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RESEARCH ARTICLE

A COMPARATIVE EVALUATION BETWEEN CT SCAN PNS WTH NASAL ENDOSCOPY FINDINGS IN PATIENTS OF CHRONIC RHINOSINUSITIS.

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Abstract

Background: Chronic Rhinosinosinusitis (CRS) is one of the common diseases affecting people globally with significant negative impact on quality of life. The objective of this study is to compare the efficacy of CT and nasal endoscopy finding for the evaluation of CRS in patients with persistant complains despite appropriate medical therapy.
Methods: Patients attending ENT OPD of SIMS, with any complains of CRS for more than 4 weeks not responding to medical treatment . Patients are selected by Random sampling method.
Results: The commonest major presenting symptom among the patients was observed as nasal obstruction and headache the minor factor. Males were affected more commonly on nasal endoscopy , the most common finding was congested nasal mucosa and mucopurulent nasal discharge .Frontal cells most commonly seen on Ct scan and maxillary sinus was most commonly involved .DNS is seen in both DNE and CT scan.
Conclusion: CRS can be reliably identified using AAO-HNS Task force criteria 1997.Diseased ,oedematous or congested nasal mucosa ,purulence , pathological secretions or mucous in middle meatus and early polypoid changes have non – specific features on coronal CT and endoscopy has essential role in diagnosing this pathology , is an outpatient procedure , relatively economic with no radiation hazard , however there are certain limitations of DNE which includes patients with gross DNS , constricted middle meatus , certain anatomical variants and presence of hidden air spaces like sphenoid sinus , ethmoidal bulla , haller cells , frontal cells ,posterior ethmoidal cells,etc .Hence we conclude that both are complimentary to each other.

Introduction:-

Chronic Rhinosinosinusitis (CRS) is one of the common diseases affecting people globally with significant negative impact on quality of life .[1]In 1996, the American Academy of Otolaryngology-Head & Neck Surgery multidisciplinary Rhinosinusitis Task Force (RTF) defined adult rhinosinusitis diagnostic criteria.[2]

Around one in five cases seen in outpatient department is concerned with a sinus disease.[3] During foetal development, the paranasal sinuses originate as invaginations of the nasal mucosa into lateral wall, frontal , ethmoid

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maxilla and sphenoid bones.[4] The three important factors on to which the pathophysiology of the sinus disease is related are:

1. The patency of the Ostia,
2. The function of the cilia, and
3. The quality of the nasal secretions.

Alteration in any one of these factors, alone or in combination, can change the physiology and lead to sinusitis. Of the three factors, the patency of the ostia is the most important factor in the development of CRS.[5] The ostiomeatal complex is the key area for the pathogenesis of Chronic Rhinosinusitis[6]. The stenosis of osteomeatal complex either from the anatomical confirmation or hypertrophied mucosa can lead to stagnation of secretions and become infected[7]. The diagnosis of CRS relies on clinical judgment based on a number of subjective symptoms and few findings in physical examination. These symptoms and signs are inherently vague and because of the uncertainty associated with the diagnosis of CRS, it is necessary to have data that are more objective about the extent of the disease.[8,9]

Diagnostic Nasal Endoscopy (DNE) enables clear visualization of all structures of the middle meatus and of the osteameatal complex and ability to accurately access these areas for evidence of localized disease, or for the anatomical defects that compromise ventilation and mucociliary clearance and also it avoids landmarks for complications to guide surgeon during surgery. Nasal Endoscopy is valuable in the work up of CRS in conjunction with detailed history [10].

Computerized Tomography (CT) provides essential preoperative information for the assessment of patients undergoing functional endoscopic sinus surgery. It has high sensitivity and provides objective findings regarding the condition of the paranasal sinuses and the presence of fluid or polyps. Furthermore, CT findings are an integral part of several severity staging systems that are used for CRS.[3]Its advent in the delineation of the sinonasal pathology and anatomic variations has proveninvaluable to the Otolaryngologists in the preoperativeplanning but CT scan is not always accurate in depicting the disease and anatomical variants. These discrepancies though minor, need further evaluation and correlation of CT findings to that of findings observed during endoscopy.[11,]The aim of the study was to compare the CT findings with the nasal endoscopy findings in patients with Chronic Rhinosinusitis, to study the incidence of different anatomical variation in nose & paranasal sinuses in patient of sinusitis by nasal endoscopy and CTscan,to study association between anatomical variations, to demonstrate the effectiveness and limitations of nasal endoscopy and CT scan in identifying variations in nose and paranasal sinus and to compare which is better investigation modality in diagnosis or if both are needed.

