Middle Meningeal Artery Aneurysm Associated with Meningioma: Case Report

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MIDDLE MENINGEAL ARTERY aneurysms are rare. Fewer than 10 true aneurysms and 30 posttraumatic aneurysms on meningeal vessels have been reported. True meningeal aneurysms are associated with tumors, Paget's disease, arteriovenous malformations, and trauma. Potential morbidity is demonstrated with hemorrhage from true aneurysms as well as from pseudoaneurysms of the meningeal vessels. We have described a meningeal artery aneurysm of the vascular pedicle of a convexity meningioma and reviewed the literature. (Neurosurgery 36:396–398, 1995)

Key words: Aneurysm, Meninges, Meningioma, Middle meningeal artery

Aneurysms of the middle meningeal artery are rare. Few of these lesions are associated with craniocerebral tumors. Posttraumatic middle meningeal artery pseudoaneurysms have a potential for rupture, with serious neurological consequences. The incidence and natural history of tumor-associated aneurysms, however, is not known. With the increased use of preoperative tumor embolization, aneurysms on tumor vascular pedicles may be identified more frequently. We have described the case of an aneurysm of the middle meningeal artery associated with an intracranial vascular supply to a convexity meningioma. These lesions should be treated by an endovascular or a surgical approach to diminish the possibility of neurological morbidity.

CASE REPORT

A previously healthy 82-year-old woman presented with a 6-month history of increasing headache, confusion, and progessive left-sided weakness. She had no history of craniocervical trauma or of seizure disorder. An examination revealed an alert and oriented woman with normal higher cortical and cognitive function. A cranial nerve examination disclosed normal results. The patient exhibited a left pronator drift and 2/5 to 3/5 hemiparesis affecting leg strength more than arm strength. Left-sided hypertonicity, hyperreflexia, and diminished fine motor control were evident. Bilateral extensor plantar responses were demonstrated.

Computed tomography and magnetic resonance imaging defined a large parietal convexity lesion with neuroimaging features consistent with a meningioma (*Fig 1*). The patient was referred for preoperative angiography and selective tumor embolization.

Right common carotid artery catheterization was performed using a 7.0 French catheter system. Anteroposterior and lateral angiograms revealed a vascular tumor blush with supply from the middle meningeal artery, the middle cerebral artery, and the anterior cerebral artery. A Tracker 18 microcatheter (Target Therapeutics Inc., Freemont, CA) was selectively navigated into the middle meningeal artery ipsilateral to the mass. Selective angiography revealed a vascular tumor blush and a small aneurysm of the middle meningeal artery proximal to the tumor (*Fig 2*). A superselective Wada test was performed using cardiac lidocaine without deficit. Selective tumor embolization was performed with polyvinyl alcohol particles (355–500 μm), and the meningeal artery was occluded proximal to the aneurysm with 5- and 10-mm straight platinum coils, without complication. A craniotomy and a surgical resection of the tumor were performed without significant hemorrhage.

DISCUSSION

Preoperative embolization of vascular dural and cranial neoplasms is associated with tumor necrosis and diminished perioperative hemorrhage (8). Superselective catheterization of tumor vessels can be achieved with minimal morbidity and has influenced an increase in the use of preoperative tumor embolization. Convexity meningiomas often receive an arterial supply from the meningeal vessels. Parenchymal neo-

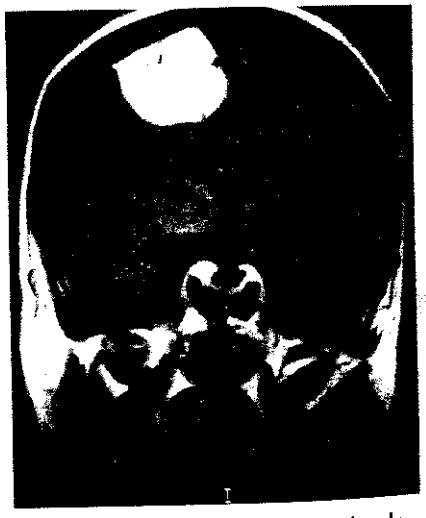

FIGURE 1. T1-weighted coronal gadolinium-enhanced magnetic resonance image demonstrating a large dural-based enhancing lesion in the right parietal region with mass effect.

