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Correlation between Computed Tomography and Histopathology Findings of Sinonasal Tumors

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Abstract

Background: A diverse range of pathologies affect the sinonasal cavities, because of the nonspecific nature of the symptoms, most patients with sinonasal masses are diagnosed late when the disease is at an advanced stage. The diagnostic challenge of identifying the nature of sinonasal masses before treatment would guide therapeutic strategies. Our objective was to evaluate the accuracy of computed tomography in the preoperative diagnosis of sinus masses at the Central Hospital of Yaoundé. **Method:** A retrospective chart review was conducted; CT scan reports and pathology reports of patients operated for sinonasal masses between January 2012 and November 2022 were compared. **Results:** Forty-five patients met the inclusion criteria for the study. The average age was 39.98 ± 18.34 years, with extremes of 15 and 87 years. The sex ratio H/F is 0.76 with a female predominance. The median time to consultation was 14 [12 - 18] months, with extremes of 11 and 36 months. The most frequently encountered histological type was benign tumors with sinonasal polyposis (PNS) in the lead, *i.e.* 34.1% of cases. The types adenocarcinoma, adenoid cystic carcinoma and non-Hodgkin's lymphoma were represented equally in 6.8% of cases. Management was dominated by Caldwell-Luc surgery, *i.e.* 59.1% of cases. The frequency of disease recurrence after surgical treatment was 18.2%. As for the mortality rate, it was 11.4%. The concordance rate of the character of malignancy on imaging compared to histology was 90.9%. This level of concordance was statistically significant according to the Gamma test ($p < 0.001$). The diagnostic performances of

imaging in malignant tumors are: Sensitivity 88.9%, Specificity 92.3%, Positive Predictive Value 88.9%, Negative Predictive Value 92.3%. This study shows that computed tomography allows the diagnosis of benign and malignant lesions of sinonasal masses but there are false positive, particularly in the case of the histological type Inverted Papilloma. **Conclusion:** Preoperative CT scans correlate with histology and have a prognostic role in surgically treated sinonasal masses.

Keywords

Computed Tomography, Histology, Sinonasal Tumors

1. Introduction

Nasal cavity and paranasal sinus diseases are frequent and diverse. While benign lesions are found in about 61% of sinonasal tumours [1], malignancies are much less frequent, accounting for about 39%. A malignant tumour is defined as rapid creation of abnormal cells that grow beyond their usual boundaries, and which can then invade adjoining parts of the body and spread to other organs; the latter process being referred to as metastasis [2]. Clinical presentation is usually nonspecific and similar for most sinonasal tumours, characterized by nasal obstruction, rhinorrhoea, and epistaxis. In advanced cases, ocular and even neurologic symptoms could ensue. Differentiating between benign and malignant tumours prior to any decision is imperative for the otolaryngologist. Diagnostic and therapeutic tools that can orient the clinician prior to histopathology confirmation include rigid and flexible endoscopy, as well as imaging techniques such as computerized tomography (CT) scan and magnetic resonance imaging (MRI). Preoperative knowledge of the nature of the tumor guides the surgeon in his surgical decision; therefore, imaging has become a real diagnostic tool for surgeons. Imaging plays a critical role in distinguishing benign and malignant disease and may occasionally illustrate characteristic radiological features of specific tumors. Biopsy of the lesion is commonly performed using a rods lens endoscope in the office under topical or local anesthesia. Surgery is the mainstay of treatment for most sinonasal tumors. Recent developments in methods and tools for the diagnosis of this disease in the early stages, in addition to the development of improved endoscopy procedures, has allowed the possibility of the simple and accurate early detection of this disease. However, these improvements require the primary care physician to play a more active role in both understanding the early characteristics of this disease. The result of the histopathological examination can only be available within 02 to 04 weeks in our context at the earliest. This relatively long diagnostic delay could be shortened by the use of computed tomography (CT scan) of the sinuses, several studies of which have also shown the essential contribution in the diagnosis of sinonasal masses. This would allow practitioners to improve the quality of life and survival rates of nas-

al cancers. The objective of this study was to assess the accuracy of pre-operative CT scan imaging in the diagnosis of nasal cavity tumours in a tertiary level hospital in a sub-Saharan African setting, at a time when endonasal sinus surgery has become very popular and common.

