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Computer Tomographic study of Anatomic Variations of Paranasal Sinuses in Libyan Population and their Clinical Correlation

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ABSTRACT

Introduction: In the era of Functional Endoscopic Sinus Surgery, precise knowledge of paranasal sinus anatomy and variations are essential for the surgeon. The multi-slice computed tomography is the imaging modality of choice provides accurate evictions of the anatomy, the anatomical variants and the extent of the disease in paranasal sinuses, such a method allowing their accurate identification with high anatomical details. Some of these variants may predispose to sinus diseases or become of high risk for injuries and complication during surgical procedure, therefore, the study of anatomic variants of paranasal sinuses is important in the preoperative endoscopic surgery.

Objectives: The purpose of this study is to assess the frequency of anatomic variants and their clinical importance. Materials and methods: This retrospective study was conducted at the Department of Radiology, Benghazi Medical Center, Benghazi, Libya. Data comprised the paranasal sinus computed images of 112 patients (46 males and 66 females) analyzed for the presence of anatomic variants and associated sinus pathology.

Results: Our results showed that the most common anatomical variants was deviated nasal septum (60.7%) with slight higher incidence on left side, followed by concha bullosa (22.3%), other variants found were absent frontal sinus (18.8%), Nasal spur (14.3%) , Agger nasi cell (16.1%), Haller cell (5.4%), Onodi cell (2.7%), accessory ostia of maxillary sinuses (10.7%), accessory middle nasal concha (1.8%), paradoxical middle turbinate (1.8%), nasal septum pneumatization (5.4%), Crista galli pneumatization (2.7%), pneumatization of hard palate (1.8%) and pneumatization of clinoid process (6.3%). (53.6%) patients suffered from sinusitis, the results showed that the most common sinus involved was maxillary sinus.

Conclusion: Anatomical variations of PNS are quite common. Analysis of every paranasal CT scan obtained for sinusitis for the presence of different anatomic variants is of questionable value unless endoscopic surgery is planned to reduce the risk of intraoperative complications.

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List of abbreviation

CT	Computed Tomography
PNS	Paranasal Sinus.
DNS	Deviated Nasal Septum
FESS	Functional Endoscopic Sinus surgery
OMC	Osteomeatal Complex
FS	Frontal sinus
CB	Concha bullosa
ANC	Agger Nasi Cell
HC	Haller Cell
OC	Onodi Cell

Introduction

CT scan of Para nasal sinuses has advantages of bony and soft tissue details using window settings. axial and coronal views both useful for the anatomical landmarks of sinuses, but coronal CT scan delineate most of the information required for an endoscopic clearance [1]. The anatomic variants include concha bullosa, paradoxical bending of the middle turbinate, pneumatization

of the (uncinate process, Agger nasi) bent uncinate process; the infraorbital cells, sphenoethmoidal cells, and deviation of the nasal septum. In addition, the height of the roof, concomitant depth of the cribriform niche and septations attaching to the region of carotid artery are of surgical importance [2]. The presence of supraorbital cells is important in both endoscopic sinus surgery and neurosurgical anterior cranial fossa approaches to the orbit, because potentially increase the risk of orbital damage during endoscopic sinus surgery, even breaching the wall of a supraorbital cell may jeopardize sterility [3]. Concha bullosa is a pneumatization of the bone plate by extension of ethmoid sinus cells. Such variation possibly causing middle meatus or infundibulum obstruction, besides the deviation of the nasal septum to the contralateral side [4]. Onodi cells are ethmoid cells that have migrated to the anterior of the sphenoid sinus, intimately related to the optic nerve, causing optic neuropathy in certain conditions that affect such cells [5]. Frontal sinus extension is a rare condition due to increased sinus aeration beyond the normal margin, symmetric extension of the frontal sinus towards the anterior ethmoid air cells found mainly in male in the age range between 20 and 40 years. No reported Cases in children [6].

Objectives

1. To study the radiologic anatomy of the paranasal sinuses to assess whether anatomic variations are associated with disease pathology, and to identify those variants that may impact operative safety.
2. To highlight the value of computed tomography as an essential tool for a better accurate identification with high anatomic details and performance of less invasive operative techniques.

