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INFLUENCE OF STRUCTURAL DIFFERENCES OF THE GYRAL AND SULCAL AREAS OF THE ACOUSTIC PROJECTION CORTEX ON PRIMARY INDUCED ACOUSTIC RESPONSES *

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TRĄBKA J., SEKUŁA J., KREINER J.: *Influence of Structural Differences of the Gyral and Sulcal Areas of the Acoustic Projection Cortex on Primary Induced Acoustic Responses.* Acta Physiol. Pol. 19 (5) : 617—624, 1968. — The aim of work was to elucidate in what manner the acoustic response parameters depend on whether they are derived from the gyrus or from the sulcus of the primary acoustic area. Experiments were performed on 26 cats. The responses of the acoustic projection cortex were recorded using silver electrodes, simultaneously from the gyrus and sulcus at both sides of the stimulated ear. The microphone potentials as well as action potential of the acoustic nerve were recorded. The behavior of responses in relation to the site of their derivation was studied. The peaks of curves derived from the sulcus showed inverted polarity as compared with peaks derived from the gyrus. The primary peaks from the sulcus or gyrus of the opposite hemisphere to that of the stimulated ear behaved oppositely to the analogous peaks of the hemispheres on the side of the stimulated ear.

So far, in the interpretation of evoked induced responses from the neo-cortex, no account was taken of the latter's non-uniform surface configuration shaping, i.e. of the shaping problem of gyri and sulci [1]. *Kreiner* [2, 3], basing on myeloarchitectonic analysis, reported the histological differences between the gyral and the sulcal areas. *Trąbka et al.* have undertaken an attempt to establish a correlation between the structural differences shown by *Kreiner* and neurophysiological changes, obtained by means of direct cortical responses.

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The present work was aimed at elucidating in what manner the acoustic response parameters depend on whether they are derived from the gyrus, or from the sulcus of the primary acoustic area.

METHODS

Surgical experiments were performed on 26 cats, of either sex, weighing 2·5—3 kg. Under chloral anaesthesia, the skull was opened on both sides, revealing the primary acoustic projection area. From the gyral areas, the acoustic responses were derived using silver ball electrodes. The sulcus was arrived at using 0·5 mm dia. electrodes with soundproof 0·5 mm end section. The acoustic responses were recorded simultaneously, from the gyrus and sulcus at both sides of the stimulated ear. Alongside with the cortical responses, records were made, using a silver ball electrode located in a circular opening, of the microphone potentials and action potential of the acoustic nerve. The operational reaching of the opening, the manner of stimulation, the recording and click producing equipment, were described in the previous paper [5]. Preceding each experiment, particular attention was attached to checking, on both recording channels, of the amplification coefficients and of the phase equilibrium of the calibration peaks.

RESULTS

Fig. 1 illustrates the disposition of gyral and sulcal areas of the acoustic projection cortex, incl. the marking of points from where the primary induced acoustic responses were derived.

In all experiments, the crash applied on the right ear induces, from the gyral area EPI, EMII, and S, of the left cerebral hemisphere, a response starting with superficially surface-negative peak, of 5—7 msec. latency, 150 μV amplitude, while the simultaneously recorded response from the top of the posterior ectosylvian sulcus started with a negative peak, followed by a late negative wave (Fig. 2).

The polarity of the recorded waves was not changed by the electrode introduction to the sulcus bottom (Fig. 3).

The responses derived from the gyrus and the sulcus were either of the same latence, period or they preceded each other reciprocally, in varying order. The responses derived from the gyral area EMI were characterized by latency shorted by 1—2 msec, compared with EPI responses (Fig. 4).

The behavior of acoustic responses recorded from the surface of the acoustic projection area of the right cerebral hemisphere, i.e. on the side of the stimulated ear, was opposite. The responses evoked induced in the gyral area started with a positive peak, and the sulcus responses with a negative peak (Fig. 5).

