Postoperative visual field outcome measured by perimetry in sellar and parasellar tumors

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Received 23 January 2015
Accepted 01 March 2015

The Egyptian Journal of Neurology, Psychiatry and Neurosurgery 2015, 52(3):212–215

Background

Compressive optic neuropathy at chiasm may lead to different degrees of visual acuity affection, color vision loss, and visual field (VF) changes in both eyes.

Objective

This study evaluates the predictive value of VF outcome 3 months after treatment of chiasmal and parachiasmal tumor compressing the anterior visual pathways.

Methods

Fifteen patients (eight women and seven men) were included in this study; their ages ranged from 30 to 57 years. All patients were operated upon at the Kasr El-Aini Neurosurgical Department. All of them underwent an evaluation of their history, a clinical examination, standard automated perimetry, evaluation of their hormonal profile, and radiological investigations. Ten patients were operated upon by means of the microscopic-assisted endoscopic endonasal trans-sphenoidal approach, and the remaining five patients were operated upon transcranially.

Results

Best-corrected visual acuity showed significant improvement from 0.464 ± 0.367 to 0.16 ± 0.17 LogMAR ($P=0.009$) in all patients after surgery. Mean deviation showed improvement in all patients, which was not statistically significant, from −11.289 ± 9.952 dB before surgery to −8.578 ± 7.651 dB at 3 months after surgery ($P=0.330$). As regards temporal VF sensitivity, group 1 showed significant improvement in temporal field sensitivity, from 88.054 to 237.967 1/Lambert (l/L), whereas group 2 showed significant worsening in temporal sensitivity, from 198.272 to 100.764 (l/L), and group 3 showed improvement in temporal sensitivity from 702.97 to 820.568 (l/L).

Conclusion

In this series, temporal field sensitivity was the best prognostic factor for determining the VF outcome in decompression surgery for sellar and parasellar tumors.

Keywords:
parasellar tumors, perimetry, visual field

Egypt J Neurol Psychiat Neurosurg 52:212–215

1110-1083

Introduction

Areas of the sellar and parasellar region have anatomical boundaries that extend from the basisphenoid sinus below, laterally to the cavernous sinus, with suprasellar extension to ventricular walls [1]. These anatomical landmarks harbor many vital structures such as pituitary gland, its stalk, the hypothalamus, optic apparatus, anterior vascular circulation, and contents of cavernous sinus cranial nerves of eye movement, venous network, and the third part of the carotid artery [2]. Lesions in that area can arise from meninges, pituitary gland, vascular tree, optical apparatus, and extension from below, such as nasopharyngeal neoplasm, or from above, such as ventricular tumors [3,4]. Many types of tumors arise in that critical area, such as pituitary adenoma, carcinoma, craniopharyngioma, optic gliomas, meningiomas, germ cell tumors, and vascular lesions like aneurysms and carotid–cavernous fistula [5]. Tumors in these areas give rise to many clinical symptoms such as headache, hormonal imbalance, cranial nerve dysfunction, and visual impairment [3].

MRI is the test of choice for diagnosing these lesions. With the aid of computed tomography (CT) and CT angiography it can outline bony invasion and the relationship between lesions and the vascular tree in these areas. Hormonal assay is very crucial for initiating therapy if needed, and the patient has to undergo perimetry and clinical assessment for visual functions [6,7].

Lesions in these areas lead to a compressive effect on the visual apparatus, which gives rise to many degrees of visual acuity (VA) and visual field (VF) affection. The mechanism of injury may be due to direct compression or axonoplasmic affection [8]. Postoperative clinical improvement depends on the structural and functional status of the visual apparatus preoperatively and postoperatively [9,10].

This study aims to evaluate the postoperative VF outcome in patients with sellar and parasellar tumors and the impact of surgery on postoperative VF prognosis.

