Original Research Article

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Association of nasal blockage and prevalence of anatomical variants on CT scan of nose and paranasal sinuses

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ABSTRACT

Background: Nasal blockage is the most common nasal symptom with which patients present in ENT OPD. Sometimes, it is associated with headache and facial pain. The symptoms are secondary to mucosal contact points in the nasal cavity without any observable nasal mass, nasal discharge or turbinate hypertrophy, hence, known as rhinogenic headache or facial pain syndrome.

Methods: This is a prospective study done in the department of otorhinolaryngology, at P.D.U. Medical College and Hospital, Rajkot, for a period of twenty months from May 2017 to December 2018. A total number of 100 CT scans of patients aged above 5 years of both genders who presented with complaints of nasal blockage at department of otorhinolaryngology, P.D.U. Hospital, Rajkot.

Results: Out of 100 patients above 5 years with symptoms of nasal blockage and CT scan showing anatomical variants, 78 patients had deviated nasal septum as the most common anatomical variant presenting with nasal blockage. Males (62%) were more commonly affected with different anatomical variants; 25-45 year old age group (48%) was the most common affected age group. The other anatomical variants: concha bullosa (13%), paradoxically curved middle turbinate (4%), Onodi cell (2%), Haller cell (2%) and unilateral choanal atresia (1%).

Conclusions: Nasal blockage is more common in 25-45 year old males and deviated nasal septum is the most common anatomical variant.

Keywords: Nasal blockage, Deviated nasal septum

INTRODUCTION

Nasal blockage is the most common nasal symptom with which patients present in ENT OPD.

It may be due to allergic rhinitis, chronic rhino sinusitis, fungal sinusitis, atrophic rhinitis, nasal or paranasal neoplastic lesions, adenoids, etc.¹⁻³

However, it is not always necessary that nasal blockage be associated with any significant pathology. The symptoms may be secondary to mucosal contact points in the nasal cavity without any observable nasal mass, nasal discharge or turbinate hypertrophy. These symptoms may also result due to pressure on nasal mucosa leading to anterior ethmoidal nerve syndrome or Sluder's neuralgia due to anatomical variants which may predispose to sinusitis hampering the quality of life. 4-6

Common anatomical variants are 1-3

- Deviated nasal septum.
- Concha bullosa.

- Paradoxically curved middle turbinate.
- Onodi cell.
- Haller cell.
- Unilateral choanal atresia.

Sometimes, it is associated with headache or facial pain due to mucosal contact points, hence, it is known as facial pain syndrome or called rhinogenic headache.

Rhinomanometry, acoustic rhinometry, rhino stereometry, spirometry, CT scan and various other investigations have been used to determine the causes of nasal blockage. Rhinomanometry has been used to measure the physiological pressure changes while acoustic rhinometry has been used for measuring anatomical causes of pressure changes. However, the precision and accuracy of acoustic rhinometry is doubtful for studying anatomical variants. Hence, computed tomography has become a very important diagnostic tool to assess chronic nasal blockage and headache. A-17

A simple septoplasty or turbinectomy may drastically improve the quality of a patient's life. ^{18.19} But sometimes, even after turbinate reduction, there is no significant improvement in patient's symptoms due to associated physiological causes. Hence, it is important to know the exact anatomical variant which can be accurately decided by CT scan of nose and paranasal sinuses.

Aims and objectives

- To study the co-relation between nasal blockage and anatomical variants.
- Assess prevalence of anatomical variants of nose and paranasal sinuses.

METHODS

This is a prospective study done in the department of Otorhinolaryngology, at P.D.U. Medical College and Hospital, Rajkot, for a period of twenty months from May 2017 to December 2018. A total number of 100 CT scans of patients who had some definitive anatomical variant aged above 5 years of both genders who presented with nasal blockage at the department of Otorhinolaryngology, P.D.U. Hospital, Rajkot were taken for the study.

Inclusion criteria

- Patients more than 5 years.
- Patients willing for undergoing investigations.

Exclusion criteria

- Patients with CT images with pathology of nose and paranasal sinus.
- Patients with history of nasal trauma.
- Pregnant females.