2. Materials and Methods

We carried out a retrospective study at the otolaryngology, head and neck surgery department of the Central Hospital of Yaoundé, covering 44 patients seen over a period of 10 years; from January 2012 to December 2022. All patients received, diagnosed and operated on for a sinusasal tumor were included. Information was obtained from patient records, surgical scheduling logs, postoperative note logs, and histopathology reports. The variables recorded included age, sex, time of consultation, clinical and radiological signs, type of surgery, postoperative course and histopathological findings, all clinical characteristics of the swelling, suggesting its benign or malignant nature, studied and correlated with histology data. On CT scan: we studied the limits of the mass, its contours, its behavior on injection of the contrast product, the extension to neighboring tissues, the existence of necrosis, haemorrhages, calcifications, or cystic degeneration. Statistical analysis and calculation of means and percentages are obtained using SPSS 23.0 software. Each of the radiological images was correlated with histology, in order to determine the predictive nature of begninitis/malignancy. A radiological criterion is significantly indicative of malignancy if the $p < 0.05$. The diagnosis proposed by the radiologist (in terms of malignant/benign nature of the tumour) was compared with the definitive histopathological diagnosis established by a pathologist. For each diagnostic modality, we calculated sensitivity (defined as the proportion of true positives correctly identified by the test), specificity (defined as the proportion of true negatives correctly identified by the test), and diagnostic efficiency (the proportion of true positives and true negatives correctly identified by the diagnostic test indicating concordance between the preoperative diagnosis and the definitive histological result).

3. Results

This study derives its originality from the fact that it is one of the first studies in the context of sub-Saharan Africa and the world to have evaluated both the usefulness of computed tomography (CT scan) examination in detecting begnitis and/or malignancy of nasosinus masses.

3.1. Socio-Demographic Data

A total of 44 patients with sinonasal tumours were received during the study period. The mean age was 39.98 ± 18.34 years, ranging from 15 to 87 years. The most represented age groups were 15 to 25 years group on one hand, and 35 to 45 years group on the other hand (**Figure 1**). Females were more concerned (56.8%, male to female sex ratio 0.76), see (**Figure 2**).

3.2. Clinical Data

Most patients (68.2%) consulted at 12 to 18 months from the onset of symptoms, with extremes at 11 and 36 months (Table 1). Clinical assessment showed a unilateral nasal syndrome (Figure 3), ocular signs were found in 15 patients. Almost all tumours were identifiable by endoscopy (43 patients; 97.7%). No patient presented neurological symptoms. Otoscopy, head and neck, and lymph node assessment were normal.

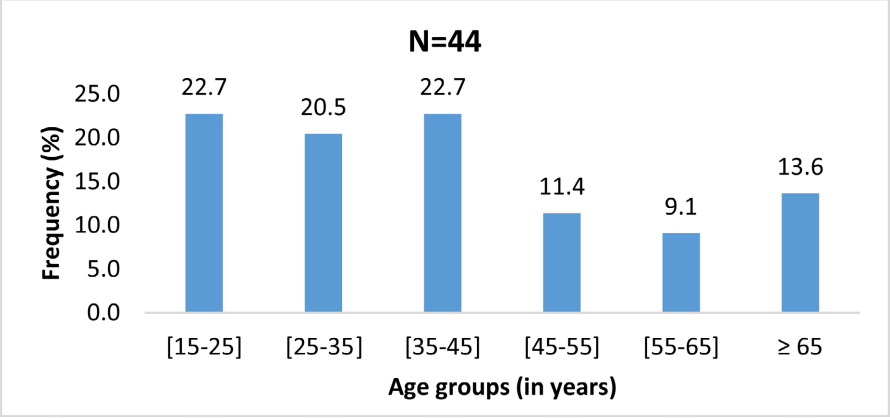

Figure 1. Distribution of the population according to age.

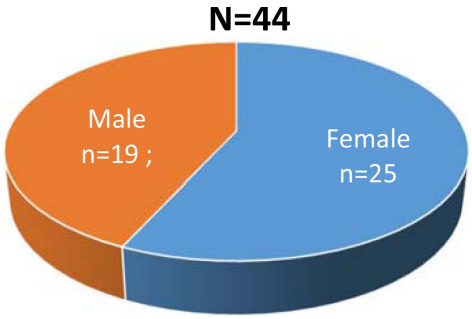

Figure 2. Distribution of the population according to gender.

Table 1. Distribution of the population according to consultation time and tumor location (N = 44).