Material and methods:-

This is a prospective study carried out over a period of year from 2014 to 2016 at the department of ENT,Shadan institute of medical sciences , Hyderabad, Telangana.Total of 104 patients were included in this study who were exposed to direct nasal endoscopy and CT scanning of paranasal sinuses after they were diagnosed as chronic rhinosinusitis and were resistant to medical management.

Inclusion criteria:

1. Age >15years and <70years.
2. Patient diagnosed as per the criteria given by AAO-HNS Task force 1997 and willing to undergo endoscopic examination and CT scanning of paranasal sinuses.

Exclusion criteria:

1. Age <15years and >70years.
2. Previous facial trauma.
3. Patients with paranasal sinus and extraparanasal sinus tumors.
4. Patients wirh sinusitis due to dental origin.
5. Patients who have had previous endoscopic sinus surgery and hence undergoing
6. Patients who have undergone previous septal or turbinate surgery.
7. Patients with chronic sinusitis responding to medical management.
8. Patients not willing to participate in the study.

Statistical methods

Descriptive and inferential statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean ± SD (Min-Max) and results on categorical measurements are presented in Number (%).

Significance is assessed at 5% level of significance.

Correlation between Nasal endoscopy and CT scan findings were done on the basis of:

1. Sensitivity
2. Specificity
3. Positive Predictive Value (PPV)
4. Negative Predictive Value (NPV)
5. ***P***-value

Chi-square test and Fisher's test has been used to analyse the catagorial data and for testing the association between variables. $p<0.05$ was considered statistically significant.Data were collected, tabulated, coded and then analysed using Statistical Programme in Social Sciences (SPSS) for windows (version 17.0).Microsoft excel was used to generate graphs and tables.

Results and observation:

The present studyincludes 104 patients diagnosed as chronic rhinosinusitis as per the criteria given by AAO-HNS Task Force 1997[2] between the period of July 2014 to September 2016. Their clinical features, endoscopic and CT scan findings were studied in detail as per pretested proforma.

Table 01:-Distribution of cases according

Age (years)	**No. of patients (%)**		
	Females (n=41)		**Total (n=104)**
≤20	4 (9.75)	14 (22.22)	18 (17.31)
21-30	17 (41.46)	23 (36.51)	40 (38.46)
31-40	10 (24.39)	18 (28.57)	28 (26.92)
41-50	10 (24.39)	6 (9.52)	16 (15.38)
>50	0 (0.00)	2 (3.17)	2 (1.92)
Total	41 (39.42)	63 (60.58)	104 (100.00)

In present study out of 104 cases, maximum patients were between the age group of 21- 30 years i.e. 40(38.46%) cases, followed by 31-40 years 28 (26.92%) cases Youngest patient was 16 year old as below 15 years excluded and eldest was 68 years old. **Mean Age: 30.28 ± 9.35**

Table 02:-Distribution of cases according to clinical diagnosis

Cases	**No. of patients (%)**		
	Females (n=41)	**Males (n=63)**	**Total (n=104)**
Chronic sinusitis	35 (85.37)	53 (84.13)	88 (84.62)
Gross polyposis	6 (14.63)	10 (15.87)	16 (15.38)
Total	41 (39.63)	63 (60.58)	104 (100.00)

Present study included 104 patients of which 88 (84.62%) cases were of chronic sinusitis and 16 (15.38%) of gross polyposis on clinical examination.

