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ORIGINAL RESEARCH

Title:

A Review of correlation between Deviated Nasal Septum and Chronic Rhino Sinusitis as its Complication

Short running header

Deviated Nasal Septum, A cause of Chronic Rhino Sinusitis

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Abstract:

Purpose: To study the clinical profile of Chronic Rhino sinusitis S and Deviated nasal septum**;** to study the association between deviated nasal septum and chronic Rhino sinusitis.

Patients and methods: 100 patients with CRS aged between 12 and 65 years; the mean age among the males was 34.65±4.80 years and 30.25± 5.20 years among the females. The males were 62% and females were 38%. The male to female ratio was 1.63:1. Diagnosis was confirmed by radiological investigations of paranasal sinuses (PNS); digital X-ray or CT PNS and diagnostic nasal endoscopy. Inclusion Criteria and exclusion criteria were fixed to identify the subjects. To evaluate the degree of nasal obstruction, nasal obstruction symptom evaluation scale (NOSE) was used.

Results: Complete opacification of maxillary sinuses involvement on only right side was found in 24 (24%) patients and only left side maxillary sinus involvement was found in 16 (16%) of the patients. Bilateral involvement was noted in 10 (10%) of the patients. Total number of patients with maxillary sinus pathology noted was 50 (50%). Both bilateral and unilateral complete opacification of osteomeatal complex was seen in 04 (04%) patients. In this study, bilateral maxillary sinusitis was found in males 07 (07%) and in 03 (03%) females.

Conclusion: Chronic Rhino Sinusitis is most common rhinological problem encountered worldwide which has greater propensity to cause morbidity. Deviated nasal septum can be associated with significant Sino nasal disease, especially a S-shaped obstructed and impacted type of DNS which showed statistically significant correlation with sinus disease

in our study.

Keywords: Nasal septum. Sinusitis, Maxillary sinusitis, deviated nasal septum and complications of DNS

Fundings: Nil

Introduction

Chronic Rhino sinusitis (CRS) is a broad umbrella term covering multiple disease entities, including acute RS (ARS), CRS with nasal polyps (CRSwNP) and CRS without nasalpolyps (CRSsNP). CRS was defined as "a group of disorders characterized by inflammation of the mucosa of the paranasal sinuses" (1, 2). Any anatomical, physiological or pathological features which obstructs free drainage from the sinuses, permits the stasis of secretion and thus predisposes to infection. These factors include allergy, asthma, dental disease, nasal polyps, immunodeficiency, mucociliary disorders, trauma, medications, surgery, noxious chemicals and micro-organisms (viral, bacterial and fungal), anatomic abnormalitiessuch as a septal deviation, concha bullosa, septal spur or paradoxical Middleturbinate [3]. Variations in intranasal and sinus anatomy have been implicated in the etiologyof chronic and recurrent sinusitis, and CT imaging has become an important Diagnostic tool.[4] The three important factors on to which the pathophysiology of thesinus disease is related which are: Patency of the Ostia, The function of the cilia and, the quality of the nasal secretions. Alteration in any one of these factors, alone or in combination, can change thephysiology and lead to sinusitis. Of the three factors, the patency of the Ostia is the most important factor in the development of CRS. The osteomeatalcomplex is the key area for the pathogenesis of C R S [5]. Deviated nasal septum is a common disorder that presents in 62% of the population, and its role in the pathogenesis of chronic sinusitis remains uncertain[3]. Within the nasal cavity, a straight septum enables laminar airflow, allowing the inspired air to be warmed, cleaned and humidified and thus optimized for gas exchange. Conversely, a deviated nasal septum can contribute to various degrees of nasal obstruction and altered nasal respiration[4]. Septal deviation may either cause osteomeatal obstruction or may interfere with proper airflow and results in sinusitis. At times it may be difficult to arrive at an etiological factor as the pathogenesis is not well defined. It is becoming more clear that CRS is an inflammatory disease and it may or may not involve pathogenic microbes[6]. In a person having a painful spot in head, with intense headaches, pus or fluid running from the nose removes the disease", stated Hippocrates in fifth century, referring to sinusitis[7]. Fred J Lavine and Wendy R.K. Smoker (1992) have reviewed the pertinent anatomy of the nasal wall and Paranasal sinus, most frequently encountered normal variations that may predispose a patient to inflammatory sinus disease and also have given an outline on imaging protocols for evaluation of this region[8]. Messerklinger studied mucociliary clearance of the sinuses. He observed that wherever two mucosal surfaces came into contact, localized disruption of mucociliary clearance occurred, causing retention of secretions in the area of contact and results in increased potential for infection. Anatomically, areas of mucosal contacts are mostly likely to occur in the narrow mucosal lined channels of the middle meatus and ethmoid air cell

