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Effect of Stimulus Intensity on Visually-Evoked Electrical Brain Activity Maps in Rabbit*

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Stimulation by means of flashes is a commonly-used method in basic research into evoked potentials. Nevertheless, the different responses obtained at different luminous intensities, to which the inter-individual and intra-individual differences are added, determine the need to control this stimulus parameter for each experimental model. Maps of visually-evoked activity in the rabbit brain, obtained after monocular stimulation with flashes at different intensities of luminosity, are presented. Variation in the intensity of the luminous stimulus does not substantially affect the distribution of the electrical potential on the surface of rabbit brain described in previous articles.

Key words: Visual evoked potential, Brain electrical activity mapping, Rabbit.

Visually-evoked brain response in rabbits by means of flashes (0.69 joules/flash) is defined by four components: N_0, P_1 N_1 and P_2 (3-5). At this intensity, about 20-25 ms after the stimulus, waves N_0 and P_1 arrange themselves in the form of a dipole oriented front-to-back on the visual area I (P_1 in the fore-most area, N_0 in the rear-most area) and P_2 in the rear (5). As the physical and time characteristics of the stimulus determine the morphology, latency and distribution of the sensorial response evoked, it is important to study the changes, associated with the parameters of the stimulus, which are produced in the potentials or in their representation by means of maps.

This article describes the variations produced in the distribution maps of the visual evoked potentials of pigmented rabbit brains undergone in response to stimulation of the left eye at different luminous intensities. The aim is to determine the effect of the intensity of the flash

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on latency, amplitude of the waves and topography of cortical components.

Materials and Methods

Five rabbits of the common variety with pigmented eyes were used. These animals were fitted with 18 electrodes. The arrangement of the electrodes, the recording method and the analysis of the signal were as described in PÉREZ-COBO *et al.* (3-5). Monocular stimulation was made on the left eye of the animal under conditions of adaptation to darkness. The luminous stimulator (Knott Elektronik, Photo Stimulator Strobotest LT-1001) was placed perpendicularly to the eye and at a distance of 50 cm. The 15 W xenon lamp has a flash duration of between 8 and 12 μs (this time cannot be controlled and depends on the state of the bulb). The stimulation intensities used were: I, 0.05 J/flash; II, (0.69 J/flash; and III, 1.30 J/flash.

Results

The maps of the visual evoked response were calculated at the three intensities (I, II and III) to study the influence of the intensity on the N_0, P_1 and P_2 components. The maps are formed by equipotential lines, separated from each other by intervals of 10 μV. The continuous line represents zero potential and the hatched areas indicate positivity. Figure 1 shows representative maps obtained at the three intensities studied.

The four characteristic components of the evoked signal appear on these maps. The two columns on the left show the components of the shortest latency, N_0 and P_1. At intensity I, the N_0 component is found on the rear part of the visual area

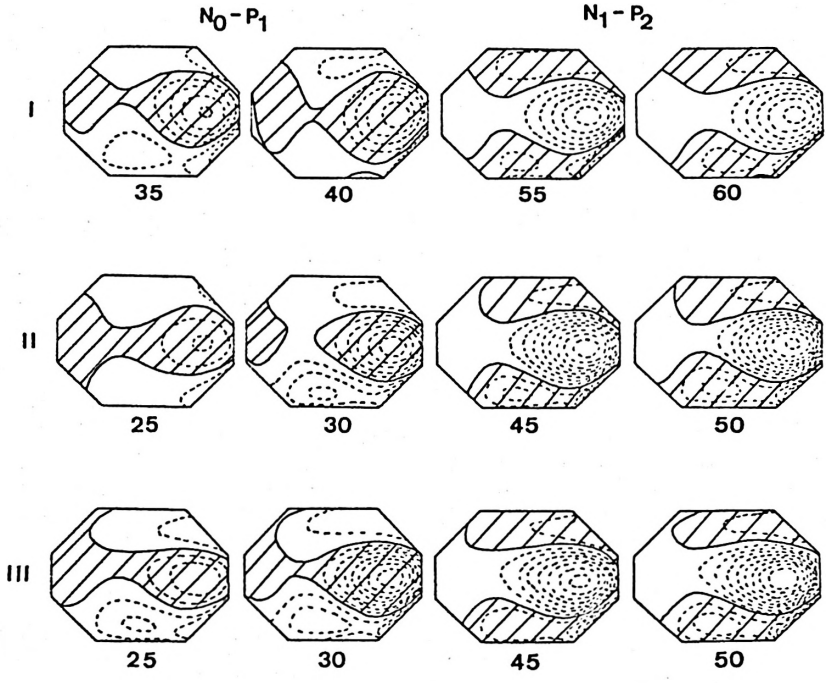

Fig. 1. *Maps of cortical electrical activity evoked visually for a rabbit.*
Four components can be seen –N_0, P_1, N_1 and P_2– at the different intensities of stimulation studied. The hatched area represents positivity.