Patients and methods

Fifteen patients with sellar and parasellar tumors (eight women and seven men) were included in this study. Their ages ranged from 30 to 57 years. All patients were operated upon at the Kasr El-Aini Neurosurgical Department from June 2013 to February 2014. All of them underwent an evaluation of their history, a clinical examination, perimetry, evaluation of their hormonal profile, and radiological investigations in the form of CT scan, MRI, and four-vessel angiography when needed to outline the relation between tumors and the vascular tree. None of the patients had local eye disease. Ten patients were operated upon by means of the microscopic-assisted endoscopic endonasal trans-sphenoidal approach for better visualization of the optic apparatus. The remaining five patients were operated upon transcranially by means of the pterional approach. All patients underwent a postoperative CT scan, hormonal assay, and assessment of VF, using perimetry, within 1 week and at 3 months. Thirteen patients were discharged within 7 days after operation. Two patients had diabetes insipidus and had to remain hospitalized for 3 more days.

All patients had an uneventful surgery without major complications. Chiasma was prefixed in seven cases and postfixed in eight cases. Seven cases were pituitary adenoma, four cases were craniopharyngioma, and four cases were meningioma; 13 patients underwent gross total excision, and in the other two cases the tumor was attached to the anterior communicating artery. A small residual tumor not more than 1.5 cm^3 was left attached to it.

Perimetry was performed in both eyes and the eye with the lesser VF defect of each patient was selected for analysis. An unreliable VF testing (>30% false positive, false negative, or fixation loss; a spherical refractive error outside the range of −5 diopters) was excluded. Standard automated perimetry was conducted using the Swedish Interactive Threshold Algorithm (SITA) 24–2 of the Humphrey Field Analyzer program (Carl Zeiss Meditec AG, Jena, Germany) with a Goldmann size III stimulus on a 31.5-apostilb background. The cluster criterion for an abnormal hemifield (split into temporal and nasal hemifields) was three or more significantly depressed (P < 5%) non-edge-contiguous points on the PD plot, with two of these points having a P-value less than 2%, not including those directly above and below the blind spot. Eyes were divided into three groups based on the initial VF defect and its evolution: group 1 had an initial VF defect that incompletely resolved 3 months after surgery; group 2 had a VF defect that worsened 3 months after surgery; and group 3 had an initial VF defect that completely resolved 3 months after surgery (Table 1).

Statistical analysis

Microsoft excel 2010 was used for data entry and the statistical package for social science (version 21) (IBM, New York, United State) was used for data analysis. Simple descriptive statistics (arithmetic mean and SD) were used for summary of quantitative data, and frequencies were used for qualitative data. The independent t-test was used to compare normally distributed quantitative data, whereas the Mann–Whitney test was used to compare non-normally distributed quantitative data. Nonparametric Spearman's correlation was used to compare non-normally distributed quantitative data, and P-value less than 0.05 was considered statistically significant.

Results

Best-corrected VA showed significant improvement from 0.464 ± 0.367 to 0.16 ± 0.17 LogMAR (P = 0.009) in all patients after surgery. Group 3 showed the most statistically significant improvement in VA. Mean deviation (MD) showed improvement in all patients, which was not statistically significant, from −11.289 ± 9.952 dB before surgery to -8.578 ± 7.651 dB at 3 months after surgery (P = 0.33). Group 1 showed statistically significant improvement in MD, whereas group 2 showed statistically significant deterioration in MD.

As regards temporal VF sensitivity, Group 1 showed significant improvement from 88.054 to 237.967 1/Lambert (l/L), whereas group 2 showed significant worsening in temporal sensitivity from 198.272 to 100.764 (l/L) and group 3 showed improvement in temporal sensitivity from 702.97 to 820.568 (l/L). In both groups 1 and 2 no correlations were found postoperatively between best-corrected VA and MD,

Table 1 Number of patients in each group postoperatively

Group	N (%)
1	7 (46.6)
2	3 (20)
3	5 (33.33)

nor with temporal sensitivity ($P > 0.05$), whereas moderate correlation was found in group 3 ($P < 0.05$, $r = 0.5–0.7$) (Table 2).

Discussion

In this study, patients were divided into three groups based on their initial VF defect and its evolution. Group 1 had an initial VF defect that incompletely resolved 3 months after surgery (seven cases were totally excised); group 2 had a VF defect that worsened 3 months after surgery (three patients; 1 underwent total excision and the other two underwent subtotal excision); group 3 had an initial VF defect that completely resolved 3 months after surgery (five cases were totally excised). Thus, 13 patients underwent total excision (86.6%) and two cases underwent subtotal excision (13.4%).

