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CLINICAL INVESTIGATION **Head and Neck**

MAGNETIC RESONANCE IMAGING OF RETROPHARYNGEAL LYMPH NODE METASTASIS IN NASOPHARYNGEAL CARCINOMA: PATTERNS OF SPREAD

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Purpose: To investigate the incidence, distribution, and spread pattern of retropharyngeal lymph node (RLN) involvement in patients with nasopharyngeal carcinoma (NPC) by using magnetic resonance imaging (MRI).

Methods and Materials: The MR images of 275 patients with newly diagnosed NPC were reviewed retrospectively. Nodes were classified as metastatic based on size criteria, the presence of nodal necrosis, and extracapsular spread.

Results: Retropharyngeal lymph node involvement was detected in 175 (63.6%) patients. Metastatic RLNs were seen at the following levels: occipital bone, 24 (9.6%) nodes; C1, 157 (62.5%) nodes; C1/2, 40 (15.9%) nodes; C2, 27 (10.8%) nodes; C2/3, 1 (0.4%) node; and C3, 2 (0.8%) nodes. The incidence of RLN involvement was equal to the incidence of cervical lymph node involvement (81.4% vs. 81.4%) in 215 patients with nodal metastases. A significantly higher incidence of metastatic RLNs was observed in the presence of oropharynx, prestyloid parapharyngeal space, post-styloid parapharyngeal space, longus colli muscle, medial pterygoid muscle, levator muscle of velum palatini, tensor muscle of velum palatini, Level II node, Level III node, and Level V node involvement. A significantly lower incidence of metastatic RLNs was found in T1, N0, and Stage I disease. Conversely, no significant difference in the incidence of metastatic RLNs was observed between T1, 2, and, 3; N2 and N3; or Stage II, III, and IV disease.

Conclusions: There is an orderly decrease in the incidence of metastatic lateral RLNs from the C1 to C3 level. Metastatic RLNs associate well with involvement of certain structures in early stage primary tumors and lymph node metastases of the upper jugular chain (Level II, Level III nodes) and the posterior triangle (Level V nodes). Both RLNs and cervical Level II nodes appear to be the first-echelon nodes in NPC. © 2006 Elsevier Inc.

Cervical lymph nodes, Magnetic resonance imaging, Nasopharyngeal carcinoma, Retropharyngeal lymph nodes.

INTRODUCTION

Although it is rare in other parts of world, nasopharyngeal carcinoma (NPC) is endemic in Southeast Asia, especially in the southern provinces of China (1). Retropharyngeal lymph nodes (RLNs) are divided into medial and lateral groups (2). The lateral nodes lie lateral to the pharyngeal constrictors and medial to the internal carotid artery. The medial group lies along or near the midline, directly posterior to the upper pharynx. RLNs are not amenable to evaluation using manual palpation. Consequently, the diagnosis of enlarged RLNs in patients with NPC is made on the basis of imaging examinations. Computed tomography (CT) or magnetic resonance imaging (MRI) can precisely determine the size and gross morphology of RLNs. Because the difference in signal intensity between the primary tumor and lymph nodes in MRI aids in the differentiation of an enlarged lymph node from a tumor extension into the retropharyngeal space, the MRI appears to be a better option than CT for RLN identification (3–5). CT is also inferior to MRI in distinguishing multiple ipsilateral RLNs.

Despite a high incidence of involvement of RLNs in NPC, their prognostic significance has not been resolved (6, 7, 8), and the recommendations in published staging systems that pertain to RLN involvement are ambiguous (9, 10). Data describing RLN spread patterns based on radiographic observations will provide critical guidance for further research on prognostic significance and staging categories. The relationship between metastatic RLNs and primary tumor extensions and cervical nodal metastases is useful for clarification of the patterns of lymphatic drainage and nodal

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metastases in NPC, but has not yet been thoroughly investigated. Chua *et al.* (6) observed a higher incidence of enlarged RLNs associated with oropharyngeal, paranasopharyngeal, nasal, and cervical lymph node involvement. Lam *et al.* (11) found a statistical association between metastatic RLNs and Level II node involvement, but not with other groups of neck nodes. Apart from these two articles, there is little published information concerning the relationship between metastatic RLNs and tumor extensions in NPC. Also, there is no consensus on whether RLNs are the first echelon nodes. RLNs had been regarded as the first echelon nodes of the NPC (12, 13). But according to the study of Shu-Hang Ng *et al.* (14), RLNs are less frequently involved than cervical nodes.