Variables	Effective	Frequency (%)
Consultation period (in months)		
<12	2	4.5
[12 - 18]	30	68.2
[18 - 24]	6	13.6
≥24	6	13.6
Tumor location		
Nasal syndrom	44	100.0
Ocular syndrom	15	34.1

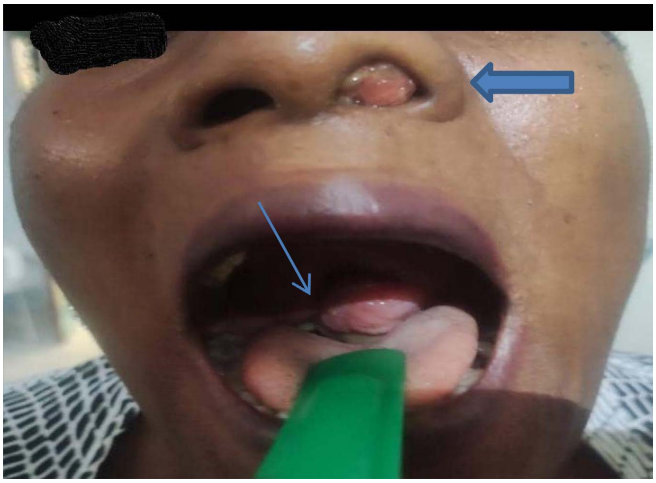

Figure 3. Preoperative image of antrochoanal polyp of the left nasal cavity.

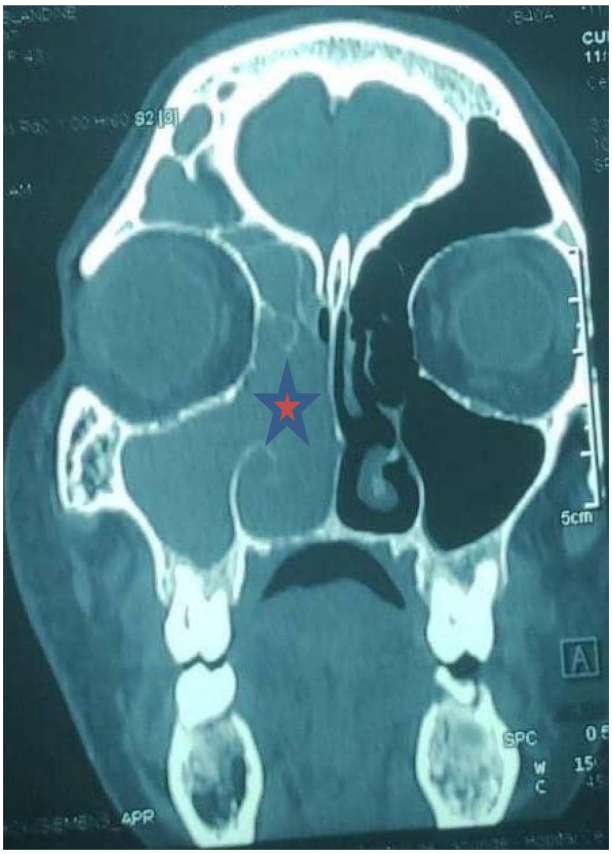

Figure 4. Nasosinus CT scan in coronal section, star in red shows the mass of the right maxillary sinus hypodense compared to the muscles with thinning of the bone walls leading to an obstruction of the right nasal cavity.

3.3. Paraclinical Data

CT scan with contrast enhancement was performed in all patients (**Figure 4**). These included axial views with sagittal and coronal reconstruction. CT scan sensitivity in identifying malignant lesions was 88.8%. Malignancies were sug-

gested in 16 patients, based on the heterogeneous appearance of lesions, rough margins, bone destruction, and contrast enhancement. Concerning benign lesions, sensitivity of CT scan was 92.3%, suggesting benign tumours in 24 patients.

Histopathology showed a preponderance of benign tumours, dominated by nasal polyps (34.1%), followed by reverse papilloma (20.5%) and antrochoanal polyps (18.1%). The most frequent malignant tumours identified, with similar frequencies, were non Hodgkin's lymphoma, adenocarcinoma, and adenoid cystic carcinoma (Table 2).

3.4. Management and Evolution

Surgical management comprised a Caldwell-Luc operation in most cases (59.1%), followed by the paralateronasal approach (40.9%) see (Table 3). Recurrence rate following surgery was 18.2%, this mostly concerned inverted papilloma. Recurrence was identified 3 - 4 years following treatment for five patients, and 6 - 7 years after for three patients. The five cases that recurred earlier were initially treated by endoscopic surgery. The repeat procedure consisted of a

Table 2. Distribution of the population according to histological type (N = 44).