system[9]. In the frontal sinus Messerklinger identified retrograde mucociliary flow from the frontal recess of the ethmoid, up the medial wall and into the ostium of the frontal sinus providing a further potential route for infection. As a result of these observations on the mucociliary clearance and endoscopic examinations, he concluded that in the majority of cases, infection spreads from the ethmoids to secondarily affect the maxillary and the frontal sinuses (Kennedy et al 1985)[10]. Ohashi Y, Nakai Y in 1983 established by a photoelectric method that in chronic sinusitis, mucociliary transport is disturbed as the result of not only change in secretory function but also a decrease in frequency of ciliary beating. In the most active phase of action, human cilia in sinusitis beat about 720 times per minute at 30degrees celsius in vitro. The ciliary actions of the mucous membrane in human chronic sinusitis were classified into 3 types: Gathering type, Bifocal type and Scattering type[11]. Cohen NA in 2006 conducted multiple investigations to demonstrate a marked decrease in sinonasal mucociliary clearance in patients with CRS. Possible explanations for this finding are: A reduced basal ciliary beat frequency, An alteration of the viscoelastic properties of airway secretions and A blunted dynamic response of Sino-nasal cilia to environmental stimuli [12]. The studies of R.H. Kamel showed that the frontal as well as maxillary sinuses are fully dependent on the anterior ethmoid region because their ventilationand drainage pass through its complicated fissures and narrow compartments.[13] Collet S et al published in 2001, reviewed a literature and showed that a definite role to the nasal septum neither as the pathogenesis of chronic sinusitis nor as a contributing factor was found. No relationship between septal surgery combined with sinus surgery, and the postoperative prognosis nor on the subjective comfort ofpatients could be demonstrated [14]. R.P.S. Harar et al published in 2004, showed no significant difference between the CRS group and the control group with regards to septal deviation. Nor were able to demonstrate any correlation between the severity of septal deformity at the osteomeatal complex region and the severity of sinus disease[15]. Rao et al used Mladina's classification of 7 types of deviated nasal septum andconcluded that disturbance to the area in the posterior flow(Type III-Type VI) playedmajor role in sinonasal disease rather than obstruction in the nasal valve area (TypeI andType II) [16]. Kyle D.Smith et al published in 2010 showed no definitive relationship between septal deviation and development of maxillary sinusitis[17]. Mohebbi et al. in their study 'An epidemiologic study of factors associated with nasal septum deviation by computed tomography scan: a cross sectional study' published in 2012 found no relationship between the severity of sinusitis, osteomeatal involvement and the degree of septal deviation[18]. Kapusuz Gencer Z, et al published in 2013, suggests that maxillary sinus volumes tend to be higher at the contralateral side of the severe septum deviations. In addition, the chance of finding maxillary sinusitis findings on ipsilateral to the severe septum deviation was significantly increased[19]

Material and methods

This was a Cross - Sectional study of 100 patients with CRS, who attended Department of ENT during the period of the study between November 2019 and October 2021. All patients

