The Role of Diffusion-Weighted Magnetic Resonance Imaging in the Evaluation of Patient with Orbital Masses

Thesis

Submitted for partial fulfillment of the master degree in Radiodiagnosis

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2015

بسم الله الرحمن الرحيم

{قالوا سبحانك لا علم لنا إلا ما
علمتنا إنك أنت العليم الحكيم}

صدق الله العظيم

سورة البقرة الاية {٣٢}

Abstract

Orbital masses represent a spectrum of benign and malignant lesions in adults and children that can be challenging to diagnose and treat. Magnetic resonance imaging is a powerful tool for imaging the orbit, due to the excellent tissue contrast it provides.

Purpose: To evaluate the ability of Diffusion-Weighted MRI in the characterization of the orbital masses.

Patients and methods: We evaluated 51 patients with 30 malignant and 21 benign orbital masses. MR examinations were performed with a 1.5-T system. Diffusion-weighted single-shot EPI images were obtained in all patients. The apparent diffusion coefficient (ADC) was calculated and correlated with the pathology results.

Results: The mean ADC value of benign was significantly higher than that of malignant orbital masses.

Key words: MRI; Diffusion-weighted images (DWI); orbital masses; Apparent Diffusion Coefficient (ADC).

ACKNOWLEDGEMENT

Firstly and lastly, Thanks are all to **ALLAH Almighty**, whose help I always seek and without his willing I will achieve nothing.

My deep appreciation and gratitude to **Prof. Dr. Ikram Hamed Mahmoud** professor of Radiodiagnosis, National Cancer Institute, Cairo University, for his remarkable effort, great experience had added much to my knowledge, his great support and kind close supervision.

I would like to express my deep thanks and sincere gratitude to **Dr. Mohamed Darweesh Homos** lecturer of Radiodiagnosis, Faculty of Medicine, Cairo University and **Dr. Ayda Aly Youssef** lecturer of Radiodiagnosis , National Cancer Institute, Cairo University for their valuable advice, helpful suggestions and kind supervision.

I wish to express my thanks to them as they gave me a lot of elegant ideas, support during work and much of their precious time during supervising and revising this whole work.

Lastly but not least, I would like to thank my **husband** & my **family** for their support, encouragement, prayers and providing me the suitable environment for concentration and progress.

LIST OF CONTENTS

List of Abbreviations

3D: 3 Dimensional.

ADC: Apparent Diffusion Coefficient.

AML: Acute Myeloid Leukemia.

AT/RT: Atypical Teratoid/Rhabdoid Tumors.

CNS: Central Nervous System.

CSF: Cerebro-Spinal Fluid.

CT: Computed Tomography.

DWI: Diffusion Weighted Imaging.

EOM: Extra-Ocular Muscles.

FSE: Fast Spin Echo.

GD: Graves Disease.

GO: Graves' Orbitopathy.

I 125: Iodine 125.

IPT: Inflammatory Pseudotumor.

MALT: Mucosa-Associated Lymphoid Tissue.

MRI: Magnetic Resonance Imaging.

NF1: Neurofibromatosis Type 1.

NF-2: Neurofibromatosis Type 2.

OC: Orbital Cellulitis.

ONG: Optic Nerve Glioma.

OVV: Orbital Venous Varices.

PAG: Perineural Arachnoidal Gliomatosis.

PHPV: Persistent Hyperplastic Primary Vitreous.

PNF: Plexiform neurofibroma.

RB: Retinoblastoma.

RF: Radiofrequency.

ROC: Receiver Operating Characteristic Curve.

ROI: Regions Of Interest.

SAS: Sub Arachnoid Space.

SE: Spin-Echo.

SI: Signal Intensity.

T1WI:T2 Weighted Image.

T2WI:T2 Weighted Image.

TIRM-sequences: Turbo Inversion Recovery Magnitude Sequence.

US: Ultrasound.

V1: Ophthalmic division of the trigeminal nerve.

V2: Maxillary division of the trigeminal nerve.

List of Tables

List of Figures

Introduction

Orbital masses represent a spectrum of benign and malignant lesions in adults and children that can be challenging to diagnose and treat. Imaging plays an important role in diagnosis, due to a potentially limited clinical examination and risks associated with biopsy. MR imaging is a powerful tool for imaging the orbit, due to the excellent tissue contrast it provides **(Sephadari et al, 2010).**

Proptosis is one of the most common indications for an ophthalmologist to order imaging. The two imaging techniques for the brain and orbit are computed tomography (CT) and magnetic resonance imaging (MRI). Imaging techniques for visualizing pathology of the brain and orbit continue to evolve and improve. The clinicians now have a wide variety of diagnostic tests from which to choose. Additional non invasive MR characterization of tumors has become available through diffusion-weighted imaging (DWI**) (Roshdy et al, 2010).**

DW imaging can help characterize indeterminate orbital masses & greatly aid in tissue characterization with high accuracy when used in conjunction with clinical and conventional MR imaging findings, providing an additional non invasive predictor of histologic nature and tool for guiding intervention **(Sephadari et al, 2010).**

Diffusion weighted MRI is based on the assessment of the random water proton movement within tissues and reflects cellular density and tissue architecture, providing imaging techniques that does not require the use of ionizing radiation or MR contrast agents and can easily be implemented into a standard MRI protocol. Changes in water molecular diffusion can be measured in vivo with DWI. This measurement of the self-

diffusion coefficient of water indicates the mobility of water within tissue and is called the apparent diffusion coefficient (ADC) **(Calandriello et al, 2013).**

Normal proton diffusion rates have been identified for specific tissue types, including cerebrospinal fluid and white matter and gray matter. The Apparent Diffusion Coefficient (ADC) is generated by measuring identical images at different b-values and represented as ADC map from which ADC value calculated. The ADC value is dependent on the amount of restriction of water diffusion; the more restricted diffusion a tissue has, the lower its ADC value. This value is then graphically reconstructed as the ADC map **(Lope et al, 2010)**.

Because malignant tumors often have restricted diffusion, possibly as the result of their increased cellularity, larger nuclei and decreased extracellular space, they frequently has low ADC value. The opposite is proposed for benign lesions **(Lope et al, 2010)**.