Intracerebral hemorrhage caused by the rupture of a nontraumatic middle meningeal artery aneurysm

Case report and review of the literature

JOHN A. SANDIN III, M.D., M. SHAHRRIAR SALAMAT, M.D., PH.D., MUSTAFA BASKAYA, M.D., AND ROBERT J. DEMPSEY, M.D.

Department of Neurosurgery, University of Wisconsin Hospital and Clinics, Madison, Wisconsin; and Department of Neurosurgery, Louisiana State University, Shreveport, Louisiana

The authors report on the case of a 46-year-old man who presented with an intraparenchymal hemorrhage after the rupture of a nontraumatic aneurysm arising from the middle meningeal artery (MMA). A review of the literature revealed no published cases of intraparenchymal hemorrhage resulting from the rupture of an MMA aneurysm.

KEY WORDS • aneurysm • intraparenchymal hemorrhage • middle meningeal artery

TRAUMATIC aneurysms of the middle meningeal artery (MMA) are not uncommon and are a well-known cause of intracranial hemorrhage (ICH). Several cases have been described in the literature, but few of these have been documented with histological studies. Our case is different from previous ones in that the patient presented with an intraparenchymal hemorrhage. Most patients have presented with delayed onset of an epidural hematoma (EDH) following a much earlier traumatic event. However, nontraumatic aneurysms of the MMA are very rare lesions. They may present as any type of ICH or be discovered incidentally. Almost all cases found in the literature were associated with increased hemodynamic stresses caused by a variety of associated intracranial pathological conditions. We report a very rare case of spontaneous rupture of an MMA aneurysm that was not associated with any other known vascular abnormalities or hemodynamic or physiological stresses.

Case Report

History. This 46-year-old man had no significant medical or surgical history except for mild hypertension that did not require pharmacological treatment. He was in his usual state of good health until January 19, 1996. On the day of admission he complained of a severe headache and then fell to the floor from a sitting position. Emergency medical technicians responding to the scene reported seizure activity that continued until the patient was treated with diazepam and phenytoin at the referring hospital. He was intubated on arriving there, and noncontrast head computerized tomography (CT) scans were then obtained. The CT scan (Fig. 1) revealed a large right-sided temporo-parietal, intraparenchymal hematoma with a 1-cm midline shift and effacement of the right lateral ventricle. The patient was immediately transported by helicopter to our institution.

Examination. The patient was intubated and unresponsive on admission. His pupils were 3 mm and reactive bilaterally. As his pharmacologically induced paralysis resolved, he was noted to have bilateral corneal reflexes and cough and gag reflexes. Motor examination revealed extensor posturing on the left side with withdrawal to noxious stimuli on the right side. An intracranial pressure (ICP) transducer was placed while the patient was in the emergency room and he was taken for emergency cerebral angiographic studies. These demonstrated the presence of a saccular aneurysm arising from the right MMA adjacent to the inner table of the skull. In addition, an avascular mass was noted in the right temporal fossa, consistent with the previous findings of a hematoma on CT scans. No other abnormalities were demonstrated on the remainder of the right carotid or vertebral artery angiograms.

Operation. The patient underwent emergency operation immediately after the angiographic studies were completed. A right temporoparietal craniotomy was performed for evacuation of the intraparenchymal hematoma and treatment of the aneurysm, which measured 1 cm. It was resected after coagulation of the parent vessel just distal to the foramen spinosum. A ventricular catheter was also placed in the patient to aid in postoperative management.
Postoperative Course. After surgery the patient’s condition stabilized. His ICP remained well controlled by mild hyperventilation and ventricular drainage. On the 1st postoperative day he began to follow commands, and over the course of the next 14 days his ICP normalized without treatment and he was weaned from the ventilator. On postoperative Day 20 he was transferred to our inpatient rehabilitation unit for further care, and he has continued to improve since that time. At a 10-month follow-up visit the patient demonstrated symptoms consistent with a right parietal lobe syndrome. Although he has not regained employment, he is living with his family and attending to his own activities of daily living.

Gross and Microscopic Examination of the Aneurysm

The surgically excised formalin-fixed tissue consisted of a small flat segment of dura with a central nodular component that measured 0.8 cm in its largest diameter. The specimen was serially sectioned at 0.2-cm intervals perpendicular to its long axis and submitted for routine paraffin embedding by using the standard methods. Serial 5-μm sections of paraffin-embedded tissues were obtained at 30-μm intervals and prepared with hematoxylin and eosin or Verhoff and Gomori trichrome stains.

Serial sections revealed a saccular aneurysm dilating a dural artery. The parent artery had an external diameter of 0.12 cm and revealed mild-to-moderate patchy intimal proliferation. The aneurysm was eccentric, but was partially surrounded by attenuated dura (Fig. 2). Its wall consisted of an irregularly thickened connective tissue layer lacking smooth-muscle cells and elastic fibers. The fibrotic aneurysm wall was in continuity with the muscularis media of the parent vessel. The internal elastic lamina was interrupted and splayed out into the proximal aneurysm wall. Severe patchy attenuation of this wall and focal transmural extension of fresh blood were seen. The progressive thinning of the dura over the expanded aneurysm reached a point at which no dural covering was noted on the meningeal surface. In the dura adjacent to the aneurysm, no inflammatory cell infiltration, excess connective tissue, or fibrosis was seen. Partial thrombosis was noted in the aneurysm lumen.

Discussion

Only 14 cases of MMA aneurysm have been described in the literature (Table 1). Only three other reports describe saccular aneurysms of the MMA that are not associated with unusual physiological stresses. One case was reported in a 50-year-old patient with an aneurysm of the MMA that was confirmed on microscopic studies.2 Another case report described a 66-year-old patient who was treated for recurrent subdural hematomas (SDHs) resulting from an aneurysm of the MMA. The most recent report is of a 22-year-old patient with two MMA aneurysms.

TABLE 1

<table>
<thead>
<tr>
<th>Authors &amp; Year</th>
<th>Age (yrs), Sex</th>
<th>Associated Disease</th>
<th>Aneurysm Location</th>
<th>Presentation</th>
<th>Type</th>
<th>Treatment</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berk, 1961</td>
<td>73, F</td>
<td>Paget’s</td>
<td>lt, MMA</td>
<td>headaches</td>
<td>UK</td>
<td>resection</td>
<td>not specified</td>
</tr>
<tr>
<td>Holland &amp; Thomson, 1965</td>
<td>49, F</td>
<td>none</td>
<td>rt, post</td>
<td>EDH</td>
<td>false</td>
<td>resection</td>
<td>intact</td>
</tr>
<tr>
<td>New, 1965</td>
<td>79, F</td>
<td>Paget’s</td>
<td>—</td>
<td>stroke</td>
<td>UK</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>New, 1967</td>
<td>57, F</td>
<td>Paget’s</td>
<td>rt, anterior</td>
<td>headaches</td>
<td>UK</td>
<td>ligation of ECA</td>
<td>no change</td>
</tr>
<tr>
<td>Sanchis, et al., 1975</td>
<td>59, F</td>
<td>dural angioma</td>
<td>rt, MMA</td>
<td>EDH</td>
<td>true</td>
<td>resection</td>
<td>improved</td>
</tr>
<tr>
<td>Bollati, et al., 1980</td>
<td>50, F</td>
<td>none</td>
<td>lt, MMA</td>
<td>epilepsy</td>
<td>true</td>
<td>resection</td>
<td>intact</td>
</tr>
<tr>
<td>Takahashi, 1980</td>
<td>10, F</td>
<td>moyamoya</td>
<td>MMA</td>
<td>incidental</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Jin, et al., 1981</td>
<td>9, M</td>
<td>asthma &amp; MMA angioma</td>
<td>lt, anterior</td>
<td>headache &amp; LOC</td>
<td>true</td>
<td>resection</td>
<td>intact</td>
</tr>
<tr>
<td>Korosue, et al., 1988</td>
<td>66, F</td>
<td>none</td>
<td>rt, post</td>
<td>SDH</td>
<td>true</td>
<td>true resection</td>
<td>intact</td>
</tr>
<tr>
<td>Ohta, et al., 1991</td>
<td>47, M</td>
<td>cavernous hemangioma of skull</td>
<td>rt, anterior</td>
<td>incidental</td>
<td>true</td>
<td>resection</td>
<td>intact</td>
</tr>
<tr>
<td>O’Neill, et al., 1995</td>
<td>82, F</td>
<td>meningioma</td>
<td>rt, MMA</td>
<td>incidental</td>
<td>UK</td>
<td>coil placement</td>
<td>improved</td>
</tr>
<tr>
<td>Ushikoshi, et al., 1996</td>
<td>69, M</td>
<td>HTN &amp; PCA occlusion</td>
<td>rt, MMA</td>
<td>intraparenchymal hematoma</td>
<td>true</td>
<td>resection</td>
<td>died, RF</td>
</tr>
<tr>
<td>Zubkov, et al., 1998</td>
<td>22, M</td>
<td>none</td>
<td>rt, anterior</td>
<td>SAH</td>
<td>true</td>
<td>resection</td>
<td>intact</td>
</tr>
<tr>
<td>present study</td>
<td>46, M</td>
<td>mild HTN</td>
<td>rt, MMA</td>
<td>intraparenchymal hematoma</td>
<td>true</td>
<td>resection</td>
<td>intact</td>
</tr>
</tbody>
</table>