The aim of our study was to evaluate the incidence and distribution of metastatic RLNs, and to examine their relationship to primary tumor extension and cervical lymphadenopathy in NPC to document the patterns of RLN spread by using MRI.

METHODS AND MATERIALS

Patients

Between July 2003 and January 2005, 275 consecutive patients with newly diagnosed, untreated NPC were entered into our study. All patients had a pretreatment evaluation that consisted of a complete history, physical examination, hematology and biochemistry profiles, MRI scan of the neck and nasopharynx, chest radiography, abdominal sonography, and whole-body bone scan (T3 disease, low cervical metastasis, or lymph node size >3 cm). Medical records and imaging studies were reviewed, and all patients were staged according to the 2002 American Joint Committee on Cancer (AJCC) staging system. The characteristics of these patients are presented in Table 1.

Imaging protocol

All patients underwent MRI with a 1.5-T system (Signa, General Electric, CV/i; General Electric Healthcare, Chalfont St. Giles, United Kingdom). The area from the suprasellar cistern to the inferior margin of the sternal end of clavicle was examined with a head-and-neck combined coil. T1-weighted fast spin-echo images in the axial, coronal, and sagittal planes (repetition time of 500–600 ms and echo time of 10–20 ms), and T2-weighted fast spin-echo MR images in the axial plane (repetition time of 4000–6000 ms and echo time of 95–110 ms) were obtained before injection of contrast material. After intravenous Gd-DTPA injection at a dose of 0.1 mmol/kg of body weight, spin-echo T1-weighted axial and sagittal sequences, and spin-echo T1-weighted fat-suppressed coronal sequences were performed sequentially, with parameters similar to those used before Gd-DTPA injection. Section thickness was 5 mm with a 1-mm interslice gap for the axial plane, and 6 mm with a 1-mm interslice gap for the coronal and sagittal planes.

Table 1. Characteristics of 275 patients with nasopharyngeal carcinoma

Characteristics	Number of patients (%)
Age (years)	
<40	86 (31.3)
40 or older	189 (68.7)
Gender	
Male	210 (76.4)
Female	65 (24.6)
Pathologic feature (World Health Organization)	
Type 1	3 (1.1)
Type 2	28 (10.2)
Type 3	244 (88.7)

Note: Numbers in parentheses are percentages.

Image assessment

Two experienced radiologists separately evaluated the MR images. Any disagreements were resolved by consensus. The RLN assessment included the medial and lateral chains. RLNs were identified by separating them from the primary tumor. Lymph nodes that were contiguous with the primary tumor were clearly identified by a contrast-enhancing rim or a difference in signal intensity compared with the primary tumor. The minimal and maximal axial (perpendicular to the course of the internal jugular vein) diameters and the longitudinal diameter of each visible RLN were measured. The minimal axial diameter corresponded to the widest diameter of the node in the axial plane that was perpendicular to the maximal axial diameter. The longitudinal diameter paralleled the internal jugular vein. Axial diameter measurements were made on T2-weighted axial planes, and longitudinal diameter measurements were made on unenhanced T1-weighted coronal images. The locations of the longitudinal center of all RLNs were also recorded according to the level of the cervical vertebral body and disk space. The cervical nodes were subdivided into specific anatomic subsites, and level assignment was predicated on the imaging based nodal classification (15).

Nodes were considered to be metastatic in the presence of necrosis or extracapsular spread (11, 12, 14, 16). The lateral RLNs were considered metastatic if their shortest axial diameter was ≥5 mm, and any visible node in the median retropharyngeal group was considered malignant (12). The cervical nodes were also considered metastatic if their shortest axial diameter was ≥11 mm in the jugulodigastric region, ≥10 mm in other cervical regions, or if there was a group of three or more nodes that were borderline in size (16). A criterion for the diagnosis of central necrosis on MRI was a focal area of high signal intensity on T2-weighted images or a focal area of low signal intensity on T1-weighted images with or without a surrounding rim of enhancement (17).

Statistical analysis

All statistical analyses were performed using the Statistical Package for the Social Sciences, version 10.0 software. The chi-square test was used to analyze the relationship between metastatic RLNs and the extent of primary tumor and cervical lymph node metastases. A two-tailed p value of <0.05 was considered statistically significant in all cases.

RESULTS

Incidence and distribution of RLNs

Based on the criteria of RLN involvement, RLNs were classified as either positive or negative. MRI revealed 468 RLNs in 239 (86.9%) patients. Of the 468 identifiable RLNs, 217 (46.6%) nodes were classified as negative, whereas 251 positive RLNs were present in 175 (63.6%)