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Case report

Primary intraventricular gliosarcoma on MRI: A challenging diagnosis ☆☆☆

Ho Xuan Tuan, MD, PhD^{a,1}, Nguyen Duy Hung, MD, PhD^{b,c,1,*}, Nguyen Dinh Minh, MD, PhD^c, Nguyen-Thi Van Anh, MD^b, Nguyen Ha Vi, MD^b, Ngo Quang Duy, MD^d, Nguyen Minh Duc, MD^{e,1,**}, Tran Cong Hoan, MD, PhD, Assoc Prof^f

^aDepartment of Radiology, Department of Radiology, School of Medicine and Pharmacy, University of Da Nang, Da Nang City, Vietnam

^bDepartment of Radiology, Hanoi Medical University, Hanoi, Vietnam

^cDepartment of Radiology, Viet Duc Hospital, Hanoi, Vietnam

^dDepartment of Radiology, Ha Giang General Hospital, Ha Giang, Vietnam

^eDepartment of Radiology, Pham Ngoc Thach University of Medicine, Ho Chi Minh City, Vietnam

^fDepartment of Radiology, E Hospital, Hanoi, Vietnam

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ABSTRACT

Gliosarcoma (GS) is an uncommon central nervous system tumor with several characteristics of a malignant neoplasm and poor prognosis. The majority of GS reports describe a predilection for the cerebral hemispheres, and cases of intraventricular GS are extremely rare, with only a few reported. In addition, intraventricular GS has not been associated with any unique radiographic or clinical features, which can result in misdiagnosis as other intraventricular tumor types. In this report, we present the case of a 32-year-old woman with GS in the trigone of the lateral ventricle and provide a retrospective review of similar, previously reported cases.

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Introduction

Gliosarcoma (GS) is typically considered a variant form of primary glioblastoma (GBM), accounting for 2%–8% of all GBM cases [1]. The first clinical case of GS was reported by

Stroebe in 1895 [2]. In 2007, the World Health Organization (WHO) classified GS as a highly malignant subtype of GBM [3]. Histopathologically, the immunochemical features of GS suggest the biphasic lesion, with evidence of both glial and sarcomatous components [3]. However, on radiographic examination, GS and GBM are difficult to distinguish due to several

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* Corresponding author.

** Co-corresponding author.

E-mail addresses: nguyenduyhung_84@yahoo.com (N.D. Hung), bsnguyenminhduc@pnt.edu.vn (N.M. Duc).

¹ These authors contributed equally to this article as first authorship.

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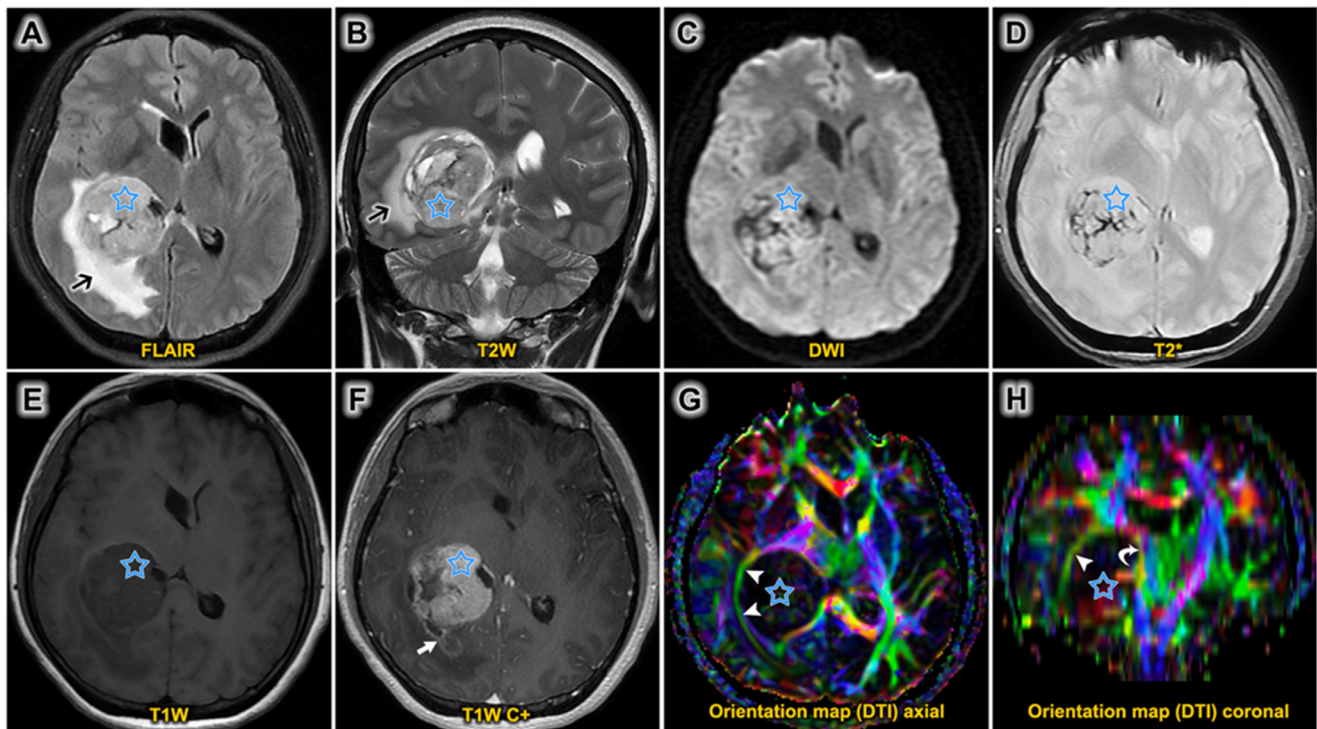


