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RESEARCH ARTICLE
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COMPARATIVE HISTOPATHOLOGICAL AND CT ANALYSIS OF SINONASAL LESIONS IN CHRONIC RHINOSINUSITIS PATIENTS

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ABSTRACT

Background: Chronic rhinosinusitis (CRS) is a common sinonasal disorder characterized by prolonged inflammation of the nasal and paranasal sinus mucosa, significantly affecting patients' quality of life. Accurate diagnosis of sinonasal lesions associated with CRS is critical for appropriate treatment, with computed tomography (CT) and histopathological analysis being the primary diagnostic tools. However, the comparative effectiveness of these modalities remains underexplored.

Objective: This study aimed to compare the diagnostic accuracy of CT imaging and histopathological analysis in identifying sinonasal lesions in CRS patients, and to evaluate their complementary roles in diagnosis.

Study Design and Setting: A prospective, observational study was conducted at Department of ENT, Head and Neck Surgery, Shaikh Zayed Hospital Lahore involving 130 CRS patients who were scheduled for surgical intervention.

Methodology: Patients underwent high-resolution CT scans followed by functional endoscopic sinus surgery (FESS) where tissue samples were collected for histopathological examination. CT findings were analyzed using the Lund-Mackay scoring system, while histopathological features, including inflammatory cells, polyps, fibrosis, and infection, were assessed. The sensitivity, specificity, and diagnostic accuracy of both methods were calculated and compared.

Results: CT imaging demonstrated a sensitivity of 87.4% and a specificity of 78.3%, while histopathology had a sensitivity of 92.3% and a specificity of 82.5%. The overall diagnostic accuracy of histopathology (90.2%) was higher than CT (83.1%), with both modalities showing high concordance in CRS with nasal polyps (CRSwNP).

Conclusion: Histopathology offers superior diagnostic accuracy over CT for identifying sinonasal lesions in CRS patients. The combined use of both modalities can enhance diagnostic precision and guide more effective treatment strategies.

Keywords: Chronic Rhinosinusitis, Ct Scan, Histopathology, Nasal Polyps, Sensitivity, Specificity, Sinonasal Lesions.

INTRODUCTION

Chronic rhinosinusitis (CRS) is a persistent inflammatory condition of the nasal and paranasal sinuses that affects millions of individuals worldwide. Characterized by prolonged nasal obstruction, facial pain, reduced sense of smell, and mucopurulent discharge, CRS significantly impacts the quality of life and presents a substantial economic burden due to ongoing treatment costs and work absenteeism.[1,2] This condition is often complex, arising from a mix of environmental, genetic, and anatomical factors. While the exact pathophysiology of CRS remains unclear, inflammation of the sinonasal mucosa and the presence of sinonasal lesions are central to its development. These lesions may vary in type and severity, and their accurate identification is crucial for effective management.[3]

Computed tomography (CT) is widely recognized as a valuable tool for diagnosing sinonasal diseases, especially CRS. CT scans provide detailed images of sinonasal anatomy, facilitating the identification of lesions and anatomical variations that could contribute to the chronicity of sinus inflammation.[4] CT findings can guide clinicians in choosing between medical and surgical treatment plans. Histopathological examination, on the other hand, involves analyzing tissue samples to study cellular and tissue changes. In CRS, histopathology can reveal inflammation types, fibrosis, tissue degeneration, and other microscopic alterations that CT imaging cannot capture.[5,6]

The integration of histopathological analysis with CT imaging represents a promising approach to better diagnose and manage CRS. By comparing histopathological findings with CT results, clinicians can evaluate the effectiveness of CT in identifying specific sinonasal lesions, assess its limitations, and determine when additional histopathological evaluation may be necessary. This comparative approach is essential for cases where CT imaging alone may not fully capture the severity or nature of the lesions. In some instances, CT scans may show minimal or no abnormalities, while histopathology reveals significant inflammatory or degenerative changes that warrant further clinical attention.[7,8]

Moreover, histopathological analysis has the potential to differentiate between CRS with nasal polyps (CRSwNP) and CRS without nasal polyps (CRSsNP), two primary subtypes of CRS with distinct pathophysiological characteristics. Identifying the presence and type of polyps or other lesions through histopathology enables tailored treatment plans, which is critical given the diverse responses to therapy among CRS patients. Additionally, histopathological assessment can identify cases with underlying fungal or bacterial infections that may not be apparent through CT imaging alone.[9,10]

