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Original Research Paper

Radio-Diagnosis

UTILITY OF DIGITAL RADIOGRAPHY AND COMPUTED TOMOGRAPHY IN DIAGNOSIS AND EVALUATION OF PARANASAL SINUSITIS.A COMPARATIVE STUDY.

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ABSTRACT The preferred imaging modality for diagnosing and monitoring patients with sinus disease is computed tomography (CT). However, there are risks associated with CT scanning for the patient. Plain radiography is the mainstay of radiological diagnostics in most underdeveloped nations since it is cheap, simple and widely available. **Objective-** The objective of this review was to establish a comparison between the role of X-ray and CT in the diagnosis of sinusitis. **Methodology-** CT scans were performed in supine position for axial sections and supine with neck extended for coronal sections in a 16 Slice machine using a kVp of 130 and mAs of 60-70 with 5mm thickness for both coronal and axial sections and 3mm were taken at osteomeatal unit on coronal sections. The patients will also undergo digital radiograph PNS(Water's view) at 60kVp and 5-8 mAs in existing xray machine. X RAY and CT findings were entered in the proforma. **Result-** The results of our investigation were evaluated using proportion and chi square test. The level of significance was 0.05. **Decision Criterion:** We compare p-value with level of significance. If $p<0.05$, we reject the null hypothesis and accept the alternate hypothesis. If $p>=0.05$,we accept the null hypothesis. Digital Radiography sensitivity(w.r.t CT PNS)for- sinus opacity(70.6%),fluid level(23.5%),bony changes(17.6%),soft tissue extension(05.9%) **Conclusion:** CT is the modality of choice to assess the clinically relevant anatomic variations of Sino nasal region. CT is the modality of choice in imaging the paranasal sinuses for evaluating the chronic diseases and associated complications. Fungal sinusitis and dense secretions are potential pitfall on CT to differentiate them. But CT may suggest fungal sinusitis in whom it is not suspected. CT is the modality of choice in evaluating the bone erosion or destruction.

KEYWORDS : CT PNS, Digital radiography, Sinus opacity

INTRODUCTION

The nasal cavity is surrounded by hollow, air-filled areas called the para-nasal sinuses, which are found in the face and base of the skull bones. Each of the four pairs of sinuses has a tiny canal that connects it to the nasal cavity. The frontal, ethmoidal, maxillary, and sphenoid sinuses are among them. 1 The paranasal sinuses are primarily identified by three factors: open sinus drainage apertures, thin, typical mucus discharges, and functional hair-like cilia that transport mucus out of the sinuses (called sinus ostium). Any condition (inflammation, tumour, foreign substance) that prevents a sinus from draining makes it susceptible to infection.2 Lesions of the paranasal sinuses are widespread and can have a number of different etiologies. They cover a broad spectrum, from inflammation to tumours. Recently, it has become clear that sinusitis is mostly a clinical diagnosis. A focused physical examination might help distinguish sinusitis from a typical upper respiratory tract infection when the clinical history suggests sinusitis.3 Examining the presence, severity, and duration of symptoms is the goal of obtaining a history in order to get a precise diagnosis. Finding any anomaly or disease that can explain the symptoms is the goal of a physical examination. Any nasal disease can be quickly and easily examined using inspection, palpation, and anterior rhinoscopy.4 The priority on collecting a patient's medical history and doing a brief physical examination arises from the observation that the majority of patients can be effectively treated (medically and economically) without a need for a nasal endoscopy, radiographic tests, or bacterial cultures.5 In cases when the history and physical examinations are ambiguous or when conventional treatment has failed, imaging of the sinuses is often reserved to provide information that supports the clinical findings or to confirm the diagnosis. Plain/digital radiography, CT, ultrasound, and MRI are some of the modality options.6 The preferred imaging modality for diagnosing and monitoring patients with sinus disease is computed tomography (CT). However, there are risks associated with CT scanning for the patient. The use of a CT scan as the primary diagnostic tool for rhinosinusitis is unsuitable due to the radiation exposure and accompanying costs. While a provisional diagnosis could be made based on a patient's clinical history and physical examination, a definite diagnosis and treatment plan require the use of radiography and sinus endoscopy. Plain radiography is the mainstay of radiological diagnostics in most underdeveloped nations since it is cheap, simple and widely available. In order to identify paranasal sinus disorders, this study evaluated the diagnostic usefulness of clinical diagnosis and sinus radiography.There are four types of sinusitis: acute, subacute, chronic, and recurrent. Sinusitis is an inflammation of one or more paranasal sinuses. Symptoms of acute sinusitis last for less than a month; subacute 2 symptoms last for 1-2 months; chronic symptoms last for more than 2 months and 3 or more attacks of acute episodes in a year is termed as recurrent.7 In India, it has been estimated that over 15% of adults suffer from sinusitis.8 Systemic or local conditions that are predisposed to infection and sinus ostial blockage may be the source of acute sinusitis. These include inflammatory or anatomical causes that impair mucociliary transport, cause sinus ostial closure, and impair immunity. Chronic allergic inflammation and acute viral upper respiratory infections are the two main causes of sinus ostial narrowing. However, some anatomical anomalies, such as agar nasi cells, Haller's cells, and concha bullosa malformations, may predispose a person to ostiomeatal narrowing.9 Hypoxia, ostial obstruction, delayed recovery from mucociliary infection and mucociliary dysfunction, recirculation of mucus, osteitis, microbiological factors in persistence, and inflammatory factors in sinusitis

