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# Clinical and radiological impact markers in evaluating characteristic unilateral paranasal sinus diseases

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**ABSTRACT**

The study was aimed to analyze the clinical and radiological features, which characterized specific unilateral sinus diseases. A retrospective review of patients' medical records with unilateral sinus opacification detected from computed tomography (CT) scan for 10 years duration in UniversitiKebangsaan Malaysia Medical Centre (UKMMC). The clinical presentation, mean age, presence of calcification and bony destruction and Lund Mackay score between groups were compared.
Total of 151 (23.5%) patients had unilateral paranasal sinus opacification on CT scan from 640 scan reviewed with 99 (65.6%) had inflammatory diseases, 38 (25.2%) had benign neoplastic condition and 14 (9.3%) with malignant neoplastic condition. Epistaxis was found to be significantly higher in malignant group (n=12/14) while rhinorrhea was higher in inflammatory condition (n=65/99). Bone erosion and mean Lund Mackay score were higher in malignant neoplasms group Computed tomography imaging combined with clinical presentation can be used as a tool to suspect malignant sinonasal disease. One should be highly suspicious of malignancy if the Lund-Mackay score of the CT paranasal sinus is high. However, tissue biopsy is still needed for confirmation.

**Key Words:** neoplasm, paranasal sinus, radiology

## Introduction

Unilateral sinonasal diseases are a common encounter in Otorhinolaryngology practices (1). The presentations are varied; from a complaint of unilateral nasal blockage, foul smelling nasal discharge, hyposmia, epistaxis or as an extranasal symptoms which includes facial pain, headache, dental or orbital symptoms (2). In these patients, a radiographic imaging often revealed unilateral sinus opacification to a certain degree, and sometimes bone erosion or expansions were noted.

The aetiology includes a wide variety of diseases ranging from inflammatory causes to malignant tumours. Inflammatory diseases are the major cause of unilateral sinonasal opacity and usually it responds well to medical treatment with a minority of patients' requiring surgical intervention [3]. Review of unilateral sinonasal diseases revealed that Chronic Rhinosinusitis (CRS) is the commonest inflammatory causes (1,2,3). Although frequently encountered, the diagnosis of CRS still remains a challenge. Task Force of Rhinosinusitis has set a diagnostic guideline for diagnosis of CRS in 1997 in where it emphasized on clinical symptoms rather than objective finding in establishing a diagnosis. However by practice many rhinologist still rely on endoscopic finding and paranasal sinus computed tomography to confirm and assess severity of diseases, and aid in management (4). Therefore, the European Position Paper on Rhinosinusitis and Nasal Polyposis 2012 includes the clinical presentation, examination and computed tomography findings for the diagnostic criteria of rhinosinusitis.

Nasal masses can be difficult to distinguish from nasal polyps clinically and radiologically (5). Nasal polyps typically present bilaterally but can also present unilaterally. The differential diagnosis of unilateral nasal masses can be antrochoanal polyp, CRS with nasal polyps, fungal sinusitis or as part of benign and malignant neoplastic processes.

Sinonasal malignancies accounted for about 3% of

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all head and neck tumours (2). An early stage of sinonasal malignancies may present with ordinary nasal complaints, mimicking symptoms of inflammatory disease. Extension beyond the paranasal sinuses may causes neurological (headache, anaesthesia at the trigeminal nerve supply territory), ophthalmological (recurrent conjunctivitis, proptosis, diplopia) or dental symptoms (mobility of the upper molar teeth, pain) (6).

The subtle symptoms of unilateral sinonasal tumour might lead to a missed diagnosis at initial presentation. A late diagnosis of the tumour might lead to disastrous outcomes. The poor prognosis and lethality of these malignant tumours are directly associated to the late or misleading symptoms and signs, which delay the diagnosis (7).