Fig. 1 – (A–F) A mixed-signal mass (star) was observed in the trigone of the right lateral ventricle, surrounded by moderate vasogenic edema (black arrow in A and B). Post-contrast heterogeneous enhancement and the thickening of the ependymal membrane with uniform enhancement were also observed (white arrow in F). (G and H) On diffusion tensor imaging (DTI), this mass appeared to compress the inferior frontal-occipital fasciculus (IFOF, G) and optic radiation (arrowheads in G and H) laterally and the pyramidal tract (curved arrow in H) medially.

common characteristics. The clinical symptoms are consistent with a rapidly expanding intracranial neoplasm, including headache, hemiparesis, seizures, and visual disturbances [4,5]. The vast majority of GS arise from the cerebral hemispheres, frontal and parietal lobes, or the posterior cranial fossa [6]. Intraventricular GS is less commonly encountered, although a few cases of GS have been described in the lateral or third ventricle [1,7–8], and intraventricular GS is often misdiagnosed as lower grade intraventricular tumors, such as ependymoma or pneumocystis astrocytoma. In this article, we report the clinical presentation, radiographic findings, histopathologic features, and treatment for a case of lateral ventricle GS.

Case report

A 32-year-old woman presented to our hospital with a long-lasting headache, with a 3-month duration with subsequent nausea and vomiting. No remarkable symptoms or medical history were identified. Laboratory tests revealed a mildly anemic condition, and no changes in biochemical reports were documented.

On magnetic resonance imaging (MRI), we detected a $42 \times 39 \times 40$ mm lobulated mass at the trigone region of the right lateral ventricle, with a well-defined margin, and a mixed signal comprised of a hyperintense component

on T2-weighted (T2W) imaging and fluid-attenuated inversion recovery and a heterogeneous hypointense signal on T1-weighted (T1W) imaging, which was restricted on diffusion-weighted imaging with internal necrotic and hemorrhagic components. The administration of a contrast agent resulted in the vivid and heterogeneous enhancement of features, including the thickening of the ependymal membrane (Fig. 1A–F). This mass compressed the ipsilateral ventricle, displaced the midline to the left, and caused moderate vasogenic edema in the region surrounding the ventricle. A diffusion tensor imaging (DTI) sequence was performed for preoperative planning, which revealed the lateral displacement of the inferior frontal-occipital fasciculus (IFOF) and the optic radiation and the medial displacement of the pyramidal tract (Fig. 1G and H). The most probable diagnosis based on MRI features was determined to be ependymoma.

Several days after admission, the patient underwent brain surgery for tumor resection. The macroscopic view revealed a soft tissue mass with a pinkish surface color surface and areas of necrosis and hemorrhage (Fig. 2). Microscopically, this neoplasm was primarily composed of spindle cells with large nuclei and basophilic cytoplasm, which suggested sarcomatous components, and multiple areas of large cells were observed, with pleomorphic nuclei and a high mitotic rate (suggestive of a glial component). The immunohistochemical results indicated intracranial gliosarcoma (WHO grade IV), including positive glial fibrillary acidic protein staining in the cytoplasm of pleomorphic cells, positive oligodendrocyte transcription fac-



Fig. 2 – Macroscopic view: A 4 × 2 × 1 cm solid mass with pinkish surface color and multiple areas of necrosis and hemorrhage.

tor staining in the nuclei of pleomorphic cells, and positive smooth muscle actin staining in the cytoplasm of spindle cells (Fig. 3).

The patient was treated postoperatively with both radiation therapy and chemotherapy. After six months of follow-up, the clinical symptoms were progressively relieved, and no pain, paralysis, or visual disturbances were reported.

