Imaging features of sinonasal lymphoma

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Learning objectives

To determine the imaging features of sinonasal lymphoma by a retrospective study.
Background

Sinonasal tumours are rare, and sinonasal malignancies comprise only 3% of all head and neck cancers and 1% of all malignancies [1]. Sinonasal tumours can be of epithelial (carcinomas) or mesenchymal (sarcomas) origin. They encompass squamous cell carcinoma, minor salivary gland malignancies including adenocystic carcinoma (ACC), lymphomas, sarcomas etc.

Lymphoma is a cancer that arises in the nodal and extranodal lymphoid tissue. Lymphomas have been named Hodgkin lymphoma (HL) and non-Hodgkin lymphoma (NHL) after Thomas Hodgkin who first described lymphoma in 1932. The term NHL has been replaced by the group of dominating cell types into B, T and natural killer (NK) cell lymphomas. Approximately 1/3 of the extranodal NHL involving the head and neck area [2-5], but sinonasal lymphomas are rare, despite being the 2nd most common malignancy found in head and neck region behind squamous cell carcinoma.

Currently, there are two distinct subgroups which are recognized, characterized by phenotype, location, prognosis, and treatment. Lymphomas of the B-cell phenotype are the most frequent sinonasal tumours, being less aggressive and with a better prognosis. The rarer T/NK-cell lymphomas are mostly found in the nasal cavity; though in South America and Asia, a T-cell phenotype predominates [3]. These are aggressive with a worse prognosis [6]. Burkitt’s lymphoma (BL) is a high grade B-cell non-Hodgkin’s lymphoma, associated with Epstein Barr virus usually involving the maxilla and facial bones in the endemic African variant; head and neck lesions in non-endemic BL are rare [7].

B- and T-cell lymphomas of the nose are rarely primary tumours and usually represent metastases from other lymph node sites. On the other hand, nasal T/NK-cell lymphomas are predominantly primary tumours [8, 9].

These primary lymphomas of the sinonasal cavities pursue an aggressive clinical course but little is known of the imaging features, and the reported anatomic site of origin may not always be accurate or well documented [3]. We have therefore performed this retrospective study to determine the imaging features of sinonasal lymphoma. We assessed the uni- and multifocality of tumour, location, CT attenuation, MRI signal, enhancement patterns, bony changes and other associated features of these tumours in an attempt to develop characteristic imaging manifestations for these tumours.
Findings and procedure details

PROCEDURE DETAILS

Patients

A review of the sinonasal tumours that were discussed at combined clinical-radiologic sessions in Changi General Hospital (CGH) and Khoo Teck Puat Hospital (KTPH), over a 14-year period, between 1999 and 2013 yielded 23 cases of histopathologically confirmed sinonasal lymphoma. The sex and age of patients at diagnosis were recorded retrospectively. The 14 men and 9 women in the study cases range in age from 38 to 83 years (mean, 67 years).

CT Analysis

CT was performed with Aquilion multisection CT scanner (Toshiba Medical Systems, Tokyo, Japan). Contiguous 2mm axial images of soft tissue window were obtained typically after intravenous administration of 100 ml of 60-65% iodinated contrast material (Omnipaque). Contiguous 2mm axial, coronal and sagittal 2mm axial images of bone window were also obtained to detect subtle bony involvement.

MRI Analysis

MR imaging was performed using either a 3-T system (General Electric Medical Systems) or a 1.5-T system (Siemen Magnetom Aera). The MRI sequences include: Axial T2W Propeller, FSE T2W FS, FSE T1W; Coronal STIR, FSE T1W; Sagittal FSE T1W and post contrast sequences axial, coronal and sagittal FSE T1W FS.

Of these cases, a total of 13 patient cases were evaluated with CT, while 6 patient cases were evaluated with MRI and 4 patient cases were evaluated with both CT and MRI.

Images were interpreted retrospectively by two head and neck radiologists (Tan TY, Yiin SZ). Images were evaluated conjointly and characterisation of the imaging features were reached by consensus. The tumours were categorized in terms of uni- or multifocality, location, CT attenuation and MRI signal relative to muscles, enhancement pattern, bony
changes, presence of haemorrhage/ calcification, lymph nodes and histopathology. Bone window images were used to detect subtle destruction of bone.

Records were retrieved from department of pathology database, which evaluates and classifies all lymphomas histopathologically.

**Definition**

We define the tumour location as, unifocal which is defined as contiguous mass; and multifocal which is defined as non-contiguous and separate masses.

Bony changes were defined as i) permeative pattern, where tumour infiltrates the bone with poorly defined margins, however with sparing of the cortex; ii) destructive pattern, where tumour infiltrates the bone involving the cortex; remodeling where tumour results in bony expansion.

