Intern. J. Neuroscience, 1986, Vol. 30, pp. 23–32
0020-7454/86/3002-0023 $18.50/0

PARTIAL PSYCHIC SEIZURES AND BRAIN ORGANIZATION

ALFREDO ARDILA, PATRICIA MONTAÑES, BYRON BERNAL
ALEJANDRO SERPA and EDWIN RUIZ
Instituto Neurologico de Colombia

(*Received December 9th, 1985*)

This research was an attempt to determine the cerebral areas involved in focal epileptic seizures accompanied by psychic manifestations. Six types of partial seizures involving psychic symptomatology and phonatory seizures were included in the study. Sixty-one clinical records of focal epilepsy, which had been revealed by means of a CT-scan examination, were analyzed and a subsample of 25 patients with psychic symptoms was selected. The scans taken of the lesions were transferred to a six-level standard template built for this purpose. Subsequently, templates of patients with the same type of seizures were superimposed. The critical zones for the seven types of seizures studied are presented. A clear correlation was found between these results and our present knowledge of functional brain organization.

Hughlings Jackson (1884) was the first to describe the psychic changes involved in epilepsy. He considered that an epileptogenic focus can produce the so-called "dreamy states" of which he distinguished three types: hallucinations, illusions and mental confusion.

At present, the interpretation of these paroxysmal psychic phenomena is not completely clear. They have been said to be related to epileptic discharges either in the neocortex or in the temporal limbic structures (Penfield & Rassmusen, 1950; Halgren et al., 1978; Gloor et al., 1982; Frederiks, 1985). The International League Against Epilelsy (1981) has distinguished six types of partial seizures with psychic symptomatology: dysphasic, dysmnesic, cognitive and affective seizures, illusions and complex hallucinations. Phonatory seizures (paroxysmal expressive type of aphasia) are regarded as motor seizures.

Several papers have been published recently in which the superimposed CT-scan techinque was employed for localizing neuropsychological syndromes (Kertesz, 1979, 1983, 1984; Kertesz et al., 1982, Damasio & Damasio, 1983; Wallesch et al., 1983). This technique could also be used for localizing the foci of paroxysmal phenomena and complex psychological phenomena in particular.

Using the superimposed CT-scans technique, an attempt was made to locate the critical areas involved in partial seizures with psychic symtomatology. Due to their importance, phonatory seizures were also included.

METHOD

Subjects. The sample comprised 61 subjects displaying some focal manifestation of epilepsy and evidencing circumscribed brain damage. Thirty-nine of the subjects

---

A previous version of this paper was presented at the VIII European Meeting of the International Neuropsychological Society and at the XIII World Congress of Neurology.

Address for Correspondence: Alfredo Ardila, Instituto Neurologico de Colombia, Apartado Aereo 17021, Bogota, Colombia, South America.

were male and 22 female, with a mean age of 35.5 (SD = 14.81). The majority of the subjects had focal seizures of recent appearance.

A subsample of 25 subjects, with focal manifestations of a psychic type, whose damage permitted adequate graphic analysis, was selected for the CT-scans superimposition. Some of the patients had more than one type of seizure and were therefore included in two different groups, giving a total of 34 "cases."

Instruments. CT-scans of 25 subjects, taken at the Neurological Institute of Colombia between 1977 and 1984 using two different types of scanning techniques were taken as basic data. Up to June 1982, scans were taken with a General Electric CT/N scanner with a 160×160 matrix and 1.0 cm cuts, and after that date a General Electric CTT/8.800 scanner with a 320×320 matrix and cuts of 0.5 and 1.0 cm were used.

A template was prepared to facilitate the transcription of the scanned lesions in a uniform manner (Figure 1). It was designed to include six standard scanner cuts, each correspoding to a representative level of the brain, from the base to the most cortical portion.

