

Coincidence of an anterior cerebral artery aneurysm and a glioblastoma: case report and review of literature

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Background: The association between glioblastoma and intracranial aneurysm is rare. Treatment guidelines do not exist, and operative mortality and morbidity are significantly high. To our knowledge, no prior cases have employed endovascular therapy for the treatment of these intracranial aneurysms followed by tumor resection.

Case presentation: A 74-year-old male, history of a left A2 aneurysm, presented after a motor vehicle accident at low speeds. Imaging was concerning for a possible traumatic brain contusion, an aneurysmal hemorrhage given history of left A2 aneurysm, or a hemorrhage from an underlying tumor given profound edema. The patient was discussed at the brain tumor board, where the plan was to address the aneurysm followed by resection of the mass versus close monitoring with subsequent imaging. The high risk of rehemorrhage, given the real possibility of an aneurysmal hemorrhage, motivated prompt treatment of the aneurysm. The patient was taken to the angiography suite; an anterosuperiorly projecting azygous A2 aneurysm, measuring 4.5 mm × 5.5 mm with a neck width at 3.5 mm and a small daughter sac, was completely obliterated with primary coiling. The following day, he underwent a left craniotomy along a forehead skin crease for mass excision. Final pathology revealed glioblastoma. The patient recovered well from both procedures, with a baseline neurological exam. The patient subsequently underwent hypofractionated radiation and temodar.

Conclusion: To our knowledge, no prior cases have employed endovascular therapy for the treatment of these intracranial aneurysms. We emphasize that efforts to introduce less invasive elements may improve the overall outcomes in this rare patient population.

Keywords: intracranial aneurysm, glioblastoma, traumatic brain injury

Introduction

The association between intracranial tumor and aneurysm is uncommon. Reported incidence has ranged between 0.3% and 4%.¹⁻⁴ The subset that involves glioblastoma is rare. Cases from literature have been organized into three general categories:⁵ 1) simultaneous discovery of both pathologies,^{1,3,6-11} 2) development of glioblastoma after the treatment of aneurysm,^{12,13} and 3) development of aneurysm after treatment of glioblastoma.^{1,5} The actual incidence of this association may be higher, since angiography is seldom completed for brain tumors.⁵ Intracranial aneurysms may arise at a location remote to the glioblastoma in some instances,^{5,8} while in others they may be anatomically close to the tumor.^{7,10}

Overall, the operative mortality for patients with a brain tumor and a cerebral aneurysm is significantly high, close to 40%.² For patients with dual pathologies, no clear guidelines exist. Past treatment strategies have varied, but have mainly emphasized

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a combination of aneurysm clipping and tumor debulking. To our knowledge, there have been no cases that employed a staged approach, consisting of endovascular intervention and followed by tumor excision. We report such a scenario, where the initial presentation also involved a traumatic brain injury, which further complicated the treatment strategy. Moreover, we review the literature regarding patients with dual pathologies.

Case report

A 74-year-old male, history of a left A2 aneurysm, presented after a motor vehicle accident at low speeds. At the scene, the patient exhibited confusion. He sustained abrasions above his left eye, around his nose, and above his lip. Upon further investigation, patient had also had a syncopal episode on the prior day, where he fell and hit his head as well. Besides the confusion, he exhibited no focal neurological deficits. A computed tomography (CT) head demonstrated a 4 cm × 6 cm hyperdensity and edema with mass effect on left frontal area (Figure 1). The concerns included possible traumatic brain contusion, aneurysmal hemorrhage (given history of left A2 aneurysm), or hemorrhage from an underlying tumor given profound edema. The patient was started on fosphenytoin. A CT angiography of the head demonstrated a pericallosal cerebral aneurysm (Figure 2A). A magnetic resonance imaging of the brain demonstrated a bifrontal, enhancing brain lesion with surrounding edema, concerning for a high-grade glioma (Figure 3A and B). Subsequently, he was started on intravenous dexamethasone.

