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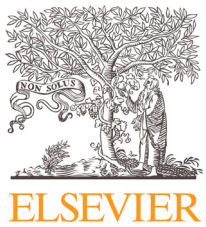

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Case Report

A rare case of gliosarcoma: Comprehensive radiological, histopathological, and clinical insights into diagnosis and management ☆

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ABSTRACT

Gliosarcoma is a rare and aggressive variant of glioblastoma, characterized by a biphasic histological pattern consisting of both glial and mesenchymal components. This case report describes the clinical presentation, radiological findings, surgical management, and histopathological analysis of gliosarcoma in a 30-year-old female. The patient presented with a 10-day history of right-sided headache and recurrent vomiting. Neurological examination was unremarkable, and vital signs were stable. Magnetic resonance imaging (MRI) revealed a heterogeneously enhancing mass lesion involving the right parietal region and the splenium of the corpus callosum, crossing the midline and causing significant ventricular effacement. Imaging features included heterogeneously hypointense signals on T1-weighted imaging, hyperintense signals on T2/FLAIR, areas of blooming on susceptibility-weighted imaging, and restricted diffusion on diffusion-weighted imaging, suggestive of a high-grade glial tumor. The patient underwent surgical resection, and histopathological examination confirmed gliosarcoma. The tumor exhibited a biphasic pattern comprising glial and sarcomatous elements. This case emphasizes the diagnostic challenges associated with gliosarcoma, where radiological features often mimic glioblastoma, necessitating histopathological confirmation. Gliosarcoma's aggressive nature poses significant therapeutic challenges, with treatment strategies involving surgical resection followed by adjuvant radiotherapy and chemotherapy. This report highlights the importance of integrating clinical, radiological, and histopathological findings to achieve an accurate diagnosis and optimize treatment outcomes. It underscores the need for early recognition and a multidisciplinary approach to managing rare central nervous system tumors like gliosarcoma. Fur-

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ther research into advanced therapeutic strategies is warranted to improve the prognosis for such patients.

Background

Gliosarcoma, a rare and aggressive primary brain tumor, is classified as a World Health Organization (WHO) grade IV glioma. Representing approximately 2% of all glioblastomas, gliosarcoma is distinguished by its unique biphasic histological pattern, comprising both glial and sarcomatous components [1,2]. This tumor typically affects adults, with a peak incidence in the fifth to sixth decade of life, and shows a slight male predominance [3]. Despite its low incidence, gliosarcoma's aggressive behavior and poor prognosis make it a significant clinical entity requiring detailed study. Most tumors are located in the supratentorial region, with the frontal and temporal lobes being the most common sites, although rarer extracranial metastases have been reported [4,5]. Clinically, patients with gliosarcoma often present with symptoms indicative of increased intracranial pressure, such as headache, nausea, and vomiting, accompanied by focal neurological deficits, depending on the lesion's location [6]. The presentation can mimic other high-grade gliomas, underscoring the need for accurate diagnostic evaluation.

Radiological imaging, especially magnetic resonance imaging (MRI), is integral to the diagnostic process. Gliosarcoma frequently presents as a heterogeneously enhancing mass with areas of necrosis and significant peritumoral edema. Advanced imaging techniques such as diffusion-weighted imaging (DWI), which detects high cellularity, and susceptibility-weighted imaging (SWI), which identifies hemorrhagic components, add diagnostic value [7]. Despite these advancements, differentiating gliosarcoma from glioblastoma solely based on imaging remains challenging, making histopathological analysis indispensable [5].

Histologically, gliosarcoma exhibits a biphasic architecture. The glial component typically resembles glioblastoma, with features such as cellular pleomorphism, necrosis, and microvascular proliferation. The sarcomatous component, characterized by spindle cells and mesenchymal differentiation, differentiates gliosarcoma from glioblastoma [8]. This dual morphology suggests a common progenitor cell capable of divergent differentiation, further supported by molecular studies showing shared genetic mutations between the 2 components [9,10].

Treatment approaches for gliosarcoma are modeled after those for glioblastoma, including maximal safe surgical resection followed by radiotherapy and temozolomide-based chemotherapy. Despite these interventions, gliosarcoma's prognosis remains dismal, with median survival ranging from 6 to 14 months, slightly lower than glioblastoma due to its higher rate of recurrence and resistance to therapy [11,12]. The poor outcomes highlight the need for novel therapeutic strategies, such as immunotherapy and targeted molecular therapies, which are currently under investigation [13,14].

