

The study of Functional Heterogeneity of Dorsal Hippocampus in Active Avoidance Memorization

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Despite of extensive research there is still controversy over the general function of the hippocampus. The Hippocampus is considered as a cognitive structure involved in the learning and memory. On the other hand hippocampal function is tied to emotion and stress responses. Behavioural, anatomical, and gene expression studies try to indicate functional heterogeneity and behavioural segmentation within the hippocampus. It is suggested that the hippocampus can be thought of as a set of separate structural zones: rostral (dorsal) zone involved in cognitive function and caudal (ventral) zone, which in correlation with amygdala and hypothalamus modulates emotional, affective behaviour. Using a combination of neuroimaging experiments and data clustering, evidence of additional distinct subregions is provided. The suggested model consists of a bilateral anterior, separate posterior and intermediate regions within the hippocampus on each hemisphere. In addition of anterior-posterior neurofunctional gradient, some data provide notion of evidence for a hemisphere-specific specialization of the hippocampal formation. However, few behavioural studies have examined these functional heterogeneity in memorization and retrieval of contextual fear memory tasks.

The main goal of current investigation was to study the hippocampal functional heterogeneity in memorization of active avoidance responses. The research was conducted in intact and operated albino rats with unilateral/bilateral lesions of anterior or posterior part of dorsal hippocampus (DH), after six/twenty days after surgery (10 groups in total) . The measured behavioral parameters are frequencies and latency of 1) reactions to the light - avoidance reactions; 2) reactions to the painful foot-shock - escape reactions; and 3) inter-trial spontaneous behavior (jumping onto shelves in inter-trial intervals).

Two experimental series were conducted: The fear conditioning treatment in (I) fixed- and (II) random-environment. The experiment lasted 20 days with 10 trials per/day. In each trial of active avoidance conditioning the avoidance was signaled by a single 10 sec light (CS). The subjects could avoid the painful foot-shock by jumping onto the shelves. If they did not, on the background of CS, the US - 25 mv foot-shock was delivered for 5 sec through the grid. The rats could escape the shock by jumping up onto the nearest shelf staying there for 3 sec until they were forced to return to the floor. Inter-trial period varied according to special schedule. during the inter-trial intervals the rats could spontaneously jump up onto the shelves for only 3 sec. since after that the experimenter lowered the shelf and forced the animals to jump down to the floor. Treatment in fixed environment (I) implied to pair CS with followed US in each trial while in random environment foot-shock was delivered not in all cases if CS didn't provoke avoidance behaviour.

The obtained results show that in fixed environment anterior dorsal hippocampus (ADH) lesions doesn't influence active avoidance acquisition, but lesions of posterior dorsal hippocampus (PDH) decrease **avoidance responses** in both groups (PDH-6 and PDH-20). In random-environment anterior and PDH lesions impair avoidance memorization only in groups with treatment after 6 day from lesions (ADH-6 and PDH-6). There is a statistical support for hemispheric-specific behavioural differences in avoidance memorization between bilateral and unilateral lesioned groups in random environment . Different patterns were revealed in **escape responses**: all groups from II series statistically significant differ from the I series' groups. As in case of avoidance responses, there are a significant differences between the intact group and groups with PDH lesions (PDH-6 and PDH-20) in I series (fixed environment). The escape reactions frequencies in rats with PDH lesions (both PDH-6 and PDH-20) were lower then in ADH rats. Random environmental series show the controversial results. In escape responses statistical significant differences between the bilateral (PDH-6) and unilateral PDH (PDH-Uni) lesioned rats were revealed. The **inter-trial spontaneous behavior** showed the same conformities as for CS avoidance reactions for (I) fixed-environment series, but for II (random environment) series we revealed increased inter-trial activity for intact, PDH-6 and PDH-20 groups in comparison with I series. Hemispheric-specific differences were observed between the PDH-Uni and PDH-6 groups.

Proposed paper provides the behavioural evidence for different contributions of hippocampus subregions' to fear-conditioning. The comparison of our findings to existing models which posit anterior-posterior differentiation of hippocampal formation will guide future research toward a resolution of controversies about hippocampal functions.

Literature:

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