Unilateral Sinonasal Opacifications: A Histo-Radiological Correlation

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Abstract

Various pathological entities may manifest on imaging as unilateral or bilateral nasal and/or sinus opacity. The vast majority is represented by inflammatory pathologies, tumors are rare, but they are dominated mainly by benign tumors. Malignant diseases are uncommon, accounting for 3% of tumors of the head and neck. Advances in imaging using preoperative computed tomography and magnetic resonance imaging have been significantly marked in the diagnostic approach to sinonasal pathologies. Surgical modalities are influenced by preoperative knowledge of the nature and topography of the tumor. The aim of this work is to describe the clinical, radiological, and anatomopathological characteristics of sinonasal pathologies expressed by unilateral sinonasal opacity in imaging, to identify the clinicoradiological variables likely to predict malignancy, and to make a correlation between the radiological images and the anatomopathological result.

Keywords
- unilateral sinonasal opacity
- computed tomography
- sinus surgery

Introduction

The nasal sinus pathology is one of the most common in the head and neck. Various pathological entities can manifest on imaging as unilateral nasal and/or sinus opacity. It is considered as a suspicious situation that needs to be investigated in order to eliminate a possible tumor pathology. Advanced imaging using preoperative computed tomography (CT) and magnetic resonance imaging (MRI) have contributed significantly in the diagnostic approach; it is essential to guide the etiological diagnosis and to establish a tumor map which determines the therapeutic strategy and the surgical tactics.

However, differentiation between benign, malign, and inflammatory pathologies that manifest as a unilateral opacification on imaging can be very challenging. For this purpose, the current study has been designed to describe the clinical, radiological, and anatomopathological characteristics of sinonasal pathologies that manifest radiologically as a unilateral sinonasal opacity (USNO) and to identify the variables that might differentiate inflammatory pathologies from tumoral pathologies on the one hand, and benign from malignant tumors on the other hand.

Materials and Methods

Between April 2016 and April 2020, a retrospective study was conducted in the ENT, Head and Neck Surgery Department of the Ibn Rochd Teaching Hospital, Casablanca, Morocco. The medical records of patients who have consulted for sinonasal and facial symptoms (including nasal obstruction, facial pain, epistaxis, rhinorrhea, facial swelling) and whose facial CT scans with or without MRIs have shown unilateral sinonasal opacification were included. All these patients underwent sinonasal endoscopic surgery with confirmation of the nature

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of the disease by anatomopathological study of the resected tissues. We have excluded from the study the patients with bilateral opacifications and prior sinonasal surgery.

The aim of this study was to identify the clinical and radiological variables that may help to predict the nature of the disease (inflammatory pathologies "IP," benign "BT," or malign tumors "MT").

The data were analyzed using chi-square test and the *p*-value was calculated for each variable using SPSS 23.0 version (SPSS, Inc., Chicago, Illinois, United States). The statistical significance level was established at $p < 0.05$.

Results

One hundred sixty-two patients were included. USNOs presented 25% of all the sinonasal opacities. IP, BT, and MT presented, respectively, 66% ($n = 107$), 22% ($n = 36$), and 12% ($n = 19$) of the USNOs.

There were 63 males and 99 females. No gender predominance was noted, for both BT and MT. For IP, a female predominance was observed (sex ratio F/M = 2.05) with a mean age of 41 years (range: 9–73 years) versus 35 years for tumoral pathologies (range: 1.5–70 years).

Concerning the inflammatory pathologies, 50% of them were located in the nasomaxillary area ($n = 54$) (►**Table 1**). It was dominated by rhinosinusitis (43%, $n = 46$) followed by antrochoanal polyps (33%, $n = 35$), mucoceles (16%, $n = 18$), and rhinolithiasis (8%, $n = 8$).

Benign tumors counted for 65% of all the tumors ($n = 36$). Their most frequent etiologies were vascular tumors (angiomas, angiofibromas) (39%), whereas squamous cell carcinomas were the most frequent among malignant tumors (47.5%) (►**Tables 2–4**).

