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Role of Multi-Detector CT in Diagnosis of Paranasal Sinuses Lesions

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Abstract

The Paranasal sinuses are complex anatomical structures. They have many functions, such as lighting the skull of the human and imparting resonance to the voice and secretion of mucus to moisten the nasal cavity. Imaging paranasal sinuses by Multidetector computed tomography is the gold standard to assess any lesions in them**.** The aim of this work was to assess the role of multidetector computed tomography in diagnosis of paranasal sinuses lesions. A prospective study included 40 patients of both males and females with an age ranged from 22 days to 57 years referred from Ear, Nose and Throat department in Al-Zahraa university hospital in the period between January 2020 to June 2021. CT Para nasal sinuses were performed without contrast medium in some patients and with contrast media in suspected cases of complicated sinusitis or neoplasia. The mean age ± SD of the patients were 27.7 ± 12.8, males were more affected than females, smoking is contributing factor in paranasal sinuses lesions, the predominant chief presenting complaint was thick nasal discharge, common CT finding was thickened mucosal lining, most common diagnosis was chronic sinusitis, and most affected sinus was maxillary sinus. CT is an excellent imaging modality for evaluating the pathologies of PNSs.

Keywords: Paranasal sinuses, Multidetector computed tomography, Chronic sinusitis.

1. Introduction

A variety of lesions occur in paranasal sinuses (PNS). These lesions may be developmental or congenital (sinus aplasia and meningioencephalocele), traumatic, inflammatory (sinusitis which may be acute or chronic and bacterial or fungal), and neoplastic (benign or malignant) [1]. Imaging PNS by computed tomography (CT) has a great role in diagnosing, localizing the lesion and characterizing the extent of the lesion. It also has a role in describing the anatomical variations of PNS [2]. Imaging of PNS with multidetector CT (MDCT) is helpful to narrow the differential diagnosis of the lesions as much as possible and it can generally detect the aggressive lesions from benign lesions [3]. MDCT imaging can

help to know the affected adjacent areas such as nose, orbit, brain, pterygopalatine fossa, nasopharynx and masticator space contents [4]. MDCT axial cuts, coronal and sagittal reconstructions are very helpful to characterize the lesions of PNS. Imaging also has a role in staging of mass lesions diseases before surgical interventions and is helpful in assessment the lesions complications as meningitis, abscess formation, orbital cellulitis and for Monitoring the response of therapeutic drugs and the postoperative case [5]. The aim of this work was to assess the role of multidetector computed tomography in diagnosis of paranasal sinuses lesions.

2. Patients and Methods

2.1 Type of study

A prospective study included (40) patients of both sexes, with age ranged from 22 days to 57 years with paranasal sinuses symptoms who referred from the ENT department and clinic to radiodiagnosis department in Alzahraa university hospital in the duration between January 2020 to June 2021. The study was done after getting approval from the ethical committee. Informed consent from all patients was taken before inclusion in the study.

2.2 Inclusion criteria

Both sexes and ages from (22 days to 57 years), Patients with: facial pain, frontal headache, pain in the ear or teeth, nasal congestion and stiffness, sneezing and itching, discoloured nasal discharges, epistaxis, sore throat, cough, fever, difficult breathing and respiratory distress.

2.3 Exclusion criteria

Pregnant females, patients with allergy to contrast media, renal failure, and serum creatinine above 2 mg/dl.

2.4 All subjects were subjected to

2.4.1 Clinical assessment

Complete history taking including patient age, sex, occupation, special habits, and history of allergy. Clinical examination including blood pressure (BP), pulse rate (PR) and respiratory rate (RR), temperature, local examination of paranasal sinuses and knowing patients' complaint as nasal obstruction and thick nasal discharge. In patients who needed contrast enhanced study, patients kept fasting for at least 4hr, and oral hydration with water (1000 ml/1hour) before scanning to promote diuresis and avoid dehydration.

2.4.2 Laboratory investigations

Serum creatinine level in patients who needed contrast enhanced study. Medical treatment should be given before CT scan to reduce transient acute inflammatory or infectious mucosal changes. A sedation drug was given to children before imaging.