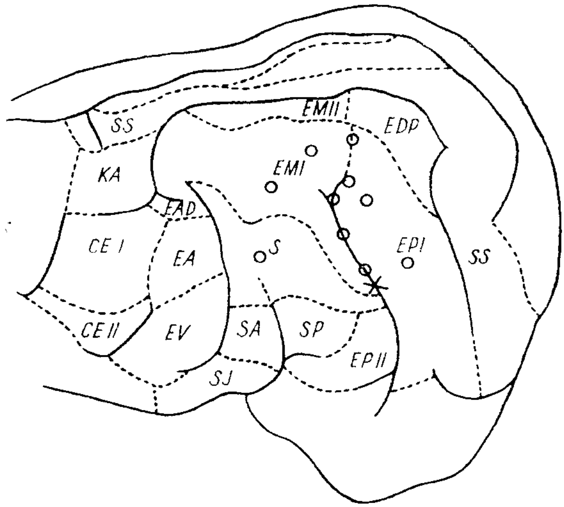

Fig. 1. Scheme of the acoustic area in the cat. SS — *area suprasylvia*, EM II — *area ectosylvia media II*, EM I — *area ectosylvia media I*, S — *area sylvia*, SP — *area sylvia posterior*, SA — *area sylvia insularis*, EP I — *area actosylvia posterior I*, EP II — *area ectosylvia posterior II*, EV — *area paraectosylvia ventralis*, EA — *area ectosylvia anterior*, KA — *area coronalis anterior*, CE I — *area composita ectosylviae I*, CE II — *area composita ectosylviae II*, EDP — *area ectosylvia posterior dorsalis*, EAD — *area ectosylvia anterior dorsalis*. The points of derivation from gyral areas are marked by circles; points of derivation from the bottom of the posterior ectosylvian sulcus are marked by crosses. The dashed lines indicate the boundaries of the areas.

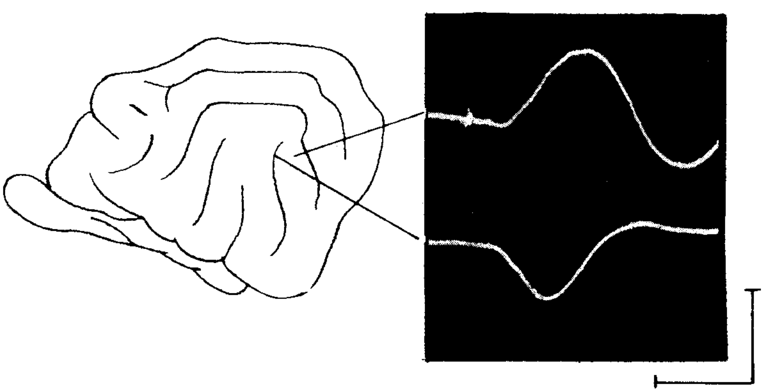

Fig. 2. Acoustic responses derived from the gyrus and sulcus of the left cerebral hemisphere. The horizontal line denotes 10 msec and the vertical line 150 μv. (The same designations are used in the following figures).

Ing Fig. 6, a situation is illustrated where the electrode is transferred from the gyral area EMI to the posterior ectosylvian sulcus. This transfer produced a change in the polarity of the primary acoustic response peak (Fig. 6).

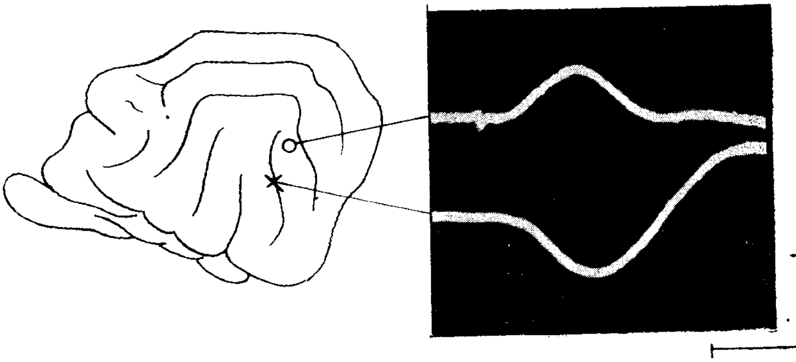

Fig. 3. Acoustic responses derived from the gyrus and bottom of the sulcus of the left cerebral hemisphere (point of derivation marked by a cross).