with CRS for more than 12 weeks were explained about the aim and design of the study. Confirmation of the diagnosis was done by thorough history taking, clinical examination and investigations such as radiological investigations of paranasal sinuses (PNS); digital X-ray or CT PNS and diagnostic nasal endoscopy. The study design was a cross-sectional study. The sample seize was calculated by recommendations of Task Force CRS criteria. Inclusion Criteria were: Patients presenting with Facial pain/pressure, Facial congestion/fullness, Nasal obstruction/blockage, Nasal discharge/purulence/discolored and postnasal discharge were included. Patients of all age groups above 12 years were included. Patients with history of hyposmia/ anosmia were included. Patients with Purulence in nasal cavity on examination and Fever (acute rhino sinusitis only) were included. Minor inclusion criteria were: Headache, Fever (in non acute cases), Halitosis, Fatigue, Dental pain, Cough and Ear pain/pressure/fullness. Presence of the two or more major factors, or one major and two minor factors, was considered suggestive of CRS and were included. Exclusion criteria were: Nasal trauma, Nasal polyposis, Septal perforation, Allergic rhinitis, Aggressive fungal infections, Odontogenic sinusitis, Patients <15 yrs. of age, Neoplasia, Immunodeficiency and mucociliary disorders, Prior history of nasal or sinus surgery, Other anatomic abnormalities and Adenoid hypertrophy. To evaluate the degree of nasal obstruction, nasal obstruction symptom evaluationscale (NOSE) was used.

Efficacy: Statistical Analysis: All the data was analyzed using standard statistical methods such as mean, standard deviation, percentages and student T test to study the statistical significance.

Results

Among the 100 patients with CRS included Patients aged between 12 and 65 years were included. The youngest patient was aged 14 years and the eldest patient was aged 61 years. The mean age among the males was 34.65±4.80 years and 30.25± 5.20 years among the females. There were 12 patients (12%) who were aged below 20 years, 34 patients (34%) aged between 21 and 30 years, 32 patients (32%) were aged 31 to 40 years, 18 (18%) patients were aged between 41 and 50 years and 04 (04%) were aged between 51 and 60 years **(Table 1).** In this study the males were 62% and females were 38%. The male to female ratio was 1.63:1. In this study, 12 patients in the group of < 20 years included 8 males (8%) and 4 females (4%), followed by 34 patients in the group 21 to 30 years included 22 males(22%) and 12 females (12%) and 32 patients in the group of 31 – 40 years included 20 males (20%) and 12 females (12%). 18 patients were in the group of 41 to 50 years age group which included 10 males (10%) and 8 females (8%) patients and 04 were in the age group of 51 to 60 years (04%), **(Table 1).** The clinical symptoms were studied among the patients revealed that the Headache was the most common symptom and was observed in 82 patients (82%). Among them 50 were males (50%) and 32 (32%) were female patients. It was followed by nasal obstruction among the 78 (78%) patients; males were 50 (50%) and females were 28 (28%). The next

common presentation observed was nasal discharge among 42 (42%) patients; 24 (24%) were males and 18 were females (18%). Facial pain among was recorded in 34 (34%) patients; 22 males (22%) and 12 (12%) females. Hyposmia accounted for 06%, facial congestion was found in 02%. The least observed symptoms were halitosis, dental pain and cough **(Table 2).** The incidence of deviated nasal septum (DNS) was observed in this study and found that in patients aged below 20 years, DNS was observed in 22 (30%) of them. In the age group of 21 to 30, it was observed in 18 (25%), In the age group of 31 to 40, it was observed in 22 (25%), In the age group of 41 to 50, it was observed in 12 (17%) and In the age group of 51 to 60, it was observed in 02 (03%) patients **(Table 3).** In this study Deviated nasal septum (DNS) was more prevalent among the males 67 (67%) than in females 33 (33%), **(Table 4).** In this study, C shaped DNS was found common among 58% of study population, which included 44 male (44%) and 14 females (14%). S shaped DNS was found in 14 patients (14%) of which 12 were males (12%) and 02 female (02%). Caudal dislocation was found in 14 % of the study population which includes 06% males and 08% females. **(Table 5)** The DNS was to the left side in 56 (56%) patients; 44 of the C shaped deviations and 12 (12%) of the S shaped deviations. The DNS was to the right side in 16 (16%) patients; 14 of them were from C shaped deviations and 02 (02%) of the S shaped deviations. In this study, Cottles classification of DNS, was used to classify the DNS and found that simple DNS was found in 36 persons of which 26 were males (36%) and 10 were females (14%) followed by Obstructed type of DNS seen in 28 patients (39%) and Impacted type being the least common accounting to 08% of the study population. In this study CRS affecting frontal sinusitis was observed in the age group of 21-30 yrs., while maxillary sinusitis was observed in the age group of 31 to 40 yrs., ethmoidal sinusitis wasa observed in the age groups of 21 to 40 years; sphenoid sinusitis was observed seen as part of Pan sinusitis commonly in age group of 41-50 yrs. **(Fig 1).** In this study, Lund Mackay score was used to analyze the CT findings of individual sinuses. Which showed complete opacification of maxillary sinuses involvement on only right side was found in 24 (24%) patients and only left side maxillary sinus involvement was found in 16 (16%) of the patients. Bilateral involvement was noted in 10 (10%) of the patients. Total number of patients with maxillary sinus pathology noted was 50 (50%). Both bilateral and unilateral complete opacification of osteomeatal complex was seen in 04 (04%) patients. In this study, bilateral maxillary sinusitis was found in males 07 (07%) and in 03 (03%) females. **(Table 6);** Involvement of other Para nasal sinuses was tabulated in the same table. In this study, we found that there was no association between the presence of simple deviated nasal septum and CRS. In this study, right maxillary sinusitis, left maxillary sinusitis and left osteomeatal complex block were found to be associated with obstructed type of DNS With P values less than 0.05 (A student T test was used to correlate the data) which was statistically significant. In this study, right and left maxillary sinusitis, right and left anterior ethmoid, right and left posterior ethmoid, and both osteomeatal complex block found to be associated with impacted DNS with P values less than 0.05 which was statistically significant. In this study, we found no association between the presence of DNS andsinusitis

