J Neurosurg. 2026 Jan 16:1-11. doi: 10.3171/2025.8.JNS25763. Online ahead of print.

Clinical benefits of photodynamic therapy in glioblastoma: systematic review and meta-analysis

Mohammad Amin Dabbagh Ohadi [1], Sevim Soleimani [2], Mohammad Mahdi Kakoienejad [3], Moein Ghasemi [3], Constantinos G Hadjipanayis [4]

PMID: 41569684 DOI: 10.3171/2025.8.JNS25763

Abstract

Objective: Glioblastoma (GBM) is an aggressive brain tumor with a poor prognosis despite standard treatments. Emerging innovations, including photodynamic therapy (PDT), offer new hope by improving local tumor control and survival. The aim of this review was to systematically assess the clinical benefits of PDT as an adjunct to surgery for patients with GBM.

Methods: A systematic review was conducted in September 2024 using PubMed, Scopus, Embase, and Web of Science, following PRISMA guidelines. Comparative cohort studies evaluating the safety and efficacy of PDT in patients with GBM were included. Oncological outcomes were assessed by comparing progression-free survival (PFS), overall survival (OS), and the difference in 1-year survival rates between the PDT and control groups. Statistical analysis was performed using a random-effects model, while study quality was evaluated with the ROBINS-I tool for nonrandomized studies.

Results: This review included 8 retrospective studies involving 772 patients with GBM (281 in the PDT group and 491 in the control group). Talaporfin sodium (TS) was used in 5 studies, while 5-aminolevulinic acid (5-ALA) was used in 3 studies. The analysis showed that PDT significantly improved the PFS (hazard ratio [HR] 0.66, 95% CI 0.50-0.86; p = 0.003) and OS (HR 0.57, 95% CI 0.46-0.70; p < 0.001) rates, leading to a notable increase of 25% in the 1-year survival rate compared with controls (95% CI 10%-40%, p = 0.001). There was no significant difference between TS and 5-ALA regarding OS outcomes (p = 0.32). Additionally, complication rates were similar between PDT-treated patients and controls (RR 1.28, 95% CI 0.66-2.46; p = 0.46), with transient cerebral edema reported in approximately one-tenth of treated patients.

Conclusions: PDT significantly improved tumor control and extended survival for patients with GBM without increasing major complications. These findings support PDT as a promising adjunctive treatment during surgery. However, further randomized clinical trials are needed to validate its long-term efficacy and to optimize treatment protocols.

Keywords: 5-ALA; glioblastoma; oncology; photodynamic therapy; talaporfin sodium; tumor.