The Egyptian Journal of Radiology and Nuclear Medicine 49 (2018) 358–367

Contents lists available at ScienceDirect

The Egyptian Journal of Radiology and Nuclear Medicine

journal homepage: www.elsevier.com/locate/ejrnm

Original Article

The diagnostic efficacy of apparent diffusion coefficient value and Choline/Creatine ratio in differentiation between parotid gland tumors

Mai E.M. Khamis[a,*], Ayman F. Ahmed[a], Eman I. Ismail[b], Mohamed F. Bayomy[b], Mohammad W. El-Anwar[c]

[a] Radiodiagnosis Department, Faculty of Medicine, Zagazig University, Egypt
[b] Clinical Oncology and Nuclear Medicine Department, Faculty of Medicine, Zagazig University, Egypt
[c] Otorhinolaryngology, Head and Neck Surgery Department, Faculty of Medicine, Zagazig University, Egypt

ARTICLE INFO

Keywords:
Parotid
ADC
Cho/Cr
Warthin tumor
Pleomorphic adenoma

ABSTRACT

Objective: To detect the diagnostic performance of apparent diffusion coefficient (ADC) value and Cho/Cr ratio in distinguishing various pathological subtypes of parotid gland tumors.
Patients and Methods: This study included 30 patients (14 males and 16 females; age ranged from 25 to 70 years; mean age 50 ± 12.5 years) with 31 parotid gland masses. Diffusion weighted imaging and MR spectroscopy were performed in all patients. ADC values and Cho/Cr ratios were measured for each parotid mass and compared with pathology. The diagnostic performance of ADC value, Cho/Cr ratio, ADC + Cho/Cr ratio and ADC × Cho/Cr ratio for differentiating pathological subtypes were assessed.
Results: Pleomorphic adenomas had highest ADC values and Warthin tumors had highest Cho/Cr ratios. ADC value had the best diagnostic performance in differentiating pleomorphic adenomas from Warthin tumors by using cutoff value $1.12 \times 10^{-3}\,mm^2/sec$ with sensitivity, specificity, PPV, NPV and accuracy 100% for each. ADC value × Cho/Cr ratio had the best diagnostic performance in differentiating malignant from benign tumors, malignant tumors from pleomorphic adenoma and malignant from Warthin's tumors by using cutoff value 2.37 at which sensitivity, specificity, PPV, NPV and accuracy all were 100%. Conclusion: ADC value and Cho/Cr ratio are useful in differentiating different pathological subtypes of parotid tumors.

1. Introduction

Salivary gland neoplasms form 2 to 5% of head and neck tumors [1] and are very diverse in terms of histopathology and these make them a great challenge for diagnosis, treatment and prognosis for radiologists and clinicians [2].

Nearly 80% of these tumors found in the parotid glands. It should be noted that the majority of parotid tumors are benign (mostly pleomorphic adenoma) [3].

The pre-operative data on whether a salivary gland tumor is malignant or benign could be useful in establishment of the policy of lymph node management, avoiding surgery for inflammatory disease, preventing late treatment for malignant cases and giving the patient more appropriate information regarding the risk of facial nerve injury and the possible treatment choices [4].

Although Fine needle aspiration cytology (FNAC) is a common method to acquire information from a tumor for the clinician before any treatment planning, there are some limitations, as it is an invasive method, shows sampling errors; it is not always conclusive; there may be a selection bias and FNAC cannot be performed in all cases as when the tumor is located in the deep lobe. Therefore, pre-operative planning, imaging has an essential role [2,5].

As the first step of diagnostic imaging procedure, US may be applied for the detection of masses that are located in superficial parotid lobe but for diagnosis of deep lobe masses, CT and MRI could be used [6].

MRI has a good ability to differentiate various soft tissue types due to its super spatial resolution. Furthermore, MRI is a non-invasive method without radiation hazards. Nonetheless, detection of tumor grading is difficult with conventional MRI [7].

In recent years, functional MR imaging techniques as dynamic contrast enhanced (DCE) MRI, diffusion-weighted imaging (DWI) and MR spectroscopy have significantly contributed to the head and neck neoplasms diagnosis [8–10]. Dynamic susceptibility contrast perfusion-weighted MR had been recently used in differentiating malignant from

Peer review under responsibility of The Egyptian Society of Radiology and Nuclear Medicine.
* Corresponding author.
E-mail addresses: maikhamis2@yahoo.com (M.E.M. Khamis), Ayman_fathy720@yahoo.com (A.F. Ahmed), Emy_21167@yahoo.com (E.I. Ismail), Mohamed_fathy29121981@yahoo.com (M.F. Bayomy), mwenteg1973@gmail.com (M.W. El-Anwar).

https://doi.org/10.1016/j.ejrnm.2018.02.004
Received 24 December 2017; Accepted 16 February 2018
Available online 04 May 2018

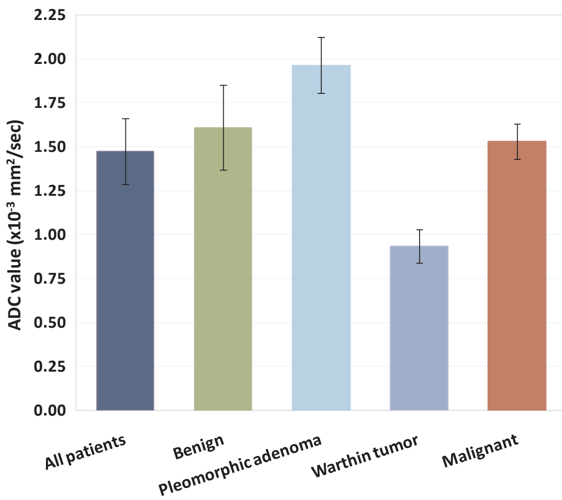

Fig. 1. Error Bar chart shows relation between histopathological diagnosis and ADC value ($\times 10^{-3}$ mm^2/sec); bar represent mean, Y-error bar represent 95% confidence interval of mean.