The exposure settings used were 130 kVp and 35 mA. The sections were taken with slice thickness of 5mm; if required, 1mm slice thickness was also considered. The sections were reviewed by expert radiologists for presence of anatomical variants namely – deviated nasal septum, concha bullosa, paradoxically curved middle turbinate, Onodi cell, Haller cell and unilateral choanal atresia in axial, coronal and sagittal views. The data collected were subjected for statistical analysis.

Table 1: Age distribution of anatomical variants.

Anatomical variants	5-24	25-44	45-64	65-84	Total
Deviated nasal septum	20	40	10	8	78
Concha bullosa	4	6	2	1	13
Paradoxically curved middle turbinate	1	2	1	0	4
Onodi cell	0	2	0	0	2
Haller cell	0	2	0	0	2
Unilateral choanal atresia	0	1	0	0	1
Total subjects corresponding to age	25	53	13	9	100

RESULTS

The most common presenting symptom among the general population is the nasal blockage. Males are more commonly affected by this symptom as compared to females. Males are more commonly affected also with the second most common presenting symptom of nasal blockage associated with headache and facial pain.

Onodi cell were found in 2% of the study population out of which 1% was male and 1% was female. Hence, there was no sex predilection. Due to inadequate sample size,

we are not able to comment on the age group in which it is more common. It is definitely possible that in these two patients, Onodi cells were present since birth but the finding was incidentally observed during the age of 25-44 years.

Haller cells were found in 2% of the study population out of which both were males and were found in the age group of 25-44 years. But again, due to inadequate sample size, we cannot consider the sex predilection and the age predilection statistically significant.

Table 2: Sex distribution of anatomical variants.

Anatomical variants	Male	Female	Total
Deviated nasal septum	50	28	78
Concha bullosa	6	7	13
Paradoxically curved middle turbinate	3	1	4
Onodi cell	1	1	2
Haller cells	2	0	2
Unilateral choanal atresia	0	1	1
Total subjects corresponding to sex	62	38	100

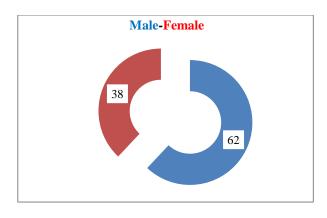


Figure 1: Sex incidence of anatomical variants.

Table 3: Age distribution of deviated nasal septum.

Deviated nasal septum (DNS)	5-24	25-44	45-64	65-84	Total
DNS to left	5	16	2	1	24
DNS to right	4	7	4	2	17
Spur independent of DNS	5	13	2	1	21
'S' shaped DNS	6	6	4	0	16
Total no. of subjects having DNS corresponding to age	20	42	12	4	78

Table 4: Age distribution of concha bullosa.

Concha bullosa (CB)	5-24	25-44	45-64	65-84	Total
CB over right	1	4	1	0	6
CB over left	1	2	1	1	5
Bilateral CB	0	2	0	0	2
Total no. of subjects having CB corresponding to age	2	8	2	1	13

Table 5: Age distribution of paradoxically curved middle turbinate.

Paradoxically curved middle turbinate (PCMT)	5-24	25-44	45-64	65-84	Total
PCMT to right	0	1	1	0	2
PCMT to left	0	1	0	0	1
PCMT bilaterally	0	1	0	0	1
Total no. of subjects having PCMT corresponding to age	0	3	1	0	4

Table 6: Age distribution of the remaining variants.

Other variants		5-24	25-44	45-64	65-84	Total
Onodi cells		0	2	0	0	2
Haller cells		0	1	0	0	1
U/L choanal atresia		0	1	0	0	1
Total	62		38		100	

Unilateral choanal atresia was found in 1% of the population who was a 25 year old female. Paradoxically curved middle turbinate accounts for 4% out of which 3%

were unilateral: 2% were over the right side while 1% was over the left side. 1% was bilateral. Only 4 subjects had paradoxically curved middle turbinate, so more

studies are required to confirm the incidence. However, as per this study, most commonly affected age groups are

25-44 years. Incidence is rarely reported from other age groups.

