ELSEVIER

Chronic Subdural Hematoma Associated with Middle Meningeal Arteriovenous Fistula Treated by a Combination of Embolization and Burr Hole Drainage

Masaki Komiyama, M.D., Toshihiro Yasui, M.D., Katsuhiko Tamura, M.D., Yasunori Nagata, M.D., Yoshihiko Fu, M.D., and Hisatsugu Yagura, M.D.

Department of Neurosurgery, Baba Memorial Hospital, Japan

Komiyama M, Yasui T, Tamura K, Nagata Y, Fu Y, Yagura H. Chronic subdural hematoma associated with middle meningeal arteriovenous fistula treated by a combination of embolization and burr hole drainage. Surg Neurol 1994;42:316–9.

A rare case of chronic subdural hematoma associated with a middle meningeal arteriovenous fistula was treated by a combination of embolization and burr hole drainage. This clinical situation might be missed in this era of computed tomography, when cerebral angiography is seldom indicated for the diagnosis of neuro-traumatic diseases. We should bear in mind the possibility of this clinical situation of a chronic subdural hematoma associated with a linear skull fracture crossing the middle meningeal groove in order to avoid possible hemorrhagic complications during surgery for chronic subdural hematoma.

KEY WORDS: Arteriovenous fistula; Chronic subdural hematoma; Embolization; Middle meningeal artery; "Railroad track" appearance

The majority of chronic subdural hematoma (CSDH) cases are of traumatic origin. With the advent of computed tomography (CT), cerebral angiography is seldom indicated for the diagnosis of head trauma except for certain neurovascular injuries. We present a rare case of a CSDH associated with a middle meningeal arteriovenous fistula (AVF) and discuss its treatment and clinical importance.

Case Presentation

A 58-year-old man was found unconscious and was immediately transferred to our hospital. He had once been admitted to our hospital 1.5 years earlier due to syncope attack; prior to his previous admission, he had often experienced syncope attacks. Although an electrocardiogram had disclosed a hemiblock (complete right bundle branch block and left axial rotation), the patient had refused implantation of a cardiac pacemaker to prevent the atrioventricular block associated with possible Adams-Stokes syndrome.

On admission, the patient was drowsy but responded correctly to simple commands. He had no apparent motor weakness. Skull x-rays demonstrated a linear fracture in the left temporoparietal region (Figure 1). CT revealed subarachnoid hemorrhage mainly in the left sylvian fissure and on the cortical surface nearby (Figure 2).

In order to rule out the possibility of a ruptured cerebral aneurysm, we performed cerebral angiography on the day after admission. This demonstrated no cerebral aneurysm but disclosed a left middle meningeal AVF (Figure 3 *A*). The fistula was located exactly at the crossing point between the linear fracture and the middle meningeal groove. A so-called "railroad track" or "tram track" appearance was noted. Shunted blood drained to the middle meningeal veins and the diploic veins and then to the superior sagittal sinus. The patient recovered completely within a week. Although CT on day 14 demonstrated a CSDH on the left side, the patient remained neurologically intact.

The CSDH gradually increased without causing any neurologic deficits. To eliminate possible hemorrhagic complications due to the AVF or to any that might occur during surgery for the CSDH, embolization was performed under local anesthesia on day 23. Through the transfemoral route, a tracker-18 microcatheter (Target Therapeutics, Fremont, CA) was navigated to the left middle meningeal artery. The angiographic appearance of the AVF as revealed through this procedure was the same as that of the previous angiography. To occlude the fistula completely, the tip of the microcatheter was first gently inserted into the middle meningeal

Address reprint requests to: Masaki Komiyama, M.D., Department of Neurosurgery, Osaka City General Hospital, 2-53, Miyakojima-hondohri, Miyakojima, Osaka 534 Japan.

Received September 7, 1993; accepted November 22, 1993.