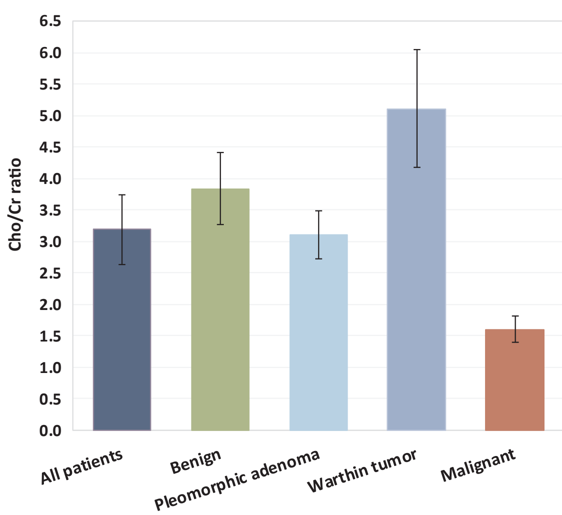

Fig. 2. Error Bar chart shows relation between histopathological diagnosis and Cho/Cr ratio; bar represent mean, Y-error bar represent 95% confidence interval of mean.

benign parotid tumors with accuracy of 91.7%. [11].

DWI depends on assessing the rate of microscopic water diffusion within tissue. The DW-MR images are quantified by an apparent diffusion coefficient (ADC), which integrates both perfusion and diffusion [12].

Results of previous studies comparing the ADC value and histopathological finding suggest that more cellularity is associated with more restricted diffusion. It has been reported that DWI is useful in characterizing head and neck tumors, and that malignant tumors has lower ADC than benign tumors [13,14].

MR spectroscopy has an effective role in oncology, including detection of tumors and its grading as well as predicting response to treatment. The first step in this process depending on identification of specific spectra associated with each cancer [15].

Typical spectral patterns for active tumor tissue include an increase in the total choline (Cho) peak relative to creatine (Cr), often in the presence of other metabolites, including lactate (Lac). The finding of higher Choline levels indicates a high cellular membrane turnover in tumors [16,17].

MR spectroscopy improving the characterization of salivary gland tumor at the same time that conventional MR imaging is done [18–20]. It has been used for differentiation of squamous cell carcinoma from normal tissue [21].

This work aimed to detect the diagnostic performance of ADC value obtained from DW MRI and Cho/Cr ratio obtained from MR spectroscopy in differentiation between various pathological subtypes of parotid gland tumors.

2. Patients and methods

2.1. Patients

This prospective study included 30 patients (16 females and 14 males; aged 25–70 years; mean age was 50 ± 12.5 years) with 31 parotid gland masses either detected by clinical examination or by ultrasonography in the time from January 2016 to April 2017.

The institutional review board of our hospital approved our study and informed consent was assigned by all included patients.

Patients with previous FNAC, patients with tumor size less than 1 cm and patients with contraindication to MRI examination were excluded from our study.

2.2. .Methods

All MRI examinations were performed by 1.5 T MRI system (Achieva, Philips Medical Systems) using the head coil. In 21 cases, normal parotid glands were examined as control.

2.2.1. Diffusion-weighted imaging and ADC map

In the transverse plane, DWI was performed utilizing a diffusion sensitive gradient SE echo-planar imaging sequences on 3 orthogonal directions (X-Y-Z) with different b values (0, 500 and 1000 s/mm^2) using the following technical parameters (repetition time: 12,000 ms, echo time: 95 ms, inversion time: 2200 ms, FOV: 230 mm, matrix: 128 × 256, section thickness: 5 mm).

The ADC maps relating to isotropic images of 500 & 1000 s/mm^2 b value were obtained by equipment automatically and ADC value of each parotid mass was measured from these maps using a circular (1–2 cm) region of interest (ROI).

2.2.2. MR spectroscopy

MRS was done by single voxel short echo (TE 35 ms) point-resolved spectroscopy. The area of interest was the parotid gland.

Optimal water resonance suppression was achieved.

The parameters used were 1500/135, 192 acquisitions, 2048 data points and a spectral width of 2500 Hz for all patients. For each sequence, the acquisition time was 7 min 54 s.

On the workstation, MRS data were processed by the spectroscopic analysis package. The main metabolites resonances were quantified: the Cr peak at 3.02 ppm, the Cho peak at 3.20 ppm, and the Lac doublet at 1.33 ppm.

The ratio of Cho/Cr was measured in cases with detected choline.

2.3. Statistical analysis

Continuous variables were checked for normality by Shapiro-Wilk test. T test was utilized for comparison between 2 groups. One Way ANOVA test was used to compare between more than 2 groups. Percent of categorical variables were compared using Chi square test or Fisher