Table 7: Sex	distribution of	presenting s	vmptoms of	anatomical	variants.

Presenting symptoms	Male	Female	Total
Nasal blockage	32	18	50
Nasal blockage with headache/ facial pain	19	11	30
Nasal blockage with altered smell	7	5	12
Rhinorrhoea, lacrimation	4	4	8
Total	62	38	100

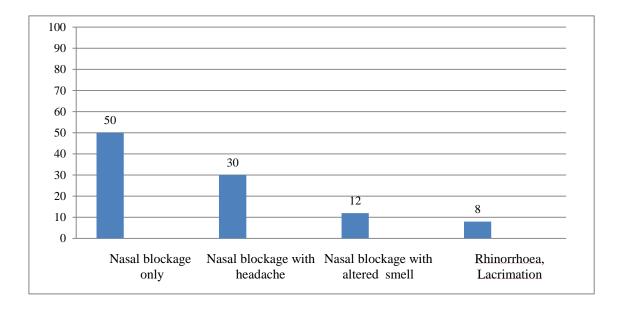


Figure 2: Presenting symptoms of anatomical variants.

As per study of 100 CT scans, concha bullosa accounts for 13% out of which 11% were unilateral: 6% were towards right and 5% were towards left and 2% were bilateral. Age group of 25-44 is the most commonly affected age group while the second most affected group is 5-24 years. With the increasing age, the pneumatisation might decrease and the turbinates might ingress leading to less symptomatic concha bullosa. 1.2.6

Deviated nasal septum was the most common variation seen.³ Out of 100 CT scans, deviated nasal septum accounts for 78% out of which 50 were males and 28 were females, among which 24 patients had DNS to left, 17 patients had DNS to right, 21 patients had spur independent of deviated nasal septum and 16 patients had 'S' shaped DNS. Even among the anatomical variant of deviated nasal septum, the most common abnormality is deviated nasal septum to left (24%) and second most common is spur which is independent of deviated nasal septum (21%) and has no mucosal contact points which might lead to symptoms. 25-44 year old males were most commonly affected.



Figure 3: Deviated nasal septum to the left with prominent lamellar and concha bullosa over right.

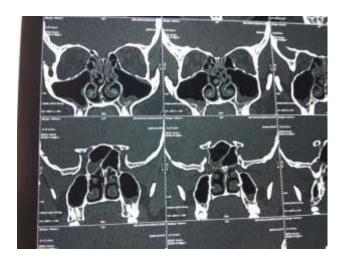


Figure 4: Deviated nasal septum to the right.

Males are more commonly affected than females irrespective of the age group may be because males come early for diagnosis with the onset of the symptoms while females neglect the symptoms and delay consultation.

Thus, the most commonly affected group with anatomical variants is 25-44 years and the least affected group is the age group of 65-84 years, the reason for this may be the incomplete development of the child as well as the incomplete development of his/her anatomical variant. The decreasing incidence with increasing age might be because of the complete development during the age of 25-44 years and the stabilization of the normal anatomy and the anatomical variant. However, atrophy of turbinates and other nasal structures would lead to decreased incidence with increased age of 45-74 years.

Table 8: Comparison between the results of other Asian studies.

Anatomical variants	Our study	Nandita et al ³	Gupta et al ²²	Adeel et al ²³	Kumar et al ²⁴
	Our study	N (%)	N (%)	N (%)	N (%)
Deviated nasal septum	78	44 (88)	180 (91.5)	20 (26)	62 (62)
Concha bullosa	13	32 (64)	78 (39.9)	14 (18.2)	43 (43)
Paradoxically curved middle turbinate	4	-	92 (46.1)	11(14.3)	14 (14)
Onodi cell	2	19 (38)	-	6 (7.8)	14 (14)
Haller cell	2	28 (56)	10 (5)	7 (9.1)	20 (20)
Unilateral choanal atresia	1	-	0	0	-
UP pneumatisation	-	-	-	4 (5.2)	-
Total subjects	100	50	180	77	100

The most common anatomical variation observed was deviated nasal septum (78%), followed by concha bullosa (13%), paradoxically curved middle turbinate (4%), Onodi cell (2%), Haller cell (2%) and unilateral choanal atresia (1%). Irrespective of the gender, 25-44 year olds were more commonly affected.

