Environmental enrichment improved cognitive performance in mice under normoxia and hypoxia

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The mammalian brain modulates its microvascular network to accommodate tissue energy demand in a process referred to as angioplasticity. There is an aging effect on cognitive function and adaptive responses to hypoxia. Hypoxia-induced angiogenesis is delayed in the aging mouse brain. It has been shown that enrichment provides an environment that fosters increased physical activity and sensory stimulation for mice as compared to standard housing; this increases neuronal activity and oxygen demand. We investigated the effect of environmental enrichment on cognitive performance in young mice (2-4 months; n=18) and the effect of hypoxia in both young (2-4 months; n=6) and aged mice (17-21 months; n=5). Mice were placed in a non-enriched or an enriched environment for 4 weeks under normoxia followed by 3 weeks of hypobaric hypoxia (~0.4 atm). Cognitive function was evaluated using Y-maze and novel object recognition tests in the enriched or non-enriched mice under normoxic or hypoxia conditions. The effect of environmental enrichment on capillary density was determined. Microvascular density (N/mm2) was calculated through GLUT-1 immunohistochemistry in young mice following a 3-week placement in a non-enriched or enriched environment. The young mice showed significantly higher alternation rate (%, 63 ± 7 vs. 48 ± 10, n = 6 young; 5 old) in the Y-Maze test as compared to the old mice. Under normoxia, the enriched mice showed an improved alternation rate (%, 63 ± 10, n = 10) in Y-Maze test and a higher novel object exploration rate (%, 68 ± 10 vs. 52 ± 10) in the novel object recognition test compared to the non-enriched controls. Similar results were observed following hypoxic exposure. The young mice that underwent environmental enrichment showed significantly higher (~30%) capillary density in cortical brain opposed to the non-enriched mice. Our data suggests that environmental enrichment improved the cognitive performance in mice under normoxic and hypoxic conditions.