Materials and Methods

The study depends on multi detector CT scan {using a helical PHILLIPS CT scan machine} to detect the anatomic variants of paranasal sinuses for different indications with symptoms such as persistent headache, facial pain and nasal congestion, some of them not respond to medical therapy. These patients had CT scan requested by their doctors, we undertook a retrospective review of paranasal CT scan from a total of 112 patient's medical radiological records. All the patients with any age group of both gender {46 males and 66 females} aged 12 to 73 years {mean age 33.6 years} attending Department of Radiology at Benghazi Medical Center, Benghazi, Libya, between 2012 - 2014; The study was conducted at CT scan unit, Radiology Department, Benghazi Medical Center. This center is a tertiary center and receives referred patients from different departments in the center and different surrounding areas. That were retrieved from archives. A Phillips CT scan of 64 slices CT scanner was used for every patient, coronal unenhanced CT of PNS, complemented by axial and sometimes sagittal views, these scans were interpreted by different radiologist, and obtained by special parameter technique with CT cut thickness is 1 millimeter or less. The exposure setting used were 120 KVP and 359 mAS. Analyzed for presence of anatomic variants such as deviated nasal septum, concha bullosa, absent frontal sinuses, nasal spur, Haller cell, Agger nasi cell, and Onodi cell and other variants. And associated findings such as inflammatory sinus diseases. Statistical analysis; SPSS for windows (version 18) is used for data analysis, analyzing the data focusing on the findings of the PNS variants also evaluating whether or not associated with sinus diseases. Results were cross tabulated. frequencies, descriptive statistics were the statistical methods used. Level of significance of findings was assessed by Chi-square test.

Results

The results of this study will be tabulated and analyzed with using SPSS program, use the appropriate statistical methods and appropriate tables, figures and diagrams. Retrospective study was performed in all the 112 patients who underwent CT scan for PNS from January 2012 to December 2014. The patients were collected most of them presented with headache and nasal obstruction. Unenhanced PNS CT scan shows different types of variants. The age of patients ranged from 12 to 73 years (mean age, 33.6 years irrespective of sex); 46 patients (41.6 %) were men, and 66 patients (58.9 %) were women (Fig. 1), Among the age and gender groups it was highest in young adult female group (20 - 30 years) 21 patients (31.8%). with highest occurrence in both gender at 3rd and 4th decade 70 patients (62.5%). (Table 1) depicts the distribution of sample by age and sex. We find most of the patients in the age group of 20 - 30 and 31 - 40years. And very few of them in higher age group. The CT scan results showed that the deviated nasal septum was the most common anatomic variants of nasal cavity and paranasal sinuses was observed. It was present in 68 of 112 patients (60.7%) also show slight predominance to the left side 36 patients (32.1%) as compared to right side 32 patients (28.6%) (Table 2) (fig. 2 & Fig. 5 B). Nasal septal spur was found in 16 patients (14.3%) (fig. 5 A). The second most common variant was concha bullosa present in 25 of 112 patients (22.3%), out of which 13 patients (11.6%) were present bilaterally and 12 patients (10.7%) unilaterally (Table 3) (fig. 3 & Fig. 6). The third most common variant noted was absence of frontal sinus present in 21 of 112 patients (18.8%) (Table 5). Several other anatomic variants were observed, including the least common one, are illustrated in (Table 5).