Table 03:-Distibution of cases according to nasal endoscopic findings

Nasal endoscopic findings	No. of patients (n=104)	Percentage
Nasal Mucosa		
Congested	52	50.00
Oedematous	16	15.38
Oedematous + Polypoidal	16	15.38
Pale	12	11.54
Normal	8	7.69
Nasal Discharge		
Mucopurulent	69	66.35
Watery	17	16.35
No discharge	18	17.31

Present study included 104 patients of which 88 (84.62%) cases were of chronic sinusitis and 16 (15.38%) of gross polyposis on clinical examination.

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Table 04:-Distribution of cases according to anatomicalvariationvisualised on nasal endoscopy

Nasal Endoscopy Findings	No. of patients (%) (n=104)		
	Right	Left	Bilateral
Nasal septal deviation	42 (40.38)	50 (48.08)	0 (0.00)
With spur	18 (17.31)	34 (32.69)	0 (0.00)
Without spur	24 (23.08)	10 (9.62)	0 (0.00)
Agger nasi cells	14 (13.46)	2 (1.92)	26 (25.49)
Middle turbinate			
Hypertropied turbinate/Concha bullosa	26 (25.00)	10 (9.62)	4 (3.85)
Paradoxically curved MT	8 (7.69)	14 (13.46)	4 (3.85)
Bifurcated MT	0 (0.00)	2 (1.92)	0 (0.00)
Uncinate process			
Medially rotated	8 (7.69)	24 (23.08)	0 (0.00)
Ethmoidal bulla			
Ballooned	12 (11.54)	10 (9.62)	20 (19.23)
Flat	4 (3.85)	0 (0.00)	0 (0.00)
Accessory ostium	12 (11.54)	16 (15.38)	8 (7.69)

In the present study

Table 05:-Distribution of cases according to the anatomical variation detected on CT imaging

Anatomical variation	No. of patients (%) (n=104)		
	Right	Left	Bilateral
Agger nasi cells	20 (19.23)	0 (0.00)	38 (36.54)
Concha bullosa	22 (21.15)	12 (11.54)	30 (28.85)
Paradoxically curved MT	4 (3.85)	20 (19.23)	4 (3.85)
Pneumatised UP	2 (1.92)	0 (0.00)	10 (9.62)
Large Ethmoidal bulla	2 (1.92)	6 (5.77)	10 (9.62)
Accessory ostium	6 (5.77)	10 (9.62)	4 (3.85)
Haller cells	6 (5.77)	8 (7.69)	4 (3.85)
Onodi cells	4 (3.85)	8 (7.69)	0 (0.00)

Discussion:-

The present study includes 104 patients diagnosed as chronic rhinosinusitis as per the criteria given by AAO-HNS Task Force 1997[2] between the period of October to March 2014. Their clinical features, endoscopic and CT scan findings were studied in detail as per pre-test proforma.

Cases according to age and gender -

In present study out of 104 cases, maximum patients were between the age group of 21- 30 years i.e., 42 (39.62%) cases, followed by 28 (26.92%) cases between 31-40 years.Youngest patient was 16 year old (as those below 15 years were excluded) and the oldest was 68 years old. Mean age was 30±11.63 years.

The presentation of chronic sinusitis was common in age group 21- 30 years. This is the most active age group and comprises the most productive age group of society. In present study we found male preponderance in cases of chronic rhinosinusitis.However , studies conducted by AR Talaiepour et al (2005)[12]and Madani S et al (2013)[13] showed slight female preponderance of 51.7% and 51.4% respectively.In present study, the most common major factor seen in patients of chronic rhinosinusitis was nasal obstruction seen in 92 (88.46%) cases, followed by nasal discharge/post nasal drip in 84 (80.77%) cases. Least common presenting symptom was hyposmia or anosmia seen in 16 (15.38%) cases.

In minor factors, headache was the most common presenting factor seen in 74 (71.15%) cases, followed by fatigue in 34 (32.69%) cases and fever in 24 (22.08%) cases. Least common symptom among the minor factors was halitosis in 14 (13.46%) cases.

Nasal obstruction may be due to anatomical abnormalities such as deviated septum, nasal polyps and enlarged turbinates. An overactivity of the parasympathetic nerve supply as compared to the sympathetic nerve supply will cause dilatation of the vascular tree, and hence engorgement, leading to nasal obstruction.