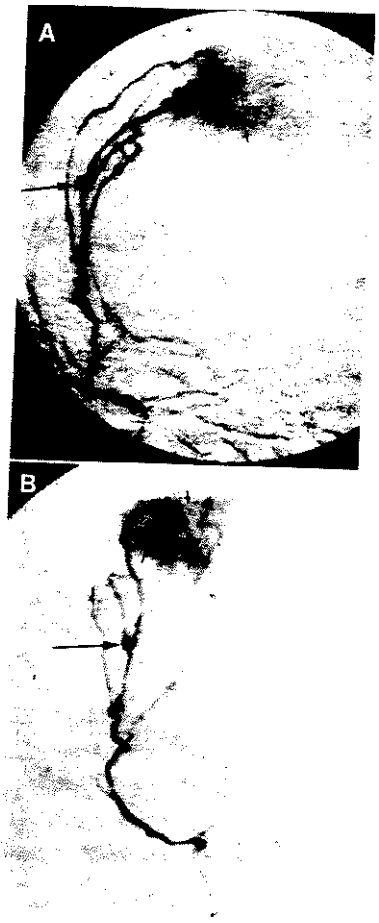

FIGURE 2. Selective middle meningeal artery angiogram. *A*, anteroposterior projection and *B*, lateral projection demonstrating a tumor blush (*small arrows*) and a branch point aneurysm (*large arrow*).

plasms, including gliomas and metastatic tumors, meningiomas, and arteriovenous malformations are associated with intracranial aneurysms (1, 5).

Aneurysms of the meningeal arteries are associated with angiomas, cavernous hemangioma, Paget's disease, dural arteriovenous malformation, and internal carotid artery occlusion (3, 4, 7). Multiple aneurysms of a meningeal vessel are described in one case of cranial cavernous hemangioma (4). A histological examination of the vessels and aneurysms has been performed on only three occasions (4). Posttraumatic pseudoaneurysms, or "false aneurysms," of the meningeal arteries are described (6, 9). In the fewer than 30 reported cases of false aneurysms of the meningeal vessels, all aneurysms, except one on the posterior meningeal artery, have occurred on branches of the middle meningeal artery (6, 9). True and false aneurysms of the meningeal arteries are associated with significant morbidity, including intraventricular, intraparenchymal, epidural, subdural, and subarachnoid hemorrhage (6, 7, 9). No reports have associated aneurysm with the dural vascular supply to meningiomas.

The pathogenesis of meningeal artery aneurysms is not fully defined. Hassler (2) suggests that defects in the vessel media, like those implicated in the formation of intracranial aneurysms, are responsible. The histological structure of the meningeal trunk distal to the foramen spinosum is identical to the intracranial vessels (2). A thinning of the media and a disruption of the internal elastic lamina are histologically confirmed in meningeal artery aneurysms associated with parietal cavernous hemangiomas (4). Increased hemodynamic stress as a result of increased blood flow might explain the occurrence of aneurysms in this location. Middle meningeal artery aneurysms have been found in patients with Paget's disease as well as in a patient with an internal carotid artery occlusion; both abnormalities may be associated with an increased external carotid artery blood flow (4). Increases in hemodynamic stress, coupled with inherent medial defects in the vessel wall, are proposed to be a cause of aneurysms in vessels supplying vascular tumors (4). Tumor invasion of the vessel wall, from either intravascular tumor cell embolization or direct invasion, resulting in aneurysm formation is demonstrated with malignant choriocarcinoma and glioma (1, 5). Histological evidence of the tumor infiltration of blood vessels leading to aneurysmal dilatation has not been demonstrated with dural vessels, to our knowledge. Direct tumor invasion was an unlikely cause of the aneurysm in this case, as the meningioma was histologically benign and the dural margins were free of tumor.