The most common involved sinus inflammatory mucosal changes were maxillary sinus. (Table 4) (fig. 4). Among 68 Patients with deviated nasal septum, 39 patients (57.4%) had sinusitis and 29 patients (42.6%) showed no features of sinusitis, and 21 of patients (47.7%) without DNS had sinusitis and 23 of patients (52.3%) showed no features of sinusitis, so was not statically significant (P=0.381). Among 25 patients with concha bullosa 9 patients (36.0%) showed features of sinusitis and 16 patients (64.0%) showed no features sinusitis and among 87 of patients without CB, was 51 (58.6%) had sinusitis and 36 (41.4%) without sinus pathology, the (P= 0.046) was statically significant. Among 21 of patients with AFS 9 (42.9%) had sinusitis and 12 (57.1%) without sinusitis (P=0.275) showed no statically significant. The incidence of sinus pathology in each variant illustrated in (Table 6). The variants seen in middle turbinate; Paradoxical turbinate with convexity toward the medial wall of the maxillary sinus was found in 2 (1.8%) (fig. 11B), both cases had not sinusitis, among the patients without paradoxical turbinate 60 (54.5%) had sinus pathology and 50 (45.5%) had sinusitis, (P= 0.125). Also the accessory middle nasal concha (fig. 11 A) found in 2 (1.8%) both of patients had sinusitis, among 110 patients without accessory middle turbinate 58 (52.7%) had sinusitis and 52 (47.3%) without sinusitis (P=0.184), both variants showed no statistically significant. Regarding occurrence of special cells we found the most common was Agger nasi cells 18 patients (16.1%) (fig. 7), 8 of them (44.4%) was diagnosed as sinusitis and 10 of them (55.6%) without sinus pathology and among 94 patient without ANC, 52 (55.3%) showed sinusitis and 42 patients (4.7%) without sinus disease, (P=0.397), followed by Haller cells; the anterior ethmoid air cell that lies in the orbital floor, found to be present in 6 patients (5.4%) (fig. 8), 2 patients (33.3%) showed sinus pathology and 4 patients (66.7%) without sinusitis, 106 patient had no HC 58 (54.7%) had sinusitis and 48 patients (45.3%) had no sinusitis (P=0.307) . and Onodi cells; the most posterior ethmoid air cell, found to be present in 3 patients (2.7%) (fig.9) all patients had sinusitis and among 109 had not OC 57 patients (52.3%) had sinusitis and 52 (47.7%) had not

sinusitis (P=0.102), our study showed the occurrence of these special cells and associated sinus disease shows no statistical significance. The paranasal sinuses pneumatization extent; The patients with nasal septum Pneumatization (fig. 10 A) was found in 6 patients (5.4%) (P=0.007) was statistical significant. Crista galli pneumatization was found in 3 patients (2.7%) (fig. 10 B) (P= 0.476), Pneumatization of the hard palate was defined as medial extension of maxillary sinuses into the palatal process of maxilla, was found in 2 patients (1.8%) (fig. 10 C) (P=0.184), and the sphenoid sinus shows variable pneumatization extent toward the related recesses of greater sphenoid wing, the pneumatization of lateral recess and pneumatization toward anterior clinoid process was found in 7 patients (6.3%) (fig. 10 D) (P=0.557). All these variants showed no statistical significant.

Accessory maxillary ostia were found in 12 (10.7%) (fig. 12) (P=0.382).

Table 1: Shows the distribution of patients by age and sex

Age group (in years)	Sex Male Female	Total
>20	6(13.0%) 8(21.1%)	14(12.5%)
20 -30	16(34.7%) 2(31.8%)	37(33.0%)
31 -40	17(36.9%) 16(24.2%)	33(29.5%)
41 -50	6(13.0%) 17(25.7%)	23(20.5%)
51 -60	0(0%) 1(1.5%)	1(0.9%)
<61	1(2.17%) 3(4.5%)	4(3.6%)
Total	46(100%) 66(100%)	112(100%)

Figure 1: Shows sex distribution

Table 2: Shows the frequency of Deviated nasal septum variant

	Frequency	Percent
Absent	44	39.3
Left DNS	36	32.1
Right DNS	32	28.6
Total	112	100.0

Table 3: Shows the frequency of concha bullosa variant

	Frequency	Percent
Absent	87	77.7
Bilateral	13	11.6
Unilateral	12	10.7
Total	112	100.0

Table 4: Shows distribution of sinuses pathology

	Frequency	Percent
Normal	52	46.4
Maxillary sinusitis	30	26.8
Maxillary and Ethmoidal sinusitis	13	11.6
Ethmoidal sinusitis	2	1.8
Pan sinusitis	15	13.4
Total	112	100.0

Table 5: Shows the frequency of different anatomical variants

	Frequency	Percent
Deviated Nasal Septum Absent Present	44 68	39.3 60.7
Concha Bullosa Absent Present	87 25	77.7 22.3
Agger Nasi Cell Absent Present	94 18	83.9 16.1
Haller Cell Absent Present	106 6	94.6 5.4
Onodi Cell Absent Present	109 3	97.3 2.7
Absent Frontal Sinus Absent Present	91 21	81.3 18.8
Accessory Middle Nasal Concha Absent Present	110 2	98.2 1.8
Paradoxical Middle Turbinate Absent Present	110 2	98.2 1.8
Crista Galli Pneumatization Absent Present	109 3	97.3 2.7
Pneumatization of Clinoid Process Absent Present	105 7	93.8 6.3
Pneumatization of Hard Palate Absent Present	110 2	98.2 1.8
Nasal Septum Pneumatization Absent Present	106 6	94.6 5.4
Nasal Spur Absent Present	96 16	85.7 14.3
Accessory Ostia of Maxillary Sinus Absent Present	100 12	89.3 10.7
Total	112	100.0

