VISUAL EVOKED POTENTIALS IN EVALUATION AND MANAGEMENT OF PITUITARY ADENOMAS

Nihat Egemen, M.D., Hamit Z. Gökalp, M.D., Adil Çulcuoğlu, M.D., Sait Naderi, M.D., Ahmet Zorlutuna, M.D.,

Departments of Neurosurgery (N.E., H.Z.G., S.N., A.Z. and Neurology (A.Ç.), Faculty of Medicine. University of Ankara-TÜRKİYE

Turkish Neurosurgery 2 : 64 - 67, 1991

SUMMARY :

As a routine part of the evaluation of patients with pituitary tumour, pattern reversal visual evoked potentials (PRVEP) were recorded in 100 patients with computerized tomographically documented pituitary tumour. VEP tests were correlated with examinations of visual scuity, visual field and computerized tomographic scan. Our study confirme that suprasellar extension of pituitary adenomas caused VEP changes such as latency delay and decrease in amplitude.

KEY WORDS :

Coputerized tomographic scan, Pituitary tumour, Visual evoked potential, Visual test.

INTRODUCTION

Evoked potentials were first described by Richard Caton in 1875, who recorded spontaneous electrical potentials from the cortex of animals and noted that spontaneous activity (EEG) changed in response to visual stimulation (4). Visual evoked potentials are a complex, widespread, orderly series of electrocortical fluctuations recorded from the scalp as one aspect of brain reaction to a visual stimulus (10,13). If the conditions of examination are standardized, the average response patterm assume as a highly consistent from for a given individual and is similar in most adults (1,2,4,6,8,10).

The average evoked response in man to stimulation of the visual field with a checker board pattern and recorded from the scalp over the occipital region has an average from which is consistent both within and between subjects.

Pattern reversal evoked responses have a consistent morphology. The latency of the principal positive component occurring at about 100 msec. (P 100) when subjected to statistical analysis yields a low standart deviation in the range of 3 to 4 msec. (4).

Criteria for abnormality related to prechiasmal lesions are statistically based primarily on the latency of the P 100 component. A significant increase in the latency of the major positive peak has been correlated with optic neuropathy, especially demyelination. In general recording from only one active electrod midline OZ has been recorded.

In the current practice of evoked potentials, stimulation of the visual system may be flash or pattern (3,14). Pattern reversal types of stimulator all provide a checker board image. The patient is instructed to fixate on the shifting pattern. Recording electrodes are placed at scalp locations over the visual cortex (OZ). The VEP produced by reversal of black and white checker board pattern has proven to be a valuable test in detection and diagnosis of optic involvement. Evoked potential latency prolongation is often seen in multiple sclerosis.

Compressive or destructive lesions in or around the optic nerve and operative manipulation may prolong response latencies but are more likely to attenuate amplitude or distort morphology (5,6,15).

The purpose of the present study is to document the clinical value of VEP in the evaluation and management of pituitary tumours that may compress the visual pathways.

MATERIAL AND METHOD

Platen electrodes were used for the recording. The active one being placed on the midline 2 cm above the inion (02) and the reference on the vertex (C2). The electrodes were connected to a Nicolet Compact four evoked potential machine. Pattern reversal visual evoked potentials were evaluated in all patients with a television display of a black and white checker board pattern. The recordings of VEP were done with the subject seated in a dimly litroom, 115 cm away from the screen. This distance is measured from a point at which a square of 2x2 cm is seen with a visual angle of 1°. The images were reversed in one second and movement was completed in 20 msec. (The black squares trun white the white turn black in one

second in every 20 msec). The patients were asked to fix their eyes on a square at the centre of the screen. Each eye was tested at least twice. A black eye patch was used to occlude one eye.

To establish the normal mean and standard deviation (SD) for latency and amplitude measures using the stimulus and analysis equipment of laboratory, we tested 15 subjects with no apparent neurological problems. Age ranged from 24 to 58 years. All subjects had a corrected visual acuity of 20/30 or better.

Mean values of VEP tests on normal subjects are listed in Table 1. P 100 is used to designate the major positive component normally occurring at approximately 100 msec. i.e.P 100. The remarkable consistency and symmetry within each of the responses for normals are shown. Also between normals the wave forms of P100 were stable and uniform even though the N1 and N2 peaks showed some deviation in form and amplitude. The upper confidence limits (99%) for normals were established by multiplying 3 times the standard deviation and adding the mean: thus for all age groups with mean latency of 99.20 msec., a value above 110 msec was considered abnormal.

One hundred patient with pituitary tumours were studied. Each patient subsequently underwent VEP study, visual tests and computerized tomographic (CT) examinations. Results of the visual tests and CT scans were not known at the time of VEP testing and interpretation.

