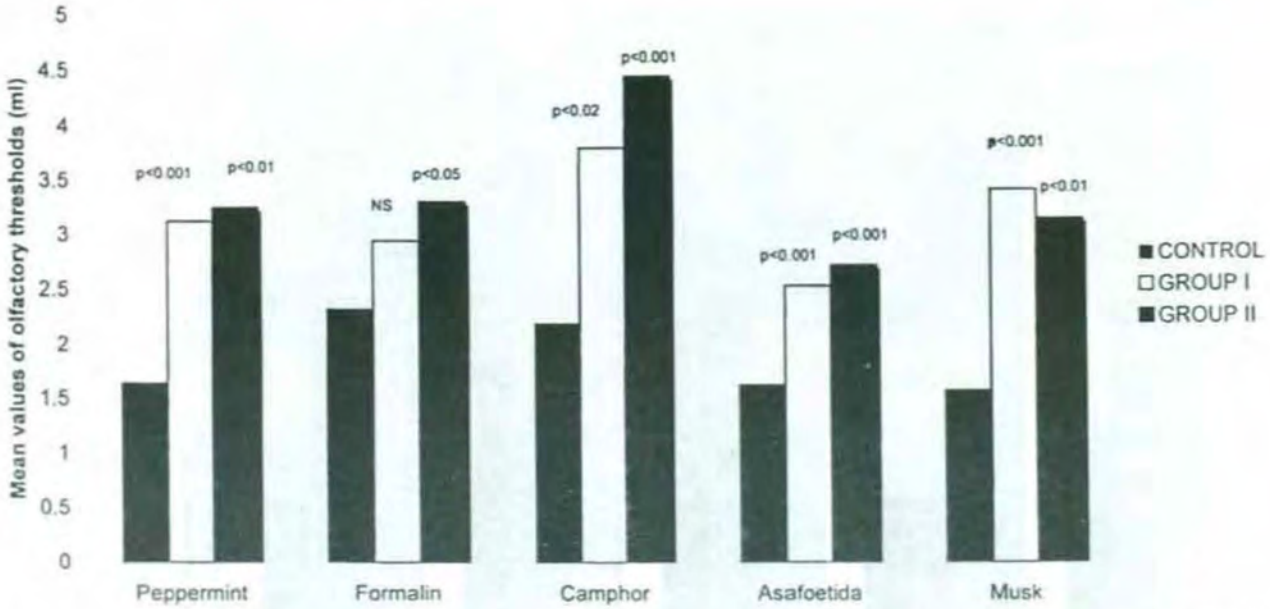

Fig. 1b: Comparison of olfactory thresholds (in ml) of patients of Allergic (group I) and Non-allergic Rhinitis (group II) with asymptomatic controls for various odorants.