0090-3019/94/$7.00

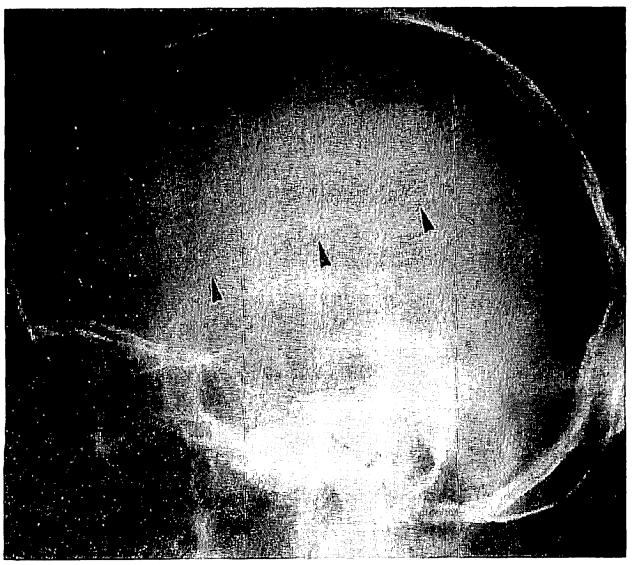


Figure 1. *Lateral skull x-ray on admission shows a linear fracture in the temporoparietal region* (arrowheads). *The fracture crosses the middle meningeal groove.*

artery distal to the fistula site to occlude this portion of the vessel (Figure 3 *B*). Several silk sutures were introduced here as embolic material, which occluded the distal middle meningeal artery. Then the catheter was pulled back to a position slightly proximal to the fistulous site (Figure 3 *C*). Again, silk sutures were introduced, completely obliterating the fistula (Figure 3 *D*). No adverse effects occurred perioperatively.

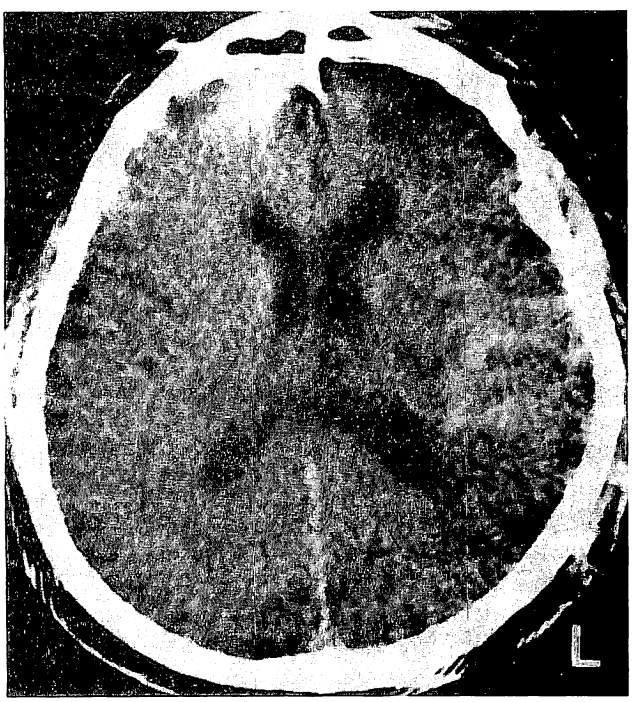


Figure 2. *Computed tomography on admission demonstrates subarachnoid hemorrhage in the left sylvian fissure, which cannot preclude the diagnosis of a ruptured cerebral aneurysm.*

The CSDH was shown bilaterally by CT on day 30 (Figure 4). It was drained by means of a burr hole procedure under local anesthesia, with no complications. The patient once again refused to have a cardiac pacemaker implanted to relieve symptoms of his possible Adams-Stokes syndrome. He was discharged without any neurologic deficit about 2 months later.