Discussion

GS is considered to be a subtype of GBM, with pathologic features highlighted by the biphasic morphology consistent with the presence of both glial and sarcomatous components [4]. GS accounts for approximately 1.8%-8% of all GBM cases, with the onset typically occurring between the ages of 50 and 70 years [9]. The oldest reported intraventricular GS patient was a 65-year-old woman, described by Moiyadi et al. in 2010 [10]. GS is predominantly identified in men, with a male:female ratio of 1.4:1 [11]. The vast majority of GS is primary, but secondary GS has been reported subsequent to a primary GBM lesion [12]. The clinical manifestations depend on the lesion size, location, and level of resulting hydrocephalus, which cause increased intracranial pressure and focal neurological deficits. The most common symptoms include aphasia, headache, hemiparesis, seizures, and cognitive decline [4]. In 2012, Hsu et al. described the case of a 37-year-old man who was admitted to the hospital due to a 3-month history of headache, dizziness, insomnia, memory loss, vomiting, and slurred speech [13]. Our patient, a 32-year-old woman, presented with several similar symptoms, including persistent headache, vomiting, and insomnia, with a duration of 3 months. No fever, weight loss, visual impairment, or motor or

sensory issues were detected. The patient's medical history had no documented occurrence of encephalitis or traumatic brain injury. Generally, GS is located in the area of the cerebral hemisphere, involving the temporal, frontal, parietal, or occipital lobes [8]. Intraventricular GS is extremely rare and is typically found in the lateral ventricle and septum pellucidum [1], and three cases of GS in the septum pellucidum have been reported [8,14,15]. In our case, the neoplasm appeared at the trigone of the right lateral ventricle.

The radiographic features of GS on computed tomography are characterized by the appearance of a round or lobulated, hyperdense, well-defined (often due to sarcomatous components), solid mass with peritumoral edema [11]. On MRI, GS typically appears as hypointense on T1W images, with heterogeneous hyperintensity T2W images due to hemorrhagic and necrotic components, with restricted diffusion. After contrast administration, GS presents as an irregular ring-like enhancement, either with or without enhancement of the ependymal lining. Our case presented as a heterogeneously enhancing mass with enhancement observed in the ependymal lining of the occipital horn, similar to the patient presentation described by Baldawa et al. in 2017 [16]. Restricted diffusion on diffusion-weighted imaging was observed for the intraventricular GS in our case, and a similar finding was described for the cases reported by Sarkar in 2011 [13] and Hsu in 2012 [15]. Most cases of GS in the ventricles are associated with hydrocephalus [1]. Magnetic resonance spectroscopy (MRS) of GS is also associated with common characteristics, including elevated choline, decreased N-acetylaspartate, and lactate or lipid peaks. Multiple studies have examined the MRS characteristics of GS. In 2009, Buhl et al. presented the MRS results for two patients, characterized by a clear lactate peak at 1.33 ppm [17]. A lactate peak is a commonly observed feature associated with necrosis and malignancy. In addition, perfusion sequences are sometimes used to detect hyperperfusion features in tumoral and peri-tumoral areas. Three patients described by Fukuda et al. presented with increased relative cerebral blood volume in the tumor compared with the surrounding normal white matter [18]. DTI is a non-invasive technique based on the principle of anisotropic water molecule diffusion in axons. Although DTI is useful for investigating the structural integrity of white matter, few studies have performed DTI in cases of GS [19]. In our case, although the lesion was not associated with any neurologic symptoms, such as hemiparesis or visual disturbances, the DTI sequence revealed that the tumor displaced the IFOF and optic radiation laterally, whereas the corticospinal tract was displaced medially. Based on these features, the most likely preoperative diagnosis was ependymoma. However, some concerning features were identified in our case, including the vivid heterogeneous enhancement pattern observed with no calcification. By contrast, ependymoma often presents with moderate enhancement, and calcification occurs in 40%–80% of ependymoma cases [1]. Eventually, the histopathological examination revealed a grade IV gliosarcoma, a less thought-provoking diagnosis of intraventricular tumor.