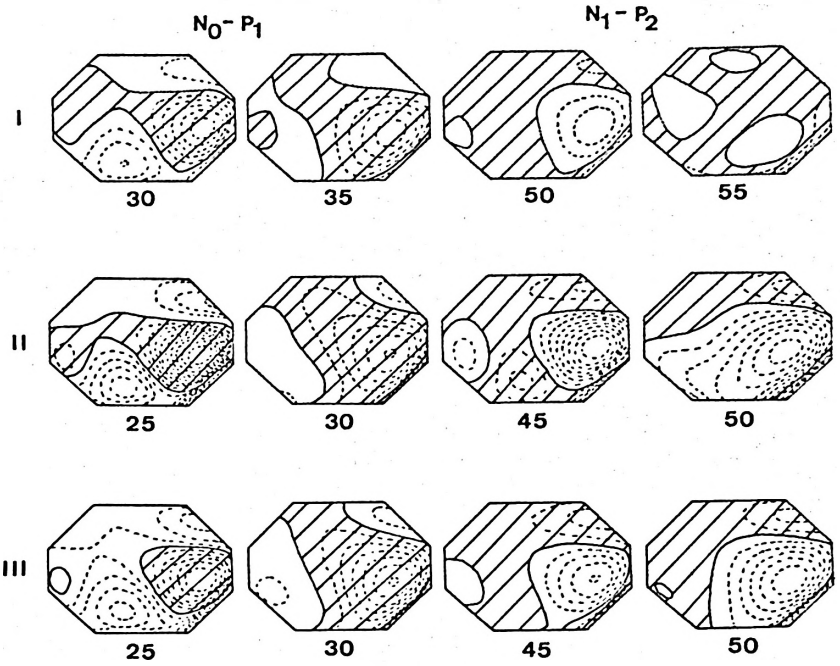

Fig. 2. *Maps for another rabbit obtained at the different intensities studied.* The hatched area represents positivity.

I, while the P_1 component appears on the front part. The maximum amplitude of N_0 (-20 μV) and P_1 (+40 μV) occurs 35 ms after the stimulus. If the stimulus is at intensity II, the appearance of N_0 and of P_1 in the same topographical location, is produced at 25 ms and 5 ms later, these waves show, respectively, a maximum amplitude of -30 and +50 μV. The response is similar to intensity III but, at 30 ms, the N_0 and P_1 components show, respectively, an amplitude of -30 and +70 μV.

In the two columns of the right of figure 1, the N_1 and P_2 components are drawn at intensities I, II and III. N_1 and P_2 reach, respectively, their maximum amplitude (of −50 and +30 μV) 55 ms after the stimulus at intensity I. At intensities II and III, although these components are well formed at 45 ms, N_1 and P_2 reach their maximum value at 50 ms. N_1 acquires a value of -80 μV for both intensities, while P_2 was an amplitude of +40 μV at intensity II and +50 μV at intensity III.

Figure 2 corresponds to the maps, using another animal, of the activity evoked visually with the three intensities under study. As in fig. 1, the two columns on the left show the N_0 and P_1 components and the two columns on the right show the N_1 and P_2 components. The first two waves, N_0 and P_1 arrange themselves front-to-back on the primary visual area VI, although N_0 virtually cannot be seen at the lowest intensity of stimulation. These components show their maximum amplitude at 30 ms for intensity I and at 25 ms for intensities II and III. The maximum amplitude reached by P_1 is +90 μV at intensity II. Wave N_0 has an amplitude of −50 μV both at intensity II and III. Components N_1 and P_2 are virtually not defined at the lowest of the intensities studied and, at higher intensities, show their maximum values at 45 ms. The maximum amplitude reached by N_1 is given at intensity III with -70 μV and for P_2 with +40 μV also at this intensity.

The cortical distribution of electrical activity is basically the same as that described in the previous figure, i.e., P_1 and N_1 are established in the fore-most part and N_0 and P_2 in the rear part of area VI. Moreover, in both samples, a greater intervention can be observed in the primary response of the ipsilateral brain hemisphere to the stimulated eye when the intensity of the flash increases. The inter-individual differences become apparent on observing the diversity of the amplitudes and latencies of the components, although the topography of the electrical brain activity in response to the flash is totally similar in both cases.

Discussion

The arrangement and sequence of the components have been demonstrated to be the same for all the intensities used on the maps of cortical electrical activity obtained in response to the monocular visual stimulation of rabbits. At intensity I, the waves appear about 5 ms later than at higher intensities. The amplitude of the potentials rises when the intensity of the stimulus increases, but the differences between intensity II and III may be unnoticeable due, perhaps, to the fact that for any of these intensities, the response is maximum.

The results obtained for rabbits are absolutely similar to those described previously in the literature for visually evoked potentials not presented in the form of maps, for the cat (1, 2) and for the guinea pig and rat (1) or gathered in experiments on humans (6) i.e., greater latencies of components when stimulated with weaker luminous stimulations and lower latencies with stronger stimulations, at the same time as the amplitude of the waves increases. The conclusion may be drawn that the different intensities used in this experiment do not modify the model described (5) of dipole inversion and that the latency between components of 20-25 ms remains unaltered whatever the intensity of the stimulus.

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J. C. PÉREZ-COBO, S. SÁNCHEZ-SUERO, M. LÓPEZ DE ARMENTIA y M. PÉREZ-ARROYO. *Efecto de la intensidad del estímulo sobre los mapas de la actividad eléctrica cerebral evocada visualmente en conejo.* Rev. esp. Fisiol. (J. Physiol. Biochem.), 50 (1), 1-4, 1994.

La estimulación por destellos es un método de uso común en la investigación básica de los potenciales evocados. Sin embargo, las diferentes respuestas obtenidas con distintas intensidades luminosas, a las que se añaden las diferencias interindividuales e intraindividuales, determinan la necesidad de controlar este parámetro experimental. Se presentan aquí mapas de la actividad evocada visual en cerebro de conejo, obtenidos tras la estimulación monocular con destellos de diferentes intensidades luminosas. La variación de la intensidad del estímulo luminoso no afecta de manera sustancial a la distribución del potencial eléctrico sobre la superficie cerebral del conejo descrita en anteriores trabajos.

Palabras clave: Potenciales evocados visuales, Mapas de la actividad eléctrica cerebral, Conejo.

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