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INTERHEMISPHERIC DIFFERENCES IN PHOTOSENSITIVE EPILEPSY. II. INTERMITTENT PHOTIC STIMULATION

C.D. BINNIE *, A.J. WILKINS ** and R.A. DE KORTE *

* *Instituut voor Epilepsiebestrijding, Heemstede (The Netherlands) and ** MRC Applied Psychology Unit, Cambridge (England)*

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Detailed studies of 15 pattern-sensitive epileptic patients (Wilkins et al. 1981) have shown interhemispheric differences of sensitivity thresholds and suggest that these asymmetries are unrelated to the type of epilepsy or to gross neurological deficit. In view of the implications concerning the distribution of the presumed cortical hyperexcitability in the generalized cortico-reticular epilepsies (Gloor 1968, 1979), it would be desirable to investigate a much larger and less selected sample of patients. The numbers of subjects available for such studies are necessarily very limited. However, in view of the positive correlation between asymmetry in pattern threshold and asymmetry in response to intermittent photic stimulation (IPS) we carried out a retrospective survey of the symmetry of epileptiform responses to IPS in a larger group of patients.

Material and Methods

Of 2712 consecutive patients referred for clinical EEG investigation in the Instituut voor Epilepsiebestrijding during the 2.5 years to June 1980, 138 were found to be photosensitive by the criterion that IPS produced at least once a classical generalized photoconvulsive response (Bickford et al. 1952) which outlasted the stimulus (Reilly and Peters 1973). Though details of IPS technique varied over the period of the study, in general the procedure was as follows. Diffuse IPS was performed with a photic stimulator at an intensity of approximately 100 nit-s/flash and a distance of 300 mm from the nasion. The patient was instructed to fixate the centre of the lamp and the technician checked so far as possible that fixation was maintained. At each frequency the conditions eyes open, eyes closure and eyes closed were tested. For further details see Binnie et al. (1981). Procedures for pattern testing are described elsewhere (Darby et al. 1980).

Assessment of asymmetry was based on the initial component of each discharge and took no account of subsequent events. Spikes, sharp waves and spike-wave complexes were considered, whether generalized, posterior or focal, but photic following and related phenomena, including occipital spikes at the flash rate, were excluded. All but 20 of these patients were receiving antiepileptic medication. One observer assessed all records. Forty were also read by a second independent rater. Despite minor disagreements concerning individual discharges there was in no case any difference in overall assessment of the symmetry of responses.

Results

Of 138 patients, 57 showed a unilateral preponderance of asymmetrical discharges elicited by IPS which was significant in each individual at the 5% level by the sign test. In 30 instances the discharges were larger on the right. Fifty-two showed either predominant-

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ly symmetrical responses or only random asymmetries and in a third group of 29 no conclusion could be reached: generally because the number of discharges elicited was less than 6 (the smallest value of n for which the sign test can reach the 5% level of significance). In 3 patients an apparent asymmetry was not sufficiently consistent to reach statistical significance despite a larger number of discharges. This third group is excluded from further consideration.

Comparing the subjects with symmetrical or clearly asymmetrical discharges there was a striking lack of clinical difference (Table I). Notably there was no association between asymmetrical discharges and the diagnosis of partial epilepsy. Lateralizing neurological signs were rare in both groups and there was no association of soft signs such as left handedness with lateralization of photosensitivity (indeed, 25% of patients with symmetrical responses were left handed or ambidextrous but only 15% of those with asymmetrical responses).

There was a high degree of test/re-test stability (Table II): 48 patients exhibited photosensitivity in more than 1 EEG. Four of those with asymmetrical reactions subsequently responded symmetrically; otherwise there was no change of symmetry or lateralization. There was also consistency between asymmetries of discharges elicited by different visual stimuli (IPS, pattern, television and self-induction by slow eye-closure). There was a strong, significant association of pattern sensitivity with asymmetry of IPS response ($\chi^2 = 16.15$, df = 1, $P < 0.001$).

Sixty-five patients exhibited both spontaneous and IPS-induced discharges in the same EEG and there were several significant associations (Table III): (i) between asymmetry of spontaneous discharges and of those induced by IPS ($\chi^2 = 5.39$, df = 1, $P < 0.05$); (ii) between laterality of asymmetrical spontaneous discharges and that of those induced by IPS ($\chi^2 = 9.76$, df = 1, $P < 0.01$); and (iii)

TABLE II

Symmetry of IPS-induced discharges: test/re-test stability and relation to symmetry of pattern-induced responses.