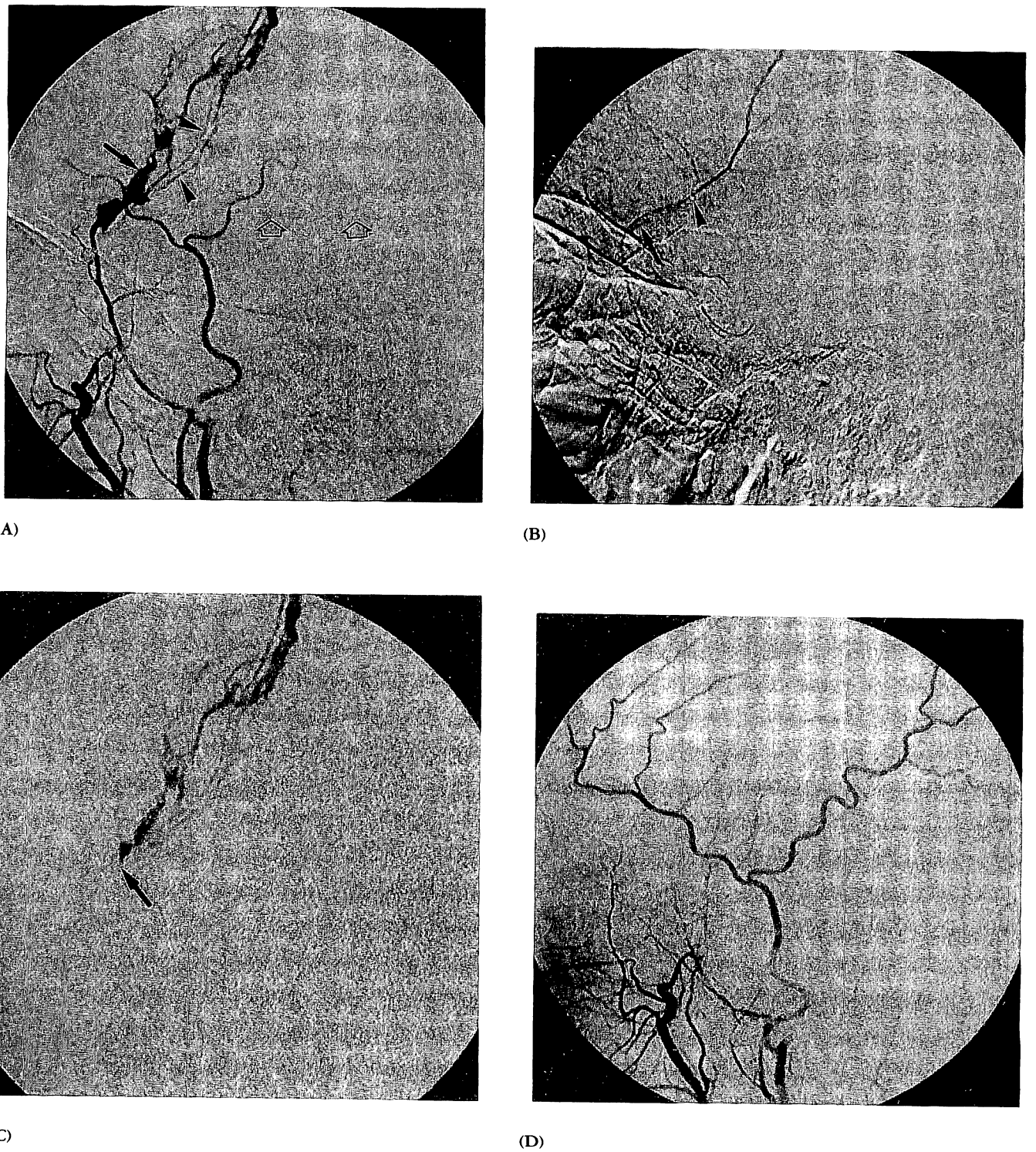
Discussion

Anatomically, the middle meningeal artery runs between the two middle meningeal veins (the sphenobregmatic sinuses), which drain to the diploic veins, to the superior sagittal sinus distally, to the superior petrosal sinus, to the sphenoparietal sinus (then to the cavernous sinus), or to the pterygoid venous plexus proximally. The drainage pattern of a middle meningeal AVF is closely related to the location of the fistula and its hemodynamics.