* ACA = anterior cerebral artery; ECA = external carotid artery; HTN = hypertension; ICA = internal carotid artery; LOC = loss of consciousness; NR = not reported; PCA = posterior cerebral artery; post = posterior; RF = renal failure; SAH = subarachnoid hemorrhage; UK = unknown; — = information not supplied.

FIG. 1. Left: Axial nonenhanced CT scan revealing a spherical homogeneous hyperintense area measuring 7 cm in diameter. The hemorrhage is located primarily in the right temporal lobe and causes 1 cm of midline shift. Right: Digital subtraction angiography demonstrating an 8-mm saccular aneurysm arising from the proximal third of the MMA (arrowhead). In addition, there is obvious displacement of surrounding vessels.
Intracerebral hemorrhage from an MMA aneurysm

that produced subarachnoid hemorrhage. Our case, also confirmed on microscopic examination, involved a saccular, nontraumatic aneurysm in a 46-year-old man with no medical history except for mild hypertension that did not require pharmacological therapy. Extension of blood from the aneurysm into the brain parenchyma was demonstrated on both neuroimaging and histopathological sections. No other case of an intraparenchymal hemorrhage resulting from the rupture of an MMA aneurysm has been documented before.

Literature in which aneurysms of the MMA are described is scarce. To our knowledge only 13 cases of nontraumatic MMA aneurysms have been reported. Most of these cases involved patients in whom extracranial cranial blood flow has had increased demands placed on it as a result of various pathological conditions. Three cases were associated with the pathological changes that accompany Paget’s disease, which include softening of the calvarial bones and exposure to chronic hypertension. There was one case associated with a cavernous hemangioma of the skull, and two cases involving angiomas; one in a 9-year-old child with asthma, and the other in a 59-year-old woman with a dural angioma. Another case was reported in an 82-year-old woman with a convexity meningioma supplied by the MMA, middle cerebral artery, and anterior cerebral artery. One case was associated with moyamoya disease. One case was associated with occlusion of the internal carotid artery, and another with occlusion of the posterior cerebral artery. One false aneurysm of the MMA was reported in a 49-year-old woman who had an EDH. The presentation of ruptured MMA aneurysms is diverse. They have presented with SDH, recurrent SDH, EDH, and now, with our report, intraparenchymal hemorrhage. Of the 14 cases that have been reported, six have presented with rupture and eight have been discovered in the unruptured state. Ten of the 14 cases reportedly have been associated with significant hemodynamic stresses, three reports did not include complete data describing associated factors, and our case is associated with very mild hypertension. This pathological entity, although rare, can be devastating. The small number of true aneurysms of the MMA makes it impossible to predict the incidence or natural history of this lesion. Table 1 shows that the outcome after surgical treatment when this lesion is diagnosed is generally favorable.

Conclusions
Ruptured aneurysms of the MMA should be included in...
the differential diagnosis of patients presenting with any type of ICH. This diagnosis should also be kept in mind while interpreting angiograms and during the preoperative planning for evacuation of intraparenchymal hematomas, SDHs, or EDHs. When this entity is discovered, it warrants aggressive therapy to minimize morbidity and mortality rates.

Acknowledgment

The authors thank Ms. Jackie Schultz, H.T., H.T.L. (A.S.C.P.), a histotechnologist at the University of Wisconsin neuropathology laboratory, for her expert help in preparation of the histopathological specimens for this manuscript.

References