**FINDINGS**

The Table shows the age and sex distribution as well as the radiologic features of the sinonasal lymphoma. Total of 23 patients had sinonasal lymphoma diagnosed at CGH and KTPH during the study period. There were 14 (60.9%) in men and 9 (39.1%) in women, giving a male: female ratio of 1.6:1. The mean age was 67 (range = 38 to 83) years.

**Location of disease**

At diagnosis, the tumour was unifocal in 17 patients and multifocal in 6 patients (Table 1).

Among these 23 patients, 6 of them showed bilateral disease involvement. Unilateral unifocal tumour was found in 16 patients, one of which showed multifocal disease, and synchronous bilateral multifocal tumours in 5 patients (Fig. 1A, 1B).

18 patients (78.3%) had disease primarily in the nasal cavity. Of these, one patient had disease confined solely to the nasal cavity (Fig. 2), and 8 patients had disease extension into the paranasal sinuses (n = 8), nasolabial fold (n = 6), nasopharynx (n = 4), nasolacrimal duct (n = 2), cavernous sinus (n = 1), orbit (n =2), periorbital region (n = 1), buccal space (n = 1), masticator space (n = 2), greater wing of sphenoid (n = 1) and zygomatic arch (n = 1).
In 3 patients, the primary disease site was in the maxillary sinus, while two of which were centered in anterior medial corner of maxillary sinus with sinus remained aerated and show disease extension into the nasolabial fold (n = 2) (Fig. 3A and 3B), the other one showed disease extension into the oral cavity through hard palate (n = 1).

Ethmoid sinus and orbital disease involvement was found in one patient, a 57 year old female patient (Fig. 4).

In one patient, an 82 year old male patient, disease presentation showed contiguous mass extended to bilateral frontal, ethmoid and maxillary sinuses, right sphenoid sinus and right orbit (Fig. 5).

**Bone Involvement**

6 (46%) of 13 patients with lymphoma involving the paranasal sinuses showed bone destruction (Fig. 6), while 4 (40%) of 10 patients with primarily nasal lymphoma showed associated bone destruction.

Permeative bone destruction was seen in 6 (46%) of 13 patients with lymphoma involving paranasal sinuses (Fig. 7), while such findings were seen in 3 (30%) of 10 patients with lymphoma primarily in the nasal cavity with soft tissue mass involving the nasolabial fold, nasopharynx, nasolacrimal duct and periorbital region.

Expansile bony remodelling was present in 3 patients with tumour confined to the nasal cavity (Fig. 8), although one of which showed disease extension into nasopharynx.

No bony change was found in only one patient with tumour centred at anterior nasal cavity and nasolabial fold.

**CT Attenuation**

Of all 17 patients who underwent CT imaging, the tumours show isodensity relative to muscle.

**MR Signal**
Of 10 patients who had MRI performed, 4 also underwent CT imaging. All of tumours showed mildly T1W and T2W hyperintensity relative to muscle.

**Enhancement Pattern**

Homogenous enhancement of tumours was demonstrated in all patients to whom contrast media was administered, save for one that which showed heterogenous enhancement.

**Presence of haemorrhage or calcification**

None of the tumours showed haemorrhage or calcification.

**Presence lymph nodes**

Only 5 of 23 cases show lymph nodes present, mainly submandibular nodes of mixed appearance.

**Histopathologic findings**

Among the 23 cases, majority of the tumours were B-cell lymphoma, while only 6 cases were NKT-cell lymphoma.

**DISCUSSION**

Among the sinonasal malignancies, the squamous cell carcinoma is the most common (80%), followed by adenocarcinoma. Carcinomas most often originate from the maxillary sinuses followed by the ethmoid sinuses, nasal vestibule and cavity; carcinomas originating from the sphenoid and frontal sinuses are very rare. Cantu et al [10] found that lymph node metastases were rare, and when present, the prognostic factors were low with 5-year survival of 17% for maxillary sinus and 0% for ethmoid sinus carcinomas. One percent of head and neck malignant neoplasm and 10% of salivary gland neoplasms are adenoid cystic carcinomas (ACC) with its origin usually in the maxillary or ethmoid sinuses. The tumour grows slowly, but neural invasion, distant metastases and multiple recurrences are common [11].

Sinonasal NHL are uncommon malignancies. B-cell lymphomas are the most common in the maxillary sinus and have a better-prognosis than T-cell lymphomas, which more
often originate from the nasal septum. Sinonasal lymphomas are more common in Asia than in the western world.

Both unilateral and bilateral presentations are shown, as suggested by Ou et al [12]. In our series, the proposed primary site for sinonasal lymphoma is nasal cavity (18 of 23 patients, 78.3%). Our study also indicated that involvement of frontal sinus (n = 1), nasolacrimal duct (n = 2), buccal space (n = 1), cavernous sinus (n = 1) and hard palate (n = 1) is rare. While many of the imaging features of sinonasal lymphoma overlap with other sinonasal tumours, multifocal masses, if present, would point to its diagnosis as this is rare in other tumours.