are only a few of the factors that contribute to the chronicity of sinusitis. 7,10 . However the perpetuation of these process and the initial simulation are unclear. According to a report, sinusitis is a condition that allergy and immunology subspecialists treat. Because sinusitis is a challenging condition to manage, it's essential to understand fully the condition and to diagnose it at an early stage.10Imaging tests and physical examinations are used to diagnose sinusitis. If the history and physical examination are uncertain or if treatment fails, imaging of the sinuses is done to confirm the diagnosis.

The imaging modalities include CT, MRI, and digital X-ray, which has multiple perspectives. Here, we'll concentrate on CT scans and digital radiographs (Water's view). The goal of the imaging modalities is to support clinical assessment and provide more knowledge for formulating effective treatment plans.6 The objective of this review was to establish a comparison between the role of X-ray and CT in the diagnosis of sinusitis

MATERIALS AND METHODS

A. Study Type- Institutional based observation study with cross section design.

B. Study Design-cross-sectional analytical design.

C. Study Setting And Timelines-
The study was conducted in The Department of Radio diagnosis and Department of Otorhinolaryngology of BSMC&H with time frame of 18 (Eighteen) months ,from the date of acceptance of synopsis.

D. Place Of Study-
The proposed study was conducted in digital radiography and CT scan room under the Department of Radio-diagnosis, Bankura Sammilani Medical College and Hospital,
Bankura, West Bengal.

E. Sample Size- calculated sample size for this study is around 34.

Inclusion Criteria
Clinically suspected patients of paranasal sinusitis referred to the Radiology Department for digital X – ray PNS(Water's view) and CT PNS investigations, and found to have sinusitis, were included in this study .

Only those patients who gave informed consent

Exclusion Criteria
1) Patients presented to Radiology Department who will be unfit for the studysuch as pregnant or were unwilling to participate.
2) Patients with maxillofacial/ head trauma.
3) Patients having neoplastic PNS diseases.
4) Children less than 5 years of age.
5) Psychiatric patients

Imaging variables-
X RAY findings:
Thickening of lining membranes.
Opacity of entire sinus
Fluid level
Changes in bony wall

CT scan findings:
Mucosal thickening
Fluid level
Soft tissue extension
Mass
Walls of sinus
Any anatomic variations

METHODOLOGY-
This study was conducted after getting the necessary clearance from the Institute Ethical Committee.All participants were aware of the study and gave informed consent to participate in the study. Recruitment for the study was done in the department at digital xray and CT Scan unit , based on the inclusion & exclusion criteria during the study period.

CT scans were performed in supine position for axial sections and supine with neck extended for coronal sections in a 16 Slice machine using a kVp of 130 and mAs of 60-70 with 5mm thickness for both coronal and axial sections and 3mm were taken at osteomeatal unit on coronal sections.

