

Giant Aneurysm of the Distal Anterior Cerebral Artery: Associated with an Anterior Communicating Artery Aneurysm and a Dural Arteriovenous Fistula

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We describe an unusual case of a giant pericallosal artery aneurysm, producing psychomotor depression from mass effect, associated with a smaller aneurysm of the anterior communicating artery, a dural arteriovenous fistula, and a meningioma. Magnetic resonance imaging (MRI) and cerebral angiography demonstrated the giant aneurysm and the meningioma. Cerebral angiography provided a detailed appreciation of the cerebral circulation, including both aneurysms, the dural arteriovenous fistula, and the potential collateral supply to the involved anterior cerebral distribution. The anterior communicating artery aneurysm was successfully clipped as was the distal anterior cerebral branch supplying the giant aneurysm before its resection. The patient made a full recovery but with persisting, slight dysphasia. We conclude that computed tomography, cerebral angiography, and MRI are of specific value in the assessment of giant aneurysms, but only angiography can provide detailed characterization of the aneurysm and demonstrate other possible cerebrovascular pathology such as multiple aneurysms and arteriovenous fistulas.

KEY WORDS: Anterior cerebral artery; Cerebral aneurysm; Cerebral angiography; Giant aneurysm; Magnetic resonance imaging; Pericallosal artery

Five to thirteen percent of intracerebral aneurysms are greater than 2.5 cm in diameter (giant aneurysms) [2,3,5,9,10,12,25,27,29]. When arising from the anterior cerebral artery, they usually originate from the anterior communicating complex [13,15,17]. Giant aneu-

rysms of the distal anterior cerebral artery are rare: we know of only nine previous reports [5,7,14,16,18,20,22,26]. No report has documented the association of a smaller saccular aneurysm with a giant distal anterior cerebral artery aneurysm, nor has a case been described with an associated dural arteriovenous fistula.

Magnetic resonance imaging (MRI) has been suggested to be superior to angiography in characterizing giant anterior cerebral artery aneurysms [14]. However, in our case angiography demonstrated a second aneurysm and a dural arteriovenous fistula not seen on MRI, and demonstrated extensive collateral supply across the anterior border zone from the middle cerebral to the anterior cerebral territory not discernable on the MR images. Angiography therefore played a crucial role in the diagnosis and treatment of this patient.

Case Report

A 72-year-old man was admitted to hospital because of a 10-day history of mental deterioration and inappropriate behavior. He was alert but oriented only to person. He did not initiate conversation and answered questions with difficulty with sparse, simple words or phrases. He was disinterested in his environment and could only concentrate on one activity at a time. Funduscopic examination was not possible because of cataracts. He had a mild left central facial palsy. Strength and sensation were normal, but he was bradykinetic. He was hypertonic in both lower limbs, more so on the right. He was diffusely hyperreflexic and had clonus of the right patella and a right extensor plantar response. Frontal signs, including visual fixation, and palmomental, grasp, snout, and glabellar tap reflexes were present.

A noninfused computed tomography (CT) scan showed a well demarcated 7 × 5-cm mixed density mass with peripheral calcification, centered in the anterior interhemispheric fissure, extending more into the left frontal lobe than the right, and displacing the genu of the corpus callosum posteriorly (Figure 1 A). Contrast-