	IPS-induced discharges	
	Symmetrical	Asymmetrical
IPS re-tested	19	29
Symmetrical	19	4
Laterality consistent	n.a.	25
Pattern sensitivity tested	35	44
Sensitive	19 (54%)	41 (93%)
Symmetrical	19	2
Laterality consistent	n.a.	38
Laterality inconsistent	n.a.	1

TABLE I

Summary of clinical findings in patients with symmetrical or asymmetrical IPS-induced epileptiform discharges.

	138 patients with IPS-induced epileptiform discharges		
	Symmetrical	Asymmetrical	Unclassified
Number	52	57	29
Mean age (years)	20.9	19.9	
Sex F/M	37/15	35/22	
Type of epilepsy			
Primary generalized	27	28	
Partial	16	14	
Secondary generalized	7	8	
Unclassified	2	7	

TABLE III

Symmetry of IPS-induced discharges and topography of spontaneous epileptiform activity.

Topography of spontaneous discharges	IPS-induced discharges	
	Symmetrical	Asymmetrical
Symmetrical	18	7
Asymmetrical	17	23
Laterality consistent with IPS	n.a.	19
Occipital/post. temporal maximum	3	9
Focal elsewhere	13	12
Diffuse/fronto-central maximum	19	9

between topography of spontaneous discharges and symmetrical responses to IPS ($\chi^2 = 6.26$, df = 2, $P < 0.05$). Patients with symmetrical IPS responses tended to have diffuse spontaneous epileptiform activity; those with asymmetrical responses often showed posteriorly situated spontaneous discharges. Asymmetry of IPS-induced epileptiform activity was unrelated to asymmetry of background activity or of photic following or to other non-epileptiform EEG abnormalities. Asymmetrical IPS was thus associated only with similar asymmetries of spontaneous discharges but was apparently unrelated to other EEG or clinical signs of lateralized cerebral pathology and in particular was independent of the type of epilepsy.

The upper and lower flash rates eliciting epileptiform activity under the most epileptogenic condition (eyes open, closed or eye closure) were closely similar in the two groups of patients (Table IV). However, when the topography of the photoconvulsive response was considered there was a significant association of epileptiform activity commencing over the occipital or posterior temporal regions with asymmetry of response ($\chi^2 = 12.18$, df = 1, $P < 0.001$). This may to some extent be an artefact of the method of visual assessment in the sense that discharges which were initially localized might more readily be classified as asymmetrical.

Discussion

The findings in this retrospective study of IPS sensitivity support the conclusion of our

TABLE IV

Characteristics of IPS-induced discharges.

	IPS-induced discharges	
	Symmetrical	Asymmetrical
IPS sensitivity		
Mean lower limit (flashes/sec)	9	10
Mean upper limit (flashes/sec)	37	36
Topography of discharges on IPS		
Diffuse/fronto-central maximum	21	6
Occipital/post. temporal	29	49
Other	2	2

investigation of hemifield pattern stimulation (Wilkins et al. 1981) that asymmetry of visual sensitivity is common and independent of the type of epilepsy. Various investigations over some 15 years, most notably by the Montreal School (Gloor 1968, 1979) have led to the replacement of the classical model of centrencephalic epilepsy by the concept of the generalized cortico-reticular epilepsies in which diffuse cortical hyperexcitability plays a major role. The present findings may suggest that the model should be further refined to allow of the cortical hyperexcitability being non-uniform and at the least markedly asymmetrical. If this is the case, then the distinction between primary generalized and partial epilepsies may need to be reconsidered.

Summary

Of a consecutive series of 138 photosensitive epileptic patients 57 showed a unilateral preponderance of asymmetrical discharges on IPS, significant in each individual at the 5% level. There was no association between asymmetry of IPS-induced discharges and clinical evidence of cerebral pathology (partial or secondary generalized epilepsy, neurological deficit, left handedness, etc.). It is concluded that these results, together with our previous findings of asymmetrical pattern sensitivity suggest that the cortical hyperexcitability postulated in primary cortico-reticular epilepsy is not uniformly distributed.

Résumé

Différences interhémisphériques dans l'épilepsie photosensible. II. Stimulation lumineuse intermittente

Dans une série de 138 patients atteints d'épilepsie photosensible, 57 ont présenté une prépondérance unilatérale des décharges asymétriques à la stimulation lumineuse intermittente (SLI), significative au seuil de 5% pour chacun des sujets. Il n'y avait pas de lien entre l'asymétrie des décharges à la SLI et la démonstration clinique d'une pathologie cérébrale (épilepsie généralisée partielle ou secondaire, déficit neurologique, gaucherie; etc.). Ces résultats, associés à nos observations précédentes sur l'asymétrie de la sensibilité au pattern, suggèrent que l'hyperexcitabilité corticale qui est postulée dans l'épilepsie cortico-réticulaire primaire n'est pas uniformément répartie.

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