2.5 Methods

All patients were subjected to MDCT study, including image acquisition followed by image processing and display. The following imaging and reconstruction parameters were used, respectively:

2.4.1 Gantry rotation speed: 0.5 seconds.

2.4.2 Collimation: 64 × .6 mm, and Pitch: 1.25.

2.4.3 The exposure factors: Tube current 150-200 mAs (milliampere second) and Tube voltage of 120 kV (peak).

2.4.4 Matrix of 512 x 512 pixels.

2.4.5 Slice thickness 3 mm.

2.4.6 Slice interval 1.5 mm (overlapping reconstructions). The data were reconstructed to 0.75-mm slice thickness at 0.5-mm intervals for MPR and 3D imaging.

2.4.7 Scan time: 0.5 sec.

2.4.8 CT machine: Toshiba Aquilion device 164 slices multi-detector scanner, Tokyo, Japan.

2.4.9 Patient position

Scans were performed with the patient lying supine, headfirst, and arms are parallel to the rest of the body.
Some patients require an injection of a contrast material to enhance the visibility of certain tissues or blood vessels. In this condition, patients were injected by nonionic contrast media by amount of 1-2 mm per kg (omnipaque 300 mg I/ml) through an 18–20-G catheter in the antecubital vein at 3 mL/s with maximum volume of 80-120 ml, followed by 30–40 mL of saline solution at the same injection rate.

2.4.10 Image reconstruction

Post study reconstructions were done at 2.5 mm interval, Sagittal and coronal reconstructions, The pathological lesions were evaluated with respect to pre and post contrast attenuation values, the size, location of the lesions.

2.5 Data Collection and Analysis

Data were analyzed using SPSS software version 16, the simple descriptive analysis in the form of means and standard deviations were calculated for numerical data. Qualitative data were described using numbers and percentage distribution.

3. Results

3.1 Demographic data of patients studied:

As show in table 1 This study included 40 cases aged between 22 days to 57 years with a mean ± SD of 27.7 ± 12.8 years. Also, we found that the majority of cases (55 %) were aged from 20 to 40 years. There were 27 males (67.5 %) and 13 females (32.5 %). As regards special habits, there were 26 smoker patients (65 %) and 14 non-smoker patients (35 %) in the patients studied. There were 22 patients (55 %) with the past history of allergies and 18 patients (45%) with no past history of medical diseases. Our results showed that there were 25 manual workers (62.5 %) & 15 patients (37.5 %) were non-manual workers.

3.2 Complaints about patients

As shown in table 2 the present study showed that the most common presenting symptoms of patients with paranasal sinus lesions were nasal obstruction as presented in 11 cases (27.5 %), thick nasal discharge represented by 8 cases (20 %), headache in 5 cases (12.5 %) and facial swelling in 4 cases (10 %). The neonatal case presented with difficulty in breathing.

3.3 CT findings

As shown in table 3 mucosal thickening was found in 8 cases (20 %) and cystic lesion in 6 cases (15 %) and were the most common findings. The CT finding of neonatal case was obstruction of the choanal air space.

3.4 Diagnosis of the patients studied

As shown in table 4 the most common cause of PSL was chronic sinusitis as it presented in 7 cases (17.5 %), followed by fungal sinusitis presented in 5 cases (12.5 %), mucous retention cyst (5 cases) (12.5 %), and Sinusoidal polyposis (5 cases) (12.5 %). In our study, the neonatal case was diagnosed to have bony choanal atresia.

3.5 Affected sinuses:

As shown in Figure .1, The present study showed that the most affected sinus was the maxillary sinus as it affected in 23 cases

(57.5 %), then the ethmoid sinus was affected in 5 cases (12.5 %). Sphenoid sinus and frontal sinus were less affected (only 2 cases) (5%).

Table 1: Demographic data of the patients studied

		Studied patients (N = 40)	
Age (years)	Range	22 day – 57 years	
	Mean ± SD	27.7 ± 12.8	
	< 20 years	12	30 %
	20 – 40	22	55 %
	>40	6	15 %
Sex	Male	27	67.5 %
	Female	13	32.5 %
Special habit	Smoking	26	65 %
	No	14	35 %
Past history	Allergy	22	55 %
	No	18	45 %
Occupation	Manual worker	25	62.5 %
	Non manual workers	15	37.5 %

Table (2): Main complaints of the patients studied.

