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# Increased expression of microRNA-9 predicts an unfavorable prognosis in human glioma

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**Abstract** microRNA-9 (miR-9) has been found to be upregulated along with tumor progression of gliomas by microarray-based expression profiling, and also be strongly linked to glioblastoma subtypes. However, its prognostic value in glioma is still elusive. miR-9 expression in human gliomas and nonneoplastic brain tissues was measured by real-time quantitative RT-PCR assay. miR-9 expression in glioma tissues was significantly higher than that in corresponding nonneoplastic brain tissues ($P < 0.001$). The increased expression of miR-9 was more frequently observed in glioma tissues with high WHO grade than those with low WHO grade tissues ($P = 0.001$). The expression levels of miR-9 in glioma tissues with low Karnofsky performance score (KPS) were also significantly higher than those with high KPS ($P = 0.008$). Moreover, the overall survival of glioma patients with high miR-9 expression was obviously lower than that with low miR-9 expression ($P < 0.001$). Multivariate analysis further showed that high miR-9 expression was an independent prognostic factor for overall survival in glioma patients ($P = 0.01$). More importantly, the subgroup analyses indicated that the overall survival of glioma patients with high WHO grade (III–IV) was significantly worse for high miR-9 expression group than for low miR-9 expression group ($P < 0.001$), but no significant difference was found for patients with low WHO grade (I–II). These findings suggest for the first time that the increased expression of miR-9 may play an important role in tumor progression in human gliomas. miR-9 might be a useful marker for predicting the clinical outcome of glioma patients, especially for advanced subtypes.

**Keywords** microRNA-9 · Glioma · Real-time quantitative RT-PCR · Prognosis

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## Introduction

Glioma accounts for nearly one-third of all intrinsic neoplasms in the central nervous system including well-differentiated low-grade astrocytomas [World Health Organization (WHO) grade I–II], anaplastic astrocytomas (WHO grade III), and glioblastoma (GBM, WHO grade IV) [1]. This tumor is aggressive and has a tendency to invade the surrounding brain tissue. Although recent advances in surgery, radiotherapy, photodynamic therapy, and chemotherapy, survival of patients with gliomas remains poor [2, 3]. The median overall survival of patients with malignant gliomas is no more than 1 year and local recurrence occurs in more than 90 % of patients [4]. GBM, as the most aggressive and most lethal type of brain tumor, has an average patient life expectancy of only 15 months after diagnosis [5]. Although age, Karnofsky performance status (KPS) score, histologic grade, and tumor necrosis have been used as important prognostic factors for gliomas, the prognosis of