The natural history of meningeal artery aneurysms is difficult to define, but there is evidence that these lesions may be associated with significant neurological morbidity. Of the nine reported true aneurysms of the meningeal artery, only one, which was associated with a dural arteriovenous malformation, hemorrhaged (4, 7). However, hemorrhage, particularly epidural hemorrhage, and subsequent morbidity seem to be common with posttraumatic aneurysms (6, 9). Aneurysms that occur after trauma to the artery have different histological features from true meningeal aneurysms and often occur with delayed hemorrhage (6). Either surgical or nonoperative management of meningeal artery pseudoaneurysms shows a mortality rate of up to 24% (6). Therefore, comparison of the natural history of true aneurysms and false, posttraumatic aneurysms is not appropriate. The small number of true meningeal artery aneurysms makes it impossible to predict the risk of hemorrhage. However, tumor-associated intracranial aneurysms with intraparenchymal, subarachnoid, and subdural hemorrhage have been reported (1). True aneurysms of the meningeal vessels, therefore, have some potential for hemorrhage.

The increased use of superselective angiography and embolization of tumors may result in more frequent identification of meningeal artery aneurysms. In the past, surgical resection of the aneurysm or external carotid artery ligation has been the only method of treatment. We recommend endovascular treatment by vessel occlusion of true or posttraumatic meningeal artery aneurysms to diminish the risk of rupture. If craniotomy is indicated for the primary abnormality, surgical resection of the aneurysm should be performed, if possible.

Received, June 13, 1994.
Accepted, August 2, 1994.
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COMMENTS

Meningeal arterial aneurysms are quite unusual but are clearly associated with significant morbidity in some cases. Because these lesions can be effectively treated, resulting in low morbidity and mortality, with endovascular or surgical approaches, O'Neill, Barnwell, and Silver are correct in indicating that they should be treated when they are identified. As the authors indicate, the occurrence of this lesion on an enlarged meningeal artery feeding a meningioma suggests the important role of hemodynamic factors in the development of intracranial aneurysms and suggests a possible experimental model that could examine this phenomenon in animals.

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The authors provide the first report of a middle meningeal artery aneurysm associated with a meningioma. As they suggest, aneurysms in this location can occur with other vascular lesions. Thus, this finding is not altogether surprising.

In their review of the pathogenesis, the authors suggest, and I agree, that hemodynamic factors play a role in the development of these aneurysms. However, many surgeons would approach this tumor without preoperative embolization, and the surgical exposure would not demonstrate the aneurysm. Therefore, we need to consider what might happen to such aneurysms after tumor resection. The literature on other vascular lesions, such as arteriovenous malformations, suggests that the aneurysms will resolve spontaneously after the hemodynamic stress is relieved.

Finally, our understanding of the natural history of incidental intracranial aneurysms has been recently clarified by Juvela et al. (1). However, the lesions they describe are not associated with other vascular anomalies or tumors. The risk for bleeding from the aneurysms described in this article is unknown. I agree with the use of endovascular treatment in this case, as it carries very low risk, requires the presence of the endovascular surgeon, and allows the neurosurgeon to use a smaller exposure. However, many surgeons would approach this tumor without preoperative embolization. Thus, the interesting question is whether the aneurysms resolve spontaneously after tumor resection. They most likely would.

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ANNOUNCEMENT

Future Meetings—American Association of Neurological Surgeons

The following are the planned sites and dates for future annual meetings of the American Association of Neurological Surgeons:

1995	Orlando, FL	April 22–27
1996	Minneapolis, MN	April 27–May 2
1997	Denver, CO	April 12–17
1998	Philadelphia, PA	April 25–30