The mean lag time between onset of symptoms and consultation for IP, BT, and MT was respectively 30, 11.5, and 12 months.

Analysis of sinonasal symptoms, using the chi-square test, revealed that epistaxis, swelling of the face, the presence of a mass on endoscopy, and extrasinusal signs were statistically associated with tumor pathology ($p < 0.05$), whereas only epistaxis, facial pain, and facial swelling were statistically significant indicators for predicting malignancy ($p < 0.05$) (►**Tables 5** and **6**).

The analysis of the CT scan data showed that irregular limits of the opacity, bone erosion, and contrast enhancement were significant indicators of tumor pathology (►**Table 7**).

Irregular limits, bone erosion, extrasinus extension, and contrast enhancement were in favor of malignancy ($p < 0.01$). The analysis of sublocations showed that the nature of the tumor was more likely to be malignant when the bone destruction involved the anterior ($p < 0.05$) or posterior ($p < 0.02$) walls of the maxillary sinus. The destructions of the roof of maxillary sinus, cribriform plate, and the frontal bone were not significant indicators of malignancy (►**Table 8**).

The sensitivity of CT in the diagnosis of inflammatory pathologies (IP) was 72.9%, the specificity was 78%. In all the patients with MT, the diagnosis offered by preoperative CT was consistent with the final pathologic results obtained

Table 1 Location-based distribution of USNO

Locations	Benign tumors ($n = 36$)	Malignant tumors ($n = 19$)	Inflammatory pathologies ($n = 107$)
Nasal cavity (NC)	12	–	10
Maxillary sinus (MS)	4	–	11
Frontal sinus (FS)	1	–	2
Ethmoidal sinus (ES)	1	–	6
ES + FS	2	1	9
ES + MS	5	5	15
NC + MS	4	1	54
NC + MS + ES	4	9	–
NC + ES	1	–	–
NC + ostiomeatal complex	2	3	–

Abbreviation: USNO, unilateral sinonasal opacity.

Table 2 Distribution of malignant tumors as etiologies of USNO

Malignant tumors	$n = 19/162$	Percentage = 12%
Squamous cell carcinoma	$n = 9$	47.5%
Sarcoma	$n = 5$	26.4%
Adenoid cystic carcinoma	$n = 1$	5.2%
Adenocarcinoma	$n = 1$	5.2%
Lymphoma	$n = 1$	5.2%
Melanoma	$n = 2$	10.5%

Abbreviation: USNO, unilateral sinonasal opacity.

Table 3 Distribution of benign tumors as etiologies of USNO

Benign tumors	$n = 36/162$	Percentage = 22%
Vascular tumors	$n = 14$	39%
Inverted papilloma	$n = 9$	25%
Bone tumors	$n = 9$	25%
Soft tissue tumors	$n = 4$	11%

Abbreviation: USNO, unilateral sinonasal opacity.

Table 4 Distribution of inflammatory pathologies as etiologies of USNO

Inflammatory pathologies	$n = 107/162$	Percentage = 66%
Rhinosinusitis	$n = 46$	43%
Antrochoanal polyps	$n = 35$	33%
Mucoceles	$n = 18$	16%
Rhinolithiasis	$n = 8$	8%

Abbreviation: USNO, unilateral sinonasal opacity.

Table 5 Clinical characteristics of USNO: inflammatory pathologies versus tumoral pathologies

	Inflammatory pathologies (*n* = 107)	**Tumoral pathologies (*n* = 55)**	***p*-Value**
Rhinorrhea	69	32	< 0.1
Nasal obstruction	70	33	< 0.5
Epistaxis	11	37	< 0.001
Facial pain	57	27	< 0.9
Face swelling	9	28	< 0.001
Mass on endoscopy	37	29	< 0.02
Extrasinusal signs	5	9	< 0.02

Abbreviation: USNO, unilateral sinonasal opacity.