There are many causes for the formation of a CSDH, the most frequent being head trauma. To our knowledge, there has been no report on a CSDH associated with an AVF of the middle meningeal vessels. This is because, with the advent of CT technology, the use of cerebral angiography for the diagnosis of head trauma has been markedly reduced.

Trauma to the middle meningeal artery usually causes an epidural hematoma and rarely leads to a subdural hematoma [3,12,15] or an intracerebral hematoma [13]. A middle meningeal AVF may be asymptomatic [4–6,11], and incidentally discovered by cerebral angiography performed for other purposes, or it may be symptomatic, presenting tinnitus (bruit) [1,2,8], proptosis and conjunctival injection [1], an extradural hematoma [12,14], or a subdural hematoma [12]. If an AVF is associated with a large intracranial hematoma, surgical removal of the hematoma is necessary. For an AVF without a concomitant intracranial hematoma, conservative treatment may be considered [5–11,14], as may such procedures as ligation of the middle meningeal artery or the external carotid artery [2,8], surgical resection or occlusion of the AVF [4,7,10,14], or embolization [1].

Kitahara et al [7] classified the angiographic features of middle meningeal AVFs into three types and correlated these with the clinical course. Type 1 has a typical "railroad track" appearance, type 2 has a rod configuration, and type 3 shows an extravasation of the contrast material or a pseudoaneurysm as well as the AVF. They concluded that type 1 has a good prognosis and can be



(A)

(B)

(C)

(D)

Figure 3. *Embolization of the middle meningeal arteriovenous fistual is carried out on day 23. (A) Left external carotid injection (lateral view) demonstrates the middle meningeal arteriovenous fistula draining to the middle meningeal veins* (arrowheads) *and the diploic vein* (arrow), *then to the superior sagittal sinus (not shown). A so-called "railroad track" appearance is noted. Note the linear fracture* (open arrows). *(B) The tip of the microcatheter* (arrowhead) *is placed in the middle meningeal artery distal to the fistula site. Using several silk sutures, the distal middle meningeal artery is occluded. The location of the arteriovenous fistula is indicated by the arrow. (C) After the occlusion of the distal middle meningeal artery, the tip of the microcatheter is pulled back to the fistula site* (arrow). *The fistula is occluded in the same manner. (D) Left external carotid injection (lateral view) after the occlusion of the arteriovenous fistula. The shunted flow is no longer shown.*

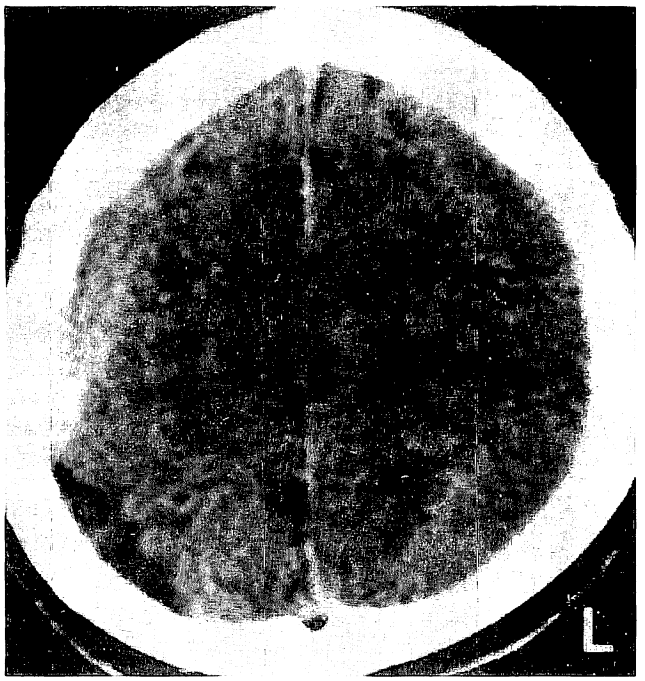


Figure 4. *Computed tomography on day 30 shows the bilateral chronic subdural hematoma. This was drained by means of a burr hole procedure.*

treated conservatively, type 2 has a fair outcome and necessitates surgery for the concomitant hematoma in most cases, and type 3 has a poor outcome and also necessitates surgical removal of the concomitant hematoma and the pseudoaneurysm in most cases. There is no consensus regarding treatment of a middle meningeal AVF with no associated intracranial hematoma. This clinical entity is essentially benign and usually heals spontaneously, whereas the pseudoaneurysm of the middle meningeal AVF may be treated conservatively if there is no concomitant pseudoaneurysm.

