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Magnetic resonance imaging features of nasopharyngeal carcinoma and nasopharyngeal non-Hodgkin's lymphoma: Are there differences?

Xue-wen Liu [1], Chuan-miao Xie [1], Yun-xian Mo, Rong Zhang, Hui Li, Zi-lin Huang, Zhi-jun Geng, Lie Zheng, Yan-chun Lv, Pei-hong Wu *

State Key Laboratory of Oncology in Southern China and Medical Imaging and Minimally Invasive Interventional Center, Cancer Center, Sun Yat-sen University, Guangzhou, China

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ABSTRACT

Purpose: To describe differences in the primary tumour and distribution of cervical lymphadenopathy for cases of nasopharyngeal carcinoma (NPC) and nasopharyngeal non-Hodgkin's lymphoma (NPNHL) using magnetic resonance (MR) imaging.
Materials and methods: MR images of patients with NPC ($n = 272$) and NPNHL ($n = 118$) were independently reviewed by two experienced radiologists.
Results: NPC had a higher incidence of tumour invasion associated with the levator and tensor muscles of the velum palatine, the longus colli and medial pterygoid muscles, the base of the pterygoid process, the clivus, the base and greater wing of the sphenoid bone, the petrous apex, the foramen lacerum, the foramen ovale, the hypoglossal canal, and intracranial infiltration. In contrast, NPNHL had a higher incidence of tumour invasion associated with the hypopharynx, the palatine and lingual tonsils, as well as the ethmoid and maxillary sinuses. NPNHL also had a higher incidence of extensive and irregular bilateral lymphadenopathy, and lymphadenopathy in the parotid.
Conclusions: NPC more often involved an unsymmetrical tumour with a propensity to invade both widely and deeply into muscle tissue, the fat space, the neural foramen, and the skull base bone. In contrast, NPNHL tended to be a symmetrical and diffuse tumour with a propensity to spread laterally through the fat space and along the mucosa to the tonsils of the oropharynx and hypopharynx. These differences facilitate a differentiation of these diseases using MR images, and enhance our understanding of the biological behavior of these malignant tumours of the nasopharynx.

1. Introduction

Based on the complexities of the human anatomy which include a variety of soft tissues present in the head and neck region, an accurate diagnosis and radiological interpretation of nasopharyngeal tumours remains a challenge. Currently, magnetic resonance imaging (MRI) provides good tissue contrast and multi-planar capability, and therefore, is used to diagnose and provide an initial evaluation of nasopharyngeal tumours.

Nasopharyngeal carcinoma (NPC) is a malignant tumour of epidermoid origin that is very common in Southeast Asia, especially in the southern provinces of China where the yearly incidence rate for NPC varies between 15 and 50 patients per 10^5 people [1]. Malignant lymphoma is the second most common neoplasm of the head and neck after squamous carcinoma, with Waldeyer's ring being the most common extranodal site in the head and neck region. Moreover, primary non-Hodgkin's lymphoma of the nasopharynx represents 18–35% of the Waldeyer's lymphomas diagnosed [2,3]. NPC is a tumour that has a propensity to invade extensively and deeply, and in some cases, tumour spread occurs superiorly into the skull base [4]. In contrast, nasopharyngeal non-Hodgkin's lymphoma (NPNHL) is associated with an absence, or a minimal extent, of tumour invasion. However, when NPNHL invasions do occur, they more often spread along the pharynx into the nasal cavity or tonsils, rather than extending deeply into parapharyngeal structures or infiltrating superiorly into the skull base [5]. Therefore, there are differences between the tumour invasion associated with NPC versus NPNHL tumours. However, to our knowledge, no large scale, systematic review of NPC and NPNHL cases has been undertaken to describe and analyze these differences. Therefore, the aim of this study was to review the features of the primary tumour and distribution of cervical lymphadenopathy associated with NPC and NPNHL cases based on MR imaging, and to determine if there

* Corresponding author at: Medical Imaging and Minimally Invasive Interventional Center, Cancer Center, SunYat-sen University, 651, Dongfeng Road East, Guangzhou 510060, China. Tel.: +86 20 87343272; fax: +86 20 87343272.
E-mail address: wuph@sysucc.org.cn (P.-h. Wu).
[1] These two authors contributed equally to this work.

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Table 1
Parameters of the MR sequences obtained.

Sequences obtained	Scanning method	TR (ms)	TE (ms)	Ex.	FOV (cm)	Matrix
Non-contrast T1WI in axial, coronal, and sagittal planes	FSE	420–450	Min full	2	22	320 × 224
Non-contrast T2WI in axial plane	FSE	3200–3500	85	2	22	320 × 224
Contrast-enhanced T1WI in axial and sagittal planes	SE	320–350	Min full	1	22	512 × 224
Contrast-enhanced T1WI in coronal plane	SE + FS	320–350	Min full	1	22	512 × 224

Abbreviations: TR: repetition time; TE: echo time; Ex.: excitations; FOV: field-of-view; FSE: fast spin-echo; SE: spin-echo; FS: fat suppression.

are differences that can help differentiate these tumours and their biology.