The patient was discussed at the brain tumor board, where the plan was to address the aneurysm followed by resection of the mass versus close monitoring with subsequent imaging. The high risk of rehemorrhage, given the possibility of an aneurysmal hemorrhage, motivated prompt treatment of the aneurysm. The patient was taken to the angiography suite. An anterosuperiorly projecting azygous A2 aneurysm,

measuring 4.5 mm × 5.5 mm with a neck width at 3.5 mm and a small daughter sac, was completely obliterated with primary coiling (Figure 2B and C). Visualization of the external carotid arteries and internal carotid arteries bilaterally did not show any tumor blush. The following day, he underwent a left craniotomy along a forehead skin crease for mass excision. Final pathology revealed glioblastoma. The patient recovered well from both procedures, with a baseline neurological exam. The patient subsequently underwent hypofractionated radiation and temodar. The Medical College of Wisconsin does not require Institutional Review Board approval or patient consent for this case study.

Discussion

For patients with an intracranial tumor and an aneurysm, Pia et al² noted that 69% of cases exhibited initial symptoms attributed to the tumor, while 22% exhibited symptoms consistent with the aneurysm, and 6% demonstrated symptoms associated with both pathologies. Our patient presented after a traumatic brain injury, but the history of recent confusion prior to his car accident insinuates the effects from the frontal mass and surrounding edema.

The etiology of hemorrhage in our patient remains unclear. CT head was consistent with intralobular hemorrhage. Moreover, there may be a component of traumatic brain injury given his physical findings and mechanism of injury. Glioblastoma has a recognized tendency for intratumoral hemorrhage.^{14–18} However, presentation with subarachnoid hemorrhage is infrequent, with reported incidences ranging between 1.4% and 4.9%.^{19,20} Based on the ISUIA study, the A2 aneurysm in our patient has a low risk of hemorrhage, given its location along the anterior circulation and its relatively small size;²¹ on the other hand, the presence of a daughter sac may increase the risk for hemorrhage.^{22,23} Overall, there was a significant concern that the hyperdensity represented aneurysmal hemorrhage, which prompted treatment of the existing aneurysm given risks for rehemorrhage.

The pathogenesis for intracranial aneurysm in the presence of glioblastoma has been debated. One theory involves the alteration in flow dynamics;⁵ aneurysms may be linked to the arteries that supply glioblastomas; pathological low-resistance vessels that result in arteriovenous shunting are present in glioblastomas; an increase in flow may augment hemodynamic stress and contribute to the development of an aneurysm, not unlike the pathogenesis of aneurysms within arteriovenous malformations.^{5,10} Another notion suggests that tumor invasion of blood vessels may lead to development of an aneurysm. Glioblastoma is characterized

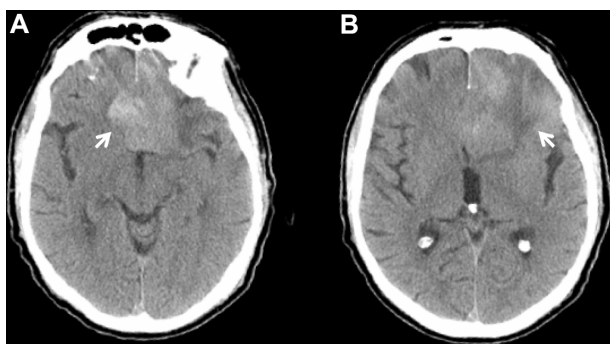


Figure 1 Axial CT demonstrates midline hyperdensity (arrow; **A**), and left frontal surrounding hypodensity (arrow; **B**).

Abbreviation: CT, computed tomography.

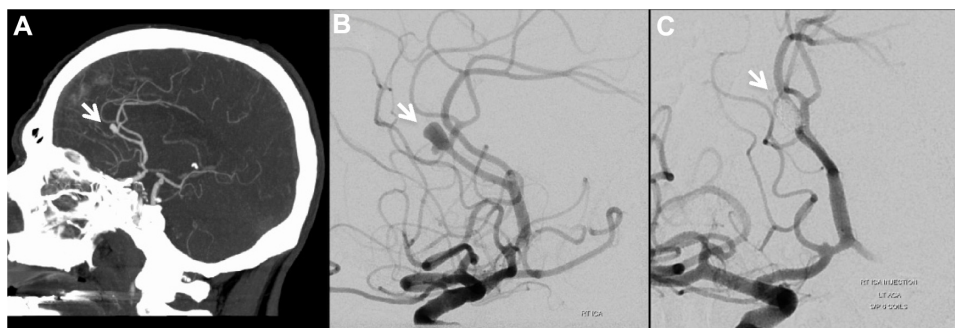


Figure 2 (A) Sagittal CT head angiography demonstrates A2 aneurysm (arrow). Diagnostic subtraction angiography **(B)** and **(C)** exhibit complete occlusion of A2 aneurysm after primary coiling (arrows).