Histological types	Effective	Frequency (%)
nasal polyposis	15	34.1
Reverse papilloma	9	20.5
antrochoanal polyp	8	18.2
Adénocarcinoma	3	6.8
Adenoid cystic carcinoma	3	6.8
non-Hodgkin's lymphoma	3	6.8
Mucoepidermoid carcinoma	2	4.5
Ewing's sarcoma	1	2.3

Table 3. Distribution of the population according to histological type (N = 44).

Variables	Effective	Frequency (%)
type of surgery		
Caldwell-luc	26	59.1
External surgery	18	40.9
Recurrence		
Yes	8	18.2
No	36	81.8
Death		
Yes	5	11.4
No	39	88.6

external surgery approach, paralateronasal approach associated to a degloving surgery. The three cases that recurred later were initially approached by a combination of endoscopy and Caldwell-Luc, the approach for the repeat procedure was similar, with bone drilling associated. Mortality rate was 11%.

3.5. Correlating CT Scan Findings and Histopathology

Histopathology confirmed that 65% of tumours were benign and 35% were malignant. Comparing CT scan and histopathology results found that 36% were true positives (tumours rightly identified as malignant), 54% true negatives (tumours rightly identified as benign), 4% false positives (tumours falsely identified as malignant), and 4% false negatives (tumours falsely identified as benign). The sensitivity (probability that the result of a malignancy would be "malignant") and specificity (probability that the result of a benign tumour would be "benign") of histopathology were 92.3% and 88.9% respectively. The positive predictive value (probability that a tumour is actually malignant if the result is "malignant") was 92.3%, and the negative predictive value (probability that a tumour is actually benign if the result is "benign") was 88.9%. The concordance rate of suspicion of malignancy on CT scan with histopathology was 90.9%. This rate was statistically significant using the Gamma test ($p < 0.001$), see (Table 4).

4. Discussion

Limitations of the study: Our results are subject to the inherent biases of a retrospective, monocentric study. More importantly, our data represent a patient group with a small number of surgically treated cases, therefore many patients were not included in the study, namely, cases with generalized metastases, and tumors not resectable. Despite this, this study draws its originality from the fact that it is one of the first studies in the context of sub-Saharan Africa to have evaluated both the usefulness of computed tomography (CT) to detect benignitis and/or or malignancy of nasosinus masses.

Sinonasal tumours seemed to occur predominantly around the age groups of 15 to 25 years, and 35 to 45 years. The mean of 39.9 years, ranging from 15 to 87 years was similar to that found by many other authors [3] [4] [5]. We found that a slight majority of patients were females (56.8%, sex ratio: 0.67), corroborating other studies done on sinonasal tumours [6] [7].

Darouasi *et al.* [6] and Amana *et al.* [8] reported a delay in diagnosis from

Table 4. Concordance between radiological tumor character and histological tumor character (N = 44).

		Histology		Total	p-value (gamma test)
		Malignant tumor	Benign tumor		
CT scan	Malignant image	16 (88.9)	2 (11.1)	18 (100.0)	<0.001
	Bénign Image	2 (7.7)	24 (92.3)	26 (100.0)	

onset of symptoms of 20 months and 12 months respectively, concurrently with our findings. The non-urgent nature of symptoms and the absence of pain at the onset of sinonasal tumours could explain this delay. It is noteworthy that persistent unilateral nasal symptoms unresponsive to routine medications are suggestive of presence of a tumour. Following an ear-nose-throat (ENT) clinical examination, an endoscopy should be performed. The majority of tumours in our study were diagnosed by endoscopy, which generally revealed a unilateral pink to grey mass, with occasional contact bleeding, extending from the nasal cavities to the choanae [9]. Ocular symptoms were identified in 33.3% of patients. Likewise, Amana *et al.* [8] found ocular manifestations in 37.2%. Regarding nasal symptoms, nasal obstruction associated to headache were leading complaints, comparable to data reported by Kanwar *et al.* [4] and Peyraga *et al.* [10].