## Materials and Methods

This is a retrospective review of Computed Tomography (CT) of Paranasal Sinuses and medical records of all patients above 18 years old with unilateral sinonasal disease who presented to Otorhinolaryngology Department at UKM Medical Centre (UKMMC) within 10 years. Patients without histopathology report except in chronic rhinosinusitis were excluded in data collections. Prior, ethical approval was obtained for the study from Research Ethics Committee Universiti Kebangsaan Malaysia (RECUKM).

The CT images were graded using the Lund-Mackay scoring system (8). The mucosal abnormalities of maxillary, anterior ethmoid, posterior ethmoid, sphenoid, frontal sinuses were graded as 0 (no abnormality), 1 (partial opacification), or 2 (total opacification) for each sinus group. The ostiomeatal complexes were scored as 0 (not occluded) or 2 (occluded). The scores ranged from 0 to 12 because the patients who participated in this study had unilateral sinus diseases and the score of the healthy side of sinus was negligable, the overall CT only represents ipsilateral severity. The extension of the disease, pathologic findings such calcification in the sinuses, and bony erosion or destruction were evaluated. The existence of septal deviation was noted.

Clinical information were collected from medical records, which includes patient gender and age, side of the disease, presenting symptoms, type and final histopathology (HPE) report. Patients were categorized based on final diagnosis; inflammatory, benign neoplasm lesion and malignant neoplasm. The clinical presentation, mean age, gender, presence of calcification and bony destruction, Lund Mackay score were compared between these groups. The data were analyzed with Kruskal Wallis Test using SPSS software. A p value of $<0.05$ was considered statistically significant.

## Results

A total of 640 Computed Tomography (CT) of paranasal sinus were reviewed and 151 (23.5%) fulfilled the criteria of unilateral paranasal sinus opacification. The study groups consist of 77 men and 74 women. The disease entities were categorized as inflammatory diseases, benign neoplasms and malignant neoplasms with mean age of patients was 45.4 years (range from 18 to 80 years). Malignant neoplasms have a higher mean age (50.43 years) followed by benign neoplasms (47.63) and inflammatory diseases (43.83 years).

Out of 151 patients, 99 (65.6%) had inflammatory diseases, 38 (25.2%) had benign neoplastic condition and 14 (9.3%) with malignant neoplastic condition. Chronic rhinosinusitis (CRS) without nasal polyp (NP) was the most common diagnosis of inflammatory disease in our series with 39 patients followed by antrochoanal (AC) polyps with 19 patients. Out of 38 patients with benign sinonasal neoplasm, 26 patients were diagnosed with sinonasal papilloma (SP). Sinonasal squamous cell carcinoma (SCC) was the highest carcinoma in our series with 4 patients followed by neuroepithelial carcinoma and sinonasal papilloma (SP) with malignant transformation, both with 3 patients (Table 1).

About 126 (83.4%) patients presented with nasal blockage and 83 (55%) complaint of persistent nasal discharge. Other intranasal symptoms were epistaxis (n=35,23.2%), hyposmia (n=26,17.2%) and postnasal drip (n=26,17.2%). Extranasal symptoms documented included facial pain (n=30,19.9%), headache (n=29,19.2%), eye symptoms (n=15,19.9%) and dental symptoms (n=6,4%). Epistaxis was found to be significantly higher in neoplastic group while rhinorrhea was higher in inflammatory condition (Table 2). Statistically there was difference regarding epistaxis amongst the groups (P=0.000).

Inflammatory diseases have a higher percentage of ipsilateral deviated nasal septum as compared to other group and malignant neoplasms have a higher percentage of contralateral deviated nasal septum. However these differences were not significant. Bone erosion and mean Lund Mackay score were higher in