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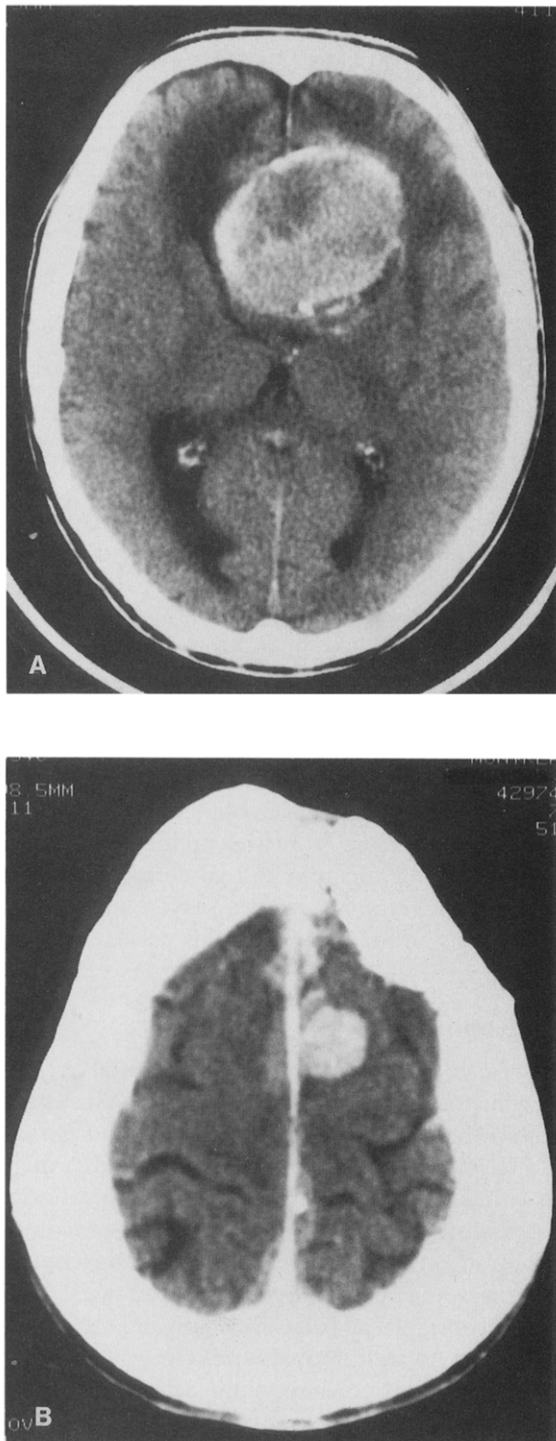


Figure 1. Noninfused CT scan (A) demonstrating the giant aneurysm. The relative hypodense areas within the aneurysm represent thrombosis. The anterior rim is hyperdense representing calcification in the wall of the aneurysm. The lateral ventricles and genu of the corpus callosum are displaced posteriorly. Areas of hypodensity in the frontal lobes anterior and lateral to the aneurysm are consistent with edema and, especially on the left, with necrotic changes caused by long-standing compression. Contrast-infused CT scan (B) shows a small area of enhancement, without associated mass effect, in the left frontal convexity adjacent to the left side of the falx cerebri consistent with a meningioma.

infused CT revealed a small meningioma of the left frontal convexity (Figure 1 B). MRI (Figure 2) showed the large, frontal, mixed signal intensity mass to originate from the region of the distal left anterior cerebral artery. The periphery was hyperintense. The center was hypointense, corresponding to slow blood flow, as was the anterior rim, corresponding to the area of calcification. The small, parasagittal meningioma was also identified.

Left internal carotid angiography (Figure 3) demonstrated partial filling of the giant aneurysm from the origin of the left pericallosal artery and opacification of both anterior cerebral arteries. The giant aneurysm displaced both orbito-frontal arteries inferiorly. The right anterior cerebral artery was displaced anteriorly and laterally in a round-shift fashion, and the left anterior cerebral artery was displaced posteriorly. Extensive collaterals from the left middle cerebral artery supplied the territory of the distal left anterior cerebral artery across the watershed region. A second, small, bilobed aneurysm was discovered at the level of the anterior communicating artery. Left external and common carotid artery (Figure 4) injections demonstrated hypertrophy of the middle meningeal artery, and a small area of prolonged capillary blush in the upper frontal convexity consistent with a meningioma. There was also a dural arteriovenous fistula next to the superior sagittal sinus at the upper parietal convexity supplied by the posterior branch of the middle meningeal artery and drained away from the superior sagittal sinus by a superficial cortical vein.