Our case illustrates the possibility of hemorrhagic complication during surgery for a CSDH if the operation is performed without knowledge of an underlying middle meningeal AVF. We do not think that the CSDH in our case was directly related to the AVF, nor that cerebral angiography is indicated for all such cases. However, when a patient has a linear fracture crossing the middle meningeal groove, the possibility of a middle meningeal AVF should be borne in mind to avoid any hemorrhagic complications perioperatively.

The authors express thanks to Jeff Hester for his editorial assistance.

References

1. Bhoopat W, Issaragrisil R, Vaeusorn N, Viranuvatti J. Traumatic middle meningeal-cavernous sinus fistula treated by percutaneous transcatheter embolization. J Med Assoc Thail 1987;70:416–21.
2. Fincher EF. Arteriovenous fistula between the middle meningeal artery and the greater petrosal sinus. Ann Surg 1951;133:886–8.
3. Galligioni F, Bernardi R, Pellone M, Iraci G. Angiographic signs of rupture of the middle meningeal artery without epidural hematoma. AJR 1968;104:71–4.
4. Handa J, Shimizu Y, Sato K, Handa H. Traumatic aneurysm and arteriovenous fistula of the middle meningeal artery. Clin Radiol 1970;21:39–41.
5. Ishii R, Ueki K, Ito J. Traumatic fistula between a lacerated middle meningeal artery and a diploic vein. Case repot. J Neurosurg 1976;44:241–4.
6. Jackson DC, du Boulay GH. Traumatic arterio-venous aneurysm of the middle meningeal artery. Br J Radiol 1964;37: 788–9.
7. Kitahara T, Shirai S, Owada T, Maki Y. Traumatic middle meningeal arteriovenous fistula. Report of 3 cases and analysis of 32 cases. Eur Neurol 1977;16:136–43.
8. Pakarines S. Arteriovenous fistula between the middle meningeal artery and the sphenoparietal sinus. J Neurosurg 1965;3:438–9.
9. Roski RA, Owen M, White RJ, Takaoka Y, Bellon EM. Middle meningeal artery trauma. Surg Neurol 1982;17:200–3.
10. Saba MI, King RB. Extravasation of angiographic contrast material from a torn middle meningeal artery into the diploi. J Neurosurg 1973;38:89–91.
11. Satoh T, Sakurai M, Yamamoto Y, Asari S. Spontaneous closure of a traumatic middle meningeal arterio-venous fistula. Neuroradiology 1983;25:105–9.
12. Tsuchida T, Sekino H, Nagai M, Hirakawa K, Matsumoto M, Miura N, Hayakawa, I, Masuzawa H. Traumatic arterio-venous fistulas of the middle meningeal artery: report of four cases. Brain Nerve (in Japanese) 1970;22:481–87.
13. Watanabe H, Kudo K, Ito K, Ishii S. Traumatic false aneurysm and arteriovenous fistula involving the middle meningeal artery. A case combined with intracerebral hematoma. Surg Neurol (Tokyo) (in Japanese) 1976;4:1101–6.
14. Wilson CB, Chronic F. Traumatic arteriovenous fistulas involving middle meningeal vessels. JAMA 1964;188:953–7.
15. Zuccarello M, Fiore DL, Padatscher K, Trincia G, Mingrino S. Subdural haematoma associated with traumatic middle meningeal artery pseudoaneurysm. Zbl Neurochir 1982;43:323–8.