**Table 1.** Incidence of various final diagnosis

| Inflammatory Disease (n=99) | | Benign lesion (n=38) | | Malignant Neoplasm (n=14) | |
|---|---|---|---|---|---|
| CRS without nasal polyp | 39 (39.4%) | Sinonasal papilloma | 26 (68.4%) | SCC | 4 (28.7%) |
| CRS with nasal polyp | 18 (18.2%) | Haemangioma | 3 (7.9%) | SP with malignant transformation | 3 (21.4%) |
| AC polyp | 19 (19.2%) | Nasolabial cyst | 2 (5.3%) | Neuroepithelial carcinoma | 3 (21.4%) |
| Fungal sinusitis | 15 (15.2%) | JNA | 2 (5.3%) | Undifferentiated carcinoma | 2 (14.3%) |
| Mucocele | 7 (7%) | Hamartoma | 2 (5.3%) | Rhabdomyosarcoma | 1 (7.1%) |
| Chronic granulamatous disease | 1 (1%) | Ameloblastoma | 1 (2.6%) | Adenoid cystic carcinoma | 1 (7.1%) |
| | | Apical cyst | 1 (2.6%) | | |
| | | Fibroosseous disease | 1 (2.6%) | | |

**Table 2.** Comparison of Presenting Symptoms Between Inflammatory Disease, Benign Neoplasm and Malignant Tumours

| Symptoms | Inflammatory Disease | Benign Neoplasm | Malignant Neoplasm | P |
|---|---|---|---|---|
| | n=99 | n=38 | n=14 | |
| Nasal blockage | 81 (81.8%) | 33 (86.8%) | 12 (85.7%) | 0.757 |
| Rhinorrhoea | 65 (65.7%) | 12 (31.6%) | 6 (42.9%) | 0.01 |
| Epistaxis | 8 (8.1%) | 15 (39.5%) | 12 (85.7%) | 0.000 |
| Hyposmia | 17 (17.2%) | 4 (10.5%) | 5 (35.7%) | 0.104 |
| Post nasal drip | 23 (23.2%) | 3 (7.9%) | 0 (0%) | 0.21 |
| Facial pain | 25 (25.3%) | 3 (7.9%) | 3 (21.4%) | 0.79 |
| Headache | 26 (26.3%) | 1 (2.6%) | 2 (14.3%) | 0.07 |
| Eye complaints | 10 (10.1%) | 3 (7.9%) | 2 (14.3%) | 0.59 |
| Dental complaints | 5 (5.1%) | 1 (2.6%) | 0 (0%) | 0.104 |

malignant neoplasms group and these differences were significant. There was no difference in calcification between groups (Table 3).Calcification on CT scan was non-specific. It was mainly detected in fungal sinusitis, which involved 9 out of 15 patients (n=9/15), sinonasal papilloma (n=8/26), malignant transformation of sinonasal papilloma (n=2/3), neuroepithelial carcinoma (n=1/3) and squamous cell carcinoma (n=1/4).

Malignant neoplasm was significantly associated with a higher Lund Mackay score compared to inflammatory disease and benign neoplasm (P=0.001). There were significant differences in the Lund Mackay scores between malignant neoplasm with inflammatory disease (P=0.000) and malignant neoplasm with benign neoplasm (P=0.002).

Malignant neoplasm was also significantly associated with bony erosion compared to inflammatory disease and benign neoplasm (P=0.000). The presence of bone erosion on CT scan were statistically difference between malignant neoplasm with inflammatory disease (P=0.000) and between malignant neoplasm with benign neoplasm (P=0.001). However, the difference between inflammatory disease and benign neoplasm was not significant (P=0.870).

We noted that malignant neoplasm was associated with epistaxis as compared with inflammatory disease and benign neoplasm and it was statistically significant (P=0.000). There was a statistically significant difference between malignant neoplasm with inflammatory disease (P=0.000) and between malignant neoplasm with benign neoplasm (P=0.003) for the presentation of epistaxis.

**Table 3.** Summary of Deviated Nasal Septum, Calcification And Bony Erosion On CT And Lund Mackay Score Amongst Group

| Parameter | Inflammatory Disease | Benign Neoplasm | Malignant neoplasm | P |
|---|---|---|---|---|
| | n=99 | n=38 | n=14 | |
| Ipsilateral DNS | 21 (21.2%) | 7 (18.4%) | 1 (7.1%) | 0.455 |
| Contralateral DNS | 19 (19.2%) | 12 (31.6%) | 7 (50%) | 0.27 |
| Calcification | 9 (9.1%) | 8 (21.1%) | 4 (28.6%) | 0.49 |
| Bone Erosion | 12 (12.1%) | 5 (13.2%) | 8 (57.1%) | 0.000 |
| Mean LM score | 4.4 | 4.7 | 8.2 | 0.001 |

Based on these results, we concluded that a malignant tumour was associated with a higher Lund-Mackay score in patients with unilateral paranasal sinus opacification, presence of bony destruction on CT and clinically presented with epistaxis as compared with benign tumour and inflammatory causes.