There are many factors that can affect visual outcome. These factors include longstanding compression of the optic pathway, intraoperative complications, preoperative degree of field changes, and obstruction of blood supply to the visual pathway. This study evaluates the different changes in the VF as a predictive value of VF outcome 3 months after treatment of parachiasmal tumors compressing the anterior visual pathways. VF was used rather than VA, as VA reflects the function of a small area of the VF, whereas the quantitative VF defect better reflects the effect of compression onto the anterior visual pathways. In addition, the majority of patients have VF defects with retained acuity [11].

Different studies [4,12] refer to multiple prognostic factors in patients with compressive parachiasmal tumors. Age and optic disc pallor were found to be predictive of the visual outcome by former but not by later. The duration of symptoms before surgery can lead to a poor visual outcome. However, this seemed to correlate more with the depth of the preoperative visual deficit in a study by Cohen *et al.* [13], and was not statistically significant on multivariate analysis in another study by Sullivan *et al.* [14] When a Goldmann perimeter was used, the preoperative VF defect had prognostic value in two studies [12,15] and did not in two other studies [13,14]. In a study by Gnanalingham *et al.* [4], Humphrey VF showed that temporal–superior and temporal–inferior VF defects were predictive of the final VF defect, but only the temporal–superior quadrant maintained that prognostic value in a multivariate analysis including age and duration of visual symptoms.

The lack of a clear result from these studies makes it difficult to predict the visual outcome in a single patient. Jacob *et al.* [16] compared the anatomical results of retinal nerve fiber layer around the disc using optical coherence tomography with SAP. They classified the patients into groups and found that the more the depth of field defects preoperatively, the more the worsening of postfield changes. Complete resolution occurred in 43% of their cases. No special measurements of temporal sensitivity were taken. In this study, the 15 patients were classified into three groups according to postoperative VF recovery: incomplete recovery in group 1; worsening in group 2; or complete resolution in group 3. Special attention was focused on temporal field sensitivity (measured by Lambert scale) as this hemifield carries the most deficits in the field of any chiasmal compressive lesion. It was found that group 3 had, preoperatively, the least MD, and the highest temporal sensitivity (best prognosis), compared with the other two groups. The lower the MD, as described in a study by Jacob *et al.* [8], the better the postoperative field results, as in group 3. We concluded that the more the temporal sensitivity, the better the prognosis of the field postoperatively. This finding was proved by Moon *et al.* [17] as well, but no classification was performed on their 18 cases as in the current study.

However, in this study, significant improvement, although incomplete, was seen in group 1 with preoperative temporal sensitivity as the prognostic value. Group 2 showed worsening of the field postoperatively, although there was lower MD and higher temporal sensitivity compared with group 1, agreeing with the results of

Table 2 Visual field parameters in each group preoperatively and postoperatively

Variable	Group 1	Group 2	Group 3	Total
Initial visual acuity (LogMAR)	0.3466 ± 0.188	0.366 ± 0.17	0.13 ± 0.02	0.464 ± 0.367
Final visual acuity (LogMAR)	0.222 ± 0.12	0.22 ± 0.03	0.036 ± 0.001	0.16 ± 0.170
P-value	**0.5**	**0.05**	**0.006***	**0.009***
Initial mean deviation (dB)	−18.127	−10.21	−2.36	−11.28 ± 9.952
Final mean deviation (dB)	−10.14	−16.363	−1.72	−8.57 ± 7.651
P-value	**0.005***	**0.006***	**0.2**	**0.33**
Initial temporal visual field (l/L)	88.054	198.272	702.97	315.06 ± 355.28
Final temporal visual field (l/L)	237.967	100.764	820.568	404.72 ± 359.788
P-value	**0.008***	**0.005***	**0.05**	**0.93**

*Significant at $P < 0.01$.

Jacob *et al.* [16]. This may be attributed to age (older patients) or short-term follow-up (3 months), which, in some patients, is considered insufficient for axonal function restoration. A more severely affected optic nerve and visual function may result in more prolonged degeneration and delayed restoration of retinal function.