Procedure. The sample was selected from patients fulfilling the following requirements: (a) that they had sustained focal seizures with psychic or phonatory symptomatology, and (b) had some local damage revealed by means of CT-brain scans. The seizures that the selected patients presented were catalogued in accordance with the International Epilepsy Classification (ILAE, 1981), and an attempt was made to obtain a detailed description of the ictal event. The form of the damage for each patient obtained through the scans was transferred to the previously prepared template. The templates were subsequently grouped according to the types of seizures and the images

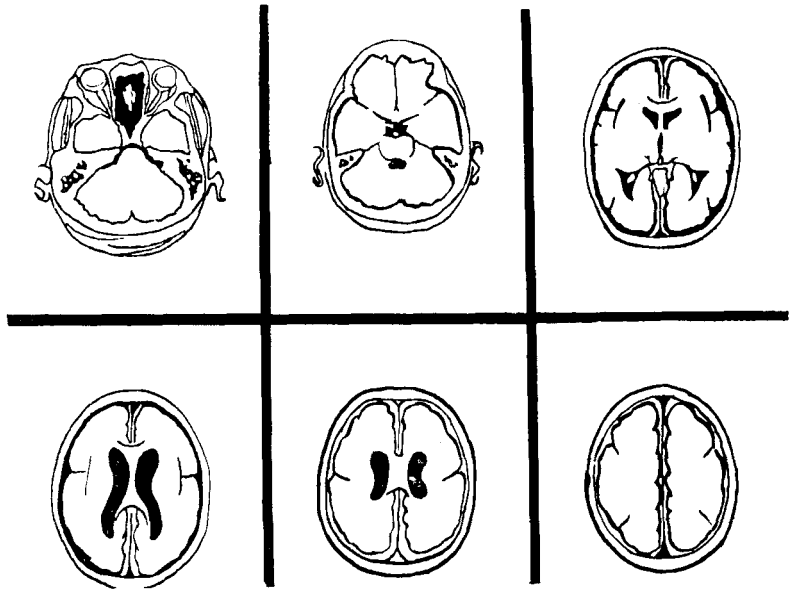


FIGURE 1 Template used

were superimposed. Images of damage in individuals presenting the same type of seizure were traced. Finally, the hemispherical lateralization was considered for each manifestation.

RESULTS

1. *Dysphasic Seizures*

Superimposition of the scans revealed damage in left hemispheric regions, corresponding to Wernicke's area. The patients reported a Wernicke-type aphasia with difficulty in understanding language, forgetfulness of words, paraphasias, etc. (Figure 2).

Depening on the exact localization of the damage, if the sample were increased, a variability of the present characteristics of these seizures would be expected, taking more the form of forgetfulness of words, phonological substitution in expressive language (phonological paraphasias), etc. The analysis of this type of case history points to the need to clarify the manifestation of seizures of this kind, especially as far as differentiation between phonotary and dysphasic seizures is concerned. As expected, and despite the small size of the sample, the seizures are limited to the language-dominant hemisphere.

2. *Dysmnestic Seizures*

The superimposition of six cases showed damage exactly above the anterior hippocampus. The most frequent case found in this type of seizure was the *déja-vu* phenomenon. Only once was a seizure reported of "things that had already happened," of "remembrances of the past" and of "the sensation of wanting to remember something" (Figure 3).

These seizures were important due to thier high frequency of occurrence. The location by means of the scan superimposition coincides with reports from previous investigations based on electrical stimulation. It is not surprising that they are generally associated with seizures of the limbic structures. No significant differences were found concerning the occurrence of *déja-vu* with respect to the right and left hemispheres. Furthermore, these seizures were frequently associated with behavioral changes.

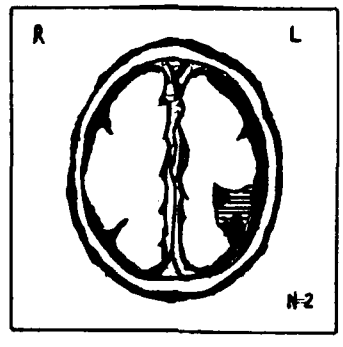


FIGURE 2 Dysphasic Seizures

3. *Cognitive Seizures*

The superimposition of three cases showed damage to the parahippocampal gyrus. The critical zone was similar to that involved in visual and auditory complex hallucinations, and relatively close, but more posterior and basal, to that of the dysmnesic phenomena. The most frequent seizures were those characterized by mental confusion, depersonalization and lack of orientation (Figure 4).