## Discussion

Unilateral paranasal sinus diseases were present in 23.5% of 640 patients in this study. The reported prevalence varies from 2.5% to 23.1% [3,9,10]. The wide range in prevalence may be due to differences between study designs and study population. The study by Lee (2008) has the highest prevalence which can be explained by the CT images reviewed in his study were taken from patients who had undergone sinus surgery [3]. The study design in this study was similar with Ahsan et al. (2005) and Yeow et al. (2011) where we analyzed all CT scan paranasal sinus and subsequently detected cases with unilateral paranasal sinus opacity (9,10). Our study has a higher prevalence of unilateral paranasal sinus opacity as compared with other two studies, which may contribute by the locoregional factor.

Chronic rhinosinusitis (37.7%) was the most common cause of unilateral sinus diseases in our study. The incidence was within the range of 33.3% to 80.2% of previous studies (3-11). The wide range of incidence in these series might contribute to definitive clinical diagnostic of CRS depends on subjective symptoms. The symptoms severity frequently does not correspond to the severity of imaging findings (12). Reports have indicated that 27%-42% of asymptomatic subjects had findings consistent with chronic paranasal sinus disease (13,14). In our Centre, CT was reserved in patients with CRS who did not response towards initial medical treatment hence our incidence of CRS was lesser as compared to majority of other studies.

Nasal septul deviation to the either side can lead to chronic changes in the nasal airflow with reduction in nasal airflow at the deviated side and increase in nasal airflow at the contralateral side (15). Shin et al. (2005) published an animal model study on 20 healthy rabbits to evaluate the effect of nasal septal deviation as a risk of developing rhinosinusitis due to abnormal airflow (16). The morphologic and physiologic changes of nasal and sinus mucosa were observed during the study at 8 and 12 weeks. Modification was done for the study which they closed one side of the nasal orifice to represent septal deviation due to nasal septal deviation was not commonly found in animal models. The closed side showed more severe ulceration and ciliary loss than open side and reduced mucociliary clearance rate. Based on these observations they nasal and sinus infection could be due to inadequate airflow (e.g side of nasal septum deviation). In our series we found out that inflammatory disease have an association with ipsilateral septal deviation as compared with neoplastic lesion group while the latter is related to contralateral septal deviation. This observation can be explained by in neoplastic group they have a property of expansion hence cause the septum deviated to contralateral side.

In unilateral sinonasal diseases much effort has been made to distinguish tumour induced sinus disease from CRS. The differentiation can be challenging. Sinonasal malignancies are uncommon and consists of 5% of head and neck cancer and less than 1% of malignancies overall (17). The incidence varies across geographical areas as in Europe the rate is 1 per 100,000 and in Asia 3 per 100,000 (18,19). The difference in incidence may contribute by ethnicity factor and exposure to carcinogenic factors. Clinical suspicion is one of the most important element to diagnose sinonasal malignancy accurately. The insidious onset of unilateral symptoms, the lack of previous inflammatory sinus disease or rhinitis, and the relative age of the patient (>50 years old for tumors compared with <50 years old for

inflammatory disease) should be key features that prompt exclusion of neoplasia as a cause for a patient's symptoms (20). Sinonasal malignancy usually affecting older age group of patients, with 75% >50 years of age at diagnosis and predominately male gender (20).

