CASE REPORT

Glioblastoma multiforme: A rare case of GBM

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Abstract

The most rapid and severe primary brain tumor in adults is Glioblastoma Multiforme (GBM), which is known for its rapid development and high invasiveness. GBM is still associated with a dismal prognosis, even with advancements in multiple treatment modalities like chemotherapy, radiotherapy, and surgical resection. The typical survival following diagnosis is only 12 to 15 months. GBM is incredibly heterogeneous due to its complicated genetic and molecular causes, which makes effective therapy very challenging. Three key molecular pathways associated with the pathophysiology of GBM include PI3K/AKT/mTOR, Rb signaling, and the p53 tumor suppressor. There are promising prospects to improve clinical outcomes with new treatment techniques that target these pathways in addition to innovative strategies like immunotherapy and personalized medicine. This research investigates characteristic approaches to GBM management which includes post op adjuvant radiotherapy with concurrent temozolomide followed by adjuvant chemotherapy for 6 to 12 cycles.

Keywords: Glioblastoma Multiforme, Tumor, Cell, Growth

Introduction

Glioblastoma Multiforme (GBM) is the most aggressive and prevalent primary brain tumor in adults, with fast development and high invasiveness [1]. Despite advancements in surgical resection, adjuvant radiation treatment, along with concurrent and adjuvant chemotherapy, patients with GBM continue to have a guarded prognosis, with a median survival duration of 12-15 months from diagnosis [2-6]. The diverse character of GBM, which is caused by a complex interaction of genetic and molecular changes, presents considerable obstacles for successful therapy. GBM pathogenesis involves many molecular pathways, including PI3K/AKT/mTOR, p53 tumour suppressor, and Rb signalling pathways. Emerging medicines targeting these pathways, as well as innovative techniques like immunotherapy and personalised medicine, have opportunities to improve patient outcomes [6-9].

Case Report

A male patient in his mid-thirties was brought to the casualty with chief complaints of chronic headache and shivering. The patient reported to have been experiencing symptoms since 2 months. No family history of any occurrences of malignancies or genetic disorders was documented. The physical and neurological assessments were done. Vital signs and laboratory results were within the expected parameters. Hence, it was recommended that the patient undergo a brain Magnetic

Resonance Imaging (MRI) to further investigate the aforementioned symptoms. After the MRI examination, the results defined a solid cystic round to oval mass lesion over left parasagittal parietal lobe measuring 7×6.1×5.7 cm with significant surrounding perilesional oedema extending to the left high parietal region superiorly appearing heterogeneously hyperintense to white matter on T2 Weighted Images (WI) and FLAIR images, and also isointense to hypointense on T1WI,where as in Diffusion-Weighted Imaging (DWI) it showed minimal peripheral restriction with no blooming on Gradient Recalled Echo (GRE) sequence. The lesion showed heterogenous strong enhancement of the solid component on post contrast, and caused mass effect in the form of effacement of adjacent brain parenchyma and bilateral lateral ventricles with midline shift of 11 mm to the right side. Moreover, magnetic resonance spectroscopy revealed an increase in lipid and lactate peaks, typically observed in glioblastomas. Due to the severity of the condition, the patient was then referred to the neurological and surgery department whereby the patient was scheduled to undergo a craniotomy and total surgical resection of the tumor. Subsequently, the patient exhibited gradual improvement and had been allocated diagnostic follow-ups and post-surgical radiotherapy [10].