Two hundred VEP tests were performed on one hundred patients with pituitary tumors.

Fifty four were intrasellar tumours. Forty-nine of the patients with normal visual fields and vision had normal VEP tests. In five patients with minimal suprasellar extension there was a mild latency delay that could be accepted as pathologic. Amplitudes were within normal limits. In general mean latency and amplitudes were accepted as normal by comparing the control group value. (Table 2). P>0.05. Results of early postoperative VEP'e (7th day) were all within normal limits (Table 3). P>0.05.

Four of the five patients with minimal supraseller extension also had normal postoperative VEPs. It seemed that this was the result of surgical decompression.

Twenty eight patients with macro-adenomas constituted the second group with abnormal VEPs or visual fileds. CT documented suprasellar extensions of pituitary tumour were no more than 2.5 cm. VEP abnormalities were based on latency values and amplitude measurements.

Table 1 : Pattern evoked response findings in control group patients (n=15)

	Amplitude		Latency	
	Left	Right	Left	Right
Mean	5.33±0.32	5.76±0.34	99.40±1.28	99.20±1.73

Table 2 : Mean latency an amplitude of pattern evoked response in fifty four patients with intrasellar tumour.

	Amplitude		Latency	
	Left	Right	Left	Right
Mean	6.3±2.0	6.2±2.0	98.7±8.8	99.1±11.4

Amplitude (microvolt), Latency (millisecond)

Table 3 : Early postoperative mean latency and amplitude of Pattern evoked response in fifty four patients with intrasellar tumour.

	Amplitude		Latency	
	Left	Right	Left	Right
Mean	6.4±2.0	6.5±2.1	98.4±8.7	94.6±11.4

In this group, 15 of the 19 patients with abnormal visual fields had abnormal VEPs; 4 patients instead of an abnormal visual field had normal VEPs (Cases 4,5,8,27). In nine patients with normal visual fields, 5 had abnormal VEP's (Cases 9,10,16,20,21). In four cases both conventional and VEP results were within normal limits.

Despite these normal subjects the mean latency and amplitude of this group is significantly pathological (Table 4) (P<0.05).

Results of early postoperative VEPe of group II. were also pathological (Table 5). Mean latency was 116.2±30.3 for the left eye and 111.0±22.4 for the right. Mean amplitude for the left eyewas 4.6±1.7 and 4.9+1.5 for the right eye. These results, were significantly impaired.

Table 4 : Mean values of pattern evoked response in twenty eight patients with macro pituitary adenoma.

	Amplitude		Latency	
	Left	Right	Left	Right
Mean	4.0±1.8	4.7±1.5	121.33±33.5	115.9±22.4

Table 5 : Early postoperative mean values of pattern evoked responsein twenty eight patients with macro pituitary adenoma

	Amplitude		Latency	
	Left	Right	Left	Right
Mean	4.6±1.78	4.9±1.5	116.2±30.3	111.0±22.0

The third group of patients was composed of giant pituitary adenomas. None had normal visual findings. Their visual acuity and fields were abnormal. Mean latency and amplitude values were also significantly impaired. (Table 6).

Table 6 : Preoperative pattern evoked response in eighteen patients with giant pituitary adenoma

	Amplitude		Latency	
	Left	Right	Left	Right
Mean	2.9±2.1	2.7±2.5	140.5±39.5	154.2±43.7

Early postoperative VEP values were also significantly pathological and there was no improvement in the early postoperative period. (Table 7)

Table 7 : Early postoperative pattern evoked response in eighteen patients with giant pituitary adenoma

	Amplitude		Latency	
	Left	Right	Left	Right
Mean	2.5±2.0	2.5±2.3	138.4±42.5	151.2±42.5

DISCUSSION

The results of this series of 100 patients with documentation of pitutitary tumour demonstrated clearly that compression of the optic nerves can produce abnormalities in the VEP pattern. This can be analyzed by quantitative measures and is correlated with findings from other clinical tests. These have also been confirmed by computerized tomography and by operative means as having significant suprasellar extension.

The first group of patients with intrasellar tumours had no apparent VEP abnormalities. Mean values of this group did not differ significantly from the control group. Only five cases, with minimal suprasellar extension had VEP abnormalities.

Results of the second group prove that suprasellar extension of pituitary tumours causes VEP abnormalities. These abnormalities are lantency delay and minimal decrease in amplitude.

Lennerstrand states (12) that amplitude measurements have proved less useful in the VEP diagnosis since normal variations are so wide. We do not accept this result because we had the same mean amplitude with the control and intrasellar tumour group ($P>0.05$) and significantly reduced mean amplitude in the suprasellar pituitary tumour group ($P<0.05$).