Headache is also the most common presenting symptom reported by many studies. Headache can be attributed to mal-ventilation of sinuses leading to local hypoxia, reduced pH, reduced ciliary beat and thick viscous mucous and increased vulnerability to infection, thus leading to headache. Other factors include constant intense mucosal contact leading to facial pain and headache or pressure from proliferating polyps.

In the study conducted by Zojaji et al (2008)[7] nasal obstruction is the most common symptom with 51 patients and headache was noted in 37 (72.5%) patients and nasal discharge in 46 (90.1%) patients and other related complaints such as hyposmia were seen in 15 cases, cough in 11 and asthma in 6 cases.
Wani A et al (2009)[14] studied 150 patients of chronic rhinosinusitis and reported headache and facial pain as main symptoms (90%) followed by nasal discharge (86.6%), nasal obstruction (85.33%), hyposmia in (20%).

D Sheetal et al (2011)[15] studied 45 patients of chronic rhinosinusitis and reported most common presenting symptom as headache (90%) followed by nasal discharge (80%).Gautam P et al (2014)[20] studied 50 patients. 84% of patients had both headache and nasal obstruction, which were the most common minor and major symptoms respectively. 70% had nasal discharge; postnasal discharge was seen in 44% and sneezing in 30%. In the study conducted by Deosthale N et al[16] the common presenting symptom of was headache (77.04%) followed by nasal obstruction (75.40%), nasal discharge (65.57%), altered sense of smell (46.72%). Other less common symptoms include facial pain (22.95%); nasal mass (18.85%) and nasal bleed (16.39%).Findings in present study correlated well with other studies. However, Saxena R et al (2010)[17] who reported post nasal drip as most common major symptom seen in 46 (76.7%) cases followed by nasal obstruction in 43 (71.7%) cases. Among minor symptoms headache was seen in 36 (60%) cases followed by cough in 20 (33.3%) and earache in 8 (13.3%) cases.

Nasal endoscopic findings-

Nasal endoscopy is valuable tool in diagnosis of chronic rhinosinusitis. It allows clear visualization of the major drainage pathways of the sinuses as well as of the entire floor of nose, nasal septum, condition of nasal mucosa. Middle meatus secretions can only be assessed with DNE but not on CT scan .In present study we have seen congested nasal mucosa in 52 (50%) cases followed by edematous mucosa in 16 (15.38%) and edematous with polypoidal nasal mucosa in 16 (15.38%) cases. Mucopurulent nasal discharge was seen in 69 (66.35%).

In study of Deosthale N et al (2014)[16], congested nasal mucosa (45.08%) and purulent middle meatus discharge (42.62%), edematous nasal mucosa (31.14%), non-purulent nasal discharge (25.40%), pale nasal mucosa and polyps (15.57%)
In 2010 Saxena R et al[17]found meatal stenosis as most common finding, mucosal changes in 43% cases & purulence in nasal cavity was seen in 46.2% cases.
In 2008, Shahizon et al [18] studied 40 patients and found diseased nasal mucosa in 9% cases, polyp with diseased mucosa in 23% & polyps in 45% cases. They also found diseased mucosa associated with mucopus in 9% cases.
These findings correlated with the study of Deosthale N et al [16] and Saxena R et al[19] but not with study of Shahizon et al[18].
The reason for different incidences in nasal finding may depend on various factors like the time of presentation, type of disease.

Identification of Anatomical variations on nasal endoscopy -
On nasal endoscopy septal deviation was found to be the most common finding. Any deviation from the midline was diagnosed as septal deviation. Septal deviation was diagnosed in 92 (88.46%) cases. It was more common on left side 50 (48.08%) cases, septal deviation with spur was seen in 52 (50%) of which 34 (32.69%) on left & 18 (17.31%) on right.

It is stated in literature that straight septum is an exception rather than a rule. Nasal septum deviation is highly accounted disease in population.

Gautam P et al[20]reported deviated nasal septum in 76%.

Talaiepour et al (2005)[12] reported septal deviation in 63% cases.

Singhal P et al[21] reported DNS in 44% endoscopically.

The incidence of septal deviation may vary according to the definition used. Mild septal deviations, which are unlikely to have any effect on pathology, might not be recorded leading to variable incidence being reported.