Abbreviation: CT, computed tomography.

by endothelial proliferation, necrosis, telangiectasia, and fibrosis of adjacent blood vessels.^{6,24} Andrews et al⁶ discovered glial fibrillary acidic protein staining within the walls of aneurysm that was associated with a glioblastoma. Moreover, Aoki et al⁷ described a dissection of the middle cerebral artery by tumor cells; similarly, Cowen et al²⁴ noted fusiform dilatation of pericallosal arteries caused by infiltration of tumor cells.

For aneurysms that develop after the treatment of glioblastoma, radiation may also play a role in pathogenesis.^{5,10,25} Radiation may cause vasculopathy, characterized by endothelial damage that progresses to inflammation, thrombosis, intimal narrowing, and atherosclerosis.²⁵ These histological alterations, which predominantly influence the media and the intima, may lead to fragile points along blood vessels that are prone for aneurysmal formation.²⁵ Brachytherapy, whole brain radiation, and stereotactic radiosurgery have all been implicated with the development of intracranial aneurysms.²⁵

Table 1 highlights the English literature regarding cases with simultaneous presentation of a glioblastoma and an

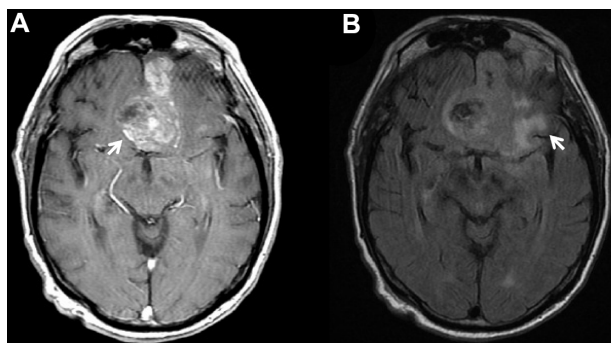


Figure 3 (A) Axial MR T1 with contrast demonstrates heterogeneously enhancing lesion along midline and left frontal area (arrow). **(B)** Axial MR FLAIR demonstrates perilesional edema (arrow).

Abbreviations: MR T1, T1-weighted image magnetic resonance; MR FLAIR, magnetic resonance–fluid-attenuated inversion recovery.

intracranial aneurysm. Several cases involve a 1-stage approach where both are treated (Cases 6, 9, 11, 13, and 15). A few cases involved a 2-stage approach (Cases 1, 8, and 10); however, Case 10 involved a postoperative hemorrhage from a previously undiagnosed anterior communicating artery aneurysm that necessitated a second surgery while Case 8 involved a glioblastoma that was undiagnosed until pathology of the aneurysm and surrounding tissue had resulted. Details were unclear regarding a 1-stage or 2-stage approach in Cases 4 and 5. In Cases 7, 14, and 16, the pathologies were discovered at different times, and as such were treated in a “staged” fashion. Surgical treatment of the aneurysms includes clipping, muscle wrapping, resection, and vessel sacrifice. Our case involved a 2-stage approach, which entailed primary coiling of the A2 aneurysm, followed by excision of the tumor. No cases have detailed this type of approach. The operative mortality of patients with the association of a brain tumor and an intracranial aneurysm is significantly high. Besides the concern for intraoperative aneurysmal rupture, there have been instances of postoperative hemorrhage if the aneurysm was not addressed.^{1,26} Although employment of endovascular therapy entails an additional procedure, the opportunity to introduce a less invasive element may help reduce morbidity and mortality in such cases. As in our case, if there is a concern of aneurysmal rupture and subsequent risk for rehemorrhage, we recommend therapy be directed at the aneurysm first. Open surgical treatment directed at the aneurysm would lead to significant alteration of the tumor anatomy and margin and would hinder subsequent tumor resection effort. Alternatively, performing tumor resection first without securing the aneurysm would risk the rerupture of the aneurysm during the case, a source of morbidity and mortality. This report proposes a definitive treatment regimen addressing both the tumor and the aneurysm with good outcomes. This treatment regimen should be an option for patients suspected to have these dual pathologies.

