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Role of MR spectroscopy and diffusion-weighted imaging in diagnosis of orbital masses

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ABSTRACT

Purpose: To assess the value of (MRI), (DWI) and (MRS) in the diagnosis of different orbital masses and differentiation between benign and malignant masses.

Patients and methods: Sixty patients were enrolled in this study (31 females, 29 males, their ages ranged from 3 month to 75 years with mean age of 35.3 years). Clinical examination, (T1WI&T2WI) MRI and postcontrast T1WI, DWI, and MR Spectroscopy were done in all cases. Histopathological examination was done for 55 patients, and follow-up was done for 5 cases after medical treatment: two cases of pseudotumor and three cases of cellulites.

Results: The study comprised 60 patients complaining of proptosis, swelling and diminution of vision. Thirty-three (55%) of patients had benign orbital masses and 27 (45%) patients had malignant orbital masses. The mean ADC value of malignant lesions was 0.89 ± 0.20. There was a statistically significant difference (p = ≤.001) between benign and malignant ADC values. The Mean Cho/Cr ratio for benign lesions was 1.19 ± 0.25 which showed statistically high significance (p = ≤.001**) compared to Cho/Cr ratio of malignant lesions which was 2.44 ± 0.30.

Diffusion-weighted MRI could differentiate between benign and malignant masses in 75% of cases. However, MRS could overcome this overlap and could differentiate benign from malignant tumors in 96% of scanned patients.

Conclusion: Both DWI and MRS imaging are helpful tools in differentiating malignant orbital lesions from benign masses.

1. Introduction

Computed-tomography and Magnetic resonance imaging (MRI) scans are useful for orbital examinations [1].

Orbital tumors include lesions of the globe, optic nerve sheath complex, conal-intraconal compartment, extraconal compartment, lacrimal gland tumors, bone and sinus compartment (fibrous dysplasia) [2].

Additional noninvasive magnetic resonance characterization of tumors has become available through proton magnetic resonance spectroscopy (MRS) and diffusion-weighted imaging (DWI). Thus, patterns could be used to discriminate different types of tumors [3]. MRI diffusion added quantitative and qualitative ideas about the integrity of cell membranes [4].

Magnetic resonance spectroscopy is depending upon various proton MR spectra. The four major resonances for MRS are choline containing phospholipids, creatine, N-acetyl-aspartate (NAA) and lactate [5]. Decrease of NAA on MRS denotes neural damage. Some lesions (e.g., meningioma) do not contain NAA, and other lesions (e.g., glioblastoma-multiforme, and metastasis) contain less amount of NAA. Creatine is elevated in hypometabolic state in ischemia or tumor (e.g., gliomatosis), or it may be decreased in hypermetabolic conditions [6] (see Figs. 1–8).

Choline is a part of cell membranes and elevated choline denoting increased membrane formation in an active proliferating or a solid, hyper cellular tumor. Creatine is stable in some disease processes and it is used as a control for MRS as a ratio to Cr [7].

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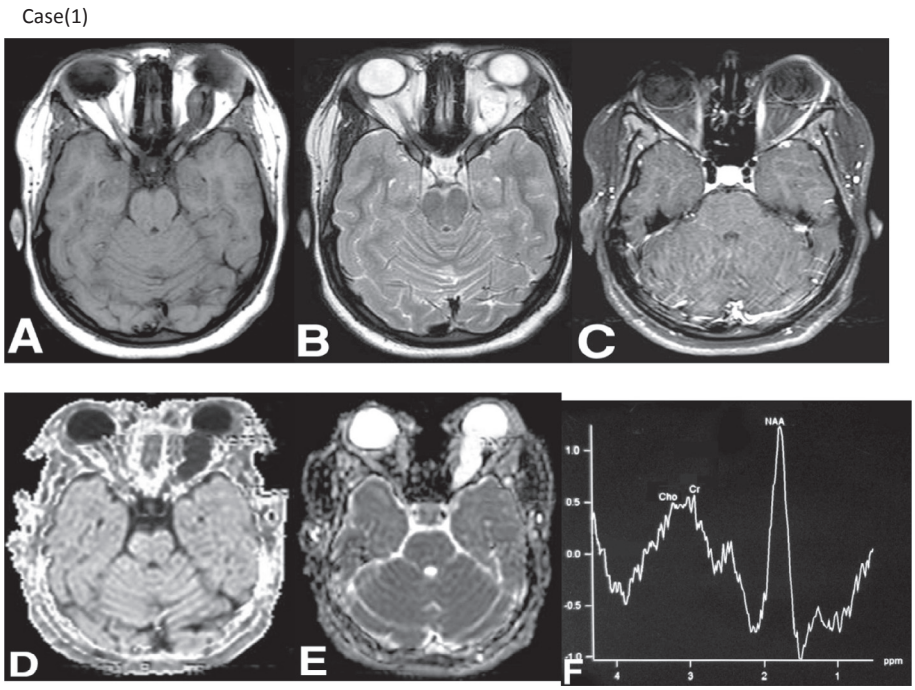

