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Hippocampal avoidance in whole brain radiotherapy and prophylactic cranial irradiation: a systematic review and meta-analysis

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Abstract

Purpose: We systematically reviewed the current landscape of hippocampal-avoidance radiotherapy, focusing specifically on rates of hippocampal tumor recurrence and changes in neurocognitive function.

Methods: PubMed was queried for studies involving hippocampal-avoidance radiation therapy and results were screened using PRISMA guidelines. Results were analyzed for median overall survival, progression-free survival, hippocampal relapse rates, and neurocognitive function testing.

Results: Of 3709 search results, 19 articles were included and a total of 1611 patients analyzed. Of these studies, 7 were randomized controlled trials, 4 prospective cohort studies, and 8 retrospective cohort studies. All studies evaluated hippocampal-avoidance whole brain radiation treatment (WBRT) and/or prophylactic cranial irradiation (PCI) in patients with brain metastases. Hippocampal relapse rates were low (overall effect size = 0.04; 95% confidence interval [0.03, 0.05]) and there was no significant difference in risk of relapse between the five studies that compared HA-WBRT/HA-PCI and WBRT/PCI groups (risk difference = 0.01; 95% confidence interval [- 0.02, 0.03]; p = 0.63). 11 out of 19 studies included neurocognitive function testing. Significant differences were reported in overall cognitive function and memory and verbal learning 3-24 months post-RT. Differences in executive function were reported by one study, Brown et al., at 4 months. No studies reported differences in verbal fluency, visual learning, concentration, processing speed, and psychomotor speed at any timepoint.

Conclusion: Current studies in HA-WBRT/HA-PCI showed low hippocampal relapse or metastasis rates. Significant differences in neurocognitive testing were most prominent in overall cognitive function, memory, and verbal learning. Studies were hampered by loss to follow-up.

Keywords: Brain tumor; Hippocampal avoidance; Hippocampus; Neurocognitive function; Organs at risk; Radiation.