The early signs and symptoms of sinonasal malignancies are usually trivial and seldom characteristic, and they are generally mimicking inflammatory diseases. Patients may initially present with nasal stuffiness, rhinorrhea, or congestion. The presence of trismus, headache, proptosis, or cranial neuropathies suggests possible extrasinus extension. Dull pain may indicate superimposed infection or could indicate extrasinus extension. However, lancinating pain at the trigeminal nerve distribution in the setting of malignancy is more indicative of perineural spread (21).

In our study, nasal blockage was the commonest symptoms presented in 83.4% of patients with unilateral sinonasal disease and statistically no difference was noted between groups. However we noted epistaxis were more common in neoplasm as compared with inflammatory group and the later clinically associated with rhinorrhea. In our data extranasal symptoms, which includes headache, eye, and dental symptoms are not exclusively associated with neoplasm.

CT imaging findings that may suggest that neoplasm rather than inflammatory disease, for instance, include unilateral sinus disease, osseous erosion, necrosis within soft tissue and lymph node enlargement, or an extensive enhancing soft-tissue mass (22). Unilateral sinus disease raises the possibility of benign or malignant tumor and, may be the only finding of sinonasal malignancy in early disease course, (23). The hallmark of sinonasal carcinomas is the presence of osseous erosion, which is seen in 80% of cases on CT (24). Benign tumors can also cause bony erosion, however it will not have aggressive osseous destruction such as in malignancies. More commonly, inflammatory processes, such as mucoceles, and benign tumours will show bone remodeling (25). Salami reported in his 114 patients with unilateral sinonasal diseases, 8 patients were diagnosed with malignancies and 100% have reported bone erosion (11). However in our series, only 8 out of 14 patients with sinonasal malignancies were reported with bone erosion on CT (57.1%). Despite lower percentage of bone erosion detected in sinonasal malignancies in our series, statistically it is significant as compared with inflammatory diseases and benign neoplasm (P<0.000).

Calcification is not a pathognomonic in any diseases. In our data calcification presented in inflammatory diseases (9/99), benign neoplasm (8/38) and malignant tumour (4/14) and no difference noted between group (P=0.49). Calcification can be seen in fungal sinusitis on CT scan intrasinous densities as a fine punctate lesion in the central part due to metabolic deposits of calcium in the mycelia mass while in non fungal sinusitis it is rare and peripherally located (2). We demonstrate 60% of fungal sinusitis have element of intrasinus calcification (9/15) and non-is found in CRS. Yoon et al. (1999) assessed 510 patients diagnosed with chronic maxillary sinusitis and found that 51% with fungal sinusitis had intrasinus calcification versus 3% for non-fungal sinusitis (26). The present of calcification on CT helps to differentiate inflammatory diseases from fungal sinusitis and non-fungal sinusitis.

Lee reported a higher Lund-Mackay scoring in patients with malignant neoplasm (3). Salami on the other hand reported CRS with or without nasal polyposis had the highest Lund- Mackay scores followed by malignant tumours (11). We reported a higher mean of Lund-Mackay score in malignancy group and statistically there is difference between inflammatory disease, benign neoplasm and malignant neoplasm in regards of Lund-Mackay scoring (P=0.001).

Despite some sinonasal tumour have its own characteristic and location of origin which can been visualized on imaging, only histopathology examination can provide the correct diagnosis (27). Aiming imaging for tumour staging should always be a focus in a case suspected of neoplastic lesion.

Malignant tumour is associated with a higher Lund-Mackay score in patients with unilateral paranasal sinus opacification, presence of bony destruction on CT and clinically presented with epistaxis as compared with benign tumour and inflammatory causes. Therefore, computed tomography imaging combined with clinical presentation can be used as a tool to suspect malignant sinonasal disease. One should be highly suspicious of malignancy if the Lund-Mackay score of the CT paranasal sinus is high.

**Ethical Approval:** All procedures performed in this study were in accordance with the ethical standards of Reseach Ethic Committee UniversitiKebangsaan Malaysia (RECUKM) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Formal consent obtained from each of the individuals in this study.

**Informed Consent:** Informed consent together with formal consent were obtained from all individual participants for whom indentifying information is included in this article

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