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An Analysis of Visual Field Defects in Pituitary Macroadenomas: A Prospective Study

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Pituitary Adenomas are common benign Intracranial tumours which cause visual field defects by anterior visual pathway compression after suprasellar extension of pituitary macroadenomas. After fulfilling the inclusion criteria, 31 patients with pituitary macroadenomas were evaluated for visual field defects using Humphrey Visual filed analyser (Perimeter). Thirteen patients had normal visual fields and 18 patients had abnormal visual fields. Bitemporal hemianopia was the most common visual field defect seen on perimetry. Also there was a positive correlation between the tumour size and the visual field defects.

Keywords: Pituitary macroadenoma; visual field defects; perimetry.

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1. INTRODUCTION

Pituitary adenomas are common benign intracranial tumors. They make up around 12% of intracranial tumors that cause clinical symptoms [1]. Depending on whether their size is less than or greater than one centimetre, they are classified as either microadenomas or macroadenomas. A variety of visual field defects may arise from anterior visual pathway compression caused by suprasellar extension of pituitary macroadenomas. The amount of visual field defect depends on the location of the optic chiasma and the size of the tumor [2]. Pituitary adenoma can cause visual field abnormalities in 9% to 32% of cases [3]. Pituitary adenoma is detected in the majority of cases when the tumor causes bitemporal hemianopia or when there is a significant loss of vision and optic disc pallor on Ocular fundus examination.

Goldmann's perimetry was the traditional method for analysing visual fields, however new automated methods that are equally or more sensitive to identify and measure visual field defects have recently been developed. The most recent and extensively used automated perimetry programme is the Swedish Interactive Threshold Algorithms (SITA) series, which makes the visual field-testing procedure considerably quicker and more user-friendly for the patient [4].

We aimed to analyse the pattern of visual field defects in patients with pituitary macroadenoma and further to evaluate the correlation between the tumor volume and the severity of visual field defects.

2. MATERIALS AND METHODS

We prospectively analysed 37 radiologically proven cases of pituitary macroadenomas who were referred to department of Ophthalmology for visual field analysis over a period of 5 years. Patients above the age of eighty years, those with optic neuropathy resulting from other disorders such as glaucoma and those with retinal disorders such as diabetic and hypertensive retinopathy, or patients with unreliable visual field test results were excluded from the study. After applying the exclusion criteria 31 patients were included in the study. The ophthalmological assessment includes best corrected visual acuity (BCVA), colour vision and visual field test using Carl Zeiss Hymphery Visual Field Analyser. The Swedish Interactive Threshold Algorithm (SITA) or full threshold 30–2 was the algorithm used in the assessment of automated perimetry. Fundus examination was done by + 78 Dioptre lens on slit lamp biomicrocopy. Visual field examinations were considered abnormal if Pattern standard deviation (PSD) or glaucoma hemifield test was abnormal. Quadranopsia was defined as either:

1) Depression of thresholds by 5 dB or more, in three or more contiguous points adjacent to the vertical meridian in the involved quadrant as compared to their mirror image points across the vertical meridian, or
2) The pattern deviation plot showed three or more points adjacent to the vertical meridian in the involved quadrant depressed to the 1% probability level with normal mirror image points across the vertical meridian.

The patient had hemianopsia if criteria for quadranopsia had to be applicable to both quadrants comprising the hemifield. Results for the mean deviation (MD) and PSD of both eyes were used. The findings of radio-imaging by magnetic resonance imaging (MRI) were reviewed and tumor volume was assessed.

Statistical Analysis: The Software used for statistical analysis was SPSS ver. 12.0 (SPSS Inc., Chicago, IL, USA). For categorical data, a chi-square test was employed, and for continuous variables, a Mann-Whitney U-test was utilised to compare groups. The associations between tumour volume and PSD and between tumour volume and MD were examined using Pearson's correlation analysis. When the p-value is < 0.05, all association tests were deemed statistically significant.

3. RESULTS

A total of 37 patients with pituitary adenoma presented to our department during the study period. Six patients were not included in the study as they didn't satisfy the inclusion criteria. The mean age of the patients was 49 ± 14.8 years, ranging from 20-67 years. 19 patients (61.29%) were males and 12 (38.70%) were females. MD was -7.26 ± 5.66 dB and PSD was 6.08 ± 3.59 dB. The characteristics of the patients are shown in Table [1].

13 patients (41.93%) had normal visual fields and 18 patients (58.06%) had abnormal visual fields. Out of 18 patients with abnormal visual fields, 7 patients (38.88%) had unilateral visual

field defects and 11 patients (61.11%) had bilateral visual field defects. The various types of visual field defects seen are summarised in Table [2].