Contrast agent : Omnipaque 350 was used if indicated, at a calculated dose of 300 mg/kg weight as a single intravenous bolus injection after serum creatinine level was estimated

The patients will also undergo digital radiograph PNS(Water's view) at 60kVp and 5-8 mAs in existing xray machine.

X RAY and CT findings were entered in the proforma

Outcome definitions and parameter-
Parameters to be observed
- Age
- Sex
- Occupation
- Socioeconomic status
- Chief complaints
- Sinus diseased
- CT findings in respect to deviated nasal septum,concha bullosa, OMU obstruction.
- CT severity grading
- Bone involvement

Statistical Method-
Data was compiled in Microsoft (MS) excel sheet and then analysed by appropriate statistical methods. Mean and standard deviation were used to describe and summarize continuous variables. Proportions and percentages were used for categorical variables. Data display were done by the help of tables and various charts. Inferential statistical tests like 'independent t' test, Pearson's chi- square test were used to establish relationship between input and outcome variables e.g. between digital radiography PNS(Water's view)and CT findings in Paranasal sinusitis patients. Significance level was at p value <0.05 . Statistical Software packages for social sciences (spss version 24) was utilised.

RESULT-

The present study was an institutional based prospective and observational(non-interventional) type of cross-sectional study. It was carried out at the Department of Radiology and Department of Otorhinolaryngology, Bankura Sammilani Medical college & Hospital, Bankura. A total of 40 patients were selected for the study between the time period of October,2020 to March,2022.

The results of our investigation were evaluated using proportion and chi square test. The level of significance was 0.05.

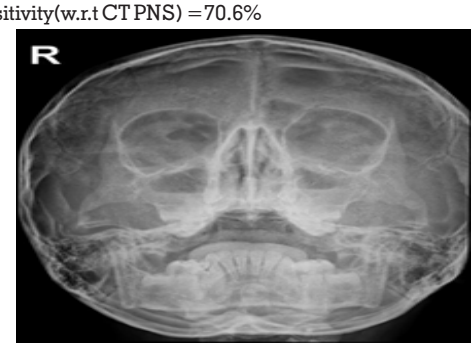
Decision Criterion:
We compare p-value with level of significance. If $p<0.05$, we reject the null hypothesis and accept the alternate hypothesis. If $p>=0.05$,we accept the null hypothesis.

Computation:
The tables below give us the various computations and p-value

Table no-1

Sinus opacity	CT PNS no	%	Digital radiography no	%	Total no	Chi-square	p-value
Present	32	94.1	24	70.6	56		
Absent	02	05.9	10	29.4	12	6.47	0.011
Total	34	100	34	100	68		

For detection of sinus opacities, Digital Radiography sensitivity(w.r.t CT PNS) =70.6%

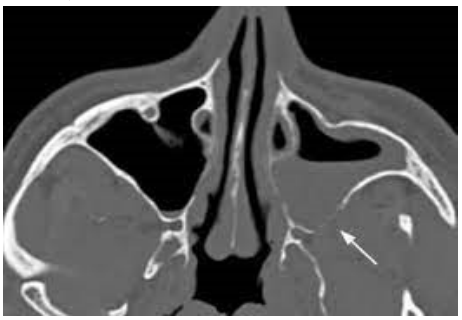


Maxillary sinusitis

Table no-2

Fluid level	CT PNS no	CT PNS%	Digital radiography no	Digital radiography%	Total no	Chi-square	P -value
Present	17	50	08	23.5	25		
Absent	17	50	26	76.5	43	5.12	0.023
Total	34	100	34	100	68		

For detection of fluid level, Digital Radiography sensitivity (w.r.t CT PNS) = 23.5%

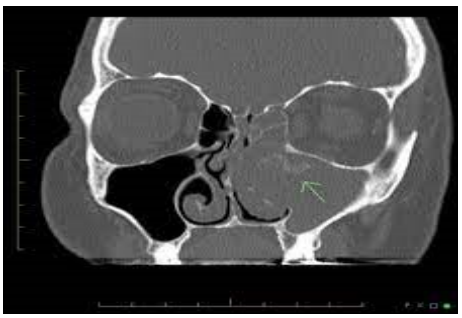


Fluid level in left maxillary sinus

Table no-3

Bony changes	CT PNS no	CT PNS %	Digital radiogaphyno	Digital radiography%	Total no	Chi-square	P -value
Present	16	47	06	17.6	22		
Absent	18	53	28	82.4	46	6.72	0.0095
Total	34	100	34	100	68		