on right side. In this study, we found no significant association between DNS and osteo-meatal complex block on left side, sphenoid sinuses involvement of both sides (p values more than 0.05), **(Table 6).**

Discussion

A total of 100 patients were enrolled in the study between 12 and 60 years old. All the patients presenting with symptoms of deviated nasal septum and CRS of more than 12 weeks duration with 2 major and one minor or 2 minor symptoms were included in the study. Patients diagnosed as cases of CRS based on TFR criteria. There are three theories explaining patho-physiological relation between the nasal septal deviation and chronic Rhino sinusitis. The first of these is the mechanical theory which states that secretions accumulate in the sinus as a result of narrowing of the osteomeatal complex and thus infections ensue in the retained secretions and causes chronic Rhino sinusitis. The second theory is the aerodynamic theory. According to this theory, the mucociliary activity decreases following the nasal flow rate increase and mucosal dryness in relation with the nasal septal deviation and consequently, chronic Rhino sinusitis develops. The third theory is the Bachert's pressure theory. According to this theory, deviation of the posterior nasal septum causes chronic Rhino sinusitis by creating pressure and air flow changes within the maxillary sinuses (20, 21). In the present study the incidence of DNS was more in male than female with an approximate ratio of 1.6:1 which is in agreement to a study done by Nayak et al (22). In a study by Madani et al, (23) there were 68.3% male and 31.7% female with a mean age of 29.13±15.21 years. Ozkurt et al in his study observed that incidence was more in male as compared to female (24). Headache is the most the commonest presentation in this study (82%) which includes 50 males (50%) and 32 females (32%) followed by nasal obstruction which includes 50 males (50%) and 28 females (28%) Next common presentation observed was nasal discharge (42%) in which 24 were males (24%) and 18 were females (18%). Followed by facial pain (34%) which accounts to 22 males (22%) and 12 females (12%). Hyposmia accounts to 8%, facial congestion was seen in 2%. Least observed symptoms were halitosis, dental pain and cough. In the study conducted by Ishwar Singh (2010), (24), headache was the predominant symptom seen in 80% of patients, nasal blockage was seen in 76.66%, nasal discharge was seen in 43.33%, facial pain in 40% patients. While in the study by Venkatachalam et al (2000), (25), the commonest symptoms were nasal obstruction in 87%, nasal discharge in 70% of patients and the other symptoms were post nasal drip in 41% and abnormalities in sensation of smell in 36% of patients[66]. In another study by Nayak et al (1991), (26) nasal discharge was the commonest complaint seen in 78.2%, while nasal blockage and headache was seen in 75.6% of patients. In our study patients bilateral maxillary sinusitis was seen in 48 patients (48%), unilateral maxillary sinusitis in 16 patients (16%), bilateral frontal sinusitis in 12 patients (12%), unilateral frontal sinusitis in 8 patients (8%), bilateral anterior ethmoidal sinusitisin 16 patients (16%), unilateral anterior ethmoidal sinusitis in 22 patients (22%), unilateral posterior ethmoidal

