The decline in spatial navigation caused by place cell dysfunction by assessing c...

Health & Medicine, Healthcare

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Impairments in experience-dependent scaling and stability of hippocampal place fields limit spatial learning in a mouse model of Alzheimer’s disease

Introduction

Summary and Critique Alzheimer’s disease(AD) affects spatial navigation causing problems with recalling surroundings. This impairment increases as AD progresses eventually affecting place cells and causing navigational problems in patients. These cells are responsible for determining location, recalling, spatial orientation and creating a map of the surroundings. A reduction in place cells is observed in AD due to the characteristics of place cells. Place cells are involved in encoding episodic memories[1] but during AD there is a decline in encoding and the hippocampus which is a degenerative structure is the home to place cells.

This paper(Zhao et al, 2014) describes the decline in spatial navigation caused by place cell dysfunction by assessing cognitive function and behaviour in an amyloid bearing mouse model of AD. The issue discussed is important since AD is a growing concern in the older population. The authors cited literature that provided background information on the

function/dysfunction of place cells affecting spatial orientation. Two of these papers were outdated(1970s) and information about place cells could of changed. Mouse models were used to investigate spatial navigation but research could of been done in other animals with a more complex hippocampus.

The purpose of the study is clear and after analysing place cell impairment in spatial navigation in a rat model this can lead to further research of AD in humans and the development of treatments. The researchers only identified place cells responsible for spatial navigation but other cells in the hippocampus might be involved. The authors did not describe what research is missing or previous research done on this experiment but this should of been discussed in order to provide the reader with details about expected results.

Results Summary and Critique

The Morris Water Maze was used to study spatial learning and session stability was done to compare the firing rate of cells. All groups had decreased path length to the platform as the training days increased but the APP/TTA mice had a longer path length compared to the controls. The APP/TTA mice showed a memory deficit in the probe trials however all groups showed improvement in STM but the APP/TTA mice took the longest. All groups swam around in a similar pattern spending similar time in each quadrant(probe1). The controls swam closer to the platform but the APP/TTA mice did not(probe4).

In order to reach criteria performance(Fig1E), the APP/TTA mice required more training days than controls. When long term memory was tested(Fig1F), the percent of path length and time spent in the trained quadrant were higher for controls. The session stability(Fig3D) on the firing rate of cells were similar for all groups. The equivalence in genotypes between all groups on day 1 was similar for days 2 and 3(Fig4C). In the same environment, the session stability for the APP/TTA mice was lower than controls suggesting that the firing pattern in the familiar environment was reduced since the mice could not remember the environment(Fig5D). Session stability increased from a novel to familiar environment for all groups but to a lesser degree in the APP/TTA mice(Fig6B). Fig1A, 1F, 5D and 6B were statistically significant whereas Fig1F, 3D and 4C were notThe results were valid relating to the hypothesis that spatial learning is slowed in amyloid bearing mice. All figures were organised with appropriate captions describing the figures efficiently.

The text complemented the figures providing additional information about the results. Statistical testing was used where relevant for calculating the p value and most of the data was statistically significant. Each graph was self explanatory but raw data in a table should of been presented to make the figures easier to comprehend. In a bar graph format would of been easier to interpret. For Fig3D and 5D, the x-axis was not labelled. The session stability data seemed undervalued and should of been described more. Fig1C and 1D depicted the same information and just one should of been used. Confounding factors such as locomotor abnormalities in mice were

accounted for by the experimenters. The authors stated that the place fields in APP/TTA mice were impaired but the results in Fig4 indicate that the APP/TTA mice had higher activation in larger place fields which contradicts impairment.

Works Cited1:

1. Eichenbaum, H. 2013. Memory on time. Trends Cogn Sci. 17(2): 81-88
2. O'Keefe, J., Nadel, L. 1978. The hippocampus as a cognitive map. Oxford Uni Press.
3. Rolls, ET. 2010. A computational theory of episodic memory formation in the hippocampus. Behav Brain Res. 215(2): 180-196
4. Smith, DM., Mizumori, SJ. 2006. Hippocampal place cells, context and episodic memory. Hippocampus. 16(9): 716-729