ROLE OF NEOCORTICAL AND SUBCORTICAL COMMISURES IN INTERHEMISPHERIC TRANSMISSION OF VISUAL INFORMATION TO THE HIPPOCAMPUS

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UDC 612.843.7:612.825.26]-06:612.826.2

KEY WORDS: hippocampus; cerebral commissures; interhemispheric transmission of visual information; evoked potential.

Studies in recent years have demonstrated the important role of the cerebral commissures in interhemispheric transmission of visual information to the visual, association, and somatosensory cortex [2-5, 9-11]. Potential capacity for commissural transmission of visual influences ought evidently to exist also for other parts of the CNS which possess developed commissural connections. Evidence of the existence of such connections in the hippocampus is given by the results of physiological investigations [1, 6].

Since this structure plays an important role in visual information processing [7, 8], the participation of hippocampal interhemispheric communication in this process must be assumed. However, the question of the contribution of the cerebral commissures to visceral afferentation of the hippocampus remains unexplained and requires appropriate experimental and theoretical investigation.

The aim of this investigation was to study the role of interhemispheric communications of the brain in visual information transmission to the hippocampus in cats. A study of the character of evoked potentials (EPs) to flashes in animals with different degrees of interruption of the visual pathways reveals the comparable effectiveness of neocortical and subcortical commissures in the interhemispheric transmission of visual information to the hippocampus.

EXPERIMENTAL METHOD

Experiments were carried out on 15 adult cats, divided into three groups, with 5 animals in each group: group 1) intact animals, 2) cats with division of the left optic tract and right half of the tegmentum mesencephali, 3) animals with division of the left optic tract and commissures of the forebrain. Division of the optic tract interrupted the classical (geniculate) inputs to the hippocampus. Additional division of the right half of the tegmentum blocked the visual commissural collicular channel. The principal commissural pathway of interhemispheric transmission of visual information in this case was the corpus callosum. Division of the forebrain commissures in the animals of group 3 included the corpus callosum, anterior commissure, fornix, septum, hippocampal commissure, interthalamic commissure, intercollicular commissures, and posterior commissure. In this case visual afferentation of the left hippocampus could be effected only along two theoretically possible interhemispheric communications (commissural structures in the floor of the 3rd ventricle and the brainstem reticular formation). Bipolar implantation of nichrome electrodes (diameter 0.3 mm) into the hippocampus, taking coordinates from the stereotaxic atlas [12], was carried out on all animals (cats of groups 2 and 3, 2 months after the operation). The reference electrode (0.4 mm in diameter) consisted of nichrome wire, inserted in the form of a ring through the frontal sinus and occipital crest. All animals were alert and mobile. Flashes 0.2 msec in duration and with a frequency of 0.2-1.0 Hz were used as photic stimuli. The experiment lasted 7-10 days, for 30-40 min every day. Electrical responses were recorded on a 4-channel magnetic recorder (Brüel and Kjaer), and subsequently processed by computer, which plotted averaged EPs (50-100 realizations) and determined the mean value and dispersion of peak latencies and amplitudes of the first three components of EP. At the end of the experiments a morphological control was set up.

Laboratory of Neurocybernetics, Brain Institute, All-Union Mental Health Scientific Center, Moscow. (Presented by Academician of the Academy of Medical Sciences of the USSR B. A. Lapin.) Translated from Byulleten' Éksperimental'noi Biologii i Meditsiny, Vol. 99, No. 2, pp. 131-133, February, 1985. Original article submitted February 2, 1984.

0007-4888/85/9902-0147$09.50

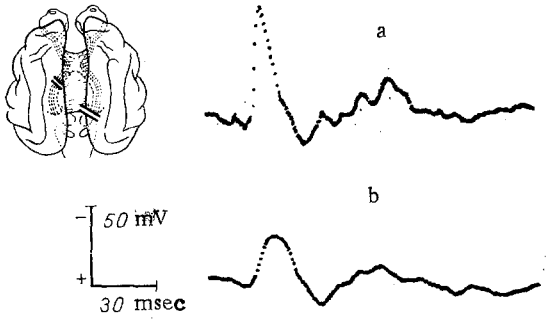

Fig. 1

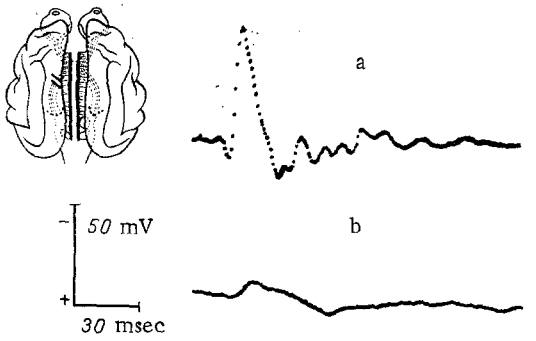

Fig. 2

Fig. 1. Averaged EPs to flashes in right and left hippocampus of animals with division of optic tract and of right half of tegmentum mesencephali (group 2).

Fig. 2. Averaged EPs to flashes recorded in right (a) and left (b) hippocampus of cat with division of left optic tract and cerebral commissures (group 3).