Case presentation

A 30-year-old female presented to the emergency department with a 10-day history of persistent right-sided headache and recurrent episodes of vomiting. She denied any associated symptoms, including trauma, neurological deficits, fever, or any prior history of chronic illnesses such as hypertension or diabetes mellitus. Her personal and family medical histories were unremarkable. Upon clinical examination, the patient was alert and oriented to time, place, and person, and her vital signs were within normal limits. The neurological assessment showed no focal abnormalities.

Given the nature and persistence of her symptoms, an MRI of the brain was conducted. The imaging revealed a heterogeneously enhancing mass lesion located in the right parietal region and the splenium of the corpus callosum. The lesion was noted to cross the midline. It caused significant effacement of the occipital horns of the bilateral lateral ventricles and the third ventricle, leading to features consistent with obstructive hydrocephalus. On MRI, the lesion appeared heterogeneously hypointense on T1-weighted imaging (T1WI) and heterogeneously hyperintense on T2/FLAIR sequences, indicating the presence of a mixed solid and edematous component Figures 1-2. Susceptibility-weighted imaging (SWI) demonstrated areas of blooming, suggestive of intralesional hemorrhage, while diffusion-weighted imaging (DWI) revealed areas of restricted diffusion, indicative of high cellular density and tumor aggressiveness Figures 3-4. These findings raised a strong suspicion of glioblastoma multiforme, a highly aggressive primary brain tumor.

The patient underwent a craniotomy with surgical microexcision of the tumor for definitive diagnosis and management. Postoperative histopathological examination revealed a biphasic tumor morphology Figure 5. The glial component, characteristic of glioblastoma, was intermixed with a sarcomatous mesenchymal component, confirming the diagnosis of gliosarcoma. This rare variant of glioblastoma is distinguished by its aggressive behavior and distinct histological features.

This case illustrates the critical role of advanced imaging and histopathology in diagnosing gliosarcoma, a rare and challenging central nervous system tumor. The preoperative imaging findings provided essential insights into the lesion's aggressive nature and its potential to cause significant intracranial complications. Surgical resection remains the primary therapeutic intervention, but the overall prognosis is poor due to the tumor's highly malignant nature. Adjuvant treatment strategies, including radiotherapy and chemotherapy, are often required to manage residual disease and delay recurrence.