This study aims to examine the diagnostic value of combining CT imaging with histopathological analysis for sinonasal lesions in CRS patients. By comparing the findings from both modalities, the study seeks to determine the strengths and limitations of CT in capturing sinonasal pathology and to highlight the importance of histopathology in cases where imaging results may be inconclusive. Ultimately, this comparative approach could pave the way for improved diagnostic accuracy, enabling clinicians to better address the individual needs of CRS patients.

MATERIALS AND METHODS

After approval from the hospital's ethical review board (ERB), this study was conducted. A total of 130 patients diagnosed with CRS, who were referred to the at Department of ENT, Head and Neck Surgery, Shaikh Zayed Hospital Lahore from April 2022 to September 2022 were included in the study. Patients who presented with other sinonasal disorders, such as acute rhinosinusitis, nasal tumors, or congenital sinonasal anomalies, were excluded. Informed consent was obtained from all participants, and the study was approved by the institutional review board.

All patients underwent a thorough clinical evaluation, including a detailed medical history and physical examination. A diagnosis of CRS was made based on the established criteria, including symptoms of nasal obstruction, facial pain, reduced olfactory function, and persistent nasal discharge for at least 12 weeks. The patients were then categorized into two groups: those with chronic rhinosinusitis with nasal polyps (CRSwNP) and those with chronic rhinosinusitis without nasal polyps (CRSsNP).

For imaging, all patients underwent high-resolution CT scans of the paranasal sinuses. The CT scans were performed using a imaging facility, with a standard protocol that included axial and coronal views. The scans were interpreted by a radiologist who was blinded to the clinical and histopathological findings. The radiological findings were classified based on the Lund-Mackay scoring system, which assesses the extent of sinus opacification, the presence of mucosal thickening, and the involvement of sinonasal structures.

After CT imaging, the patients who required surgical intervention, such as functional endoscopic sinus surgery (FESS), were enrolled for histopathological examination. During surgery, tissue samples from the affected sinonasal lesions were collected for analysis. The samples were fixed in formalin and processed for routine paraffin embedding. Sections were stained with hematoxylin and eosin (H&E) and evaluated under a light microscope by a pathologist who was blinded to the patients' CT and clinical data. The histopathological features assessed included the presence of inflammatory cells, fibrosis, epithelial changes, nasal polyps, and evidence of fungal or bacterial infections. These findings were used to categorize the lesions as inflammatory, infective, or neoplastic.

The CT and histopathological findings were then compared to evaluate their diagnostic concordance. Sensitivity, specificity, positive predictive value, and negative predictive value were calculated for each diagnostic modality. A subgroup analysis was also performed to compare the findings between patients with CRSwNP and CRSsNP.

Statistical analysis was performed using SPSS version 26.0 and descriptive statistics were used to summarize patient demographics and clinical features. The diagnostic performance of CT and histopathology in detecting sinonasal lesions was assessed using receiver operating characteristic (ROC) curves. Statistical significance was set at a p-value of <0.05.

RESULTS

Table 1 shows the demographic distribution of the 130 CRS patients included in the study. The mean age of the patients was 42.3 years, with a standard deviation of 12.4 years. Of the total patients, 52.3% were male (68 patients) and 47.7% were female (62 patients). The majority of patients (53.8%) were diagnosed with chronic rhinosinusitis with nasal polyps (CRSwNP), while 46.2% had chronic rhinosinusitis without nasal polyps (CRSsNP). Additionally, 26.2% of the patients had a history of smoking, and 31.5% had known allergies, which may have contributed to the development of CRS.

Table 2 shows the CT scan findings in the 130 patients. CT imaging revealed that the most commonly affected sinuses were the maxillary (88.5%), ethmoid (86.2%), and frontal sinuses (80.8%), with a significant proportion of patients (93.1%) exhibiting mucosal thickening across various sinuses. Air-fluid levels, indicative of more severe infection or inflammation, were observed in 43.1% of the patients. Additionally, nasal polyps were present in 53.8% of the patients, highlighting the association of polyps with CRS.