Presence of pneumatisedagger nasi cells was suspected on endoscopy in 42 (40.38%) cases. It was found to be bilateral in 26 (24.49%), on right side in 14 (13.36%) cases and on left side in only 2 (1.92%) cases

Singhal P et al[21] reported pneumatised agar nasi in 24%.

However, diagnosis of agger nasi on nasal endoscopy is a subjective finding and needs CT imaging for confirmation.

In present study on nasal endoscopy, hypertrophied middle turbinate/concha bullosa was diagnosed in 40 (38.76%) cases, of which 26 (25%) cases had hypertrophied turbinate on right side, 10 (9.62%) cases on left side, and in 04 (3.85%) cases it was seen bilaterally. Gautam P et al[20] reported hypertrophied middle turbinate in 40%.Saxena R et al[17] reported hypertrophied middle turbinate on endoscopy in 45%.

Joe et al (2000)[22] reported 15% incidence of hypertrophied middle turbinate on endoscopy.[23] These findings concur with our study except for Joe et al.[22]

Paradoxically curved middle turbinate was seen in 26 (25%) cases. It was on left side in 14 (13.46%) cases. On right side in 08 (7.69%) and bilateral in 04 (3.85%) cases. Its reported incidence varies in the studies stated above. On nasal endoscopy bifurcated middle turbinate was seen in 02 (1.92%) cases which were on left side.

In uncinate process variations, medially rotated uncinate process was seen in 32 (30.75%) cases. It was seen on left side 24 (23.08%) and on right 08 (7.69%) cases. Joe et al[91] and Bist SS et al[24] reported uncinate variation incidence in 15% and 10% cases respectively. Saxena et al[17]reported a higher incidence.

Ballooned ethmoid bulla was diagnosed in 42 (40.38%) cases. It was seen bilaterally in 20 (19.32%) cases, on right side it was seen in 12 (11.54%) and on left side in 10 (9.62%) cases. Flat ethmoidal bulla was seen in only 04 (3.85%) cases, both of which were on right side. Joe et al[22]reported incidence of ballooned ethmoidal bulla in 34%.
Accessory ostium was identified in total 36 (34.61%) cases. It was mainly found on left side in 16 (15.38%) cases, on right side 12 (11.54%) cases and bilaterally 08 (7.69%) cases.Reported by Joe et al[22] in 23%.

Anatomical variations detected on CT imaging -
CT scan is considered as gold standard for identifying bony anatomical variations.
Various authors had shown incidence of anatomical variations on CT scan in patients of chronic rhinosinusitis and its correlation with present study.

Agger nasi cells -
Aggernasi cells were seen in total 58 (55.76%) cases of which 20 (19.23%) cases had prominent aggernasi on right side & 38 (36.54%) cases had bilateral aggernasi. This findings correlates with study of Mamtha H et al[25].

Concha bullosa -
The definition of concha bullosa used in various studies is the main reason for this variation. In present study we defined concha bullosa as presence of any kind of air cell in middle turbinate. Accordingly concha bullosa was seen in 64 (61.53%) cases. It was bilateral in 30 (28.85) cases, on right side in 22 (21.15%) cases, and on left side in 12 (11.54%) cases.

The incidence of concha bullosa (60.37%) in present study correlates well with Al-QudahM et al[26].Studies of Gupta AK et al[27]and Mamtha H et al[25] showed lower incidence.

Paradoxically curved middle turbinate -
Paradoxically curved middle turbinate was reported in 28 (26.92%) cases, which included 20 (19.23%) cases on left side and 04 (3.85%) cases each on right side and bilaterally. This correlated well with study conducted by Bolger et al (1991)[28.]

Uncinate Pnuematisation -
Uncinate pneumatisation was seen in 12 (11.53%) cases. In 10 (9.62%) cases it was bilateral, while only in 02 (1.92%) cases it was found on the right side. Lloyd et al (1991)[29] reported 16 % cases of uncinate pnuematisation. Incidence was lower in Singhal P et al[21].

