

Artikel Asli/Original Articles

Functional MRI Characteristics in Visual Cortex (BA 17, 18 and 19) Corresponding to the Visual Field of Normal, Glaucoma Suspect (GS) and Primary Open Angle Glaucoma (POAG) Patients

(Ciri MRI Kefungsian dalam Korteks Visual (BA 17, 18 dan 19) yang Berpadanan dengan Medan Penglihatan bagi Subjek Normal, Disyaki Glaukoma (GS) dan Glaukoma Sudut Terbuka Primer (POAG))

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ABSTRACT

The purpose of this study was to characterize, differentiate and correlate visual field and brain activation in visual cortex for normal, glaucoma suspect (GS) and primary open angle glaucoma (POAG) participants using Standard Automated Perimetry (SAP) and functional Magnetic Resonance Imaging (fMRI) respectively. The fMRI scans and SAP test were both carried out in Pusat Perubatan Universiti Kebangsaan Malaysia (PPUKM). Two types of black-and-white checkerboard pattern were displayed to the participants during the fMRI scans. The fMRI data were analyzed using WFU pickatlas toolbox targeting visual cortex area. The results showed that there was no significant difference in number of activated voxel between the three groups in visual cortex (BA 17, 18 and 19) while viewing all the given stimuli ($p > 0.05$). The pattern standard deviation (PSD) of SAP for visual field also revealed no significant differences ($p > 0.05$) in all groups of participants. However, negative correlation between PSD and fMRI activation was observed. The PSD values increased with a decrease in fMRI activation. With reference to visual field analysis, the results suggest that glaucomatous neuropathy of POAG patients has led to a gradual decrease in visual cortex activation and a gradual increase in PSD.

Keywords: fMRI; statistical parametric mapping; brain activation; standard automated perimetry; visual cortex

ABSTRAK

Tujuan kajian ini adalah untuk mencirikan, membezakan dan mengaitkan antara medan penglihatan dan pengaktifan otak dalam korteks penglihatan individu normal, suspek glaukoma (GS) dan glaukoma sudut terbuka primer (POAG) masing-masing menggunakan automasi perimetri piawai (SAP) dan pengimejan resonans magnet kefungsi (fMRI). Imbasan fMRI dan ujian SAP dilakukan di Pusat Perubatan Universiti Kebangsaan Malaysia (PPUKM). Dua jenis rangsangan penglihatan corak dam hitam dan putih ditayangkan kepada peserta semasa imbasan fMRI. Data fMRI dianalisis menggunakan kotak peralatan WFU Pickatlas mensasarkan kawasan korteks penglihatan. Hasil kajian menunjukkan terdapat perbezaan yang tidak signifikan dalam bilangan voxel aktif antara tiga kumpulan kajian semasa melihat semua jenis rangsangan tersebut ($p > 0.05$). Sisihan piawai corak (PSD) SAP bagi keputusan medan penglihatan juga mendedahkan perbezaan yang tidak signifikan ($p > 0.05$) dalam semua kumpulan peserta. Terdapat korelasi negatif antara PSD dan bilangan voksel aktif fMRI. Nilai PSD meningkat dengan pengurangan pengaktifan fMRI. Berdasarkan analisis medan penglihatan, neuropati glaukoma pesakit POAG membawa kepada penurunan secara beransur-ansur pengaktifan di korteks penglihatan dan peningkatan PSD secara beransur-ansur.

Kata kunci: fMRI; pemetaan statistik berparameter; pengaktifan otak; automasi perimetri piawai; korteks penglihatan

INTRODUCTION

POAG is a disease of the optic nerve and is associated with an increase in intraocular pressure (IOP). A person with POAG has an open anterior chamber angle, cupping as well as atrophy of the optic disc with loss of optic nerve fibres. An increase in IOP is a strong risk factor for glaucoma. Clinical diagnosis of POAG and its monitoring of progression are made possible through the evaluation of its functional deficit (such as visual field), structural

deficit (such as optic nerve head) and retinal nerve fibre layer (Litwak 2001). While GS participant can be defined as a person with one or more risk factors that might lead to glaucoma, this individual however, does not have a definite glaucomatous optic nerve damage or visual field defect (Shingleton et al. 1999).

A common consequence of glaucoma is glaucomatous optic neuropathy. Yagci et al. (2005) stated that even though high IOP is a major risk factor for glaucoma, it is not the only existing factor. However, IOP and aqueous humour dynamics pressure control is important for the