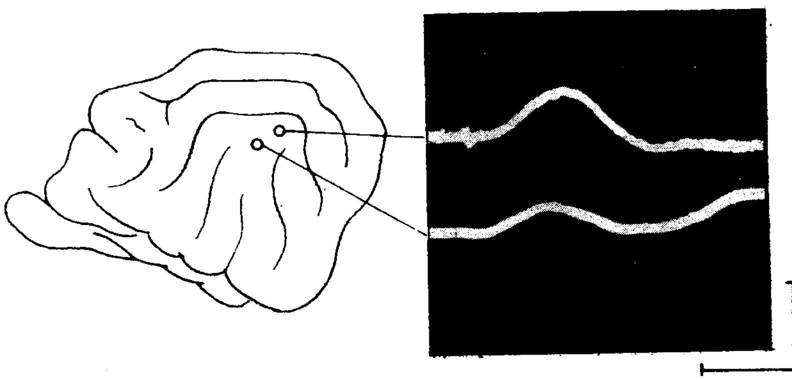

Fig. 4. Acoustic responses from the gyral area *EM I* and from the boundary of two adjacent gyral areas of the left cerebral hemisphere.

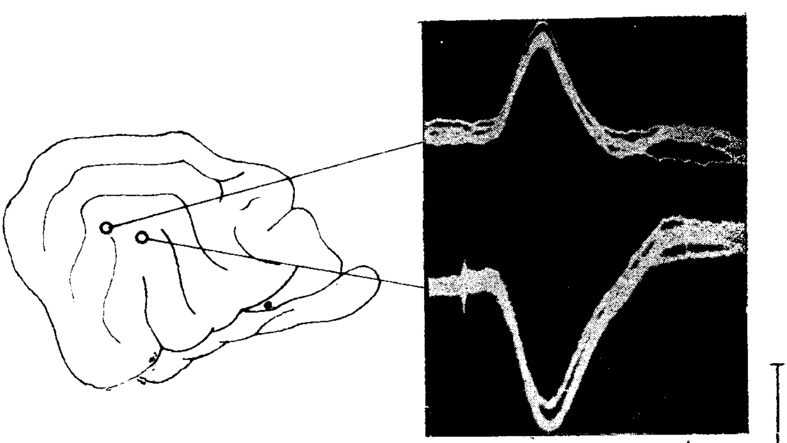

Fig. 5. Acoustic responses derived from the gyrus and sulcus of the right cerebral hemisphere.

Simultaneous recording of the symmetric points of both hemispheres from the top of the ectosylvian sulcus shows inverted polarity of the first peaks of bilateral responses (Fig. 7). Moreover, the left side response, starting with a positive peak, has a latency period shorter by 2—3 msec., compared with the right side response with negative peak.

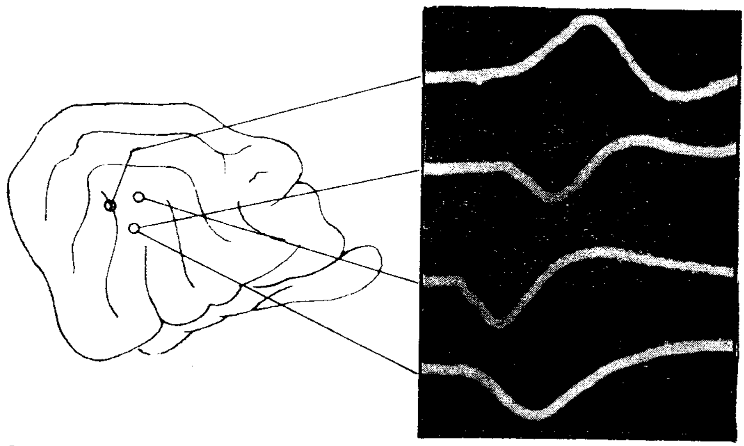

Fig. 6. Acoustic responses derived from the right cerebral hemisphere.