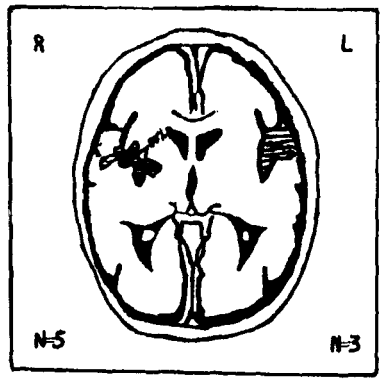
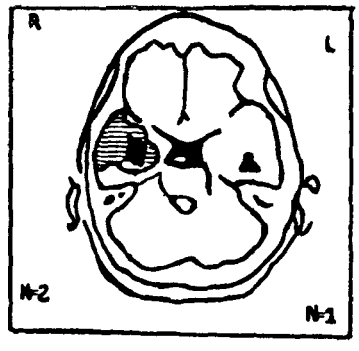


FIGURE 3 Dysmnesic Seizures



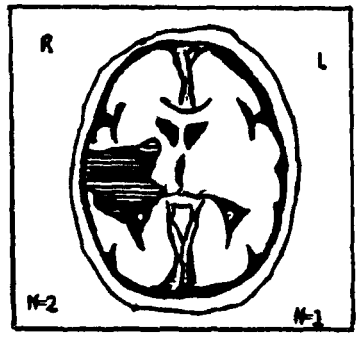


FIGURE 4 Cognitive Seizures

The results allow us to propose that damage to the temporal lobe base (parahippocampal and fusiform gyri) results in hallucintory and cognitive phenomena involving strange feelings, thoughts, ideas and such. On the other hand, damage located towards the anterior hippocampus leads to phenomena more related to memory (vision of past images), amnesic hallucinations, false recognition, etc.

4. *Affective Seizures*

In seizures characterized by fear and anxiety, the superimposition of scans showed damage to the amygdala. In the case of anger as an ictal manifestation, the only graphically analyzed case does not lead to a clear interpretation. In this case, damage was found in the base of the right temporal lobe, almost coinciding with, but more posterior to, the critical zone of the anxiety experience (amygdala) (Figure 5).

An unusual type of seizure was found, a happiness seizure, in which the location of the damage was considerably higher and more extended. In this case, the lesion involved a large meningioma of the left hemisphere, extending along the interhemispheric fissure and possibly covering the cingulum which would be responsible for this feeling.

The behavioral charges observed in these individuals correspond to the type of seizure and, in the case of anger, agree with the hypothesis that aggression is only evoked in aggressive individuals.

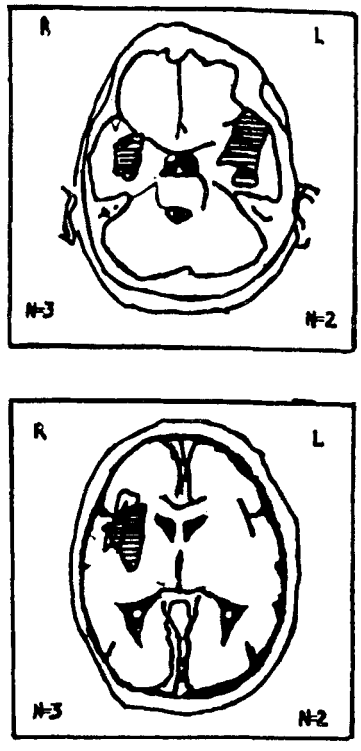


FIGURE 5 Affective Seizures

In the case of affective seizures, where the amygdala was found to be the critically damaged area, a high frequency of appearance of "unpleasant" feelings was observed.

5. *Visual and Auditory Illusions*

Superimposition of the cases showed damage to the optical radiation. In this case, no significant differences in the frequency of occurrence between the two hemispheres were found. However, the reduced size of the sample and the low frequency of appearance did not permit a more valid comparison. In the case of auditory illusions, scans were not superimposed as only one case was found with right hemisphere damage. This seizure was associated with a dysmnesic seizure, a visual illusion, and a seizure in which a feeling that everything was moving farther into the distance was involved.

6. *Auditory and Visual Hallucinations*

The critical zone of superimposition for auditory hallucinations corresponded almost exactly to the critical zone for complex visual hallucinations, a small zone located at the level of the parahippocampal gyrus (Figure 6).