TABLE 1. Latent Period and Amplitude of First Components of EPs to Flashes in Hippocampus (M ± σ)

Group of animals	Hemisphere	Latent period, msec			Amplitude, mV		
		P_1	n_1	P_2	P_1	n_1	P_2
1	Right and left	16,7±0,9	27,4±1,7	55,6±3,1	19,1±2,5	78,4±7,3	40,0±5,2
2	Right	15,4±1,1	25,0±1,9	53,2±3,6	14,0±2,6	63,4±6,6	38,6±4,9
	Left	15,6±1,8	24,1±2,1	51,3±4,2	8,2±2,1*	31,0±4,7*	23,7±3,5*
3	Right	18,0±2,0	29,7±2,1	58,1±4,8	11,6±2,6*	47,4±5,0*	21,0±4,21*
	Left	14,9±1,70	28,0±2,3	63,3±4,0*	4,3±2,2*	10,1±3,6*	5,0±2,1*

Legend. *P < 0.05 compared with group 1; P_1, P_2) 1st and 2nd positive components of EP respectively; n_1) negative component.

EXPERIMENTAL RESULTS

In all animals characteristic EPs to flashes were obtained in both sides of the hippocampus (Figs. 1 and 2; Table 1). Averaged EPs in all animals consisted of three components: positive, negative, and positive. Peak latencies of these three components in animals undergoing the operation did not differ significantly from normal, except for the second positive component of the response in the left hippocampus in cats of group 3. The peak latency of this component was significantly ($P < 0.05$) longer than that of intact cats, and was 68.3 ± 4.0 msec (55.6 ± 3.1 msec in group 1).

A reduction in the amplitude of EP compared with normal was observed in both sides of the hippocampus in all animals undergoing the operation. This was particularly so in the case of the first negative and second positive components. The amplitude of individual components of EP in the hippocampus on the side of division of the optic tract was significantly (3-5 times) less than on the opposite side. EPs to flashes of minimal amplitude were recorded in the left hippocampus of cats of group 3 (Fig. 2). The amplitude of the first negative and second positive components of these potentials was 8 times less than in the animals of group 1 (Table 1).

The results of this investigation demonstrate the important role of forebrain commissures in interhemispheric transmission of visual information to the hippocampus. This is shown by preservation of EPs to flashes in the left hippocampus of the animals of groups 2 and 3, when there was complete blocking of the classical visual pathways into that hemisphere (Figs. 1 and 2). Meanwhile a considerable reduction in the amplitude of EPs to flashes in the right hippocampus of the cats of groups 2 and 3 can evidently be explained by a decrease in power of the total afferent input because of blocking of its commissural components.

Interruption of the forebrain commissures (cats of group 3), together with blocking of the classical visual inputs, causes a sharp reduction in EPs which, in turn, points to an important role of these communications in the interhemispheric transmission of visual information. The sharp reduction in amplitude of EPs in the left hippocampus of these ani-

mals compared with the relatively small reduction in amplitude in the cats of group 2 point to the greater power of its visual commissural inputs in the telencephalon compared with the subcortical inputs. Preservation of low-amplitude EPs in the left hippocampus in the cats of group 3 was evidently connected with the conduction of visual information into this structure via interhemispheric communications in the floor of the third ventricle and the brainstem reticular formation.

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EFFECT OF PHOSPHATE AND ACIDOSIS ON SENSITIVITY OF CARDIAC MYOFIBRILS TO CALCIUM

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UDC 612.173.1.015.31:546.41].014.46:546.18]-06:612.173.1.014.462.6

KEY WORDS: phosphate; acidosis; sensitivity of myofibrils to calcium; myocardial ischemia.

The force developed by muscle fibers is known to depend on the Ca^{++} concentration in the medium surrounding the myofibrils. However, various factors can modify this dependence. One such factor is the phosphate concentration. It has been shown that phosphate lowers the sensitivity of skeletal fibers with chemically destroyed sarcolemma to Ca^{++}, and also reduces the maximal developed tension [1]. An increase in phosphate concentration leads to a decrease in isometric tension of the glycerinized rabbit papillary muscle [7]. However, it is not known to what degree phosphate modifies sensitivity to Ca^{++} or maximal tension of heart muscle fibers. Acidosis is another factor which changes the sensitivity of myocardial fibers to Ca^{++} [4]. In myocardial ischemia, acidosis [3, 8] and phosphate accumulation through breakdown of creatine phosphate and ATP [2, 9], usually develop simultaneously.

The aim of this investigation was to study the effect of phosphate on calcium sensitivity of myocardial fibers with hyperpermeable sarcolemma at neutral pH and under conditions of acidosis.

EXPERIMENTAL METHOD

The method of preparation of bundles of fibers with hyperpermeable sarcolemma was basically the same as that described previously [11]. Male Wistar rats were decapitated, and the heart was removed and transferred into Krebs' solution at 0-4°C. Bundles of muscle fibers 0.2-0.3 mm in diameter were separated from the endocardial surface of the left ven-

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Translated from Byulleten' Éksperimental'noi Biologii i Meditsiny, Vol. 99, No. 2, pp. 133-135, February, 1985. Original article submitted May 25, 1984.