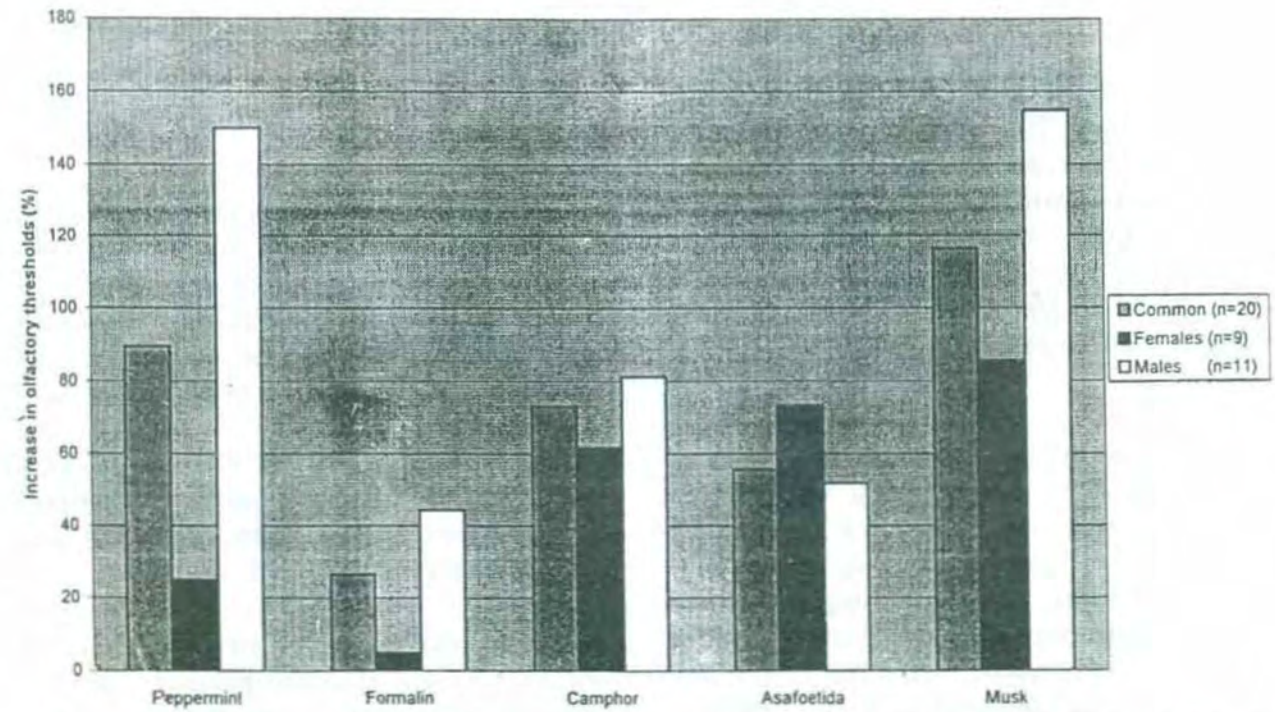

Fig. 2: Increase in olfactory thresholds (Δ%, control values taken as 100%) in Allergic Rhinitis patients indicating gender based specificities for various odorants.

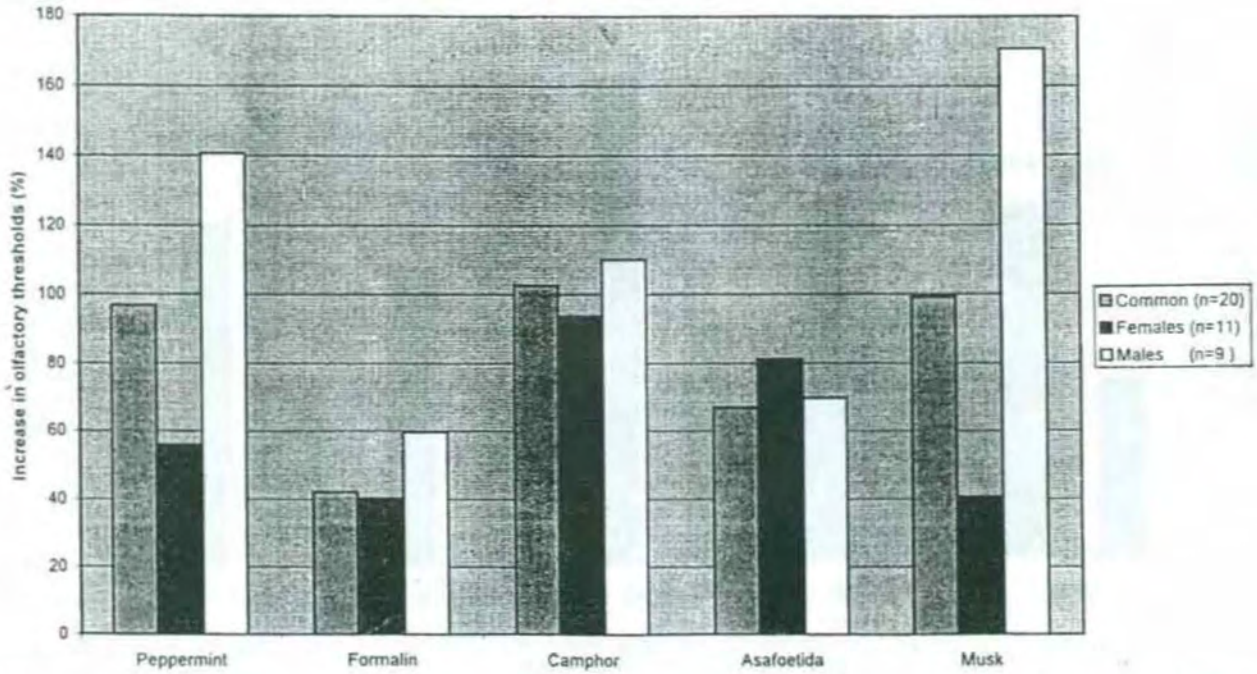

Fig. 3: Increase in olfactory thresholds (Δ%, control values taken as 100%) in Non-Allergic Rhinitis patients indicating gender based specificities for various odorants.