As expected, visual hallucinations were found less frequently and although the zone in which they were found is small, damage tends to extend either toward the fusiform gyrus or the hippocampus. These hallucinations were very varied and complex.

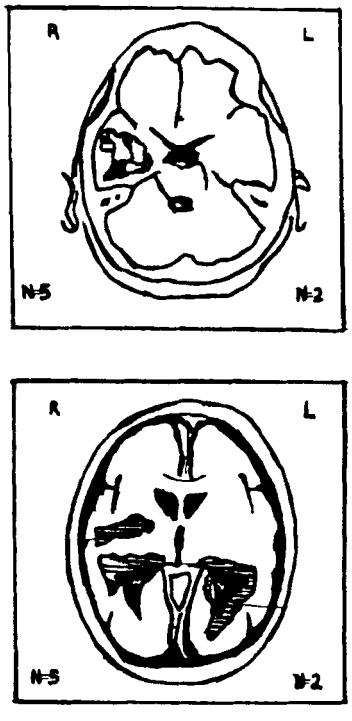


FIGURE 6 Visual illusions and hallucinations

It is important to emphasize the fact that the above mentioned seizures were more frequently related to cases of right hemisphere damage, a finding which agrees with the observation of Penfield and Perot (1963).

7. *Phonatory Seizures*

The superimposition of the CT-scans was based on four cases, Two critical areas were made evident: (1) a parasagittal area which probably concerns the supplementary motor area, and (2) a premotor area, located in front of the primary motor area of the face and the tongue, corresponding to Broca's area.

The phonatory seizures consisted of language detention ("could not talk," "the words would not come out"). A subsequent analysis would possibly permit the association of the first cortical area to the supplementary motor area, and the second to Broca's area, lesions of which produce difficulty in expression iteration, assimilations, etc.

Upon subsequent analysis, we would hope to find a third type of phonatory seizure, characterized by the so-called "paroxysmal palilalia," where the patient repeats, in a reiterative manner, verbal elements of a higher level (words, phrases). In the only detected and documented case, damage was found in front of Broca's area and was consequently prefrontal, thus simulating a more paroxysmal dynamic-type aphasia. Due to the fact that only one case was available, it was not included for further analysis.

The following facts call our attention with respect to phonatory seizures: relatively low frequency of occurrence as compared to the remaining types of seizures and predominance of left hemisphere damage.

8. *Cerebral Asymmetry*

Regarding the relation between the type of seizure and the damaged hemisphere, Chi-square analysis showed significant differences only in phonatory seizures (Chi-square $=6.4$; $p<.05$), visual hallucinations (Chi-square $=5.44$; $p<.05$), and dysphasic seizures (Chi-square $=4$; $p<.05$).

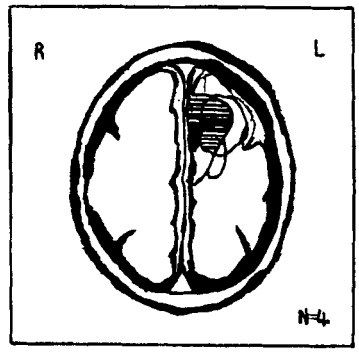


FIGURE 7 Phonatory Seizures

DISCUSSION

Although the present study is of a basically descriptive value, more systematized investigations would enable researchers to probe numerous hypotheses related to the focal seizures of neuropsychological interest. The continuation of this research, using the method of superimpositions and based both on detailed questionsing and on a larger sample, would yield results of great interest.

A general factor worth mentioning, is the scarce importance that has been given to epileptic seizures other than motor, somatosensory, and generalized ones. The way in which these seizures are related demonstrates our frequent failure to question patients in detail, especially as far as the complete sequence of the ictal event is concerned.

The psychic phenomenon very frequently appears as the aura of a generalized seizure and in itself is considered to be of little relevance to either patient or doctor. On occasions, the patient is only able to report the phenomenon after careful interroguation.

