SOME ADDITIONAL ELECTROENCEPHALOGRAPHIC TECHNIQUES FOR THE LOCALIZATION OF INTRACRANIAL LESIONS

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INTRODUCTION

The importance of electroencephalography as a non-traumatic procedure for the localization of intracranial lesions is becoming increasingly evident. The success of the procedure depends upon the care with which it is applied, upon the variations to which it is subjected for attacking different types of lesions present in different regions, and upon the possibility of building pieces of evidence obtained from recordings into one total pattern of interpretation. Interpretation, though it is an intellectual process which establishes interrelationship between different data, is in the final analysis dependent upon such data. An advance in interpretation would obviously be predicated in part upon the introduction of techniques that would furnish us with new data, and in part upon the availability of correlation of these data on the one hand and the clinical neurological, and neuropathological findings on the other.

Investigators have placed on the skull 16 or 22 leads, and have used different types of monopolar and bipolar recordings for localization purposes. Some have preferred monopolar recordings, whereas others certain types of bipolar recordings which show a reverse phase relationship of slow waves near the lesion areas. Still others use both monopolar and bipolar recordings. It would be difficult to claim absolute success for any one standardized localizing method in all cases as the following variables are likely to show different degrees and types of electroencephalographic changes in the favored and non-favored leads; i.e., size, nature, rate of change, location and milieu of the lesion, and orientation of the lesion to the cortex and to the leads. It is not a question of how many leads are put on the skull that is important, but where they are put on. It is also important how the abnormal electrical activity surrounding the lesion is brought into prominence differentially by a choice of electrode combinations in simultaneous recordings of critical and non-critical areas. Bits of knowledge thus gathered form the basis of the final localizing evaluation. As in the neurological examination the two halves of the body are compared for strength and character of the reflexes, sensation, motor power, etc., so in electroencephalographic localization homologous areas of the two hemispheres, and distant or neighboring areas of the same hemisphere are compared. This comparison involves an
elaborate technique and a prolonged attempt at sorting the essential from the non-essential.

The problem of a close and accurate localization of a lesion electroencephalographically resolves into the following aspects:

1. Elimination of or correction for complicating factors as follows:
   a. Physiological and technical artifacts. (These will not be elaborated here.)
   b. The distance effect. In the comparison of homologous or heterologous areas, the high voltage of slow waves or other waves with long inter-electrode distance should not be considered *per se* to have greater localizing weight than the low voltage of slow waves or other waves with short inter-electrode distance. This is because of the general observation that normally the longer the distance between the electrodes the higher the voltage, and conversely, the shorter the distance the lower the voltage. This principle applies only within certain limits, the reasons being that the four lobes of the brain have somewhat different voltage, and the relationship between voltage and distance is not linear. For example, an increase of 2 cm. beyond an 8 cm. inter-electrode distance would not record as much voltage increase as a similar increase beyond a 3 cm. inter-electrode distance. The distance effect need not always be corrected for, especially when the situation is reversed, the high voltage of slow or other waves with short inter-electrode distance having greater localizing significance than the low voltage of slow or other waves with long inter-electrode distance.
   c. The effect of electrical spread of electroencephalographic signs to homologous areas (particularly in the frontal areas), to contiguous or distant areas that are not the main focus of structural involvement.
   d. High voltage bilateral delta waves or bursts due to "idiopathic" epileptic changes (Fig. 1, strips 4, 5, and 6), prolonged high intracranial pressure, or conditions severely clouding the sensorium.
   e. Generalized slow wave bursts in monopolar or bipolar recordings that are likely to confuse the validity of important differential unilateral bursts of the same or similar types. This is particularly true of deep parasagittal gliomatous neoplasms, vascular lesions, or traumatic lesions having a slight preference for one side.

2. Lateralization.
3. Determination of antero-posterior extension, of medio-lateral extension, of superior-inferior extension, or of parasagittal involvement.
4. Determination of the size and nature of the lesion.

An adequate solution of all these aspects of the localizing problem needs in the first place as many simultaneous comparisons of the involved and the non-involved areas as possible. Even so, one cannot be certain of consistent success or success on all counts. All these aspects cannot be attended to at