& 56%; M:85.6% & 40.6% in group I and II respectively). The results also indicate moderately severe olfactory loss in males for the odors Formalin & Camphor (F:44.4% & 59.7%; C:81.19% & 110% in group I and II respectively) as compared to females (F:4.8% & 40.3%; C:61.7% & 93.77% for group I and II respectively).

However, for the odorant asafoetida, females showed greater olfactory loss as compared to males in both the groups (73.38% versus 52% in group I and 81.29% versus 69.7% in group II). The results also point out that in non allergic rhinitis patients there was greater olfactory loss for the odorant Formalin, noted both in males and females as compared to allergic rhinitis patients.

DISCUSSION

The present study was initiated to test the quantitative olfactory loss in patients of allergic rhinitis vis-a-vis non-allergic patients as there are limited number of such studies to date. Studies exploring gender based specifities for the olfactory loss sustained are also lacking in the literature. The studies are also intended for testing the efficacy of Elsberg-Levy's olfactometer as a simple outdoor procedure, in comparison to the more expensive and cumbersome procedures.

The results suggest significant olfactory loss in allergic rhinitis patients for the odorants Peppermint, Asafoetida, Musk and Camphor. The non allergic rhinitis

patients sustained significant olfactory loss for all the five odorants tested (including formalin). The magnitude of the olfactory loss for various odorants (common values) was also greater in the non allergic rhinitis group as compared to the allergic rhinitis patients (except for the odorant Musk).

Based on the positivity of nasal smear cytology for eosinophils, we had classified the patients suffering from rhinitis into allergic/non-allergic rhinitis. It is quite possible that in non allergic rhinitis group where the aetiological factors are not definitely known, there could have been atrophy/thickening of the nasal mucosa or crust formation preventing air current to come in contact with the olfactory mucosa. It could also be due to insufficient mucus being available to dissolve the odoriferous material due to degeneration of mucous and serous glands. Thus even the pungent odorant formalin could not elicit normal response in group II patients who sustained significant hyposmia for this odorant also indicating diminished function of the chemosensitive nerve endings of the trigeminal nerve through the irritant pathway. In allergic rhinitis group, it can be speculated that the severity of the hyposmia is less as the pathological damage to the mucous membrane could have been less. The mechanisms by which allergic rhinitis might cause impairment of smell are not well studied to date. The possible mechanisms could be mast cell degranulation with release of mediators such as histamine, leukotrienes, prostaglandins etc resulting in oedema of the mucosa and distortion of neuronal fibres. There could also be late phase response in response to IgE mediated activation of mast cells with antigen challenge. Inflammatory cells such as eosinophils, release substances such as major basic protein, eosinophil cationic protein and neurotoxic protein which may cause certain structural changes in olfactory neuroepithelium. Changes in the quality and quantity of mucus due to histamine release in allergic rhinitis could also influence the solubility of odorant molecules and hence perception thresholds (3). The nature of the change occurring in allergic rhinitis seems to be reversible thus highlighting the need for therapeutic intervention at an early stage. Olfactory receptor neurons are the only nerve cells known to regenerate, again emphasising the need for timely therapeutic intervention. It is well documented that allergic & non-allergic rhinitis are curable and the olfactory loss sustained is reversible (7). However, studies to assess the olfactory status after therapy were not conducted by us as this had already been reported in the literature.

Another finding observed was the increased susceptibility of the males and greater olfactory loss than females in both the groups. It has been reported that females have a better olfactory acuity than males in general. A plausible explanation given by Daniel et al (8) was that estorgens exercise a prophylactic effect on the olfactory neuroepithlium in women. The authors observed that the factors that damage the olfactory system do so to the same degree in men and women thus retaining the gender difference in olfactory perception. This relationship remained true for the olfactory loss sustained in our experiments except for the fact that for the

odorant asafoetida, females sustained greater olfactory loss than males in both the groups. The control olfactory thresholds in females for various odorants were almost equal to those of men in the present set of experiments for the control group except for better acuity for asafoetida and higher perception thresholds for Peppermint (Table II).

It has been reported that patients with diminished smell function frequently have nasal polyps or sinusitis making it difficult to separate the impact of allergic rhinitis from the effects of these other problems. No such anomalies were encountered in our patients and hence the interpretations from our experiments are direct and attributed to the disease process entirely.

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