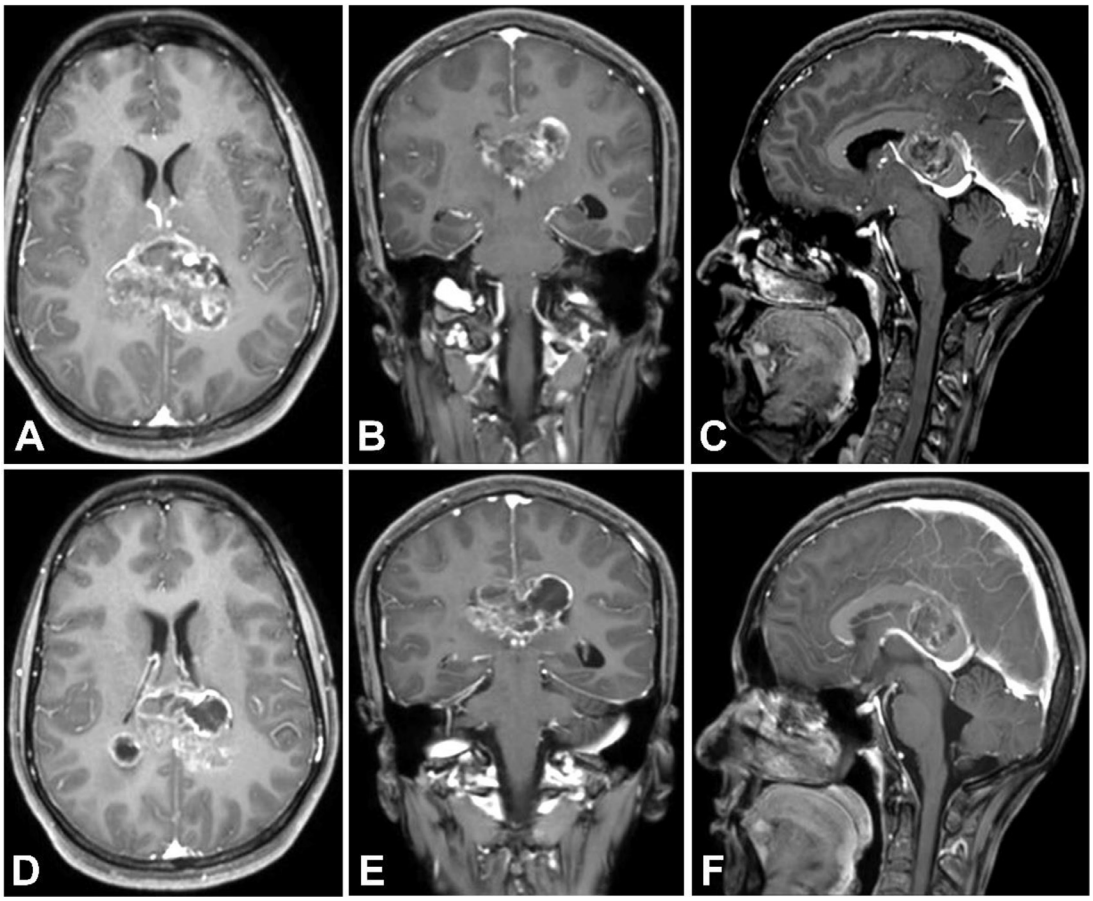

Fig. 1 – Axial, coronal, and sagittal MRI T1+C sections highlighting a heterogeneously enhancing lesion in the splenium of the corpus callosum, causing effacement of the occipital horns of the bilateral lateral ventricles and the third ventricle.

Discussion

Gliosarcoma is an uncommon and highly malignant brain tumor, representing approximately 2% of glioblastoma cases [15]. It is classified as a Grade IV tumor under the World Health Organization (WHO) classification of central nervous system tumors. This neoplasm is distinguished by its biphasic histopathological composition, comprising both glial and mesenchymal components [16]. The rarity and heterogeneity of gliosarcoma pose significant diagnostic and therapeutic challenges, as reflected in this case report.

Clinical presentation

Patients with gliosarcoma commonly present with symptoms of increased intracranial pressure, such as headache, nausea, vomiting, and, occasionally, focal neurological deficits [17]. In this case, the patient experienced a 10-day history of headache and vomiting, with no evidence of trauma, systemic illness, or neurological deficits on examination. These nonspecific symptoms necessitated advanced imaging to identify the underlying pathology.

Radiological features

Imaging plays a vital role in the preoperative evaluation of gliosarcoma. MRI is the modality of choice, providing detailed insights into the tumor's location, extent, and characteristics. Gliosarcoma often appears as a heterogeneously enhancing mass with surrounding vasogenic edema. The lesion in this patient was located in the right parietal region, extending to the splenium of the corpus callosum, crossing the midline, and causing ventricular compression. Advanced MRI techniques added diagnostic value: diffusion-weighted imaging (DWI) revealed areas of restricted diffusion, indicating high cellularity, while susceptibility-weighted imaging (SWI) demonstrated blooming, consistent with intralesional hemorrhage [18]. These imaging features often overlap with those of glioblastoma, highlighting the need for histopathological confirmation.

Histopathological analysis

Histopathological examination is the gold standard for diagnosing gliosarcoma. This tumor's hallmark is its biphasic ar-