Medical imaging is essential in providing information regarding precise tumour location and extension, lymph node assessment and evaluation of suspicious tumour characteristics [11] [12] [13]. For benign lesions like nasal polyps, imaging enables disease staging. CT scan and MRI appear to be the most performed investigations [14] [15]. CT scan was performed for all patients included, with a sensitivity of 88.9% for malignancy. Suspicious characteristics on CT scan considered were bone erosion/destruction and infiltration of surrounding tissue or organs. We found a very high sensitivity of CT scan in identifying malignant tumours (92.3%). This is close to results obtained by Ushami *et al.* [16] from a study comprising 11 patients presenting benign and malignant sinonasal tumours. They demonstrated that CT scan had a sensitivity of 80% and specificity of 97.1% for malignant tumours, and a sensitivity of 77.8% and specificity of 98.4% for benign tumours. Histopathology showed a total of 32 benign tumours (72.7%), versus 12 malignancies (27.3%). Amana *et al.* [8] found a proportion of 66.3% benign tumours, versus 33.7% malignant tumours from a series of 89 patients. The difference could be explained by their larger sample size. Kanduri *et al.* and Darouasi *et al.* [6] [14] similarly reported that inverted papilloma was the second most common benign tumour. Most authors described adenocarcinoma as the most common malignant tumour [3] [6]. The presence of diversity of histologic structures in the nasal cavities and paranasal sinuses, ranging from bone, glands, blood vessels, nerves, and nerves, explains the potential variability of tumours that can develop. All patients had surgery, open surgical approaches comprised the paralateronasal and Caldwell-Luc approaches. Caldwell-Luc operation was more frequently performed (59.1%), concurrent with other studies [9]. There has been some controversy on the relevance of surgical exploration in the case of tumours with CT scan images that suggest that complete resection could be impossible. We believe the most important factor to reduce the risk of recurrence is that initial resection should be as complete as possible. We had a recurrence rate of 18.2% following surgery, with a mortality rate of 11.4%. Interestingly, CT scan results were discordant with histopathology regarding the nature of the tumour in only 4.5% of cases. This does not however undermine

the fact that only histopathology can affirm the nature of the tumour. CT scan reports made by the radiologist were concordant with histopathology in 4.4% of cases. This is comparable to results obtained by Kandukuri *et al.* [3] who found significantly, in a study assessing correlations between CT scan, histology and per-operative findings, a sensitivity of 90.9% and specificity of 99.2% for benign tumours, and a sensitivity of 94.1% and specificity of 99.3% for malignant tumours. These figures are greater than those found by Usmani *et al.* [16]; for malignant tumours they found a sensitivity of 77.8% and specificity of 98.4%, with a high capacity for CT scan to discriminate between benign and malignant tumours. Lloyd *et al.* [17] found in a sample of 246 patients with sinonasal tumour (98% of cases). A possible explanation of these variations in sensitivity and specificity rates could be the existence of indeterminate or atypical pathology specimens that were variably considered as benign or malignant by various authors [18]. Nevertheless, CT scan seems to strongly correlate with histology of sinonasal tumours. Associating CT scan and MRI is more and more recommended for better evaluation of these tumours [17] [19]. Nasosinus tumors are rare and indolent neoplasms. Although long-term survival can be observed after complete surgical treatment, up to 18.75% of tumors recur during follow-up [6]. Thus, several studies have attempted to identify pathological, radiological and bio-tumor characteristics to predict the risk of relapse after surgical treatment. Precise preoperative evaluation is mandatory to correctly define the surgical strategy. Mortality was 11%, different from that of Darouassi (28.1%) [6]. In terms of surgery, current advances in robotic surgery will probably provide new perspectives. Since a definitive histological diagnosis can only be obtained during the final pathological examination, the preoperative parameters that identify patients at higher risk of cancer can be of great importance in defining the strategy surgical. The surgical procedure could be more extensive and/or radical. The results of the present study confirm that preoperative CT features can provide preoperative definition of nasosinus lesions in terms of stage, histology, and prognosis. All of these elements are crucial to guide the patient towards the most appropriate therapeutic cure in order to maximize oncological results and treatments.

5. Conclusion

At the end of our study, we concluded that the specific CT sensitivities were 92.3% and 88.9%, respectively; the false negatives and false positives of the histological examination by 4% for the two cases. MRI with the measurement of the diffusion coefficient, and MRI spectroscopy have demonstrated promising results in terms of differentiation between malignant and benign tumors and seems to be an area of future research in the diagnosis of nasosinus masses. The CT/MRI couple could be essential to provide relevant information for the surgeon.

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Consent of Rights

Written informed consent was obtained from the patients for the publication of this article and all accompanying images.

Authors' Contributions

All authors have read and approved the final version of the manuscript.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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