Table 6 Clinical characteristics of USNO: benign tumors versus malignant tumors

Clinical signs	Benign tumors *n* = 36	Malignant tumors *n* = 19	*p*-Value
Rhinorrhea	2	2	< 0.5
Nasal obstruction	12	11	< 0.1
Epistaxis	18	19	< 0.001
Facial pain	5	15	< 0.001
Facial swelling	11	17	< 0.001
Mass on endoscopy	23	6	< 0.05
Extrasinusal signs	3	6	< 0.5

Abbreviation: USNO, unilateral sinonasal opacity.

Table 7 Radiologic characteristics of USNO on CT scan: inflammatory pathology versus tumoral pathology

Radiologic findings		**Inflammatory pathologies *N* = 107**	**Tumoral pathologies *N* = 55**	***p*-Value (chi-square test)**
Limits	Regular	107	23	< 0.001
	Irregular	–	32	
Opacity	Homogeneous	102	5	< 0.10
	heterogeneous	5	55	
Contrast enhancement		15	37	< 0.001
Bone erosion		10	30	< 0.001
Extrasinusal extension		41	18	< 0.5
Calcifications		12	8	< 0.9

Abbreviations: CT, computed tomography; USNO, unilateral sinonasal opacity.

from surgery (sensitivity of 100%, specificity 47.5%). The discrepancy between CT and histology was noted in 30% of cases (►**Table 9**).

Discussion

Sinonasal disease is one of the most common clinical head and neck pathologies. The majority of sinonasal pathology is inflammatory, neoplasms comprising approximately 3% of all head and neck tumors.[1] Nasal obstruction is usually the most frequently noted functional sign.[2] This was also the case in our study, 63.5% of the patients presented a nasal obstruction, whereas epistaxis was the revealing symptom in 67% of the patients with tumor pathologies, which was higher than reported in the literature.[3-5] Because of the predominance of vascular tumors, epistaxis was a frequent sign even in case of benign tumors (50%).

In this study, epistaxis, facial pain, facial swelling, and the presence of a mass on endoscopy were statistically significant indicators in favor of malignancy ($p < 0.05$), which agrees with the data in the literature.[6,7]

Sinonasal tumors are frequently asymptomatic at the initial stage, or produce nonspecific symptoms common with other pathologies, in particular inflammatory. The role of imaging is to diagnose the tumor, and differentiate it from an inflammatory process. Then to define its exact extension, which is essential for the choice of the appropriate therapeutic modalities guaranteeing a satisfactory tumor resection with negative margins.[8]

The suspicion of a sinonasal tumor is often the result of an analysis of the CT images requested for the initial assessment of a banal chronic rhinosinusitis. Four main signs help to distinguish the two entities: an atypical tumor signal in sinonasal opacity, contrast enhancement of the opacity, which was associated with malignancy in this study; an atypical topography of sinus opacities: Any opacity unilaterally involving both the anterior and posterior sinus complexes without respecting the basal lamina, producing the appearance of unilateral nasal polyposis must point out to the presence of a tumor, and finally atypical extrasinusal extension.

Imaging aims also to differentiate between benign and malignant tumors, this is based on a set of arguments, certain criteria must be considered suspect such as unilaterality and osteolysis.[2] Eighty percent of squamous cell carcinomas are osteolytic, but some benign tumors and fungal sinusitis

Table 8 Radiologic characteristics of USNO on CT scan and MRI: benign tumors versus malignant tumors