Gott et al. (7) showed that the latency delay was the most prevalent VEP abnormality. He also said that the surprisingly small incidence (4/19) of delayed latency of patients of Halliday et al. (1,2) may be attributed to advanced stages of optic pathway compression. This is not true for our cases. Macro and giant tumours with advanced stages of optic pathway compression have delayed latency and this result does not correlate with Gott's interpretation.

Halliday declares that delayed response may be encountered in the early stages of compression but may disappear when amplitude is reduced by further progress of the lesion. In our second and third group of patients latency delay and reduced amplitude were encountered and these resulte are statistically significant (8). In two groups contrary to Halliday's explanation latency delay and reduced amplitude were encountered simultaneously, and latency delay did not disappear when the amplitude was reduced.

In another study of 10 patients (8 pituitary tumours) with chiasmal compression, Holder (9) found abnormal VEPs in all patients. In this study, in contrast to the cases of Halliday, 7 patients had an abnormal (or absent) latency. In contrast to Holder's study, our cases exhibited both latency and amplitude abnormalities.

In our study, CT correlates with VEPs. Suprasellar extension of the pituitary tumour affects the VEP. In marco and giant tumours prominent VEP changes occur and do not improve after total tumour resection. According to Korol (11) if no improvement occurs, the expansive process has caused an irreparable optic nerve pathway.

This study shows that compression of optic pathways by pituitary tumour causes latency delay and amplitude reduction and these changes are in correlation with the tumour size. VEP changes are not reversible when macro and giant tumours cause irreparable optic nerve atrophy.

Correspondence and reprints to : Assoc. Prof. Dr. Nihat Egemen
A.Ü. Tıp Fakültesi Nöroşirürji Anabilim Dalı.
İbni Sina Hastanesi. Sıhhıye ANKARA-TÜRKİYE.

This work was supported by a grant from Ankara University Research fund (87-09-0059)

REFERENCES

1. Barret g. Blumhardt L. Halliday A M. et al: A paradox in the lateralisation of the visual evoked response: Nature 26:May 20:253-255. 1976
2. Blumhardt L. Barret G. Halliday A.M:The asymmetrical visual evoked potential to pattern reversal in one half field and its significance for the analysis of visual field defects: Brith J of Ophthalmol 61:454-461. 1977
3. Costa e Silva I. Wang AD. Symon L: The application of flash visual evoked potentials during operations on the anterior visual pathways: Neurol Res 7(1):11-16. 1985
4. Erwin CW. Brendle A. Drake ME: Evoked potentials from the visual. auditory and somato-sensory systems: Wilkins RH and Rengachary SS(ed): Neurosurgery. Mc Graw-Hill book Company. 1985. 211-223
5. Feinsod M. Auerbach E: The electroretinogram and the visual evoked potential in two patient with tuberculum sella meningioma before and after decompression of the optic nerve: Ophthalmolgica 163:360-368. 1971
6. Feinsod M. Selbhorst J. Hoyt W. et al: Monitoring optic nerve function during craniotomy: J Neurosug 44:29-31. 1976
7. Gott PS. Weiss MH. Apuzzo M. et al: Checkerboard visual evoked response in evaluation and management of pituitary tumors: Neurosurgery 5(5):253-258. 1979
8. Haliday A M. Halliday E. Kriss A. et al: The pattern evoked potential in compression of the anterior visual pathways: Brain 99:357-374. 1976
9. Holder CE:The effects of chiasmal compression on the pattern visual evoked potential: Electroencephalog and Clin Neurophysiol 45:278-280. 1978
10. Kooi KA. Güvener A. Bagehi BK: Visual evoked responses in lesions of higher optic pathways: Neurology 15:841-854. 1965
11. Korol S: Le syndrome chiasmatique-L interest des potentieles evoques visuels pour le diagnostic: Klin Mbl Augenheilk 170:314-322. 1977
12. Lennerstrand G: Visual recovery after treatment for pituitary adanoma: Acta Ophthalmol 6:1104-1117. 1983
13. Peterson J: Objective determination of visual acuity by visual evoked potentials: Dev Ophthal 9:109-114. 1984
14. Pullan PT. Carroll WM. Chacera TM. et al.: Management of extrasellar pituitary tumors with bromocriptine: Comparison of prolactin secreting tumors with non-functioning tumors using half-field visual evoked potentials and computerized tomography: Aust NZ J Med. 15(2):203-208. 1985
15. Wilson WB. Krisch WM. Stears J. et al: Monitoring of visual function during parasellar surgery: Surg Neurol 5:323-329. 1976