Complaints	Studied patients (40)	
Nasal obstruction	11	27.5%
Thick nasal discharge	8	20%
Headache	5	12.5%
Facial swelling	4	10%
Motor car accident	4	10%
Bad odour nasal discharge	3	7.5%
Rhinorrhea	3	7.5%
Difficult breathing	1	2.5%
Epistaxis	1	2.5%

Table (3): CT findings in studied patients.

CT Findings	Patients (N = 40)	Percentage %
Mucosal thickening	8	20%
Cystic lesion in the sinus	6	15%
Polypoidal mucosal thickening	5	12.5%
Trauma in the sinus	4	10%
Soft tissue lesion	4	10%
Air fluid level	3	7.5%
Opacification of all sinuses	3	7.5%
Aerated middle turbinates	2	5%
Absence of frontal sinus	1	2.5%
Hyper dense bony lesion in Ethmoid sinus	1	2.5%
Left concha bullosa and left Haller's cell	1	2.5%
Obstruction of the choanal air space	1	2.5%
Paradoxical curvature of middle turbinates	1	2.5%

Table (4): Diagnosis of the studied patients

Diagnosis	Number	Percentage %
Chronic sinusitis	7	17.5%
Fungal sinusitis	5	12.5%
Mucous retention cyst	5	12.5%
Sinusoidal polyposis	5	12.5%
Trauma to the sinus	4	10%
Acute sinusitis	3	7.5%
Conchae bullosa	3	7.5%
Adenocarcinoma of right maxillary sinus	1	2.5%
Bony choanal atresia	1	2.5%
Frontal sinus aplasia	1	2.5%
Left side bullositis	1	2.5%
Nasopharyngeal juvenile angiofibroma	1	2.5%
Odontogenic cyst	1	2.5%
Osteoid osteoma	1	2.5%
Paradoxical curvature of middle turbinates	1	2.5%

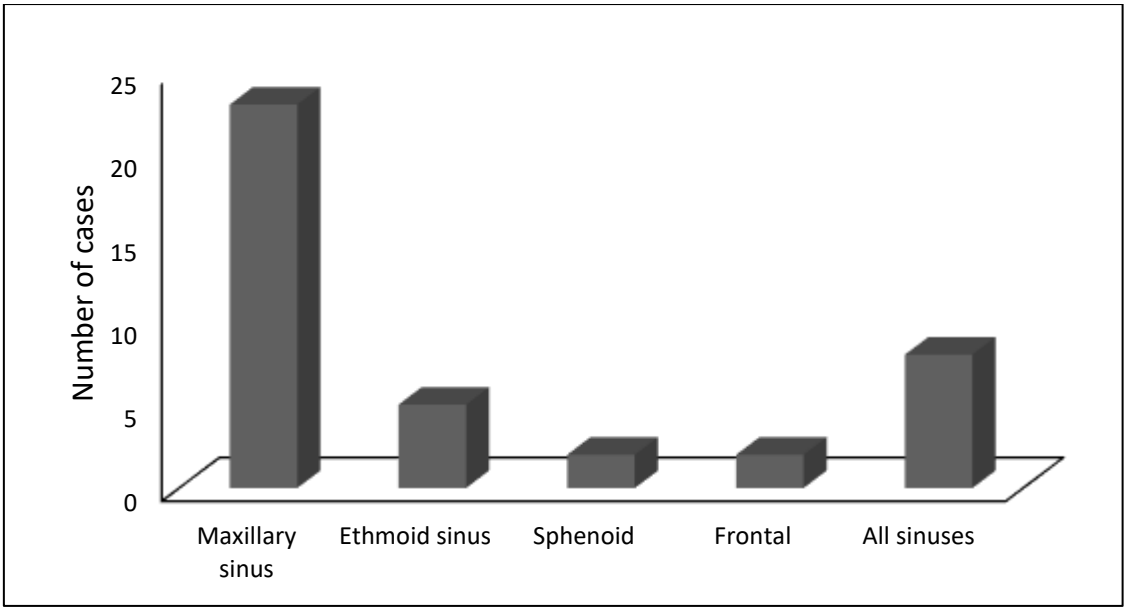

Figure 1: Affected sinuses in the studied cases

4. Cases

Case 1:

A male patient, 26 years complaining of thick yellowish nasal discharge and nasal obstruction

Figure 2: NCCT PNS in (a &b) axial, (c) sagittal, and (d) coronal views showed: air fluid level in both maxillary sinuses, no masses, no mucosal thickening, no nasal septum deviation, patent osteomata complex. **Diagnosis:** acute maxillary sinusitis

Case 2:

Male patient 22 days complaining of difficult breathing, respiratory distress and unilateral nasal obstruction.