Radiologic findings		Benign tumors *N* = 36	Malignant tumors *N* = 19	*p* (chi-square test)
Limits	Regular	23	–	< 0.001
	Irregular	13	19	
Density on CT scan	Homogeneous	5	–	< 0.10
	Heterogeneous	31	19	
CT Scan: contrast enhancement		18	19	< 0.001
MRI: T1	+	10	3	< 0.5
	_	26	16	< 0.5
T2	+	6	2	< 0.9
	_	30	17	< 0.9
MRI: contrast enhancement		31	19	< 0.10
Bone erosion		11	19	< 0.001
Floor of orbit		11	10	< 0.2
Anterior wall of maxillary sinus		10	11	< 0.05
Posterior wall of maxillary sinus		5	9	< 0.02
Cribriform plate		4	3	< 0.9
Frontal bone		2	0	< 0.3
Extrasinusal extension		7	11	< 0.01
Calcifications		4	4	< 0.5

Abbreviations: CT, computed tomography; MRI, magnetic resonance imaging; USNO, unilateral sinonasal opacity.

Table 9 Correlation between radiological and histological diagnosis of USNO

Histological diagnosis and radiological diagnosis	MT, *n* = 19	BT, *n* = 36	IP, *n* = 107
MT	19	7	2
BT	–	17	27
IP	–	12	78

Abbreviations: BT, benign tumors; IP, inflammatory pathologies; MT, malignant tumors; USNO, unilateral sinonasal opacity.

can have a very aggressive appearance. Moreover, numerous studies have confirmed that bone erosion is typically found in malignant tumors.[9-12]

In this study, irregular limits, bone lysis, and extrasinusal extension were significant indicators of malignancy ($p < 0.01$). Calcifications are more likely to indicate a benign inflammatory nature such as aspergillosis or rhinolithiasis, they can be noted in certain tumors: inverted papilloma, adenocarcinoma, esthesioneuroblastoma, and chondrosarcoma. In our study, the presence of calcifications did not make it possible to differentiate between a benign and malignant tumor.

The late diagnosis explains the difficulties in identifying the exact anatomical origin of the tumor. For cancers, all the series agree on the clear predominance of T3-T4 lesions over T1-T2 lesions at the time of diagnosis,[2] which ties in with our observation. The presumed starting point can be deduced from the "geographic center" or epicenter of the tumor.

Imaging can sometimes facilitate the etiological approach of certain tumors with a very evocative specific profile, nerve tumors, hypervascular tumors, and malignant melanomas, based on the epidemiological context, the effect of the tumor on the bone, the location of the tumor, and behavior after contrast administration. Imaging aims also to eliminate a tumor originating from neighboring regions avec extending into the nasal and paranasal cavities such as meningocele, meningioma, etc.

Establishing a tumor map necessarily requires the differentiation between tumor and surrounding tissues: normal mucosa, inflammatory mucosa, and fluid retention. The CT scan, even with iodine injection, poorly dissociates the tumor from inflammatory reactions. MRI by varying the tumor and inflammatory signal (T1, T2, and Tl gadolinium) is more accurate for this distinction and for determining the location and exact tumor volume.

T2-weighted MRI has the ability to clear a retaining sinus with hypersignal from an hypointense tumor process, whether benign or malignant.

The imagery is thus very useful in guiding the therapeutic strategy, choosing the best surgical tactics. CT, even with iodine injection, imperfectly analyzes certain orbital extensions.[13] MRI (T1, T2, and T1 gadolinium) is more precise in determining orbital and neuromeningeal extensions or toward deep spaces of head and neck, which may constitute a limit or even a contraindication to surgery. Imaging is also essential in postoperative follow-up due to the usual post-treatment changes (postoperative and/or radiation fibrosis).

Conclusion

CT scan should be considered as the initial imaging modality to be performed in front of a unilateral and chronic rhinosinusitis. The MRI finds its indication when the information provided by the CT scan is insufficient. The surgical strategies are influenced by the preoperative knowledge of the nature and the topography of the tumor. Imaging plays an important role in the preoperative evaluation of nasal sinus tumors. However, the distinction between malignant tumor and benign tumor is sometimes difficult, hence the need to develop and generalize dynamic MRI techniques such as the measurement of the diffusion coefficient which enhance significantly the ability to differentiate between benign and malignant tumors.

Conflict of Interest
None declared.

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