Table 6: Shows the prevalence of sinus pathology in the different variants.
(N=112)

Anatomic Variation	Without sinus pathology	With sinus pathology	Total	P- value
Deviated nasal septum				
Present	29 (42.6%)	39 (57.4%)	68 (100%)	0.318
Absent	23 (52.3%)	21 (47.7%)	44 (100%)	
Concha Bullosa				
Present	16 (64.0%)	9 (36.0%)	25 (100%)	0.046
Absent	36 (41.4%)	51 (58.6%)	87 (100%)	
Agger Nasi Cell				
Present	10 (55.6%)	8 (44.4%)	18 (100%)	0.397
Absent	42 (44.7%)	52 (55.3%)	94 (100%)	
Haller Cell				
Present	4 (66.7%)	2 (33.3%)	6 (100%)	0.307
Absent	48 (45.3%)	58 (54.7%)	106 (100%)	
Onodi Cell				
Present	0 (.0%)	3 (100%)	3 (100%)	0.102
Absent	52 (47.7%)	57 (52.3%)	109 (100%)	
Absent Frontal Sinus				
Present	12 (57.1%)	9 (42.9%)	21 (100%)	0.275
Absent	40 (44.0%)	51 (56.0%)	91 (100%)	
Accessory Middle Nasal Concha				
Present	0 (.0%)	2 (100%)	2 (100%)	0.184
Absent	52 (47.3%)	58 (52.7%)	110 (100%)	
Paradoxical Middle Turbinate				
Present	2 (100%)	0 (.0%)	2 (100%)	0.125
Absent	50 (45.5%)	60 (54.5%)	110 (100%)	
Crista Galli Pneumatization				
Present	2 (66.7%)	1(33.3%)	3 (100%)	0.476
Absent	50 (45.9%)	59 (54.1%)	109 (100%)	
Pneumatization of Clinoid Process				
Present	4 (57.1%)	3 (42.9%)	7 (100%)	0.557
Absent	48 (45.7%)	57 (54.3%)	105 (100%)	
Pneumatization of Hard Palate				
Present	0 (.0%)	2 (100%)	2 (100%)	0.184
Absent	52 (47.3%)	58 (52.7%)	110 (100%)	
Nasal Septum Pneumatization				
Present	6 (100%)	0 (.0%)	6 (100%)	0.007
Absent	46 (43.4%)	60 (56.6%)	106 (100%)	
Nasal Spur				
Present	6 (37.5%)	10 (62.5%)	16 (100%)	0.439
Absent	46 (47.9%)	50 (52.1%)	96 (100%)	
Accessory Ostia of Maxillary Sinus				
Present	7 (58.3%)	5 (41.7%)	12 (100%)	0.382
Absent	45 (45.0%)	55 (55.0%)	100 (100%)	

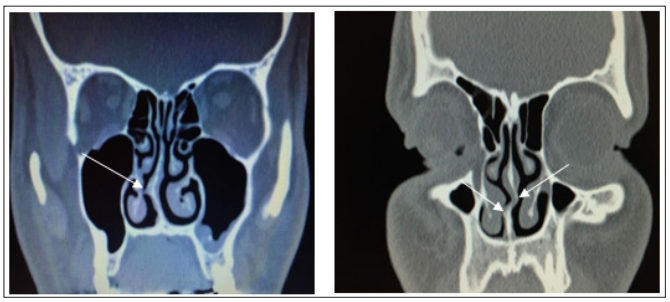

Figure 5. A: Deviated nasal septum to right side with Nasal spur. B: Double nasal septum deviation, with the upper portion deviated to the left, and the lower portion to the right