Table 1 Available English literature review

Cases	Literature	Age	Sex	Presentation	Tumor location	Aneurysm location	Approach	Outcome
1	Taylor et al ¹	33	M	Focal seizures, left side weakness, headaches	R frontal	R ACA	Tumor resection, post operative SAH from right A2 aneurysm, reoperation for trapping of aneurysm	Death
2	Pia et al ²	32	***	Tumor symptoms	L parietal	L ICA	Tumor resection, no treatment for aneurysm	Good
3	Pia et al ²	55	M	Subarachnoid hemorrhage	R parietal	R Pcomm	Tumor resection; aneurysm thrombosed	Death
4	Obrador et al ²	54	M	Tumor symptoms	L temporo-occipital	? AcoA	Unclear 1 or 2 stage; tumor resection and aneurysm clipping occurred	Good
5	Pia et al ²	***	***	Tumor symptoms	? MCA	***	Unclear 1 or 2 stage; tumor resection and aneurysm clipping occurred	Good
6	Honda et al ³	59	F	Right spastic hemiparesis and motor aphasia	L temporal	L AcoA	1 stage: aneurysm clipping, followed by tumor resection	Good
7	Yoon et al ⁵	57	M	Headache and memory difficulty	R frontal	R ACA	2 stage: tumor resection, followed by aneurysm clipping	Good
8	Andrews et al ⁶	53	F	Sudden headaches, lethargy, meningismus	L frontal temporal	L M2	2 stage: aneurysm resection with weck clips, tumor resection	No data
9	Aoki et al ⁷	57	M	Acute onset left hemiplegia, dysarthria	R frontal temporal	L MCA	1 stage: resection of mass, sacrifice of M1	Good
10	Cheng and Shen ⁸	67	F	Right hemiparesis and aphasia	L parietal	L ICA	2 stage: aneurysm clipped via keyhole approach, followed by tumor resection 1 week later	Good
11	Gokalp et al ⁹	50	M	Visual disturbances	Bifrontal	L ACA	1 stage: conservative resection, then clipping	Death
12	Hashiguichi et al ¹⁰	44	F	Recurrent GBM, disabled, bedridden	L frontal	Tumor feeding vessel	No surgery	Vegetative
13	Paoletti et al ¹¹	59	M	Confusion, emesis	L frontal	L MCA	Radiation/CCNU	Good
14	De Chiara et al ¹²	52	F	Headaches and neck pain	R temporal	R ICA	1 stage: late resection, then clipping 2 stage: aneurysm clipping, followed by tumor resection	Fair
15	Cowen et al ²⁴	57	M	Headaches, dizziness, hearing difficulty, blurred vision	Bifrontal	Pericallosal arteries	1 stage: radical resection of tumor and aneurysm	Good
16	Ali et al ²⁷	63	M	Headaches, dizziness, left hand ataxia	R fronto-temporal	R MCA	2 stage: tumor resection, followed by aneurysm clipping	Death
17	Present case	74	M	Traumatic brain injury, confusion	L frontal	L A2	2 stage: primary coiling of aneurysm, followed by tumor resection the next day	Good

Notes: ***No available information. ? indicates the tumor/aneurysm location was not clear.

Abbreviations: M, male; F, female; L, left; R, right; ACA, anterior cerebral artery; ICA, internal carotid artery; MCA, middle cerebral artery; SAH, subarachnoid hemorrhage; GBM, glioblastoma; CCNU, 1-[2-chloroethyl]-3-cyclohexyl-1-nitrosourea; Pcomm, posterior communicating artery; AcoA, anterior communicating artery.

Conclusion

The simultaneous presentation of a glioblastoma and an intracranial aneurysm is rare. Treatment guidelines do not exist, while operative mortality and morbidity is significantly high. To our knowledge, no prior cases have employed endovascular therapy for the treatment of these intracranial aneurysms. We emphasize that efforts to introduce less invasive elements may improve the overall outcomes in this rare patient population.

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Disclosure

The authors report no conflicts of interest in this work.

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