Ethmoid bulla -
Ethmoid bulla was seen to be enlarged in 18 (17.3%) cases. It was encountered bilaterally in 10 (9.62%) cases, on left side 06 (5.77%) cases and on right side in 02 (1.92%) cases.
Incidence of enlarged ethmoid bulla in present study is 16.98% cases. This finding correlated well with Lloyd et al[29] (1991) and Saxena R et al[17](2009).

Haller cells -
Haller cells were found in 18 (17.3%) cases, mainly on left side in 08 (7.69%) cases, followed by 06 (5.77%) cases on right side, and 04 (3.85%) cases had Haller cells on both sides. These findings correlated with studies of H Mamtha et al[25].

Onodi cells -
Onodi cells were seen in 12 (11.53%) cases of which 08 (7.69%) cases had it on left side and 04(3.85%) cases had it on right side. Pinas et al[30] in 2000 studied 110 CT's of patients suspected of inflammatory disease and reported onodi cells in 11% cases.

Accessory ostium -
In present study, accessory ostium was found in 20 (19.23%) cases in which 10 (9.62%) cases had on left, 6 (5.77%) on right and in 4 (3.85%) cases bilaterally.
Saxena R et al[17] reported accessory ostium in 6% cases.

The preoperative knowledge of presence of accessory ostium on CT scan will prevent a common pitfall in surgery of not connecting it to the natural ostium which may lead to recurrent sinusitis because of recirculation of mucous leading to recurrence.

Septal variations -
In present study most common septal variation was septal deviation seen in 88 (84.62%) cases. It was more common on left side 52 (50%) cases. Septal deviation with spur was seen in 24 (23.08%) cases on left side and 16 (15.38%) cases on right side. The incidence of septal deviation ranges from 40% (Calhoun et al)[23] to 96.6% (Takanishi et al)[31]. The prevalence of septal spur is reported as 33% by Danese et al[32]and 25.3% by Jarenocharsi[33]. In our study it was 38.46%.

In present study septal pneumatization is seen in 50 (48.08%) cases which are higher than that reported by Gupta A K et al[22](13.02%).

Superior attachment variation of uncinate process -
In present study of 104 patients we found superior attachment of uncinate process mainly to lamina papyracea in 68 (65.38%) on left side and 48 (44.23%) on right side. This was followed by attachment to middle turbinate seen in 40 (38.46%) cases on right and 28 (26.92%) cases on left. Attachment to skull base was seen in 18 (17.31%) cases on right and 08 (7.69%) cases on left.

The knowledge of superior attachment of uncinate process gives information about the extent of disease from anterior ethmoids to frontal sinus. If uncinate process is attached to lamina papyracea it creates a recess above infundibulum known as terminal recess and frontal recess opens directly in middle meatus. Thus it may be spared from anterior ethmoids in osteomeatalcomplex pattern of disease.

D Sheetal et al (2011)[15]also reported superior attachment of uncinate process, most commonly to lamina papyracea (70% on right side and 66% on left side), followed by the middle turbinate (24% on right and 31% on left side)

Frontal cells
In present study frontal cell type I was most commonly seen in 16 (15.38%) cases, followed by frontal cell type II 08 (7.69%). Frontal cell type III was seen in 04 (3.85%) and type IV in only 02(1.92%) cases.

Meyer et al [34]studied 768 scans and found type I frontal cells in 114.9% cases, type II in 1.3%, type III in 1.7% and type IV in 2.1%. Gupta AK et al et al (2012)[22] studied 69 CT PNS and found type I frontal cells most common in 18.11% followed by type III in 2.17% , type IV in 4.34% and type II in 4.34% cases.

Findings of our study correlated well with other studies.

Severity of concha bullosa on CT imaging -
Concha bullosa pneumatisation of middle turbinate were classified by Bolger et al (1991)[28]in following three different type i.e. lamellar, Bulbous and Extensive or true concha bullosa.