Figure 6: Bilateral concha bullosa, more evident in the right side

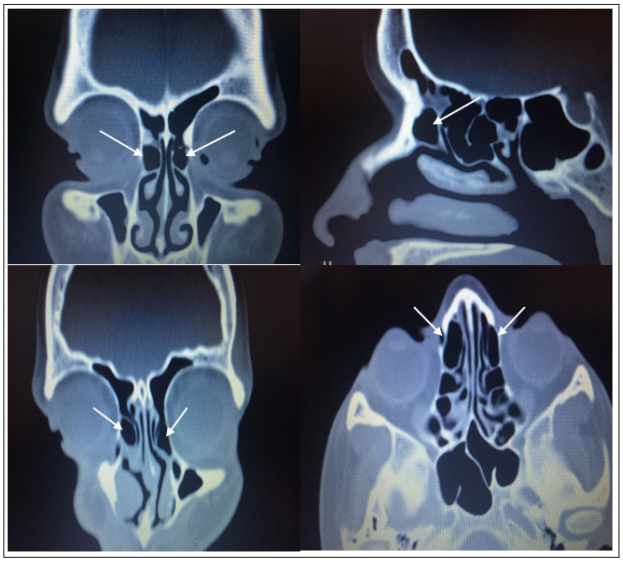

Figure 7: Shows Agger nasi cell in different patients

Figure 8: Haller cell. Bilateral infraorbital ethmoid cells, the largest at right

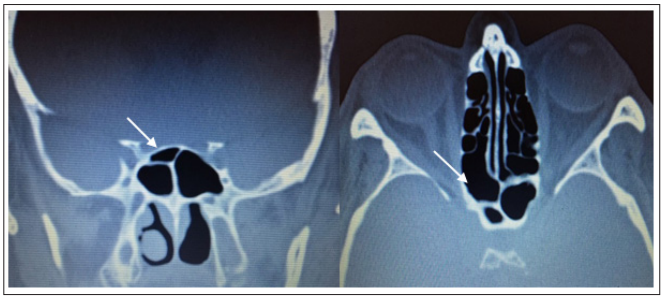

Figure 9: Onodi cell. A, B: unilateral right Onodi cell

Figure 10: Extension of pneumatization of paranasal sinuses A: Nasal septal pneumatization characterizing septal recess. B: Pneumatization of crista galli. C: Bilateral pneumatization of hard palate (arrows), representing pneumatization from maxillary sinus into palatal process of maxilla. D: Extension of pneumatization of sphenoid sinus toward the lateral recess of the sphenoid bone (bilateral) and toward the anterior clinoid processes

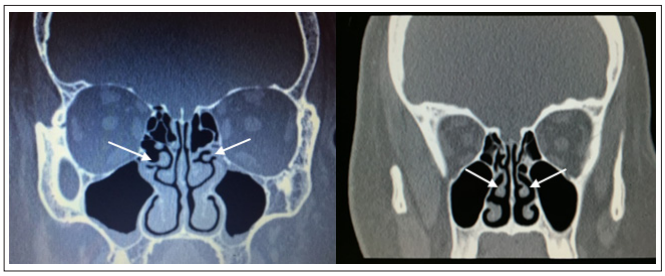

Figure 11 A: Bilateral, accessory middle nasal concha. B: Paradoxical middle turbinate bilaterally

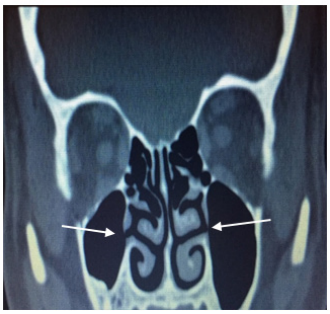

Figure 12: Bilateral accessory ostia of maxillary sinuses

Discussion

The results will be discussed in view of achievement of the aim, their significance and their comparison with previous researchers. Nasal cavity and paranasal sinuses regions are subject to a large number of variants. The PNS anatomical variants have potential role mainly in predisposed to recurrent sinusitis and in some cases causes severe headache [7]. These variants have two distinct viewpoints, their relationship to disturbing drainage system and the potential impact on surgical safety [7,8]. The advance in Functional Endoscopic Sinus Surgery (FESS), which requires to precise knowledge of sinus anatomy and its variations, which are only detected by CT scan. The conventional radiography doesn't provide detailed anatomical information. In our study, the PNS variant have been described as determined by coronal CT in series of 112 patients.

Age and Sex Determination

Among 112 patients in our study with anatomical variants 46 patients (41.6%) were male and 66 patients (58.9%) were females. Majority of patient, 33 males and 37 females, total 70 patients (62.5%) were in age group of 20 – 40 years. Gender wise, no statically difference was observed.