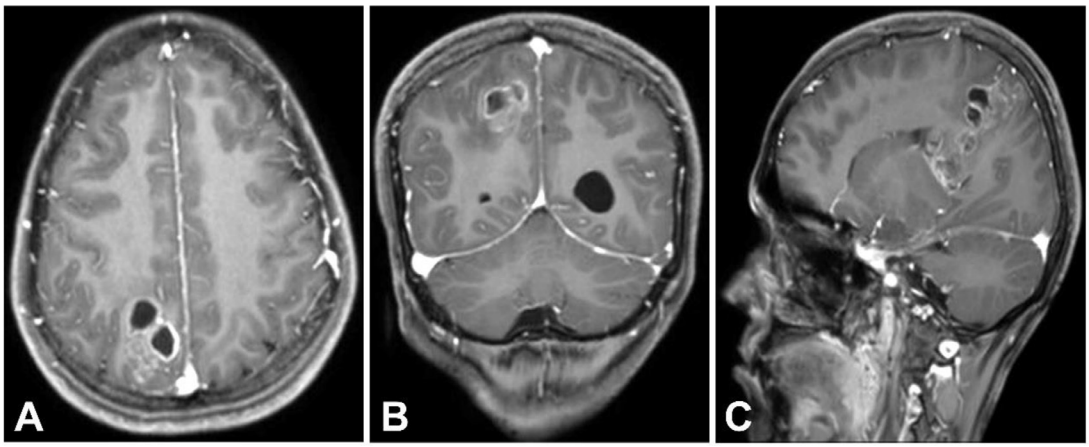

Fig. 2 – Axial, coronal, and sagittal MRI T1+C sections showing a heterogeneously enhancing lesion in the right parietal region.

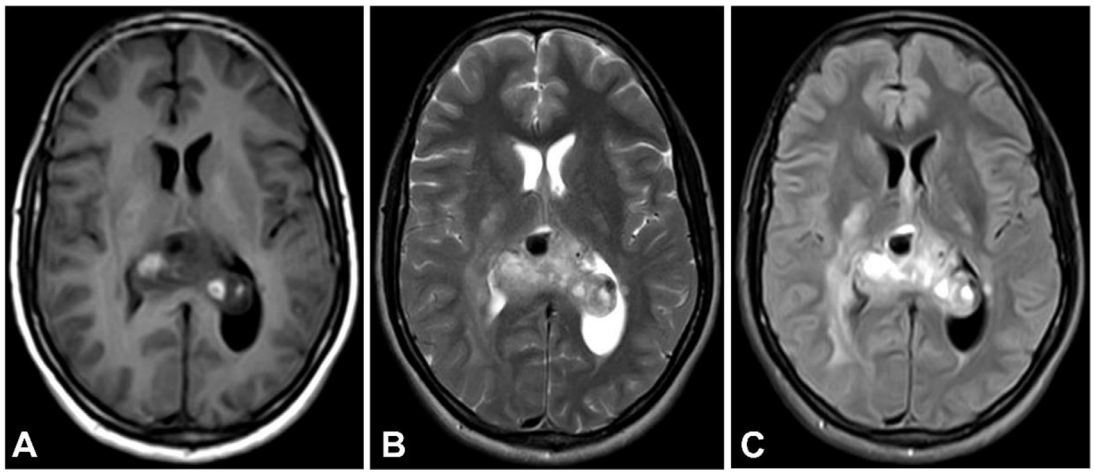

Fig. 3 – Axial T1 sections showing a heterogeneously hypointense lesion, and axial T2/FLAIR sections showing a heterogeneously hyperintense lesion.

chitecture, with a glial component—characterized by GFAP-positive astrocytic cells—and a mesenchymal component, often sarcomatous in nature [19]. The distinct separation between these components, as observed in this case, confirms the diagnosis. The mesenchymal element is thought to arise from malignant transformation of endothelial cells or metaplasia within the tumor microenvironment [20]. Immunohistochemical staining further aids in differentiating gliosarcoma from other gliomas and metastatic tumors.

Treatment and management

Surgical resection remains the cornerstone of gliosarcoma management, aiming to achieve maximal tumor removal while preserving neurological function [21]. In this case, the patient underwent microexcision of the tumor, which provided both therapeutic benefit and tissue for histopathological diagnosis. However, complete resection is rarely achievable due to the tumor's infiltrative nature. Adjuvant therapy, including radiotherapy and temozolomide-based chemotherapy, is a critical component of treatment, mirroring the protocols for glioblastoma [22]. Studies have shown that while these therapies improve progression-free survival, the overall prognosis remains poor, with a median survival time of 6–18 months [23]. Gliosarcoma exhibits higher rates of extracranial metastasis compared to glioblastoma, further complicating management [24].