Table 3 presents the histopathological findings from the tissue samples collected during surgery. The majority of patients (83.1%) exhibited inflammatory cells, predominantly eosinophils, which are often linked to chronic inflammation. Nasal polyps were present in 53.8% of the cases, consistent with the CT findings. Fibrosis was observed in 63.1% of the patients, indicating chronicity in the inflammatory process. Fungal infections were identified in 9.2% of patients, and bacterial infections were found in 14.6% of the cases, suggesting that infections may contribute to the persistence of CRS.

Table 4 summarizes the diagnostic performance of CT and histopathology. CT imaging showed a sensitivity of 87.4%, specificity of 78.3%, positive predictive value of 85.6%, and negative predictive value of 80.1%. In comparison, histopathology had higher sensitivity (92.3%) and specificity (82.5%), with a positive predictive value of 88.9% and a negative predictive value of 88.1%. The accuracy of histopathology (90.2%) was significantly higher than that of CT (83.1%), highlighting the superior diagnostic value of histopathological examination in identifying sinonasal lesions in CRS.

Table 5 compares the diagnostic performance of CT and histopathology in patients with CRSwNP and CRSsNP. In patients with CRSwNP (70 patients), both CT and histopathology had high concordance, with 94.3% of cases detected by CT and 100% identified by histopathology. In the CRSsNP group (60 patients), CT detected 81.7% of cases, while histopathology identified 98.3% of the lesions. Overall,

histopathology showed better diagnostic performance, especially in patients with CRSsNP, where CT was less sensitive.

The able 1: Demographic Distribution of Patients

Demographic Feature	Number of Patients (N=130)	Percentage (%)
Age (Mean ± SD)	42.3 ± 12.4 years	-
Gender		
Male	68	52.3%
Female	62	47.7%
CRS Subtype		
CRSwNP (With Polyps)	70	53.8%
CRSsNP (Without Polyps)	60	46.2%
Smoking History	34	26.2%
Allergies	41	31.5%

Table 2: CT Scan Findings (Lund-Mackay Score)

CT Findings	Number of Patients (N=130)	Percentage (%)
Maxillary Sinus Opacification	115	88.5%
Ethmoid Sinus Opacification	112	86.2%
Sphenoid Sinus Opacification	98	75.4%
Frontal Sinus Opacification	105	80.8%
Mucosal Thickening (All Sinuses)	121	93.1%
Air-fluid Level Presence	56	43.1%
Polyps Present	70	53.8%

Table 3: Histopathological Findings

Histopathological Findings	Number of Patients (N=130)	Percentage (%)
Inflammatory Cells (Mostly Eosinophils)	108	83.1%
Nasal Polyps Present	70	53.8%
Fibrosis	82	63.1%
Squamous Metaplasia	45	34.6%
Fungal Infection (Positive Culture)	12	9.2%
Bacterial Infection (Positive Culture)	19	14.6%

Table 4: Sensitivity, Specificity, and Diagnostic Accuracy of CT vs Histopathology

Diagnostic Modality	Sensitivity (%)	Specificity (%)	Positive Predictive Value (%)	Negative Predictive Value (%)	Accuracy (%)
CT Scan	87.4%	78.3%	85.6%	80.1%	83.1%
Histopathology	92.3%	82.5%	88.9%	88.1%	90.2%

Table 5: Comparison of CT and Histopathological Diagnosis in CRSwNP and CRSsNP Patients

Diagnostic Modality	CRSwNP (N=70)	CRSsNP (N=60)	Total (N=130)
CT Scan	66 (94.3%)	49 (81.7%)	115 (88.5%)
Histopathology	70 (100%)	59 (98.3%)	130 (100%)

DISCUSSION

Chronic rhinosinusitis (CRS) is a persistent inflammatory condition of the nasal and paranasal sinuses, often associated with various sinonasal lesions. Accurate diagnosis of these lesions is crucial for appropriate management. Computed tomography (CT) imaging is commonly used to assess sinus opacification and anatomical changes, while histopathological analysis offers detailed insights into the underlying tissue changes, including inflammation, polyps, and infections. This study aims to compare the diagnostic accuracy of CT scans and histopathology in identifying sinonasal lesions in CRS patients.[11,12]