Although of great potential value, the results obtained raise more questions than they answer. It is important to mention that enormous technical difficulties are involved in determining the lesion precisely. No matter how expert a neuroradiologist may be, it is difficult correctly to ascertain the exact limits of the lesion and transcribe it accurately onto a standard template. Strictly speaking, the convulsion-producing focus is not represented by the lesion itself, but rather by its borders. It is difficult to determine precisely the exact extension of the associated perilesional edema and the epileptic discharge extends from the focus to other areas of the cortex. Furthermore, in the case of our research, the scanner cuts used in the standard template were relatively few. Although more than 10,000 case histories were reviewed, covering the records of almost ten years, it was only possible to find 61 cases with a sufficiently accurate diagnosis and history of simple partial seizures. Of these, only 25 offered a perfectly defined, psychic symptomatology together with an accurate radiological diagnosis.

In spite of these limitations, it is possible to draw certain conclusions worthy of consideration. Since the time of Jackson (1884) to the present day, paroxysmal language disorders have been associated with discharges coming from the left hemisphere (Frederiks, 1985), and it has usually been accepted that they can adopt different modalities. Alajouanine and Sabourand (1960), for example, suppose that at least three different varieties can exist: (1) aphasia, (2) language detention, and (3) dysarthria. In its most recent classification of epileptic disorders, the International League Against Epilepsy (1981) considers expressive disorders in language to be phonatory seizures and includes them within the group of motor seizures; on the other hand, the League considers impressive defects to come under the category of partial psychic seizures, within the dysphasic seizures group. Our results indicate the existence of three types of expressive defects corresponding to different topographic foci in the frontal lobe and we believe that with a sufficiently accute clinical analysis of the ictal event, it should be possible to distinguish variants of paroxysmal aphasia of the Wernicke type, in the way that it is possible to recognize variants of Wernicke type aphasias in the neuropsychological clinic. Indeed, Wilson et al., (1983), for example, were able to mention a case of paroxysmal jargon aphasia. To do this, however, it will be necessary to use much larger samples.

Paroxysmal perceptual disorders are of many kinds (illusions and hallucinations, simple and formed, unimodal and multimodal) and are usually of a temporal origin

(Fredericks, 1985). Given the enormous complexity and variability of paroxysmal perceptual phenomena, it has been supposed that their localization value is little more than suggestive (Ajmone, Marsan & Goldhammer, 1973). However, the careful distinction between different types (Daly, 1975) could in some way throw light on the cerebral organization of perceptual activity. A large number of perceptual deficits which could be the result of circumscribed brain damage have described in the neuropsychology clinic (Ardila & Ostrosky, 1984) and have been correlated with different topographies.

Phenomena of a cognitive type (feelings of strangeness, depersonalization, "dreamy states," forced thought, etc.) were found in this research to be the result of irritative foci in zones similar to the critical zones for visual and auditory hallucinations, the parahippocampal region, and to be relatively close, but more posterior and basal, to the zone where paraxysmal dysmnesias appear. These cognitive phenomena in some way refer to the individual's experiences in relation to the outside world and the content of his thoughts and, strictly speaking, could be classified as "paroxysmal psychoses." It is to be supposed that their analysis can, to a certain extent, illustrate the mechanisms underlying psychotic states in the same way that paroxysmal aphasias throw some light onto the cerebral organization of linguistic processes.

Paroxysmal states of fear and anxiety were found to be related to discharges from the amygdala. Anxiety has generally been considered to be the most frequent aura in epilepsy of the temporal lobe (Gloor, 1972). The relationship between the amygdala and anxiety states in both humans and animals has been reported repeatedly in the literature (Blanchard et al., 1979; Panksepp, 1985).

Paroxysmal dysmnesic phenomena have been analyzed in detail (Daly, 1975) and their relation to the hippocampal structures is not surprising. There is also a close connection between hallucinatory and dysmnesic phenomena and on occasion it is difficult to distinguish the one from the other.

With the exception of language-related seizures, whose origin has always been connected to the classic language areas in left hemisphere, psychic phenomena, or at least a large number of them, appear as the result of the presence of irritative foci surrounding the structures of the mesial temporal lobe. Complex partial seizures (involving the conscience) are of a similar origin (Daly, 1975) and in some way, therefore, illustrate the cerebral organization of psychic activity.