DISCUSSION

Nasal cavity and paranasal sinuses together configurate a single anatomical and functional unit. 1,2,7,9,15-17,20,21 This region is subject to a large number of anatomical variations and a variety of lesions. 1,2,7-9,12,15-17,20,21 The potential role of anatomical variations of paranasal sinus region is mainly predisposed to nasal blockage and recurrent sinusitis. 1,2,4-7,9 Also, these variants may determine contact points between nasal structures leading to headache and other symptoms.

These variants are important in 2 distinct view points: (1) Disturbing drainage and ventilation system causing impedance of air flow. (2) The potential impact on operative technique and surgical safety. (9-11,18,19)

As per literature, deviated nasal septum is the most frequent anatomical variation found. In our study, nasal septum accounts for 78%, among which 24 patients had

DNS to left, 17 patients had DNS to right, 21 patients had DNS with spur and 16 patients had 'S' shaped DNS. The study conducted here corresponds to various studies conducted in the past including the most recent study conducted by Nandita (88%), Gupta (78.8%), Adeel (26%).^{22,23}

It represents a divergence of septum from the midline. Deviated nasal septum can be cartilaginous, bony type or combined. Deviation may cause lateral decompression and displacement of turbinate leading to nasal obstruction. ^{1-3,10,11,15-17, 21}

It can also lead to mucosal contact points leading to facial pain syndrome or rhinogenic headache.

The term 'Concha Bullosa' was given by Zuckerland in 1862. It represents extensive pneumatisation of the middle turbinate from the frontal recess, the agger nasi cell, the anterior ethmoid cells or the middle meatus. It may have septations and therefore, multiple cells within it.^{1-3,5-10,14,21}

It can block the roof and impede the air flow leading to nasal blockage and other symptoms like headache. In our study, Concha bullosa accounts for 13% out of which 11% were unilateral: 6% were towards right and 5% were

towards left and 2% were bilateral. Gupta (32.7%) and Adeel (18.2%) had nearly the same results. ^{22,23}

The middle turbinate may show sharp bend laterally instead of its usual smooth medial curvature. 2,7-9,11,15-17,21 It can block the infundibulum. It may compromise ventilation and drainage of secretions to produce chronic infection of paranasal sinuses. 1-3, 5-10,14,16,21

In our study, paradoxically curved middle turbinate accounts for 4% out of which 3% were unilateral: 2% were over the right side while 1% was over the left side. 1% was bilateral.

Onodi cells are posterior ethmoid cells that extend backwards over the sphenoid that pneumatises lateral and superior to the sphenoid sinus and has intricate relation with the optic nerve and the carotid artery.

1,2,4,7-10,15,16,21

As per our study, Onodi cell were found in 2% of the study population out of which 1% was male and 1% was female.

Haller cells also known as infraorbital ethmoidal air cells, are located lateral to maxilloethmoidal suture along the inferomedial orbital floor. ^{1,2,4,7-10,15,16,21} They were found in 2% of the study population out of which both were males and were found in the age group of 25-44 years. As per another study conducted by Sanyukta Gupta in May 2016, Haller cells had incidence of 5%.

Unilateral choanal atresia was found in 1% of the population who was a 25 year old female. This entity was not considered in any other known study; hence, the overall incidence cannot be compared.

CONCLUSION

This study reflects similar results as are found in different literature studies and references. Different anatomical variants are found in nose and paranasal sinuses leading to nasal blockage like symptoms but may not be necessarily pathological. No surgery is required for these incidental findings on CT scan. They may, however, be the etiological factor for nasal blockage leading to sinus infections and should be especially looked for when an isolated variation is involved which can easily be treated surgically and the operating surgeon would achieve a clinically gratifying result with minimally invasive surgery.

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Ethical approval: The study was approved by the

Institutional Ethics Committee

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