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Role of diffusion weighted MR in the discrimination diagnosis of the cystic and/or necrotic head and neck lesions

Osman Koç [a], Yahya Paksoy [a,*], İbrahim Erayman [b], Ali Sami Kivrak [a], Hamdi Arbag [c]

[a] *Selcuk University, Meram Faculty of Medicine, Department of Radiology, Konya 42080, Turkey*
[b] *Selcuk University, Meram Faculty of Medicine, Department of Infectious Disease, Konya, Turkey*
[c] *Selcuk University, Meram Faculty of Medicine, Department of Otolaryngology-Head and Neck Surgery, Konya, Turkey*

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Abstract

Purpose: The purpose was to determine whether the diffusion weighted imaging (DWI) was able to differentiate necrotic tumor or metastatic lesions from infected necrotic lesions such as abscesses and necrotic lymphadenitis in the neck.
Materials and methods: DWI was performed on 37 consecutive patients with 85 head and neck necrotic and cystic lesions. The lesions were classified into four categories: metastatic lymph node involvement including lymphoma, necrotic tumor, abscesses and necrotic lymphadenitis. Each lesion was histopathologically studied and proved.
Results: In 12 patients, there were 35 necrotic lymphadenitis (necrotic tuberculosis lymphadenitis, $n = 18$; necrotic nonspecific suppurative lymphadenitis, $n = 17$). Of the 15 necrotic metastatic nodes, 11 lesions were lymphomatous involvement and 4 lesions were other tumor involvement. Other 11 patients have abscesses. Thirteen primary tumoral necrotic lesions arose in the neck of nine patients. All of the abscesses and necrotic lympadenitis showed hyperintensity on DWI, in contrast to necrotic tumor and necrotic nodal metastasis that showed hypointensity on DWI. DWI successfully differentiated metastatic nodes and necrotic tumors from necrotic lymphadenitis and abscesses.
Conclusion: DWI may be supportive for differentiating necrotic tumor lesions such as necrotic tumor and metastatic necrotic nodes from the infective necrotic lesions such as necrotic lymphadenitis and abscesses in the head and neck.
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Keywords: Diffusion weighted imaging; MRI; Head-neck; Necrotic lesion

1. Introduction

Enlarged necrotic nodes in the neck are usually associated with inflammatory or neoplastic diseases. The distinction between these two entities is critical in the treatment of patients. The recognition of the involvement of nodes with tumors will definitely affect the decision about the treatment of patients. Sometimes necrotic lymphadenitis can simulate necrotic metastatic node. Therefore, accurate preoperative evaluation of the presence or absence of nodal disease is essential. Magnetic resonance (MR) provides information comparable to that of computed tomography (CT) regarding the presence and size of nodes [1]. Attempts at characterizing nodes using signal intensity have been unsuccessful [2].

Lymph node size is one of the most frequently used criteria for differentiating metastatic from nonmetastatic (benign reactive) nodes in the neck. Furthermore, in CT and sonography, internal architectural evaluation was found to be beneficial for the detection of metastatic nodes [3]. In MR imaging, the use of conventional imaging sequences does not seem to significantly exceed that of CT [4]. However, the use of specific techniques, such as diffusion weighted imaging (DWI) [5] and magnetization transfer imaging [6], may improve the performance of MR imaging in identifying metastatic nodes in the neck [3].

DWI is a useful technique for evaluating the diffusion properties of the water molecules in tissues and has been used extensively to study brain infarctions, tumors, epilepsy, and white matter lesions [7,8]. Diffusion hyperintensity has been previously reported in intracerebral abscesses, with high sensitivity and specificity [9]. Although DWI has been applied to studying different head and neck lesions [9], up to now to our knowledge, there has been no report of DWI findings in the differentiation of the necrotic lesions of the head and neck region.

* Corresponding author. Tel.: +90 332 2236452; fax: +90 332 2236181.
E-mail address: yahyapaksoy@yahoo.com (Y. Paksoy).

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The purpose of this study was to determine whether DWI could differentiate between necrotic tumor and metastatic lesions (especially necrotic metastatic lymph nodes) from the infected necrotic lesions (abscesses and necrotic lymphadenitis) in the head and neck.