In present study, presence of any air cells in middle turbinate was considered as concha bullosa, Total 208 middle turbinates were studied in 104 patients and we found 94 concha bullosa in 64 (61.53%) cases. Out of 94 concha, 64 lamellar concha were seen in 40 (38.46%) cases of which 22 (21.15%) cases had unilateral lamellar concha and 18 (17.31%) had bilateral lamellar concha. Bulbous and extensive concha was seen 12 (11.53%) cases each. In 06 (5.77%) cases it was unilateral and in remaining 06 (5.77%) cases it was bilateral. In 1991, Bolger et al[28] studied 202 patients and found lamellar concha in 46.2% cases, bulbous concha in 31.2% cases and extensive i.e., true concha bullosa in 15.7% cases.

Uygur et al[35] in 2003 studied 100 consecutive patient of chronic sinusitis and found lamellar concha 55.3%, bulbous in 33.97% and extensive in 10.8% cases.

Badran et al 2011[36]studied 47 patient sinuses CT scan showing pneumatisation of middle turbinate and found 17% cases of lamellar, 46.8% cases of bullous and 36.2% cases of extensive concha bullosa.

The incidence of appearance of lamellar concha in present study correlated with Bolger et al (1991)[28] and Uygur et al (2003)[35].

Severity of septal deviation -
In present study we have classified septal deviation depending upon the severity angle of deviation as mild, moderate and severe as described by Jin HR et al[37].

We found severe type of septal deviation most commonly seen in 46 (44.23%) cases, moderate septal deviation in 30 (28.85%) cases and mild in 12 (11.54%) cases.

Septal deviation and its relation to concha bullosa -
In present study, we found septal deviation and concha bullosa related to each other in its appearance. Presence of septal deviation to one side was related to concha bullosa on opposite side.

Left sided septal deviation was associated with right sided concha bullosa in 28 (26.69%) cases and right sided septal deviation with left sided concha bullosa in 16(15.38%) cases. Septal deviation with concha bullosa on same side was found in 14 (13.46%) cases. But this association was found to be statistically not significant ($Z= 1.2$, $P >0.05$) .

In study conducted by Stallman et al (2002)[38] significant association was found between septal deviation and concha bullosa. They found that patients with left sided unilateral concha (117 i.e. 70% cases) had right sided nasal septal deviation, 11 (7%) cases had left sided nasal septal deviation and 38 (23%) cases had no septal deviation.

Cho JH et al (2010)[39]evaluated the relationship between nasal septal deviation and concha bullosa in 73 healthy and 461 symptomatic patients, and reported that anatomic variation of the middle turbinate was related to contralateral septal deviation.

Involvement of sinus on CT imaging -
In present study we found most common sinus involved was maxillary seen 90 (86.53%) cases followed by involvement of anterior ethmoidal air cells in 54 (51.92%) cases, frontal sinus in 20 (19.2%) and posterior ethmoidal air cell in 16 (15.38%) cases,least common involved was sphenoid sinus in 14 (13.46%) cases. While evaluating frontal sinus, we found aplasia of frontal sinus in 2 (1.92%) cases.

D Sheetal et al[15]studied 45 cases and found maxillary sinus to be most commonly affected (57% right side, 46% left side) followed by anterior ethmoids (40% right side, 37% left side), posterior ethmoids, frontal sinus and sphenoid sinus.

Singhal P et al[21] studied 330 patients and found maxillary sinus commonly involved (93.33%) followed by ethmoids (66.66%), frontal and sphenoid sinuses.

Wani A et al[40]studied 150 patients and concluded that anterior ethmoids were involved in 87.33% cases, maxillary sinus in 65.33%, followed by posterior ethmoids, frontal and sphenoid sinus.

Saxena R et al (2010)[17], in his study of 60 cases found anterior ethmoids most commonly involved in 31 (51.7%), followed by maxillary sinus in 29 (48.3%) cases.

Our findings correlated with D Sheetal et al[15] and Singhal P et al[21] in involvement of maxillary sinuses as the most common sinus.

Correlation of nasal endoscopy and CT imaging findings –
In the present study of 104 cases, nasal endoscopy has good sensitivity for hypertrophied middle turbinate/concha bullosa (CB) and septal deviation (SD).
Sensitivity of nasal endoscopy is low for large ethmoidal bulla (EB) and accessory ostium (AO).
In our study, all parameters were statistically significant ($p<0.05$) except pneumatized uncinate process that is only seen on CT scan.
Thus, there is a correlation between nasal endoscopic findings and CT scan findings.