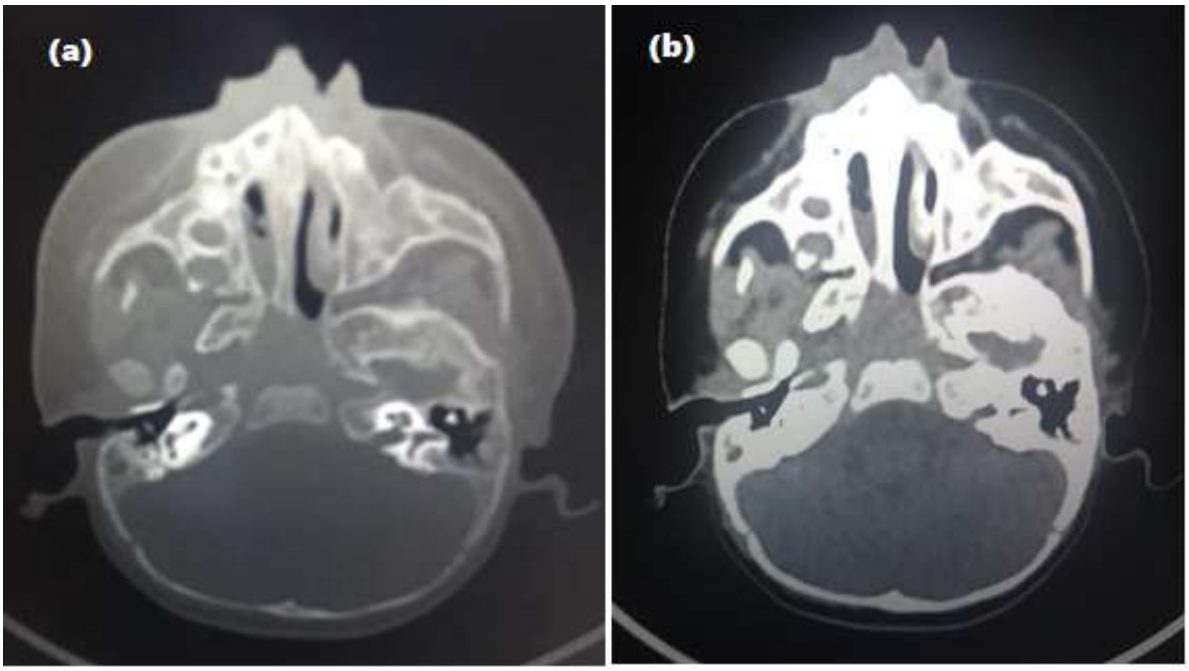

Figure 3: NCCT PNS in axial (a &b) views shows narrowing of posterior nasal opening and thickening of the vomer, air fluid level is present above the level of obstruction. **Diagnosis:** unilateral right bony choanal atresia.

Case 3:

Female patient 9 years old complaining of nasal obstruction and bad odor of nasal discharge

Figure 4: NCCT PNS in (a &b) axial, (c) coronal, and (d) sagittal views (bone and soft tissue windows) showed: opacification of both ethmoid and maxillary sinuses with polypoidal mucosal thickening of the Rt ethmoid sinus extending to the nasal cavity. Hyperdense material and calcified foci seen in it. It was diagnosed primarily as an ossifying fibroma. Functional sinus surgery was done, and a biopsy was taken and diagnosed as fungal sinusitis. **Diagnosis:** Rt ethmoid and maxillary fungal sinusitis.