Conclusion

In this series, the temporal field sensitivity was the best prognostic value in determining the VF outcome in decompression surgery for sellar and parasellar tumors. The lower the preoperative temporal sensitivity, the more significant the field improvement. Further studies are needed to confirm this result.

Acknowledgements

Nil.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1 Elster AD. Modern imaging of the pituitary. Radiology 1993; **187**:1–14.

2 Ruscalleda J. Imaging of parasellar lesions. Eur Radiol 2005; **15**:549–559.

3 Gallioud P, Ruiz D, Muster M, Murphy KJ, Fasel JH, Rüfenacht DA. Angiographic anatomy oflaterocavernous sinus. Am J Neuroradiol 2000; **21**:1923–1929.

4 Gnanalingham KK, Bhattacharjee S, Pennington R, Ng J, Mendoza N. The time course of visual field recovery following transphenoidal surgery for pituitary adenomas: predictive factors for a good outcome. J Neurol Neurosurg Psychiatry 2005; **76**:415–419.

5 Saeger W, Lüdecke DK, Buchfelder M, Fahlbusch R, Quabbe HJ, Petersenn S. Pathohistological classification of pituitary tumors: 10 years of experience with the German Pituitary Tumor Registry. Eur J Endocrinol 2007; **156**:203–216.

6 Famini P, Maya MM, Melmed S. Pituitary magnetic resonance imaging for sellar and parasellar masses: ten-year experience in 2598 patients. J Clin Endocrinol Metab 2011; **96**:1633–1641.

7 Glezer A, Belchior Paraiba D, Bronstein MD. Rare sellar lesions. Endocrinol Metab Clin North Am 2008; **37**:195–11.

8 Kerrison JB, Lynn MJ, Baer CA, Newman SA, Biousse V, Newman NJ. Stages of improvement in visual fields after pituitary tumor resection. Am J Ophthalmol 2000; **130**:813–820.

9 Kanamori A, Nakamura M, Matsui N, Nagai A, Nakanishi Y, Kusuhara S, *et al.* Optical coherence tomography detects characteristic retinal nerve fiber layer thickness corresponding to band atrophy of the optic discs. Ophthalmology 2004; **111**:2278–2283.

10 Li B, Barnes GE, Holt WF. The decline of the photopic negative response (PhNR) in the rat after optic nerve transaction. Doc Ophthalmol 2005; **111**:23–31.

11 Schlottmann PG, de Cilla S, Greenfield DS, Caprioli J, Garway-Heath DF. Relationship between visual field sensitivity and retinal nerve fiber layer thickness as measured by scanning laser polarimetry. Invest Ophthalmol Vis Sci 2004; **45**:1823–1829.

12 Marcus M, Vitale S, Calvert PC, Miller NR. Visual parameters in patients with pituitary adenoma before and after transsphenoidal surgery. Aust N Z J Ophthalmol 1991; **19**:111–118.

13 Cohen AR, Cooper PR, Kupersmith MJ, Flamm ES, Ransohoff J. Visual recovery after transsphenoidal removal of pituitary adenomas. Neurosurgery 1985; **17**:446–452.

14 Sullivan LJ, O'Day J, McNeill P. Visual outcomes of pituitary adenoma surgery. St Vincent's Hospital 1968–1987. J Clin Neuroophthalmol 1991; **11**:262–267.

15 Findlay G, McFadzean RM, Teasdale G, Findlay G, McFadzean RM, Teasdale G, *et al.*. Recovery of vision following treatment of pituitary tumours; application of a new system of assessment to patients treated by transsphenoidal operation. Acta Neurochir (Wien) 1983; **68**:175–186.

16 Jacob M, Raverot G, Jouanneau E, Borson-Chazot F, Perrin G, Rabilloud M, *et al.* Predicting visual outcome after treatment of pituitary adenomas with optical coherence tomography. Am J Ophthalmol 2009; **147**:64–70.

17 Moon CH, Hwang SC, Kim BT, Ohn YH, Park TK. Visual prognostic value of optical coherence tomography and photopic negative response in chiasmal compression. Invest Ophthalmol Vis Sci 2011; **52**:8527–8533.