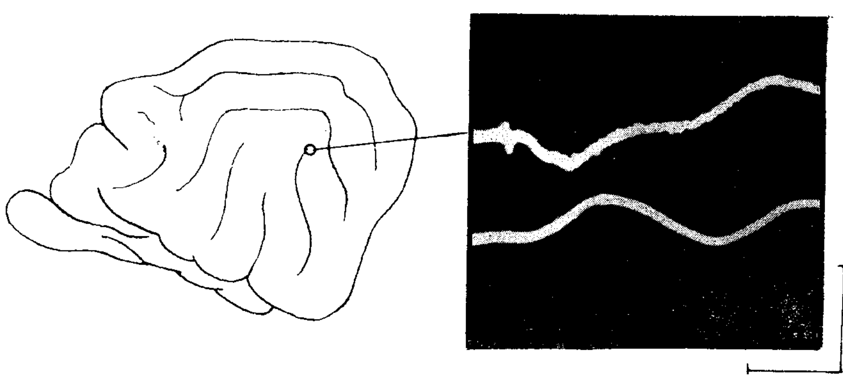

Fig. 7. Acoustic responses derived from symmetric points of the cerebral hemispheres. The horizontal line denote 20 msec, and the vertical line 200 μV.

DISCUSSION

The problem of the cerebral cortex surface configuration shaping was purposely omitted in the considerations on evoked induced cortical responses. According to *Burns*, the introduction of the sulci and grooves problem to the discussion renders difficult the interpretation of results.

From the above described investigations it results that the induced responses evoked from the acoustic projection area show inverted polarity of primary peaks, depending on the site of their derivation. The primary peaks derived from the sulcus of the cerebral hemisphere opposite to that of the stimulated ear, are surface superficially positive, and the responses derived from the gyrus start with a surface superficially negative component. The situation is inverted when the responses are recorded from the hemisphere on the side of the stimulated ear. Basing on the reported results, and on data obtained from investigations on direct cortical responses [5], it is possible to assume that inverted polarity of individual response peaks is not an artefact conditioned by the spatial disposition of gyri and sulci on the cerebral hemispheres surface, but that it depends on structural differences of the gyral and sulcal areas.

Comparison of the one side responses latency is in favor either of the simultaneousness, or of the varying, non-constant succession of the gyral and sulcal areas excitation, i.e. it contradicts the theory of *Burns*. According to that theory, the excitation wave migrates over the cerebral cortex surface, first appearing on the gyrus, from where it then disperses onto the sulcal area. This penetration into the sulci, expressedly, would seemingly account for the inverted wave polarity.

From the comparing of the latency and shape of responses derived from the symmetrical points of the primary accoustic area it results that, owing to transcommisural conductivity, the other side response is delayed by 2—3 msec, and that the positive peak in the sulcal area is corresponded, on the opposite side, by a negative wave, maybe induced from the surface layers of the cerebral cortex. Invertedly, the negative peak in the left gyral area influences the formation of a positive wave in the symmetrical gyral point of the right hemisphere.

The investigations of *Scherrer* [4] speak in favor of the existence, in the cerebral cortex, of three potential sources which may appear in varying order. The actuation of a shallow set generator, located at ca. 600 μ depth, results in the apparition of a negative peak and denotes depolarization of the cerebral cortex surface layers. On the other part, the operation of two deep set generators, located at 1000 μ below the cortex surface, may produce, in result of superficial surface recording, either a negative, or a positive wave. The presence of two deep set generators renders the interpretation of the obtained results difficult, since, so far, it is not known on what structural elements, and on what spatial arrangement of these, the said generators depend.

Better comprehension of the problem will be afforded by further investigations, using electrodes introduced into deeper cerebral cortex layers, both gyral and sulcal.

CONCLUSIONS

Basing on the reported experimental results it is permitted to assume the existence of differences between the gyral and the sulcal areas of the acoustic projection cortex, influencing inverted polarity behavior of the primary peaks of induced responses.

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