Fig. 1. Optic nerve glioma *of female patient aged 5 years* (A & B & C): Axial T1WI, T2WI and post-contrast T1WI, respectively, display a fusiform hypointense mass involve the optic nerve. Optic nerve cannot be separated from it. On T2WI it displays high SI and showed minimal enhancement after post-contrast injection. (D): DWI shows hypointensity of the lesion compared to brain parenchyma. (E): ADC shows free diffusion value was $1.6 \times 10^{-3}\,mm^2/s$. (F): MRS revealed low CHO/CR ratio 1.2.

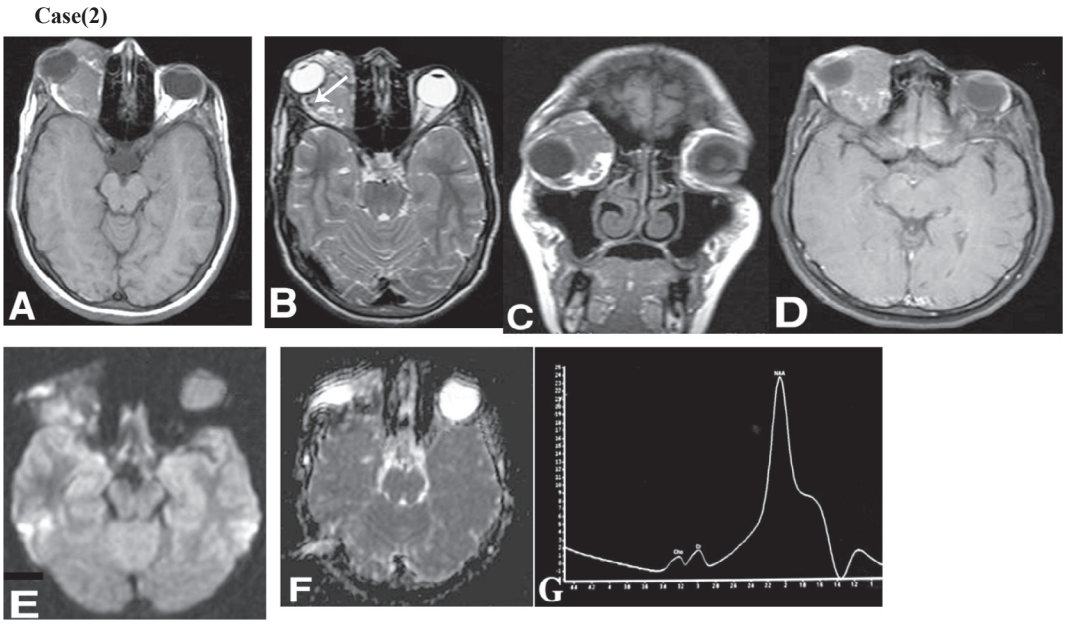

Fig. 2. Cavernous hemangioma of right orbit in female patient aged 22 years: (A & B & C): axial T1WI, T2WI and coronal T1WI, respectively, show a large intraconal and extraconal mass of low SI on T1WI, and it displays mixed SI on T2WI with pathognomic sign of phlebolith (signal void foci) (arrow pointed). (D): Postcontrast axial image shows minimal enhancement. (E): DWI shows mixed signal. (F): ADC map shows restricted diffusion ADC value $1.1 \times 10^{-3}\,mm^2/s$. (G): MRS revealed low Cho/Cr ratio = 1.

2. Aim of the work

To evaluate the role of (MRI), (DWI) and (MRS) in the diagnosis of different orbital masses and differentiation between benign and malignant masses.

2.1. Patients and methods

This prospective study was performed in the time frame from May 2012 till March 2016. Sixty patients with clinically diagnosed proptosis, swelling eye and diminution of vision were enrolled in this study. (31 females, 29 males, their ages ranged from 3 month to 75 years with mean age of 35.3 years) (see Tables 1–7).

Patients were examined using 1.5-T (Siemens Erlangen Medical System) MRI system. All patients were examined in the supine position using standard head coil with the head maintained in a neutral position. When necessary, sedatives by oral chloral hydrate (50 mg/kg) were administered to the patients.

Inclusion Criteria were as follows:

∗Patients with clinically diagnosed proptosis and orbital swelling.
∗Available final diagnosis with pathological prove as a standard.

Exclusion Criteria were as follows: