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Review Article

The coexistence of anterior communicating artery aneurysm and meningioma: A literature review and illustrative case

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ABSTRACT

Background: Anterior communicating artery (Acom) aneurysm has an association with many types of intracranial lesions. However, its association with meningioma can be challenging, which is not well addressed in the literature. Herein, we described a literature review focused on the association between Acom aneurysm and meningioma, explicitly highlighting the spatial presence between these two pathologies. We analyzed the literature according to that association with particular emphasis on location-based challenges. Furthermore, we present an illustrative case of surgically treating both lesions in one surgery utilizing the same approach.

Methods: A Medline database search was conducted by the following combined formula: (Meningioma [Title/Abstract]) AND (Aneurysm [Title/Abstract]) AND (((Anterior communicating artery [Title/Abstract]) OR (Acom [Title/Abstract])) OR Acomm [Title/Abstract]))). Additional resources were added after screening the references of the included papers.

Results: Nine patients with coexistence of Acom aneurysm and meningioma were found in the literature. The coexistence of both pathologies was found in seven females and two males. The presence of an aneurysm was found to be solitary in 66.67% (n = 6/9). Furthermore, meningioma was found to be an isolated lesion in all included cases, and in 22.2% (n = 2/9), they were located ipsilaterally. The location of the meningioma to the aneurysm seems to be in proximity.

Conclusion: Acom aneurysm can coexist with intracranial meningioma; this association can be spatially related intracranially. Such coexistence entails a variety of nuances and challenges that neurosurgeons encounter during the management of these complex lesions.

Keywords: Anterior communicating artery aneurysm, Intracranial meningioma, Meningioma

INTRODUCTION

Intracranial aneurysm (ICAn) is a common cerebrovascular disease characterized by abnormal localized dilation of blood vessels that mostly found through the branching points of major

cerebral arteries that course through the subarachnoid space. A subarachnoid hemorrhage (SAH) resulting from aneurysmal rupture is a potentially devastating event found in 3–5% of the general population and associated with high morbidity and mortality rates, reaching 50% of cases.[2,8] The most common type of ICAn is the anterior communicating artery (Acom) aneurysm which makes up 30–37% of occurrences among other cerebral aneurysms.[22] Acom aneurysm is one of the most complex aneurysms to be treated among other types of aneurysms due to its anatomical complexity; even now, the surgical treatment of this aneurysmal type is considered to be challenging.[14] The association between ICAn and brain tumors was considered to be a rare phenomenon. However, different types of brain tumors, such as pituitary adenoma, glioma, meningioma, lipoma, or metastatic tumors, have been previously reported in association with ICAn by 0.3–0.7% estimated incidence.[4,12] With increased utilization of diagnostic imaging, this incidence has increased to 2–5%.[5] Although ICAn is associated with many types of tumors, the coincidence is shown to be highest in patients with meningioma.[20] However, Acom aneurysm has a specific relation with meningioma, which is not well addressed in the literature. Here, we describe a literature review focused on the association between Acom aneurysm and meningioma, focusing on the spatial relationship between Acom aneurysm and surrounding meningioma. We analyzed the literature with particular emphasis on location-based challenges. In addition, we present an illustrative case of surgically treated Acom aneurysm and meningioma utilizing the same approach.

MARTIALS AND METHODS

We conducted a different Medline database search by the following combined formula: (Meningioma [Title/Abstract]) AND (Aneurysm [Title/Abstract]) AND (((Anterior communicating artery [Title/Abstract]) OR (Acom [Title/Abstract])) OR Acomm [Title/Abstract]))). A total of 30 results were found. Seventeen articles were included; they included twenty-four cases. Specifically, from these 17 articles, nine articles were found to address Acom aneurysm and meningioma relationship, with a total of nine cases. Furthermore, references cited by the retrieved articles were thoroughly reviewed to search for additional articles. The included cases were analyzed according to these parameters:

1. Preoperative data: (A) Patient demographics (age, gender). (B) Clinical presentation. (D) Aneurysmal characteristics: multiplicity other than Acom aneurysm, shape, size, the direction of the dome, neck diameter, and dome to neck ratio. (E) Meningioma characteristics: multiplicity, location, types, source, nature, hemorrhagic or not, grade according to the World Health Organization (WHO) grading scale, adhesion to Acom aneurysm present or not. (F) Sides of lesions.
2. Intra-operative data: (G) Treatment of aneurysm: clipping, coiling, observation. (H) Treatment of meningioma: surgical resection, gamma knife or radiotherapy, observation. (I) which one was treated first? Or treated together?
3. Postoperative data: it includes outcome and follow-up.

The location of meningioma was classified as (parasagittal area, followed by the falx, sinus cavernous, tuberculum sellae, lamina cribrosa, foramen magnum, and torcular zones). In contrast, the type of meningioma was classified as (convexity, falcine and parasagittal, intraventricular, cavernous sinus, clival, foramen magnum, olfactory groove, posterior fossa, sphenoid wing, spinal, and suprasellar, tentorial). Furthermore, Meningioma was classified according to the WHO into Grade I (benign slowly growing), Grade II (atypical or mid-grade tumors), and Grade III (malignant rapidly growing).[9] Our article also presents a similar case about Acom and meningioma, which was managed using the same surgical approach and compared with the literature.

RESULTS

Patients' characteristics

An analysis of published data from 1992 to 2019 showed coexistence of Acom aneurysms and meningiomas in nine cases. Analyzing the available data, we found the coexistence of aneurysm and meningioma in seven females and two males (ratio 7:2). Range of patients' age was (46–72 years) with a mean of 62.2 years. Data for the all available cases are presented in Table 1.[6,10,15,16,19]

Aneurysm and tumors characteristics

The Acom aneurysm was found to be isolated in (n = 6/9) (67%) cases, and one case included a multiple Acom aneurysm. Moreover, the aneurysmal size ranged between 4 and 15 mm in (n = 8/9) (89%) cases. The status of the aneurysm was unruptured in (n = 6/9) (67%) cases, while in the remaining three cases, it was found to be ruptured. Another aneurysmal characteristic, like the direction of the dome, was mentioned in (n = 5/9) (56%) cases, which was anteriorly directed, and the neck-to-dome ratio was mentioned in one case, which was 2.5 mm. Further, meningioma was found to be isolated in 9 cases. Regarding the location, meningioma was located in tuberculum sellae in (n = 4/9) (44%), planum sphenoidale (n = 2/9) (22%), frontal convexity (n = 1/9) (11%), left clinoid process (n = 1\9) (11%), and suprasellar region (n = 1\9) (11%).

Regarding the grade of meningioma (according to the WHO grading scale), Grade 1 was documented in (n = 7/9)

Table 1: The clinical characteristics and management of patients with coexisted AcomA and intracranial meningioma.

ID	Author/ year of publication	Age (years)	Presentation	Multiplicity other than AcomAA aneurysm	AcomAA aneurysmal shape	AcomAA aneurysmal size	Direction of Acom dome	Multiplicity of meningioma	Locations of meningioma	Grade according to WHO grading scale	Adhesion with Acom?	Ipsilateral with acom or contralateral?	Treatment of Acom aneurysm (clipping, coiling, observation)	Treatment option of meningioma	Which one treated first? or treated together?	Outcome	Follow up (duration, outcome)
1	Preul *et al.*/1992[18]	72/M*	Paraparesis	Giant DACA	Unruptured Small	Small 4 mm	Anterior	No	Frontal convexity	NA***	No	Ipsilateral to the selected approach for Acom	Clipping	NA	AcomAA ****then Meningioma	expressive dysphasia	NA
2	Dolenc *et al.*/1998[6]	50/M	Loss of vision in right eye	No	Unruptured Giant (partially calcified)	Large 15 mm	Anterior	No	Tuberculum sellae	NA	No	Both in midline	Calcified and cannot be clipped	Surgical resection	Meningioma then AcomAAA	Good	1 year
3	Ogino *et al.*/1999[16]	70/F**	Meningismus	No	Ruptured	5 mm	Superior	No	Tuberculum sellae	Grade 1	Yes (tumor overlies the murphy's teat). A neck is free	Both in midline	Clipping	Surgical resection	AcomAA then Meningioma (same session)	Good apart from hydrocephalus then required shunting	NA
4	Javadpour *et al.*/2004[9]	61/F	Progressive bilateral decrease vision	No	Unruptured	5 mm	Superior	No	Suprasellar region	Grade 1	Yes, A on top of tumor	Both in midline	Coiling	Surgical resection	AcomAA then Meningioma	Good	18 months
5	Javalkar *et al.*/2009[10]	63/F	Meningismus and decrease level of consciousness GCS 8	No	Ruptured	NA	NA	No	Planum sphenoidale Discovered intraOp	Grade 1	No	No	Clipping	Surgical resection	AcomAA then Meningioma (same session)	Good	NA
6	Chen *et al.*/2015[3]	65/F	Progressive bilateral decrease vision	No	Unruptured	5 mm	Anterior	No	Tuberculum sellae	Grade 1	Yes, A on posterior aspect of tumor	Both in midline	Clipping	Surgical resection	Meningioma (partially) then AcomAA then Meningioma (same session)	Partial improvement In R eye only	5 years
7	Yildirim *et al.*/2015[22]	72/F	Progressive bilateral decrease vision	No	Unruptured Discovered intraoperatively	6 mm	Anterior	No	Tuberculum sellae	Grade 1	Yes, A on top of tumor	Both in midline	Clipping	Endoscopic transsphenoidal surgical resection	Meningioma then AcomAA	Good	6 months
8	Chiriac *et al.*/2016[4]	62/F	Headache and seizure	No	Unruptured	4 mm	Superior	No	Planum sphenoidale	Grade 1	NA	Both in midline	Clipping	Surgical resection	Meningioma then AcomAA	Good	NA
9	Sharma *et al.*/2019[19]	46/F	Meningismus and decrease level of consciousness	No	Ruptured	6 mm	Anterior	No	Left clinoidal Discovered intraoperatively	Grade I	No	Ipsilateral to the selected approach for Acom	Clipping	Surgical resection	Meningioma then AcomAA	Good	3 months
10	Present 2022	48/F	Meningismus Disturbed level of consciousness and history of seizure.	No	Unruptured	Medium	Anterior	No	Left frontal convexity	Grade I	No	Ipsi	Clipping	Surgical resection	Meningioma then AcomAA	Good	1 year

*M: Male, **F: Female, ***NA: Not available, ****AcomAA: Anterior communicating artery aneurysm, Acom: Anterior communicating artery

(78%) cases. Out of nine cases, aneurysm and meningioma were found to be located in the midline in 67% (n = 6/9) of patients and ipsilaterally in 22% (n = 2/9) of patients.

Clinical data

The cases presented in Table 1 did not specify whether the symptoms were related to the Acom aneurysm or the meningioma. Nevertheless, we found that visual impairment was the main presentation in 44% (n = 4/9) of cases, headache in 44% (n = 4/9), and loss of consciousness in 22% of cases (n = 2/9).

Treatment

The majority of aneurysms were treated by clipping (n = 7/9) (78%), whereas coiling was found in one case; observation of the patients with aneurysms was noted in one case. Meningioma was treated by surgical resection in (n = 8/9) (89%) patients, which represents the most common type of treatment, and it was not mentioned in 1 case. In (n = 3/9) (33%) cases, the meningioma was treated first, followed by the aneurysm. However, the aneurysm and meningioma were treated together in (n = 3/9) (33%) cases. In one case, the aneurysm was managed first; a week later, the meningioma was resected. Furthermore, in one case, the aneurysm was treated first, and in another one, the meningioma was treated first.

Outcome and follow-up

The postoperative outcome was reported as good (no neurological deficit) in six out of nine cases, while the other three patients had postoperative complications. One patient had hydrocephalus requiring CSF diversion procedure. In terms of tumor outcomes, follow-up of 4 cases was reported as good; 5 years follow-up showed tumor recurrence in one case, while the remaining cases were not reported.

Case description

Forty-eight-year-old female was admitted to the Neurosurgery Teaching Hospital, Baghdad, Iraq, with a sudden onset of loss of consciousness. She had a history of recurrent seizures. Her initial Glasgow Coma Scale was13/15 (E3, V5, M5); there was no weakness. A head CT scan revealed diffuse SAH suspected to be related Acom aneurysm rupture [Figure 1] associated with ipsilateral frontal calcified meningioma [Figure 2]. The left supra-orbital approach was used to clip the Acom aneurysm. Ipsilateral frontal meningioma was encountered during the surgical approach and was resected before clipping the Acom aneurysm. The surgery went unremarkable. The postoperative course was uneventful, with no neuro deficits. In addition, 6 months follow-up showed an independent functioning patient with no seizures.

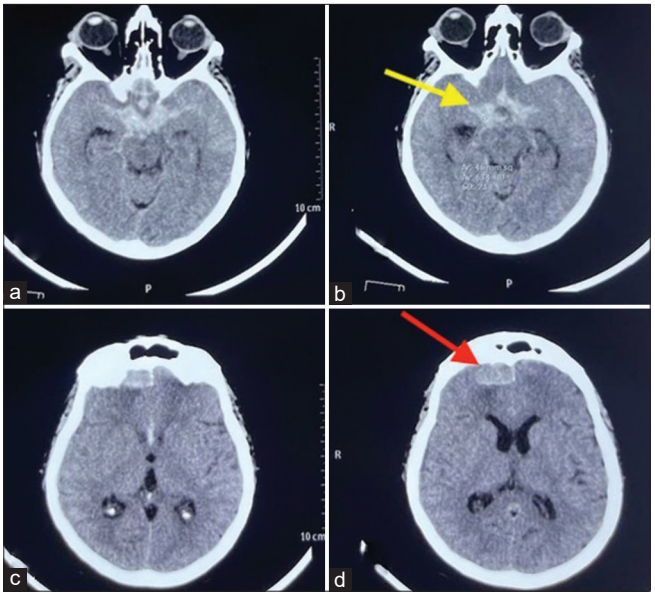

Figure 1: A preoperative cranial computed tomography showing subarachnoid hemorrhage in the basal cistern (yellow arrow) in (b) and The R frontal meningioma (red arrow) in (d).

Figure 2: Diagnostic catheter angiography of the right internal carotid artery illustrates the anterior communicating artery aneurysm (red arrow).

DISCUSSION

The association between ICAn and brain tumors is rare but not a new phenomenon.[12] In 1944, Arieti *et al.*[1] reported the first case of this association. Pia *et al.* documented the prevalence of ICAn and brain tumors in <0.3% in a series of 23,876 patients.[17] This association is considered challenging

to the health care provider regarding the diagnosis and therapy. Furthermore, this coexistence is further complicated by an incidental diagnosis of a brain tumor on imaging or a patient presenting with clinical symptoms primarily related to the brain tumor.[5] ICAn has been associated with many types of tumors, including meningioma, glioma, pituitary adenoma, lymphoma, craniopharyngioma, chordoma, epidermoid tumor, dermoid tumor, and choroid plexus adenoma. However, meningioma is the most frequent intracranial tumor associated with ICAn, with an estimated prevalence of 34.9%.[5,20] The initial symptoms caused by the tumor were estimated in 54–78% of cases.

In comparison, symptoms from the aneurysm, especially if it is ruptured, are estimated in 17–45% of all cases, and symptoms of both lesions were recorded in 6% of cases.[17] Acom aneurysm, the most common type of ICAn (30–37%), is associated with many intracranial lesions such as arachnoid cysts, perianeurysmal cysts as described by Molyneux and Moyamoya disease as described by Kawaguchi in 1996. However, the association between Acom aneurysm and meningioma is higher and estimated at 2–5%.[21] The complexity of both lesions is unpredictable, and choosing the best management plan is challenging as no guidelines or recommendations have been established for treating cases present with both lesions.[3] In most patients with ICAn s and ipsilateral coexisting meningioma, the clinical characteristics seem to be different compared to those with contralateral lesions.[23]

Several articles in the literature attempted to explain this correlation using various hypotheses such as local hemodynamic, hormonal, and genetic factors and direct invasion of tumor cells to the vessel wall (considered a primary reason for this clinical coexistence).[4] The first mechanism of local hemodynamic factors is due to the body's physiology in maintaining constant cerebral blood pressure. Therefore, when there is a tumor, more blood goes to the brain, leading to a chronic increase in arterial blood pressure. This chronic increase could cause hemodynamic stress on cerebral arteries in the entire brain, especially around slowly growing meningioma that may result in degeneration of the arterial wall leading to aneurysmal formation[7,17] The second mechanism of hormonal influence is explained by some scientific researchers who reported that hormones like estrogen might be responsible for the coexistence of meningioma and the aneurysm.[13] The third factor, which is the genetic factor, was explained by Pia *et al*. when they reported a rare genetic disorder, Klippel-Treaunay syndrome, that causes an association between meningioma and aneurysm, however with insufficient evidence.[17] Kim *et al.* mentioned a fourth mechanism which includes the invasion of tumor cells to the vessel wall. It explains the aneurysmal formation by the damage of the arterial wall by meningioma based on tumor adhesion to the arterial adventitia.[11]

Based on the results of the reviewed literature and our case, seven out of all nine cases were female, which is interesting and points toward the hormonal theory. The presence of Acom aneurysms and meningiomas in most patients was found to be ipsilateral within the same hemisphere. The occurrence of both pathologies in different hemispheres seems purely accidental. The presence of meningioma associated with aneurysms was found to be isolated in most cases. Furthermore, the presence of an aneurysm was found to be solitary in most patients. In terms of management, most patients noted surgical clipping of the aneurysm and resection of the tumor during the same setting. Similar to the first case by Preul *et al*. in 1992, we encountered a calcified meningioma in our patient, which was not planned to be resected. However, while considering the supraorbital approach, we decided to resect the tumor in the same setting.[18]

Moreover, when an intracranial tumor is closely related to the major intracranial vessel, preoperative magnetic resonance imaging angiography can be considered for the early diagnosis of a possible coexisting aneurysm and for reducing the risk of intraoperative aneurysm rupture.

CONCLUSION

Acom aneurysm can coexist with intracranial meningioma; this association can be spatially related intracranially. Such coexistence entails a variety of nuances and challenges that neurosurgeons encounter during the management of these complex lesions.

Declaration of patient consent

Patients' consent not required as patients' identities were not disclosed or compromised.

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Conflicts of interest

There are no conflicts of interest

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