We also noted that the involvement of nasolabial region is present in quite a significant number of our cases. To our knowledge, this imaging feature has not been reported in any previous English literature. Our study showed nasolabial fold involvement in 8 of 23 patients with sinonasal lymphomas (35%); 5 of B-cell type; 3 of T-cell type. This raises the possibility that this feature might be more common with lymphomas than other sinonasal tumours, although this has to be confirmed by further studies by comparing with other tumours.

It is well known that most sinonasal lymphomas in Asian countries have been T-cell tumours [3, 13,14]. Hashimoto et al [14] reported T-cell type found in 11 (37%) of 30 patients with sinonasal lymphomas. Conversely in the western populations, majority of sinonasal lymphomas are of B-cell tumours [15, 16, 17]. Our data indicated that while majority cases are of B-cell type tumours, there is predominance of T cell/ NKT cell lymphoma in the nasal cavity without paranasal sinus involvement (3 of 6 patients, 50%). Our study showed that lymphomas with paranasal involvement predominantly are of B-cell type (10 of 17 patients, 59%) and only 2 of 17 patients (12%) with B cell lymphoma involved strictly nasal cavity. Abbondanzo and Wenig [3] stated that 34 (53%) of 64 lymphomas that were strictly of nasal origin were of T-cell lineage. Similar results were attained by Ferry et al [18] who stated that nasal lymphoma that involved predominantly the nasal cavity was T-cell derived while most paranasal lymphomas were B-cell tumours. Similar conclusion was obtained by Nakamura et al [19]. Our study strongly support these conclusions.

Our study results noted that the CT and MRI features were non-specific. The common findings of tumour are isodense to muscle at CT, and at MR imaging, the signal is mildly high on T1W and T2W; and majority show homogenous enhancement similar to muscle (14 of 23 patients, 61%). The tumours are non-calcified nor haemorrhagic. These findings are largely in agreement with published CT findings in sinonasal lymphomas [20].
As suggested by Kondo et al [19], sinonasal lymphoma can be either expansile with permeative bony wall involvement, or more infiltrating and destructive, as is commonly seen in squamous cell carcinoma. Our series showed there is equal predominance of bony destructive and permeative change for lymphoma with paranasal involvement and primarily nasal cavity. Bony permeation or destruction is a feature consistent with T/NK cell or B cell lymphoma.

Lymph node metastasis is uncommon in sinonasal lymphomas.

It is essentially impossible to differentiate tumour histologic types with imaging criteria alone, and ultimately a diagnosis based on histopathologic findings is essential [19].
<table>
<thead>
<tr>
<th>Case No.</th>
<th>Sex</th>
<th>Age (yr)</th>
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<th>Side</th>
<th>Location</th>
<th>Affirmation (CT)</th>
<th>MRI signal</th>
<th>Enhancement pattern</th>
<th>Bone changes</th>
<th>Soft Tissue</th>
<th>Histology</th>
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| Table 1 |

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Fig. 1A: Axial MRI T2W and T1W FS post contrast (1B) in patient with synchronous bilateral multifocal tumours, involving the left nasal cavity (*), left maxillary sinus, left nasopharynx, and right maxillary sinus.

Fig. 1

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Fig. 2: Axial MRI T2W and T1W (Fig. 2B) in patient with bilateral multifocal tumour (*) confined solely to the nasal cavities, separated by the nasal septum.
Fig. 3

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Fig. 4

Axial CT brain shows ethmoid sinus (*) and orbital (→) disease involvement in a 57 year old female patient.
Fig. 5: Coronal CT face in soft tissue window shows contiguous mass extended to bilateral frontal (→), ethmoid and maxillary sinuses, right sphenoid sinus (not seen in this image) and right orbit (*)
Fig. 6A and 6B: Axial CT brain in soft tissue window in patient with lymphoma involving the paranasal sinuses showed bone destruction (→) pattern

Fig. 6

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Fig. 7: Axial MRI T2W in patient with lymphoma primarily in the nasal cavity with soft tissue mass involving the maxillary, anterior ethmoid (♂) and sphenoid sinuses. Underlying bony permeative pattern is not well appreciated in current MRI modality

Fig. 7
Fig. 8: Coronal CT face in patient with tumour confined to the nasal cavity causing expansile bony remodelling (↔)
Conclusion

While many of the imaging features of sinonasal lymphoma overlap with other sinonasal tumours, multifocal masses, if present, would point to its diagnosis as this is rare in other tumours. We also noted that the involvement of nasolabial region is present in quite a significant number of our cases, raising the possibility that this feature might be more common with lymphoma than other sinonasal tumours, although this has to be confirmed by further studies by comparing with other tumours.
REFERENCES