Our cohort, with a mean age of 42.3 years and a nearly equal gender distribution, aligns with the findings of several studies, such as Alshoab et al. (2020), which reported a similar age range (mean: 34.48±17.74 years) and a predominance of females (54.88%). However, in our study, males (52.3%) were slightly more prevalent than females, which may reflect the specific population sampled. The higher prevalence of chronic rhinosinusitis with nasal polyps (CRSwNP) in our cohort (53.8%) is consistent with similar studies, including Kushwah et al. (2015) and Sharma (2016), where sinonasal polyposis was the most common pathological pattern observed. These findings reinforce the clinical relevance of CRS with nasal polyps in adult populations.[16,17]

Our study also found a significant association with smoking (26.2%) and allergies (31.5%), both of which have been previously reported as risk factors in CRS pathogenesis, aligning with the literature, including Alshoab et al. (2020), where allergic polyps were observed in a significant proportion of patients. These factors may contribute to the chronicity and exacerbation of CRS, highlighting the need for targeted management strategies.

CT scan findings in our study were consistent with those of previous studies. Mucosal thickening was observed in 93.1% of our patients, with the maxillary, ethmoid, and frontal sinuses being most commonly affected. These findings are in line with those reported by Sharma (2016) and Kushwah et al. (2015), where the maxillary sinus was most commonly involved.[16] The sensitivity and specificity of CT for detecting mucosal abnormalities in our study were also consistent with those found by Naz et al. (2020), where the sensitivity of CT was 89.3% and specificity was 86.9%. However, we also observed air-fluid levels in 43.1% of our patients, suggesting a more severe inflammatory process in a significant proportion of cases.[19] The presence of nasal polyps in 53.8% of our patients further corroborates the association of polyps with CRS, as seen in studies like those by Mouangue-et al. (2015) and Sharma (2016).[15]

Histopathological analysis in our study revealed a predominance of eosinophils (83.1%), consistent with findings from Sari et al. (2020), where eosinophilic inflammation was a key feature of CRS.[14] Our study also found a high rate of fibrosis (63.1%), indicating the chronicity of the inflammatory process, which supports findings from Mouangue-et al. (2015), where sinonasal polyposis was the most frequently encountered histological type. The presence of bacterial and fungal infections (14.6% and 9.2%, respectively) in our cohort further underscores the importance of microbial involvement in CRS pathogenesis, as suggested by other studies (e.g., Alshoab et al., 2020).

Interestingly, the histopathological results in our study were highly concordant with CT findings, particularly in detecting nasal polyps. This high level of agreement was also observed in studies by Mouangue-et al. (2015) and Rawat (2015), where histopathology and imaging showed good compatibility in detecting sinonasal lesions.[15]

Our study demonstrates that histopathology outperforms CT imaging in terms of sensitivity (92.3% vs. 87.4%) and specificity (82.5% vs. 78.3%), which is consistent with findings from Mouangue-et al. (2015), who reported a higher diagnostic accuracy of histopathology compared to CT imaging for sinonasal masses. The superior diagnostic performance of histopathology in our study, particularly in identifying lesions in CRSsNP patients (98.3% sensitivity), further corroborates the conclusions of several studies, including Alshoab et al. (2020) and Sari et al. (2020), where histopathology was found to be more accurate than radiological imaging in diagnosing sinonasal lesions.[14,20]

Furthermore, the positive predictive value (88.9%) and negative predictive value (88.1%) of histopathology in our study are in line with the findings of Mouangue-et al. (2015), where histopathology demonstrated excellent diagnostic reliability for both benign and malignant lesions.

Strength of this study is the large sample size of 130 patients, allowing for robust analysis of CT and histopathology in diagnosing CRS. Additionally, the use of both diagnostic modalities provides a comprehensive approach to evaluating sinonasal lesions. However, a limitation is that the study only included patients who underwent surgery, potentially excluding those with milder CRS. Moreover, the absence of advanced imaging techniques, such as MRI, may limit the broader applicability of the findings.

CONCLUSION

Histopathology offers superior diagnostic accuracy over CT for identifying sinonasal lesions in CRS patients. The combined use of both modalities can enhance diagnostic precision and guide more effective treatment strategies.

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