In spite of the immense difficulties outlined earlier, clinical study and the nervous correlates of paroxysmal psychic phenomena represent an extremely promising field of research of great interest to neuropsychology.

REFERENCES

Ajmone Marsan, C. & Goldhammer, L. Clinical ictal patterns and electrographic data in cases of partial seizures of frontal-central-parietal origen. In M.A.B. Brazier (Ed.) *Epilepsy: Its phenomena in man*, New York: Academic Press, 1973, pp. 235–258.

Alajouanine, T. & Sabourand, A. Les perturbations paroxystiques de langage dans l'epilepsie, *Encephale*, 1960, **49**, 95–133.

Ardila, A. & Ostrosky, F. The right hemisphere and behavior: a review of the problem. In A. Ardila & F. Ostrosky (Eds.) *The right hemisphere: Neurology and Neuropsychology*, New York Gordon and Breach Science Publishers, 1984, 3–50.

Blandchard, D. C., Blanchard, R. J., Lee, E. M., & Nakamura, S. Defensive behavior in rats following septal and septalamygdala lesions. *Journal of Comparative & Physiological Psychology*, 1979, **93**, 378–390.

Daly, D. D. Ictal clinical manifestations of complex partial seizures. In J. N. Perny & D. D. Daly (Eds.) *Advances in Neurology*, Vol. 11, New York: Academic Press, 1975.

Damasio, A. R. & Damasio, H. The anatomic basis of pure alexia. *Neurology*, 1983, **33,** 1573–1585.

Frederiks, J. A. M. Paroxysmal neuropsychological disorders. In J. A. M. Frederiks (Eds.) *Handbook of clinical neurology: Clinical neuropsychology*. Amsterdam: Elsevier Science Publishers, 1985, pp. 507–514.

Gloor, P. Temporal lobe epilepsy: Its possible contributions to the understanding of the functional sigificance of the amydala and of its interactions with neo-cortical temporal mechanisms, In B. E. Eleftheriou (Eds.) *The neurobiology of amygdala*. New York: Plenum Press, 1972, pp. 423–457.

Gloor, P., Olivier, A., Quesney, L. F., Andermann, F., & Horowitz, S. The role of limbic system in experimental phenomena of temporal lobe epilepsy. *Annals of Neurology*, 1982, **12,** 129–144.

Halgren, E., Waltor, R. D., Cherlow, D. G., & Crandall P. H. Mental phenomena evoked by electrical stimulation of the human hippocampal formation and amygdala. *Brain*, 1978, **101,** 83–117.

ILAE, New international classification of epileptic seizures. Kyoto (Japan), 1981.

Jackson, H. *Evolution and dissolution of the nervous system*, Groonian Lecture, Selected papers II, 1884.

Kertesz, A. *Aphasia and associated disorders: Taxonomy, localization and recovery*. New York: Grune & Stratton, 1979.

Kertesz A., Sheppard, A., & MacKenzie, R. Localization in transcortical sensory aphasia. *Archives of Neurology*, 1982, **39,** 475–478.

Kestesz, A. *Localization in neuropsychology*, New York: Academic press, 1983.

Kertesz, A. The clinical spectrum and anatomical localization of visual agnosia. Seventh INS European Conference, Archen (Germany), 1984.

Panksepp, J. Mood changes. In J. A. M. Frederiks (Eds.) *Handbook of clinical neurology: Clinical neuropsychology*, Amsterdam: Elsevier Science Publishers, 1985, pp. 271–286.

Penfield, W. & Rasmussen, T. *The cerebral cortex of man: A clinical study of localization of functions*. New York: Macmillan, 1950.

Penfield, W. & Perot, P., The brain record of auditory and visual experience. *Brain*, 1963, **86,** 595–696.

Wallesch, C. W., Kornhuber, H. H., Brunner, R. J., Kunz, T., Hollerbach, B., & Suger, G. Lesions of the basal ganglia, thalamus and deep white matter: Differential effects on language functions. *Brain and Language*, 1983, **20,** 286–304.

Wilson, A., Petty, R., Perry, A., & Clifford, R. Paroxysmal language disturbance in an epileptic treated with clobazan, *Neurology*, 1983. **33,** 652–654.