sinusitis was seen in 18 patients(18%)and bilateral posterior ethmoidal sinusitis was seen in 10 patients (10%) and bilateral sphenoidal sinusitis was seen in 4 patients (4%). 6 patients had pansinusitis (6%). In a study by Mohebbi et al, bilateral maxillary sinusitis presentation was seen in 27% of patients while unilateral presentation was seen in 18.4%, similarly unilateral frontal sinus involvement was seen in 12.5% and bilaterally in 11.2%, bilateral ethmoidal sinusitis was seen in 36.1% and unilateral ethmoidal sinusitis was seen in 18.1%, bilateral sphenoidal sinusitis was seen in 12.3%, unilateral sphenoid sinusitis was seen in 13% (18). In a study by Madani et al, (23) involvement of maxillary sinuses is seen in 41.6% followed by ethmoidal sinuses in 22.9%, then sphenoidal sinusitis in 18%, frontal sinuses in17.3%. In this study, C shaped DNS was more prevalent on the left in 44 patients (44%). In a study by Young ju Jang et al,, type I deformity, which may correspond to the C-shaped concave dorsal deformity was the most common deformity, accounting for 32% of the case (27). In our study, we found that simple type was DNS was more prevalent in 40 patients (40%) followed by obstructed DNS in 20 patients (20%) followed by impacted DNS in 6 patients accounting to 6%. In a study by Vinay Kumar Poorey (28) and Pooja et al, (29) Obstructed type of DNS was more prevalent in 50%, followed by impacted DNS in 30% and simple DNS in 19% of study population. In this study, obstructed type of DNS was associated with right and left maxillary and left osteomeatal complex. Impacted type of DNS is associated with maxillary, anterior and posterior ethmoid, left sphenoid and osteometal complex block on both side with a highly significant P value. Moorthy et al found that the DNS can be associated with significant sinonasal disease even in absence of any nasal symptoms, especially an “S” shaped DNS (30), similarly in our study we have found significant association between S shaped DNS and anterior and posterior ethmoiditis and sphenoid sinusitis. C- shaped deviation was associated with osteomeatal complex block in 42.5% of patients and pansinusitis was seen in 50% of patients, similarly S-shaped deviation was associated with OMC block in23.3% and pansinusitis in 83.3%, spur was associated with OMC block and pansinusitis in 30% of patients each respectively. In a study by Storms WW et al, (31) it was observed that DNS showed no impact on frontal, maxillary and sphenoid sinuses. The anterior and posterior ethmoid sinuses found to be relatively affected by DNS. Lund V.J in his study found horizontal spur was most commonly associated in sinus pathology, 43.4% of patients spurs were accounted for sinus pathology, similarly type III (posterior vertical deviation) was seen having osteomeatal complex (OMC) blockin 62.5% of cases, S-shaped deviation was associated with OMC block in 50% of cases (31). In our study, we conclude that DNS has significant impact on anterior and posterior ethmoids, and maxillary sinuses. And relatively less impact on sphenoid onsphenoid sinus and no impact on frontal sinus. In this study we found that the prevalence of nasal septal deviations and the sinusitis was significant. (p-value is 0.000).

Conclusion

Chronic Rhino Sinusitis is most common rhinological problem encountered worldwide

which has greater propensity to cause morbidity. Deviated nasal septum can be associated with significant Sino nasal disease, especially a S-shaped obstructed and impacted type of DNS which showed statistically significant correlation with sinus disease in our study. Also, DNS to left, in general, was associated with higher incidence of sinuses disease than DNS to right. This study brings to light various presentations of DNS implicated in causation of chronic sinusitis which will influence the treatment decisions and also reduce the morbidity caused by it.