Nasal Septum variants

In our study 60.7% of patients showed deviated nasal septum and also showed slight predominance to the left side (32.1%) as compared to right side (28.6%), which is somewhat consistent with varies studies were done, showed that the incidence of DNS up to 80% and most were toward right side, our results was almost similar to [9,10]. In study showed the 63% of patients with DNS (31.5% toward the left and 28.0% toward the right side). Among The anatomical variants the most frequent variant was deviated nasal septum which can be bony, cartilaginous, or combination. The divergence of septum from the midline causes lateral displacement of middle conch leading to nasal obstruction [11]. Our study also shows 14.3% of patients with nasal septum spur, which is bony deformity that may obstruct the nasal air flow, and may be associated nasal septal deviation. It may require a surgical correction depending on the severity of symptoms and degree of obstruction. The nasal septum can be pneumatized due to sphenoid sinus extension through the septal recesses 5.4% [12].

Frequency of variation of middle turbinate

In our study 22.3% showed concha bullosa out of which bilateral is the maximum of about 11.6% and unilateral involvement of about 10.7%. In the study by the concha bullosa found in 35% [10]. Different studies showed that the frequency of CB ranges from 14 to 80% [13]. Our result coping with 24.5% result of Perez-Pinas et al, 2000. The concha bullosa represent pneumatization of middle turbinate bony plate by extension of ethmoid cell, it may cause significant symptoms, such as headache and nasal obstruction. Concha bullosa is one of most common PNS variant [14]. It may cause middle meatus or infundibulum obstruction in conjunction with deviated nasal septum to contralateral side [4]. Concha bullosa may implicated as possible cause of recurrent sinusitis but the presence of CB does not mean of sinus pathology. however, in chronic sinusitis, resection of the concha bullosa should be considered to improve sinus passage. The interior of concha bullosa may affected from the other diseased sinuses [15]. We found Paradoxical middle turbinate 1.8% which slightly lower in our study compared with Lusk et al 8.5% [16]. The paradoxical turbinate occur as the convexity faces towards the meatus. Depending on the degree of curvature of the paradoxical turbinate may contribute to sever narrowing of middle meatus [4]. Also our study shows low incidence of the accessory middle nasal concha which found in 1.8%.

Anatomical variation of frontal sinus

Our study shows that the bilateral absence of FS had incidence rate 18.8%, other studies showed the lowest incidence 10% [17]. And other studies showed the bilateral absence of the FS was significantly higher in some populations, including Alaskan Eskimos 61% and Canadian Eskimos 83% [18]. The absence of paranasal sinuses in general is uncommon condition that appears mainly in FS.

Occurrence of Special Cells

in our study the occurrence of Agger nasi cell 16.1%, In varies studies showed that the incidence of ANC varies from 10 - 98.5% [19]. Our results fall within that range of those different studies. The ANC represents the most anterior ethmoidal cells, located at the upper margin of nasolacrimal duct and anterior to maxillary sinus infundibulum. The extensive pneumatization of these cells has clinical importance by causing fontal pain and chronic frontal sinusitis [20]. Haller cells is pneumatized ethmoid air cell projects along the medial roof of maxillary sinus and inferior part of the lamina papyracea, and lateral to uncinate process. First described by an anatomist Albert Haller in 1765 [21]. These cell may narrow the adjacent ostium leading to maxillary sinusitis, the patients presented with headache, facial pain and nasal obstruction [22]. In our study, Haller cell were found in 5.4%. The incidence of HC in other studies varies from 2-70.3% [23]. The study by showed the incidence of HC 3.5% which is close to our result [10]. The incidence of Onodi cells in our study is 2.7% which is lowest incidence in comparison with other studies which showed the incidence of OC ranges from 8-13% [11]. These cells also known as sphenoethmoidal cells, they are the most posterior ethmoid air cells that extend laterally and located anterosuperior to sphenoid sinus [5]. The optic nerve is in close relation with Onodi cell when present causing optic neuropathy in certain condition. Accurate delineation of optic nerve is important in preoperative planning, because its important factor limiting extent of endoscopic clearance.