Multiple studies have indicated that GS is associated with a poor prognosis. Lutterbach et al. conducted a study of 12 GS patients, which reported a median overall survival for GS of 11.5 months, and all GS patients experienced local tumor

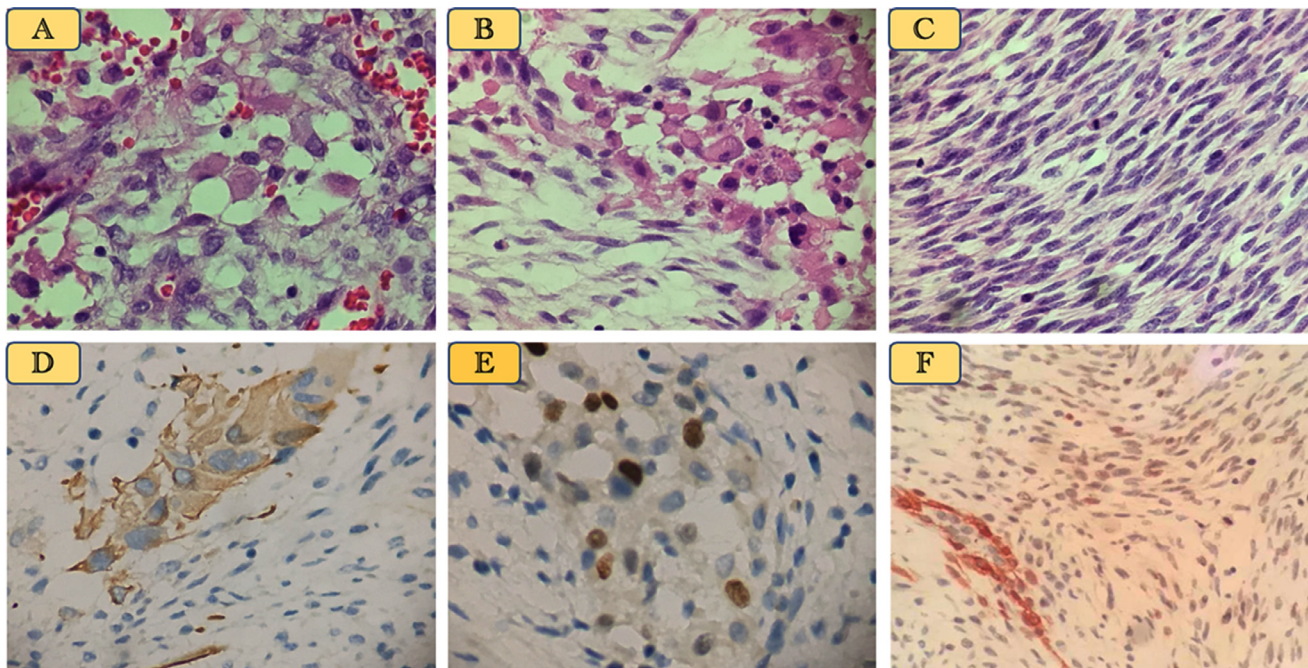


Fig. 3 – (Microscopic view) A–C (Hematoxylin and eosin; $\times 100$): Microscopic image: Spindle cells, with large nuclei and basophilic cytoplasm, suggesting a sarcomatous component, and multiple areas featuring large cells, with pleomorphic nuclei and a high mitotic rate (suggestive of a glial component); D–F (Immunohistochemical staining; $\times 400$). Immunohistochemical imaging revealed glial fibrillary acidic protein (GFAP) staining in the glial cell cytoplasm (D), oligodendrocyte transcription factor 2 (OLIG2) staining in the glial cell nuclei (E), and smooth muscle actin (SMA) staining in the sarcomatous cell cytoplasm (F).

recurrence and died due to neurological causes within 19.3 months following radiation therapy [11]. Govindan et al. described the complete resection of a GS in the septum, which extended into the lateral ventricles on both sides. However, 10 days after surgery, the patient developed acute respiratory distress and died of pulmonary thromboembolism [8]. The metastatic rate of GS is considered higher than that for GBM due to the sarcomatous component. The hematogenous spread of this tumor typically extends to extracranial regions [10]. Hsu et al. reported a case of GS in the left lateral ventricle with leptomeningeal tumor spread along the pontine surface and C1–C3 spinal cord on follow-up cervical spinal MRI [13]. Tumor resection with postoperative radiotherapy and chemotherapy (temozolomide or nitrosourea) is the most common treatment plan. Our case underwent tumor resection surgery followed by radiation therapy and chemotherapy.

Conclusion

In conclusion, we report a rare case of intraventricular GS at the trigone of the right lateral ventricle, which was vividly and heterogeneously enhanced on MRI. The compressed ventricle caused hydrocephalus and infiltrated the nearby ependymal membrane. Although an uncommon entity, GS should be considered in the differential diagnosis of intraventricular tumors.

Patient consent

Informed consent for patient information to be published in this article was obtained.

Author contributions

Ho XT, Nguyen DH, and Nguyen MD contributed equally to this article as co-first authors. All authors have read the manuscript and agree to the contents.

Ethical statement

Appropriate written informed consent was obtained for the publication of this case report and accompanying images.

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