ORIGIN OF THE EARLY COMPONENT OF ASSOCIATIVE CORTICAL RESPONSES IN CATS

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Besides studying electrical activity in cortical projection areas, investigators are now paying increasing attention to the study of association areas. These have a definite localization in cats, occupying the anterior marginal and middle suprasylvian gyri, the orbital and motor cortex, and some parts of the medial surface of the hemisphere (1, 10, 12-14, 22). A characteristic function of the association zones is their ability to respond to stimuli of different modalities (photic, acoustic, somatosensory). Investigations (3, 5, 13, 14, 22) have shown that associative responses (ARs) differ in their genesis and electrophysiological characteristics from primary responses (PRs) recorded in projection zones. However, few attempts have been made to study components of the AR, or the origin of these components. The presence of a low-amplitude negative component, preceding the positive (principal) component of the AR (under chloralose anesthesia or in unanesthetized animals) has occasionally (1, 9, 10, 21) been regarded as a phenomenon unconnected with neuronal activity of the association cortex. Amassian (11), on the other hand, first suggested that the early component of a two-component AR is due to impulses arising from projection areas of the cortex. Narikashvili and Timchenko (6) consider that the origin of this component is dependent on neuronal activity of the association cortex in response to subcortical afferent impulses, and on influences arising from projection areas. One of us (A. G. P.), following experiments under Nembutal anesthesia (2, 7), obtained evidence to show that this component is generated in the association cortex itself. The origin of the early AR component has thus not yet been finally settled.

The object of the present investigation was to compare different components of the AR with the properties of unit activity in different layers of the association cortex. Such a comparison would give a better understanding of the genesis of the early and late components, for which different afferent impulses are responsible.

METHOD

Experiments were carried out on unanesthetized cats and cats anesthetized with chloralose (80 mg/kg) and nembutal (40 mg/kg). Operations on the unanesthetized animals and those anesthetized with chloralose were carried out under ether, after which a relaxant (remyylan) was injected and the animal maintained on artificial respiration. Animals anesthetized with nembutal did not require ether. Anesthetics were injected intravenously and further doses given during the experiment if the animal showed signs of arousal. To record responses, a hole was drilled in the skull above the association cortex (anterior part of the marginal and suprasylvian gyri) and the projection area of the forelimb. The dura was removed. The animal was fixed in a stereotactic apparatus and the region located in which responses of greatest amplitude were recorded to different stimuli.

Single unit activity was recorded with glass microelectrodes, with tip 1-2 μ in diameter, filled with 3M sodium citrate solutions (resistance 5-10 MΩ). The microelectrode was inserted through different levels of the cortex by means of an oil-driven
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micromanipulator. To avoid pulsation the brain was flooded with 4% agar-agar made up in physiological saline. PRs and ARs were recorded with springloaded silver ball electrodes. Measurements of laminar levels in the investigated part of the association cortex were taken from the paper by Durinyan and Polyakova (2).

The atropinized eyes were stimulated with flashes and the skin of the contralateral fore- and hind limbs with square pulses. These stimuli were chosen because they produce the clearest early component of the AR. Single pulses were applied not more frequently than once every 5 sec. To determine the optimum evoked unit activity in each individual case, a stimulus of maximum intensity was chosen.

Responses were recorded simultaneously with micro- and macroelectrodes on an “Elema—Shenander” multichannel electroencephalograph and a two-channel “Disa-Electronic” CRO.

RESULTS

The experimental conditions affect individual AR components differently. In unanesthetized and chloralose preparations, regardless of the stimulus applied, both early (Fig. 1, I:1, 2) and late components (Fig. 1, I:3, 4) are detected, and under chloralose anesthesia the late AR component is more stable and more clearly defined (10, 14, 15, 22). Under nembutal anesthesia only the early AR component is recorded (Fig. 1, II).

![Fig. 1. Schemes showing early (1, 2) and late (3, 4) AR components recorded in association cortex (CTX). I) In unanesthetized and chloralose animal; II) moderate level of nembutal anesthesia. A) Associative response to stimulation of forelimb, B) of hind limb, C) to photic stimulation.](image)

The relationship between unit activity and the integral surface potential of the association cortex under different experimental conditions varies within wide limits. This relationship varies, above all, depending on the experimental conditions. The difference is seen most clearly if results obtained under nembutal anesthesia are