Other variants

The sinus pneumatization extension as crista galli pneumatization was associated with hyperpneumatization of frontal sinus. In our study crista galli was pneumatized in 2.7%. in other studies, showed much higher incidence ranged from 13.6-89.2% [24,25]. The frequency of lateral sphenoid and anterior clinoid pneumatization in our study is 6.3% somewhat similar to with incidence 6% [26]. There is controversial about the clinical significant of PNS variants. Most the anatomical studies of nasal and sinus region have been done in patients suggestive they have inflammatory sinus pathology. Study done by Showed no increase of sinus pathology in patients with deviated nasal septum, as our study no significant association between sinusitis and DNS (P= 0.318) [27]. And the same study showed no increase of sinusitis in patients with concha bullosa (Smith et al, 2010) but our study shows significant association between sinus disease and CB (P= 0.046) [27]. Some studies show The contact between the nasal mucosa and massively enlarged concha bullosa can cause headache even in absence of sinus pathology [25, 28]. Also in present study shows no significant association between increase sinus disease in patients with Agger Nasi cells or Haller cells, one study showed the same findings [29]. Varies studies have reported the higher incidence of sinus pathology was in maxillary sinuses ranges from 50- 85% in our study shows the higher incidence in maxillary sinus 51.8% [8].

This study reveals that the presence of PNS variants does not mean a predisposition to sinus diseases. However, it is importance for surgeons to be aware of PNS variants that impact the intraoperative safety and increased the risk of complications. The radiologist must pay close attention to that variants in the preoperative evaluation and help avoid possible complications. Most notably, the presence of Onodi cells and the associated risk of injury to carotid artery and optic nerve during the endoscopic surgery [27,28]. The presence of Haller cells during the ethmoidectomy can increases the risk of orbital injury [31]. The risk of CSF rhinorrhea increased with pneumatization of the anterior clinoid processes after the endoscopic surgery, in these surgeries requiring anterior clinodectomy to access to cavernous sinus lesions also this variant increases the risk of optic nerve during the endoscopic surgeries [31,32]. In our study All 112 patients at least had two anatomic variants. The association of different variants in the same patient was not analyzed. Although surgical complication occurs for different reasons, failure to recognize that anatomic variants is an important cause. The radiologist responsible to comment on certain clinical important anatomic variant to decrease the risk of surgical complication.

Limitation of the study

In fact, the vascular structures like ICA could not be assessed for its protrusion in sphenoid sinus, because these non-enhanced contrasts study of PN.

Conclusion

From the above results, we conclude that different anatomic variations may be found in paranasal sinus region and nasal cavity. The computed tomography is the imaging modality of choice for the evaluation of the paranasal sinuses variants. The improved the visualization of paranasal sinus anatomy has allowed great accuracy in evaluating sinus disease. Thin sections coronal CT-scan provides more detailed variations of paranasal sinus. It evaluates the OMC anatomy which is not possible with conventional radiographs, since plain radiographs do not provide detailed information because of structural superimposition. PNS Anatomical variations have an impact on the predisposition to inflammatory disease. Frequency of anatomical variations and their influence on causing sinus disease can be assessed. In our study some of the variants are so common that they are found mostly in the majority of the population, among anatomic variations DNS to the Left is the most common, the concha bullosa are predisposing factors for sinusitis. Among the special cells, Agger nasi cell is the most common type. Analysis of every routine CT scan of the paranasal sinuses obtained for sinusitis or rhinitis for the presence of different anatomic variants is of questionable value unless surgery is planned. Improvement in Functional Endoscopic Sinus Surgery and CT technology has increased interest in the paranasal region anatomy and its variations. To conclude, in view of the presence of these of these significant variations, we reemphasize the need for surgeons to be fully prepared preoperatively in every patient and identification of these variants plays an important role while guiding the surgeons preoperatively thereby reducing iatrogenic complication of morbidity and mortality in order to accomplish a safe and effective FESS. It is important to be aware of certain anatomic variants, such as sphenoethmoidal (Onodi) cells, pneumatization of anterior clinoid processes, infraorbital ethmoidal (Haller) cells, pneumatization of the dorsum sellae, failure to recognize these variants is associated with higher rate of surgical complications. This study is a step to alert the endoscopic nasal surgeons in our area regarding the importance of defining anatomical variations and various parameter involved and the significant impact of these variations on patient care.

Recommendation

The following recommendations proposed for the improvement of the preoperative assessment and treatment options available for PNS.

1. Collaboration between the endoscopic sinus surgeons and radiologists is very important in proper diagnosis and interpretation of sinuses scans.
2. Establishment of a standard CT scanning protocols for the PNS, including windows, cut thickness, and views to increase the detection of pathology and anatomical variants.

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