Table [3] shows comparison between gender, age, tumor volume, mean deviation (MD) and pattern standard deviation (PSD) between the group with and without visual field defect. As seen in table, there is no statistical significant difference between the two groups in gender (p-value = 0.913) and age (p-value = 0.069). The group with visual field defect had significantly larger pituitary tumor (p value < 0.001). Mean deviation (MD) was significantly higher in patients with normal visual field, whereas pattern standard deviation (PSD) was significantly less in patients with normal visual fields.

4. DISCUSSION

Pituitary adenomas account for approximately 12% of symptomatic intracranial tumors. Visual impairments are the most common objective manifestations of pituitary adenoma. There was a male preponderance in our study. The age and gender distribution in our study was similar to the community-based study conducted by Fernandes A et al. [5].

Bitemporal hemianopsia was the most common symptom in our study, seen in 6 out of 18 patients with visual field defects (33%). Because the lesions that damage the body of optic chiasm produce bitemporal hemianopsia, that is the most common symptom [6]. A similar result was seen in study reported by Huang WC et al. [7]. Lee I.H et al in a study found “bitemporal hemianopsia to be more common in patients whose MRI showed a displacement of the optic pathway of more than 3 mm from the baseline” [8]. Helen V.D et al also described novel advances in magnetic resonance imaging such as diffuse tensor imaging to explain the underlying mechanism of visual loss in chiasmal compression due to pituitary macroadenoma [9]. However, as per size and position relative to optic chiasma, multitude of visual field defects can be produced [10]. In our study, 61 % of the patient with visual field defect had bilateral involvement. Mono-ocular involvement was present in 39% patients. 2 out of 18 patients with visual field defect had homonymous hemianopsia. Many authors previously also have reported that pituitary adenoma can cause homonymous hemianopsia [11]. So evaluation by radio-imaging should be done even in mono-ocular visual field defects.

Our study showed that there was a positive correlation between tumor volume, as measured by MRI, and visual field defects. This was shown in a number of previous studies.

Table 1. Baseline characteristics of the patients

Variable	Value
No. of patients	31
Male: Female	19:12
Mean Deviation(dB)	-7.26 ± 5.66 (0.65- 17.71)
Pattern Standard Deviation (dB)	6.08 ± 3.59 (1.13- 11.73)
Tumor Volume (cm^3)	7.46 ± 5.90 (1.05 – 17.31)

Table 2. Spectrum of visual field defects

Visual Field Defect		Number of Patients
Normal Visual Field		13 (41.93%)
Abnormal Visual Field		18 (58.06%)
Unilateral		7 (38.88%)
	• Temporal hemianopsia	3 (42.85%)
	• Superotemporal quadranopsia	4 (57.14%)
Bilateral		11(61.11%)
	• Bitemporal hemianopsia	6 (54.54%)
	• Hemianopsia in one eye, Superotemporal quadranopsia in other eye	2 (18.18%)
	• General reduction in one eye, temporal defect in other eye	1
	• Homonymous hemianopsia	2

Table 3. Comparison between patients with and without visual field defects

Variable	Patients with normal visual field	Patients with visual field defect	p-value
Male:Female	8:5	11:7	0.913
Age(years)	36.69 ± 11.62	44.78 ± 11.90	0.069
Tumor volume(cm^3)	2.96 ± 1.36	10.71 ± 5.79	< 0.001
Mean Deviation (dB)	-1.97 ± 0.94	-11.08 ± 4.37	< 0.001
Pattern Standard Deviation(dB)	2.54 ± 0.71	7.20 ± 2.16	<0.001

Thomas et al also demonstrated that the severity of visual field defects was related to tumor size [12]. Lee J.P et al also showed significant positive correlation between visual field defects with tumor volume [13]. The difference between our study and most of the previous studies is that ours was a prospective study.

Visual field defects were quantified in our study using Median Deviation (MD) and Pattern Standard Deviation (PSD) using 30-2 SITA strategy. Our study showed a significant positive correlation between visual field defects and MD and PSD values. Higher MD values were seen in normal visual field patients where as, lower PSD values were seen in normal visual field patients. These findings are supported by the study by Lee et al, who showed a similar association.

5. CONCLUSION

In summary, pituitary macroadenoma is known to manifest in a variety of visual field defects, with binocular involvement occurring in the majority of cases. The tumor volume determined the kind and extent of the visual field defect. Pituitary macroadenoma related visual field defects can be quickly and quantitatively assessed using the SITA 30-2 procedure with Humphrey parameters.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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