In 2008 Shahizon et al[18] reported correlation of CT and nasal endoscopic findings in CRS. They found CT scan identifies a higher frequency of enlarged turbinate/concha bullosa, paradoxical turbinate and nasal septal deviation abnormalities. They stated that multiple inexperienced endoscopist who were ENT medical officers in speciality training may have contributed to the low detection rate of enlarged turbinate/concha bullosa endoscopically.

In 2010, Saxena R et al[17]have shown that correlation between the nasal endoscopic findings and CT scan findings was highly significant ($p<0.01$).

D Sheetal et al (2011)[15] concluded that endoscopy and CT scan are complimentary in assessment of various anatomical variations in the osteometal complex and in intrasinus mucosal disease.

Singhal P et al[21]correlated CT scan findings with endoscopic findings with respect to anatomical variations and pathology in 300 patients and found that certain parameters like gross polypoidal change (97–98%) showed very good correlation with endoscopic findings while others like presence of pus/mucopus in sinus (60%), paradoxical turbinate (76.9%) and sphenoethmoidal disease (75%) showed poor correlation.

Srinivasa V et al[41]studied 60 patients and concluded that nasal endoscopy was better than CT scan in diagnosing septal deviation, spur, polyp and hypertrophied turbinate.

Similar study by Vining in 1993 has shown that diagnostic nasal endoscopy could pick up more findings in nasal cavity than CT Scan[42].

In another study by Bhattacharyya N[43] it was concluded that combined with a symptom history, endoscopy can be a highly specific technique for predicting positive CT findings of chronic rhinosinusitis. Rosbe[10] in his study, came to the conclusion that nasal ensoscopy was moderately sensitive and highly specific in predicting results of CT Scanning.

Arun Kumar Patel et al (2015)[44]concluded that in patients with CRS symptoms (AAO-HNS) nasal endoscopy has high specificity in identifying CRS but doesnot rule it out which as compared to CT scan has high sensitivity. Out of 90 patients studied ,49 (54.44%) were with positive CT findings and 41 (45.55%) with negative CT findings. 33 (36.66%) patients had positive endoscopic findings and 57 (63.3%) with negative endoscopic results. Out of 33 (36.66%) positive endoscopic findings patients, 23 (25.55%) were CT positive and 10 (11.11%) were with CT negative findings.

Thus, there is a correlation between nasal endoscopy and CT scan findings in CRS patients i.e. most of the endoscopic positive findings were having CT positive findings also. Therfore CT scan is much useful to confirm the CRS prior to any surgical intervention and with the use of high specificity of DNE and high sensitivity of CT Scan PNS , patients with CRS symptoms can be selected for surgical intervention.

Limitations of the Study:

However there are certain limitations of nasal endoscopy which includes inability to look for disease in patients with deviated nasal septum, constricted middle meatus and presence of hidden air spaces like sphenoid sinus, ethmoid bulla and posterior ethmoids where it is impossible to pass on the scope beyond a certain point. Also , extent of the disease , posterior anatomical variations and density of each sinus is very well recognized in CT scan PNS which is important in evaluation and surgical planning for CRS.

Conclusion:-

In present study , we found , Chronic Rhinosinusitis can be reliably identified using the AAO-HNS Task force criteria 1997.Diseased oedematous or congestion of nasal mucosa , pathological secretion , purulence or mucous in middle meatus mucosa middle meatus have non-specific features on coronal CT and nasal endoscopy has essential role in accurately diagnosing this pathology as well as anterior anatomical variations. Also , DNE is better diagnostic to detect early polypoidal changes in mucosa which are otherwise missed on CT PNS. it is an outpatient procedure, relatively economic, with no radiation hazards. Thus , by performing DNE prior to CT , can aid in early diagnosis and medical management of CRS as it is easily available , is an outpatient procedure , relatively economic and can spare patient from unnecessary cost and radiation exposure .Hence we conclude that nasal endoscopy and

CT scan paranasal sinus are complimentary to each other and both help in more accurate diagnosis and make treatment planning easier, while avoiding complications.

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