5. Discussion

Our study was a prospective study carried out on 40 symptomatic sinus diseased patients who had undergone MDCT imaging of paranasal sinuses in coronal, sagittal and axial sections. The aim of this work was to assess the role of multi detector CT scan in the diagnosis of different paranasal sinuses lesions. The results of the present study showed that males were more affected than females, the most common affected age group was 20 to 40 years. Smoking, allergic diseases, and manual workers were predisposing of risk factors for PNL. This was in agreement with a retrospective study of Tretiakow et al., (2021) that included 65 patients diagnosed clinically with nasal cavity disorders and PNS diseases. They were examined with MDCT using CT protocol of paranasal sinuses. The study showed that the majority of patients were male 37(56.9%), whereas females 28(43,1%). Frequency distribution of patient ages affected by paranasal sinuses disease, the majority of patients ages in 2nd decade (23.7%); mean age was 33 ± 9.10 years [6]. Other study of Homood et al., (2017) who included 867 participants, most of them 617 (71.2%) were males and 250(28.8%) were females. The mean age of participants was 28.75 ± 9.59, the most common age between participants was the age range 20-39 years old representing 687(79.2%), while participants with age range 40-59 represented 116(13.4%), followed by those with age range <20 years old 56 (6.5%) and finally those with age of ≥60 years old 8(0.9%). Most of the participants were from urban areas 491 (56.6% while 376 (43.4%) were from rural areas. Regarding the type of work, there were 624 (72%) working in the non-medical job while 243 (28%) were working in a medical job. The Presence of any type of allergy was a risk factor for chronic sinusitis. They concluded that allergies are considered as a risk factor for chronic sinusitis. By studying several risk factors for sinusitis, it was found that more male had sinusitis than female, regarding age, more individuals with age less than 40 years old suffered sinusitis than those with age more than 40 years old [7]. Previous studies found that smoking and allergies are potent risk factors for PSL. Nguyen et al., (2019) found a significant association between current smoking and rhinosinusitis in women but not men [8]. Kilty et al., (2020) revealed a 20 % increased risk of rhinosinusitis in current smokers and reported that multi-symptom asthma was closely related to symptoms of nasal allergy as well as to PSL [9]. The present work showed that most cases with PSL are presented by nasal obstruction, nasal discharge, headache and facial swelling. The neonatal case was presented with difficulty in breathing. This was in accordance with Nathan et al., (2021) whose study was in 122 patients, who presented various sinonasal complaints and results were statistically analyzed. They found that the common presenting symptom of the patients was headache (77.04%) followed by nasal obstruction (75.40%), nasal discharge (65.57%), and the altered sense of smell (46.72%). Other less common symptoms include facial pain (22.95%); nasal mass (18.85%) and nasal bleed (16.39%) (10). Also, Kanwar et al., (2017) illustrated that the chief presenting complaint of patients with PNL was headache (67.7%) followed by nasal discharge (40.8%), nasal obstruction (42.3%), facial pain (33.8%), and others (37.7%) [11]. The present work showed that mucosal thickening and cystic lesion were the most common findings. The CT finding of neonatal case was obstruction of the choanal air space. This was in agreement with Eltayb et al., (2020) who reported both male and female patients of different age groups from 12 to 60 years old with clinically suspected PNS diseases were enrolled for the study. Both axial and coronal images were acquired using multi-detector CT unit. The paranasal sinuses showed: mucosal thickening, and nasal polyposis [12]. Our study showed that the

most common cause of PSL was chronic sinusitis, followed by fungal sinusitis, mucous retention cyst, and Sinusoidal polyposis. In our study, the neonatal case was diagnosed to have bony choanal atresia. The most affected sinus was the maxillary sinus, then ethmoid sinus. Sphenoid sinus and frontal sinus were less affected. This goes in line with Kanwar et al., (2017) who reported that the most common CT diagnosis of PSL was chronic sinusitis (40/91) followed by polyp (22/91) and fungal sinusitis (16/91). Out of 91 cases sent for histopathology, the most common diagnoses were nonspecific inflammation (57.7%) followed by inflammatory polyp (24.1%), antrochoanal polyp (7.6%), fungal sinusitis (6.5%), and poorly differentiated carcinoma (4.3%) cases [11]. Also, Eltayb et al., (2020) illustrated that the most common pattern of PSL was chronic sinusitis (31.2%) followed by polyposis (26.9%), mucosal thickening (22.8%), acute sinusitis (11.8%), fungal sinusitis (7.5%) and bone erosion (4.2%). Maxillary sinus was the most commonly involved sinus (39.9%) followed by frontal sinus (29%), sphenoid sinus (16.7. %) and ethmoid sinus (14.5%) [12].

6. Conclusion

CT is the modality of choice in imaging the sinonasal region for evaluating various congenital, inflammatory, benign and malignant pathologies and associated complications thereby planning the further management of the patient.

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