2. Materials and methods

MR imaging was performed on consecutive patients with head and neck necrotic and cystic lesions. We first performed T1- and T2-weighted imaging and then DWI on these consecutive patients. Patients with poor quality MR studies (due to low signal to noise ratios, or due to artefacts) were excluded from this study. We excluded patients who had fine needle aspirations. Because; there were susceptibility artifacts in these lesions due to intra-lesional blood products and fine needle tract. We also excluded benign non-complicated cystic lesion such as congenital cysts easily diagnosed with conventional MR sequences. Lymph nodes without necrosis were not included the study. We considered the necrosis as an area showing bright signals in T2-weighted images but does not show contrast enhancement. Thus, the population comprised 37 patients (20 female and 17 male) between 8 and 74 years of age (mean 45 ± 19) with 85 head and neck lesions. Thirty-five lesions (12 patients) were due to necrotic lymphadenitis and 15 necrotic lesions (5 patients) were due to metastatic lymph nodes. Twenty-two lesions (11 patients) were abscesses and 13 lesions (9 patients) were necrotic tumors (Table 1). One of the patients with a tumor, the mass had three separate necrotic areas, and in two patients, the mass had two separate necrotic areas. Each necrotic area was counted separately. Consequently, we imaged 15 metastatic nodes, and 35 necrotic lymphadenitis in the head and neck. All these lesions were surgically removed or underwent biopsy except abscess and nonspecific purulent lymphadenitis, because we treated them medically or with drainage. Each lesion was histopathologically studied and proved except abscess and nonspecific purulent lymphadenitis. We surgically removed the lymph nodes, which are infected with tuberculosis, because they did not recover with nonspecific antibacterial therapy and we established the correct diagnosis only with surgical resection and biopsy. The benign lymphadenopathic lesions were imaged because of the presence of some features very suggestive of malignancy, such as large size and necrosis. We obtained consent from the participants.

Table 1
Patient characteristics

Characteristic	Value
Age (year)	
Mean	45 ± 19
Range	8–74
No. of patients	37
Sex	
No. of females	20
No. of males	17
No. of necrotic lesions	
Lymph node	50 (17)
Abscess	22 (11)
Tumor	13 (9)
Total	85 (37)
Sizes of the necrosis	
Necrotic lymphadenitis 0	0.5–4 cm (mean, 1.5 ± 0.66)
Metastatic necrotic nodes	1–4 cm (mean, 2.2 ± 0.91)
Abscess	1–4 cm (mean, 2.45 ± 0.84)
Tumor	1–7.5 cm (mean, 2.88 ± 1.78)

Note: Numbers in parentheses are number of patients.

In patients with multiple necrotic lesions of the same histological diagnosis, each lesion was included and counted separately. Therefore, in this study statistical analysis was based on the number of lesions rather than on the number of patients.

Axial T1-weighted images (TR/TE/excitations 400 or 550/14/2 or 3) of the neck were obtained with a 1.5-T MR imager (Magnetom Vision Plus, Siemens, Erlangen, Germany) by using a conventional spin echo sequence and a neck coil. Axial, with or without fat suppression, T2-weighted (3000–3400/104/2) images were obtained by using a fast spin-echo sequence. Gadolinium-enhanced T1-weighted (400 or 550/14/2 or 3) images were obtained by using a conventional spin-echo sequence. We injected 0.1 mmol/kg of an extracellular contrast agent inravenously. For all of these sequences, the section thickness was 4–6 mm. MR imaging was performed with a matrix of 256×224, field of view of 24–24 or 20–20 cm, and an intersection gap of 1 mm. When necessary, one or more pulses of T1- or T2-weighted sequences were added in the coronal or sagittal plane, with the same pulse sequence parameters. Axial DWI of the neck was obtained with a neck coil. The section thickness was 4–6 mm. DWI was performed with a matrix of 96×128, field of view of 230, and an intersection gap of 0.3 mm described TR 4000, TE 110. DWIs were obtained in the axial plane using echo-planar spin-echo pulse sequence with three b values (0, 500, 1000 s/mm^2). The ADC map was also obtained. The sequence labeled as "0–500–1000-ADC" automatically provides ADC maps. On visual inspection, the signal intensities of the lesions on DWI and the ADC map were interpreted according to the brain parenchyma (that is, we used brain parenchyma as a reference) and defined as "low", "same" or "high" compared with normal brain parenchyma. Regions of interest were defined with visual inspection on ADC maps without ADC value measurements.

Because biopsy was performed with reference of MR images and reports, it was not difficult to identify the nodes for biopsy. We classified the lesions into four categories: metastatic lymph node lesions including lymphoma, necrotic tumor, abscess and necrotic lymphadenitis. MR images were presented to two radiologists who were experienced in MR imaging. Sensitivity, specificity, positive and negative predictive values for abnormal signal intensity in the lesions and their ADCs maps and DWI evaluated qualitatively.

3. Results

Of the 35 necrotic lymphadenitis in 12 patients, 18 lesions (in 6 patients) were necrotic tuberculosis lymphadenitis, 17

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