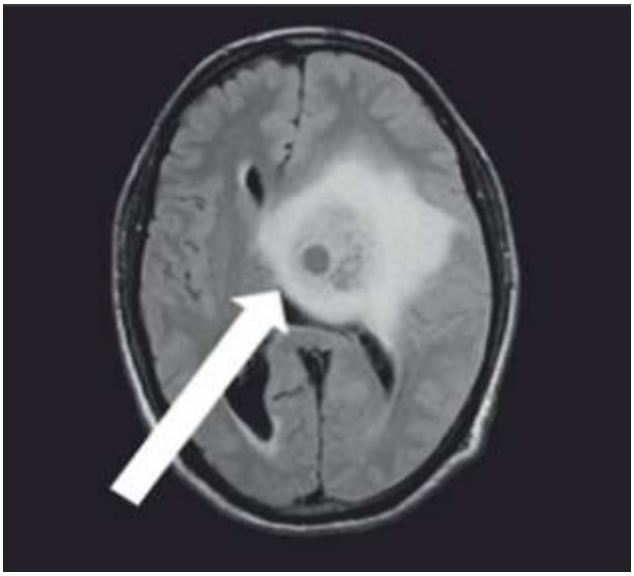

Figure 1: Axial T1 weighted image showing glioblastoma multiforme

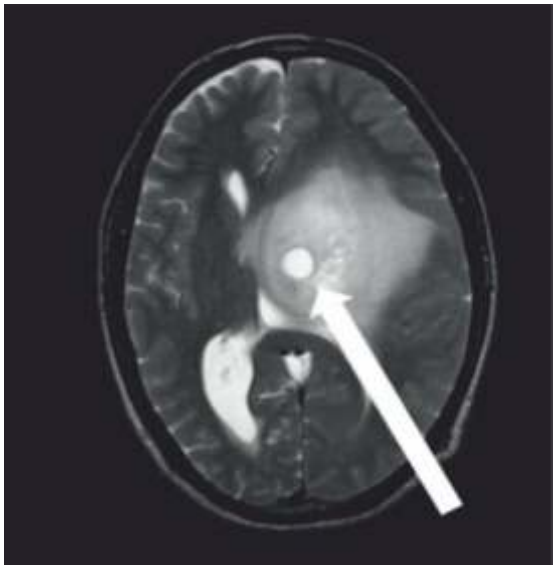

Figure 2: Axial T2 weighted image showing glioblastoma multiforme

Figure 3: MRS image demonstrating NAA peak

Discussion

Glioblastoma (GBM) is the most aggressive and common primary malignant brain tumor, accounting for 16% of all primary brain and central nervous system neoplasms. It has an incidence rate of 3.2 per 100,000 people, with a median diagnosis age of 64, though it can occur at any age. GBM is more prevalent in men and Caucasians and primarily arises in the brain, though it can also affect the brain stem, cerebellum, and spinal cord. Originally thought to originate from glial cells, GBM is now believed to arise from neural stem cell-like cells with molecular alterations in signaling pathways, such as p53, receptor tyrosine kinase/Ras/phosphoinositide 3-kinase, and retinoblastoma. These alterations drive uncontrolled cell proliferation and survival. GBM is classified into primary (de novo) and secondary (evolving from low-grade tumors), with primary GBM being more common, occurring in older patients, and having a poorer prognosis. Genomic profiling has identified four molecular subtypes classical, pro-neural, neural, and mesenchymal each with distinct progression and survival outcomes.

Treatment for GBM involves a multidisciplinary approach, starting with maximal safe surgical resection, though complete removal is challenging due to the tumor's invasive nature and critical brain locations. Advances in surgical techniques, such as functional MRI, diffusion tensor imaging, and 5-aminolevulinic acid fluorescence guidance, have improved resection precision while preserving brain function. Post-surgery, the standard treatment is the Stupp regimen: concurrent Radiation Therapy (RT) and Temozolomide (TMZ) chemotherapy, followed by adjuvant TMZ. This approach, established in 2005, significantly improved median survival from 12.1 to 14.6 months compared to RT alone. MGMT gene methylation status is

a key prognostic factor, as it enhances TMZ efficacy by impairing DNA repair. Modern RT techniques, such as Involved Field RT (IFRT), have replaced whole-brain RT to reduce neurocognitive toxicity while maintaining efficacy.

Despite advances, GBM prognosis remains poor, with a median survival of 15 months. Factors influencing survival include age, Karnofsky Performance Status, tumor size, and location. Younger patients with higher performance status and smaller, accessible tumors tend to have better outcomes. In 2015, the FDA approved Optune®, a tumor-treating fields (TTFields) device, which disrupts tumor cell division using alternating electrical fields. When combined with TMZ, TTFields improved progression-free survival (7.1 vs. 4 months) and overall survival (20.5 vs. 15.6 months) compared to TMZ alone.

Ongoing research focuses on optimizing treatment strategies, including molecular subtyping for personalized therapies and exploring novel approaches like imaging genomics, which links molecular profiles to radiologic features for non-invasive genomic prediction. While aggressive multimodality treatment has improved outcomes, GBM remains a highly aggressive disease with significant unmet needs. Further research is essential to establish new standards of care and improve survival and quality of life for GBM patients.

Conclusion

Glioblastoma Multiforme (GBM) is a common, aggressive, and prevalent kind of primary brain tumour in adulthood. It starts from astrocytes, in the brain, and is categorised as a Grade IV astrocytoma by the World Health Organization (WHO). GBM is well-known for its rapid development, aggressiveness, and resistance to treatment, which makes it a major challenge in neuro-oncology. GBM accounts for around 15% of all brain tumors and about 60-70% of all astrocytomas. Common genetic abnormalities in GBM include mutations in the TP53 gene, amplification of the EGFR gene, and mutations in the PTEN gene. These alterations lead to unregulated cell proliferation, avoidance of apoptosis (programmed cell death), and accelerated invasion of adjacent brain tissue.

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