2. Materials and methods

2.1. Patients

Between June 2003 and October 2005, 272 consecutive patients with NPC were diagnosed at the Sun-Yat Sen University Cancer Center, and were selected for the present study. Similarly, 118 consecutive patients with NPNHL diagnosed between May 2003 and September 2009 were selected for the present study. For both groups of patients, criteria for inclusion included: (1) previously untreated, histologically proven disease of the nasopharynx, (2) no history of prior head and neck cancer, and (3) an absence of a synchronous second primary tumour in the upper aerodigestive tract, lung, and esophagus.

This study was conducted with the approval of the Institutional Review Broad of our hospital. As a retrospective study, patients did not receive any other treatment than conventional management, and written informed consent was not needed from the enrolled subjects.

All patients had MRI scans of the nasopharynx and neck obtained before treatment. A diagnosis of NPC or NHL was made based on histological examinations of biopsy specimens collected from the nasopharyngeal primary tumours. All patients with NPC were staged according to the 2002 American Joint Committee on Cancer (AJCC) staging system, while all patients with NPNHL were staged according to the Ann Arbor system with modification for extranodal lymphoma. The intact clinical materials and imaging files of these patients were collected and retrospectively reviewed.

2.2. Imaging protocol

All MRI examinations were performed using a 1.5-Tesla unit (Signa, General Electric, CV/i) with a head and neck combined coil. For all patients, the following seven sequences were obtained: non-contrast-enhanced T1-weighted images (T1WI) in axial, coronal, and sagittal planes, non-contrast-enhanced T2-weighted images (T2WI) in the axial plane, contrast-enhanced T1WI in axial and sagittal planes, and contrast-enhanced, fat-suppressed T1WI in the coronal plane. The parameters of these sequences are listed in Table 1. A 0.1 mmol/kg body weight bolus injection of gadopentate dimeglumine was administered for contrast-enhanced sequences.

2.3. Image assessment

Two experienced radiologists, who were blinded to the final pathological diagnosis and did not participate in the selection or management of the enrolled patients, evaluated the MR images independently. Any disagreements were resolved by consensus. All MR images were viewed on a picture archiving and communication system workstation monitor (Centricity RA1000 Workstation V.3.0, GE Healthcare).

MRI features of primary tumours that were evaluated included: tumour distribution (symmetrical and diffuse involvement of all walls, or unsymmetrical involvement of one or several walls), signal intensity (compared with adjacent muscles), lesion texture (homogeneous or heterogeneous), and contrast enhancement patterns (homogeneous or heterogeneous; poor, moderate, and intense). In the latter case, poor enhancement was described if the degree of enhancement was similar to that of skeletal muscle, moderate if the degree of enhancement was greater than that of skeletal muscle, and intense if the degree of enhancement was similar to mucosa.

Tumour invasion of regional structures included involvement of the nasal cavity, paranasal sinus, oropharynx, laryngopharynx, lingual tonsil, palatine tonsils, parapharyngeal muscles, parapharyngeal fat space, skull base bone, neural foramen, and intracranial infiltration. Nasal involvement was defined as tumour involvement beyond the posterior line of the posterior wall of maxillary sinus. Oropharynx involvement was defined as tumour involvement below C1/C2 [4,6]. Tumour detection below the lower margin of C3, or the free edge of the epiglottis, was regarded as laryngopharynx involvement [7]. Parapharyngeal involvement was defined as posterolateral infiltration of tumour beyond the pharyngobasilar fascia [4,8]. Skull-base invasion was defined as the presence of low-intensity tissue in the high signal bone marrow on non-contrast T1WI images, and with enhancement on contrast-enhanced T1WI.

Cervical lymphadenopathy was subdivided according to the specific anatomic subsites involved, and assignment of level was predicated on imaging-based delineation of cervical lymph nodes [9,10]. A diagnosis of nodal involvement was made radiologically based on one or more of the following criteria: central necrosis, extracapsular neoplastic spread (ENS), and size criteria. Central necrosis was demonstrated by a focal area of high T2 signal intensity, or a focal area of low T1 signal intensity, with or without a surrounding rim of enhancement, on MR images [11]. ENS was demonstrated by the presence of indistinct nodal margins, irregular nodal capsular enhancement, or tumour infiltration into adjacent fat or muscle [12,13]. Size criteria was defined by the shortest axial diameter equal or greater than 5 mm in the retropharyngeal region, 11 mm in the jugulodigastric region, and 10 mm in all other regions of the neck, or when a group of three or more nodes that were borderline in size were present in all cervical regions [14,15].

2.4. Statistical analysis

A computerized database was assembled to include patients' characteristics and radiologic information. Data are presented as the mean ± standard deviation (SD) and *n* (%). Differences between patients with NPC and NPNHL were analyzed using Pearson's chi-square test or Fisher's exact test. All statistical analyses were carried out using SPSS version 11.0, and $P < 0.05$ was considerate statistically significant.

3. Results

3.1. Patients

A total of 272 patients with NPC were included in this study, and their mean age was 45.26 ± 11.36 years. These patients were predominantly male (76.47%), and the histopathological types