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Disclosure

The authors report no conflicts of interest in this work.

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Table 1 A**ge and Gender distribution in the study (n-100).**

AGE in years	NO. OF PATIENTS	NO. OF PATIENTS	%
	Male	Female	
<20	08	04	12%
21 – 30	22	12	34%
31 – 40	20	12	32%
41 – 50	10	08	18%
51 – 60	02	02	04%
TOTAL	62	38	100%

Table 2 the incidence of clinical symptoms in this study (n-100)

SYMPTOMS	FREQUENCY	MALE	FEMALE	PERCENTAGE
NASAL OBSTRUCTION	**78**	**50**	**28**	**78%**
NASAL DISCHARGE	**42**	**24**	**18**	**42%**
FACIAL PAIN	**34**	**22**	**12**	**34%**
FACIAL	**02**	**02**	**00**	**02%**

CONGESTION				
HYPOSMIA/ANOSMIA	08	08	00	8%
HEADACHE	82	50	32	82%
FEVER	06	02	04	06%
HALITOSIS	00	00	00	00
FATIGUE	04	02	02	04%
DENTAL PAIN	00	00	00	00
COUGH	00	00	00	00

Table 3 the incidence of DNS among the different age groups (n-100)

AGE GROUP	FREQUENCY	PERCENTAGE
<20	22	30%
21 to 30	18	25%
31 – 40	18	25%
41 – 50	12	17%
51 – 60	2	3%
TOTAL	72	100%

Table 4 the incidence of DNS among the both genders (n-100)

GENDER	FREQUENCY	PERCENTAGE
MALE	48	67%
FEMALE	24	33%
TOTAL	72	100%

Table 5 the types of DNS in terms of gender distribution in the study (n-100)

TYPE OF DNS	MALE	FEMALE	FREQUENCY	PERCENTAGE
C SHAPED	**44**	**14**	**58**	**58%**
S SHAPED	**12**	**02**	**14**	**14%**
CAUDAL DISLOCATION	**06**	**08**	**14**	**14%**
TOTAL	**62**	**24**	**72**	**100%**

Table 6 the association between types of DNS and incidence of sinus involvement (n-100)

CT FINDINGS	No.	Type of deviations					Student T test P value
		Simple	Obst.	Imp	C	S	
Maxillary sinus – right	24	09	08	05	01	01	**0.024**
Maxillary sinus – left	16	06	04	02	02	02	**0.041**
Bilateral maxillary sinus	10	03	03	02	01	01	**0.010**
Frontal sinus-right	14	04	04	00	02	04	**0.053**
Frontal sinus – left	18	06	04	00	06	02	**0.038**
Anterior ethmoid sinus-right	26	06	08	02	05	05	**0.047**
Anterior ethmoid sinus-left	30	08	07	02	06	07	**0.028**
Posterior ethmoid sinus-right	18	04	04	02	04	04	**0.038**
Posterior ethmoid sinus-left	20	06	04	02	05	03	**0.051**
Osteomeatal complex-right	14	04	04	02	02	02	**0.612**
Osteomeatal complex-left	10	02	02	02	02	02	1.000
Sphenoid sinus-right	06	00	02	02	00	02	0.207
Sphenoid sinus-left	04	00	01	02	00	01	0.125

Table 7 the comparison between clinical features of CRS of different studies

Symptoms	Ishwar singh *(25)* (2010)	Nayak et al *(22)* (1991)	Venkatalachalam *(26)* (2010)	Jang JY et al (2016)	Present study
Headache	80%	75.5%	-	93%	82%
Nasal obstruction	76%	75.5%	87.1%	89%	72%
Nasal discharge	43%	78.2%	70%	63%	42%
Facial pain	40%		-	47.5%	34%

Notes:

Abbreviations: CRS Chronic Rhino Sinusitis, DNS Deviated Nasal Septum, RS (ARS), CRS with nasal polyps (CRSwNP) and CRS without nasalpolyps (CRSsNP)

Figure 1 the age distribution among the CRS patients affected by different para nasal sinuses (n-100).