For detection of bony changes Digital Radiography sensitivity (w.r.t CT PNS)=17.6%



Chronic invasive fungal sinusitis with bony involvement

Table no-4

Soft tissue extension	CT PNS no	CT PNS %	Digital radiography no	Digital radiography %	Total no	Chi-square	P -value
Present	10	29.4	02	05.9	12		
Absent	24	70.6	32	94.1	56	6.47	0.011
Total	34	100	34	100	68		

Table no-4 For detection of soft tissue extension, Digital Radiography sensitivity (w.r.t CT PNS) =05.9%

Soft tissue in right nasal passage

7. DISCUSSION

In the recent past, it has come to be recognised that CT is the ideal imaging technique for displaying everything from an uncomplicated inflammatory condition to paranasal sinus neoplasms. Previous studies have shown poor correlation of X-ray with CT. For the examination of paranasal sinus disease, radiographs are no longer commonly recommended since they are unreliable. Acute sinus infections should be evaluated clinically, and chronic sinus conditions that are resistant to medical treatment should be investigated using CT scans. CT evaluates the osteomeatal complex anatomy, which is not possible with radiographs. The fundamental idea of FESS, which is best understood on a CT scan, is the elimination of illness in the osteomeatal complex region.

Symptoms with which patients presented were recorded during clinical examination. The most common predominant symptom was headache in 18 patients consisting of 52.9%, followed in descending order by nasal blockage (29.4%) and nasal discharge (14.7%). The other symptoms with which they presented were facial pain, sneezing and dyspnoea. Patients presenting with history of maxillofacial / head trauma was excluded in the study.

DNS was seen in 11 of 34 patients constituting 33%. Left DNS was seen in more patients than the Right DNS. Concha bullosa was seen in 14 (41%) patients and in literature it varied between 16-53%.OMU were involved in 22 (65%) patients. Hence, the overall incidence of inflammatory disease in the Osteomeatal complex in symptomatic patients was no different between with and without concha bullosa.

Most common sinus involved was maxillary sinus in 28 pa ti ents (82.3%),followed by anterior ethmoid (73.5%), posterior ethmoid (67.7%), frontal (50.0%) and sphenoid sinuses (35.3%) in decreasing order. Studies in literature observed involvement of anterior ethmoid sinus and maxillary sinus Present study correlates well withprevious studies. In all the studies sphenoid was least involved, which is also observed inthis study. The CT severity assessed for 34 patients with inflammatory diseases showed highest no of patients of grade 2- 10(29%) patients and lowest of grade 0- 2(6%) patient.

CONCLUSION

1. CT is the modality of choice to assess the clinically relevant anatomic variations of Sino nasal region.

2. CT is the modality of choice in imaging the paranasal sinuses for evaluating the chronic diseases and associated complications.
3. Fungal sinusitis and dense secretions are potential pitfall on CT to differentiatethem. But CT may suggest fungal sinusitis in whom it is not suspected.
4. CT is the modality of choice in evaluating the bone erosion or destruction.
5. CT evaluation of PNS in symptomatic patients helps in planning the further management of the patient.
6. CT helps in staging the PNS disease and its extension and involvement of surrounding structures.

However, CT has certain potential drawbacks and disadvantages like complex projections, artifacts induced by very high density structures in and around PNS, by the patient movement, limited soft tissue resolution. Even radiation exposure in CT examination limits frequent usage, test repeatability and its use in children and pregnant women.

For these reasons, MRI is taking an increasingly important role in many of these areas. The soft tissue contrast discrimination is greater than with CT images, with an equivalent spatial resolution. Further advantages of MRI include the ability to image in any plane without loss of spatial resolution, the ability to demonstrate vessels without the need for contrast medium, no ionizing radiation, and the relative freedom from artifacts compared with CT.

Both CT and MRI with their unique features for better depiction bone details and soft tissue details respectively, carry their own importance and play a complimentary role to each other in identifying the pathological conditions of paranasal sinuses

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