Challenges and future directions

The aggressive behavior and therapeutic resistance of gliosarcoma highlight the need for novel treatment strategies. Research into targeted therapies, such as molecular inhibitors and immune checkpoint blockers, has shown promise in pre-

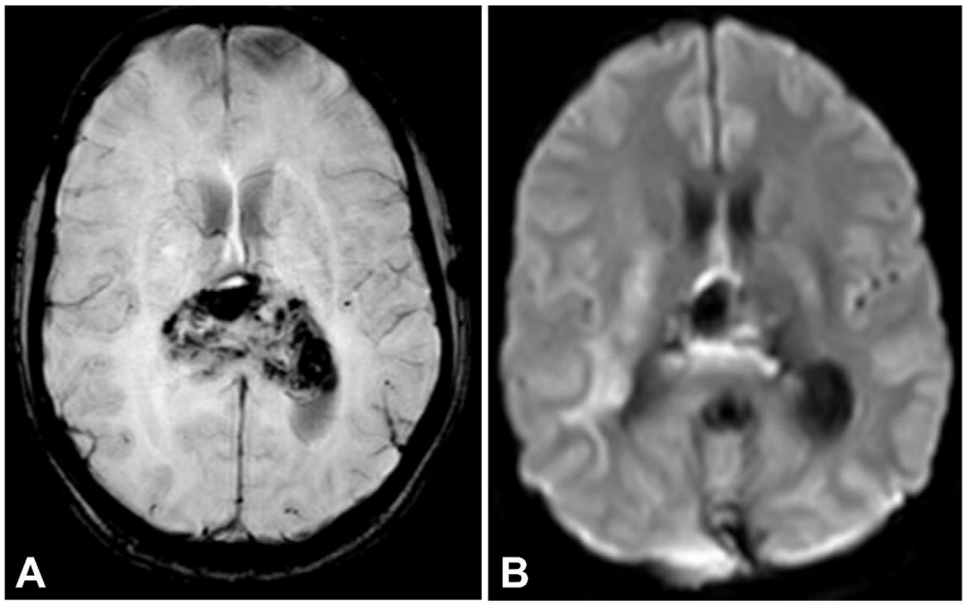

Fig. 4 – SWI axial section showing areas of blooming within the lesion, and DWI axial section showing areas of restriction.

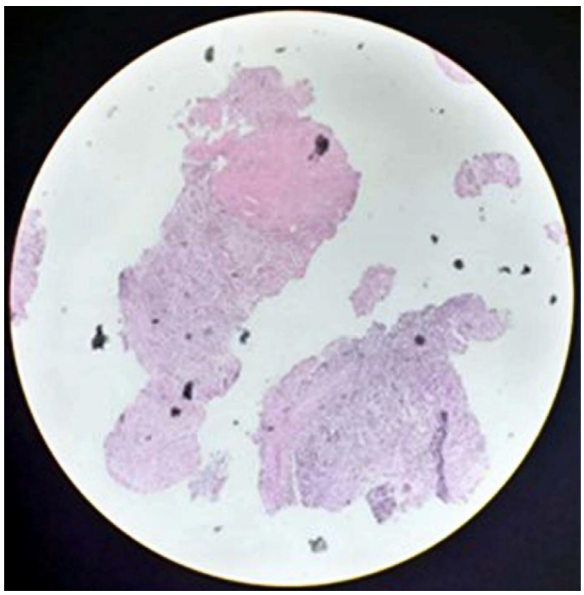

Fig. 5 – Histopathological slide showing 2 large cell bodies: Glial and sarcomatous components.

clinical studies [25]. For example, therapies targeting the EGFR and VEGF pathways, frequently altered in gliosarcoma, could provide more effective options [26]. Moreover, advancements in immunotherapy, including CAR-T cell therapy and vaccine-based approaches, are under investigation and may offer hope for improving outcomes [27].

Conclusion

Gliosarcoma is a rare and highly aggressive variant of glioblastoma that poses significant diagnostic and therapeutic challenges. This case report highlights the critical role of comprehensive clinical evaluation, advanced radiological imaging, and definitive histopathological analysis in accurately diagnosing this uncommon tumor. The integration of MRI findings, such as heterogeneous enhancement, midline crossing, and characteristic signal patterns, with the histopathological identification of biphasic glial and mesenchymal components, was pivotal in establishing the diagnosis in this patient. Surgical resection remains the cornerstone of management, offering symptomatic relief and tissue diagnosis, while adjuvant therapies are essential to address the tumor's invasive nature and reduce recurrence risk. Despite advancements in multimodal treatment approaches, the prognosis for gliosarcoma remains poor due to its aggressive behavior and resistance to conventional therapies. This case underscores the importance of early recognition and a multidisciplinary approach to optimizing patient outcomes. Future research into targeted therapies and novel treatment strategies is crucial to improve the survival and quality of life for patients diagnosed with gliosarcoma.

Patient consent

Written informed consent was obtained from the patient for the publication of this case report.

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