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ORIGINAL ARTICLE

Apparent diffusion coefficient measurements in the differentiation between benign and malignant neck masses

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KEYWORDS

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Abstract *Aim:* Evaluate the role of ADC value measurements in the differentiation between benign and malignant neck masses.
Methods: From April 2011 to February 2013, prospective study was conducted on 30 patients (17 male and 13 female), with the mean age 43.3 ± 6 years. Collected from wards and clinics of General Surgery and Otolaryngology Departments complaining from neck masses. MRI, Diffusion-Weighted Imaging (*b* value 0, 100, 500 and 1000 s/mm) and ADC value calculation were performed and the results were correlated with histopathological results and/or follow up.
Results: The present study include 30 patients (Lymphadenopathy {(n = 15) (11 as single entity), (4 associated with other entities)}, Focal thyroid swelling (n = 5), Salivary gland masses (n = 3) {Parotitis (1 case), Parotid carcinoma (2 cases)}, Nasopharyngeal masses (n = 5), Oropharyngeal masses (n = 2), Ludwig angina (n = 2) and Laryngeal masses (n = 2).
The mean ADC of the malignant neck masses was ($0.699 + 0.267 \times 10^{-3}$ mm^2/s) while that of the benign masses was ($1.879 + 0.751 \times 10^{-3}$ mm^2/s).

Abbreviations: MRI, magnetic resonance imaging; ADC, apparent diffusion coefficient; NPC, nasopharyngeal carcinoma; PPV, positive predictive value; NPV, negative predictive value; DWI, diffusion weighted imaging; TE, echo time; TR, repetition time

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The results confirmed by biopsy in 23 cases and follow up (7 cases).
The sensitivity, specificity, PPV, NPV and overall accuracy of quantitative diffusion WI in differentiating benign from malignant neck masses were 95.4%, 83.3%, 95.4%, 83%, and 92%.
Conclusion: ADC value calculation are promising noninvasive imaging approach that can be used in distinguishing between benign and malignant neck masses. Benign lesions have higher mean ADC values than malignant lesions, the cutoff value was 1.25×10^{-3} mm^2/s while 0.8×10^{-3} mm^2/s in thyroid lesions.

1. Introduction

Head and neck masses are a common clinical concern in different age groups. The differential diagnosis for a head or neck mass across these age groups is broad and includes congenital, inflammatory, and neoplastic lesions (1).

Conventional MRI and CT continue to be the primary imaging modalities for evaluating head and neck cancers. However, both of these modalities rely on volumetric and morphological criteria and consequently suffer from low sensitivity and accuracy when making the diagnosis (2,3).

DWI and apparent diffusion coefficient (ADC) measurements are being considered as potentially useful in the evaluation and characterization of head and neck lesions (4).

Diffusion-Weighted Imaging (DWI) plays an important role in the diagnosis, prognosis and monitoring of treatment response in tumors arising in the head and neck region (5,6). It is able to distinguish between the viable and necrotic portions of head and neck tumors. Also, DWI is indicated for characterizing lesions in children avoiding the use of contrast (7).

The apparent diffusion coefficient (ADC) value, determined from DWI, can help in cancer staging and detection of subcentimeter nodal metastasis. The ADC value also discriminates carcinomas from lymphomas, benign lesions from malignant tumors and tumor necrosis from abscesses (8,9).

Moreover, differentiation between the different subtypes of squamous cell carcinoma (SCC) is possible using ADC measurements (10). Low pretreatment ADC values typically predict a favorable response to chemoradiation therapy (6).

Furthermore, Diffusion-Weighted Imaging is a very useful tool in the distinction between irradiation effects and recurrent tumor (11). It is probably the best imaging technique for nodal staging and the presence or absence of distant metastatic nodes in the head and neck region, and is able to accurately differentiate benign and malignant lymph nodes (6).

The aim of this work is to evaluate the role of ADC value measurements in the differentiation between benign and malignant neck masses.

2. Materials and methods

Research Ethics Committee (REC) approval and written informed consent were obtained.

From April 2011 to February 2013, a prospective study was conducted on 30 patients (17 male and 13 female), age range from 12 years to 78 years with the mean age 43.3 + 6 years. Collected from wards and clinics of General Surgery and Otolaryngology Departments complaining from neck masses. Conventional MRI and Diffusion-Weighted Imaging (*b* value 0, 100, 500 and 1000 s/mm) were performed and the results were correlated with histopathological results (23 cases) and follow up in 7 cases.

2.1. MR examination

2.1.1. Patient positioning

All MR examinations were done with the patient in the supine position and immobilized in a comfortable position using surface head and neck coil from the skull base up to the thoracic inlet.

All MR images were performed with 1.5-T MRI system (Signa; GE Medical Systems,) in the MRI unit of the Radiodiagnosis and Imaging Department.

For all patients, the imaging protocol consisted of using fast spin echo pulse sequences with different repetition time (TR) and echo delay time (TE) to obtain T1 and T2 WI as follow:

A scout T1 WI sagittal view to verify the precise position of lesion.

The routine imaging studies included MRI. Routine spin echo (SE) T2 (TR/TE 2200/80) and T1 weighted (TR/TE = 660/15) images were obtained in the axial coronal and sagittal planes, contrast material (Gadopentetate Dimeglumine diethylenetriamine penta-acetic acid (Gd DPTA)) (Magnevist) injected IV (18 cases) with a dose of (0.1 mmol/kg).

The imaging data were reviewed by two radiologists with no knowledge of the primary lesion; they reached a consensus opinion before reviewing the pathology results. The lesion contour, size, intensity, extensions and pattern of enhancement were recorded.

3. Diffusion-Weighted Imaging and apparent diffusion coefficient mapping

Diffusion-Weighted Imaging was performed in the transverse plane by using an SE echo-planar imaging sequence with the following parameters: TR/TE/TI (inversion time), 12,000/95/2200 ms; diffusion gradient encoding in three orthogonal directions; *b* values were 0, 100, 500, 1000 s/mm; FOV, 24×24 cm; matrix size, 128×256 pixels; section thickness, 5 mm; section gap, 2.5 mm. An ADC map was obtained. In quantitative study, an imaging slice was chosen, multiple (1 to 2 cm) circular region of interest (23 cases) or one large ROI (7 cases) (according to the size and heterogeneity of the mass) were located on the lesions detected as well as the normal part or contralateral side if present, ROIs were not positioned in the cystic or necrotic portion identified on the T2-weighted images and the contrast enhanced T1-weighted images because this