Operation and Hospital Course

The anterior cerebral artery and anterior communicating artery complex were exposed through a left pterional craniotomy, and the anterior communicating artery aneurysm was clipped. The large, firm, and noncompliant partially thrombosed giant aneurysm filled the undersurface of the orbito-frontal region. The left pericallosal artery was clipped, and the wall of the giant aneurysm was incised, revealing liquified hematoma, calcification, organized thrombus, and neovascularization of the aneurysm wall. The giant aneurysm was evacuated of as much thrombus as allowed through this approach, and the procedure was concluded. The patient awoke from anesthesia without new neurologic deficits; the effects of clipping of the pericallosal artery were mitigated by the extensive collateral supply from the left middle cerebral artery. The remainder of the giant aneurysm was excised, except for the inferior most portion of its wall overlying the hypothalamus, through an interhemispheric approach 14 days later. Pathologic examination confirmed the diagnosis of an aneurysm with partial thrombus and calcification.

The patient did not undergo further surgery to re-

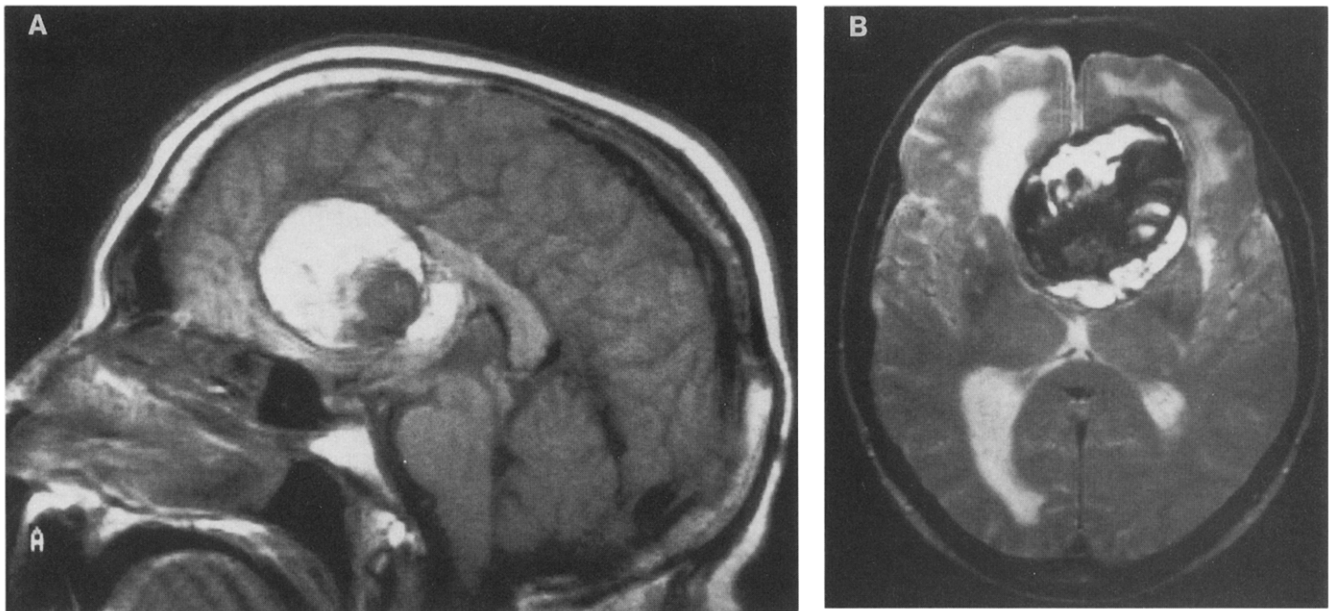
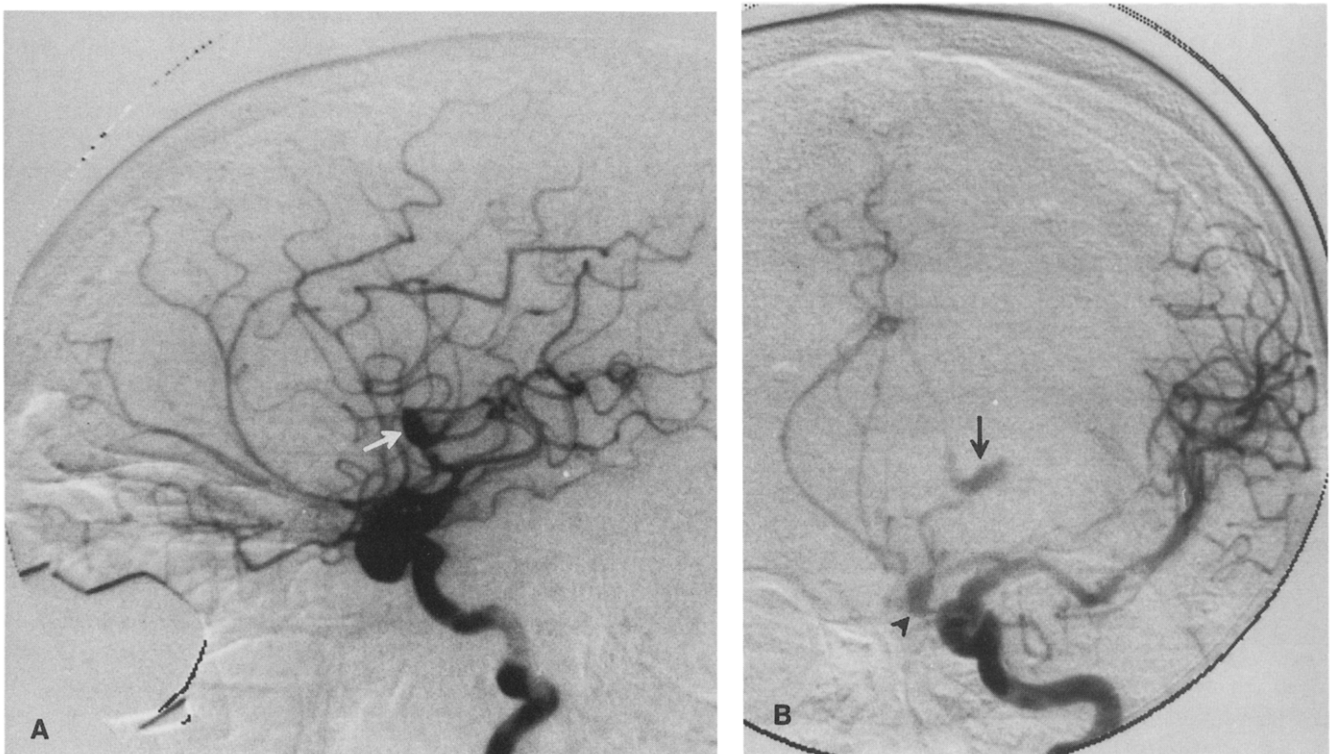


Figure 2. MRI T1-weighted (TR 550, TE 30) sagittal (A) and T2-weighted (TR 2100, TE 60) axial (B) scans. The thrombosed portion of the aneurysm appears hyperintense, and the residual sac is iso- to hypointense. In the T2-weighted image, a portion of the thrombus appears hypointense because of hemosiderin content. The anterior wall of the aneurysm is calcified as demonstrated by the hypointense signal in both T1- and T2-weighted images. The small, parasagittal meningioma is isointense on the T1-weighted image.

Figure 3. Left internal carotid angiogram demonstrating filling of both anterior cerebral arteries, the mass effect of the extensively thrombosed giant pericallosal aneurysm, and slow filling of the distal left anterior cerebral artery. The residual lumen of the pericallosal artery aneurysm is indicated by the arrow. A small anterior communicating artery aneurysm is also seen (arrowhead).



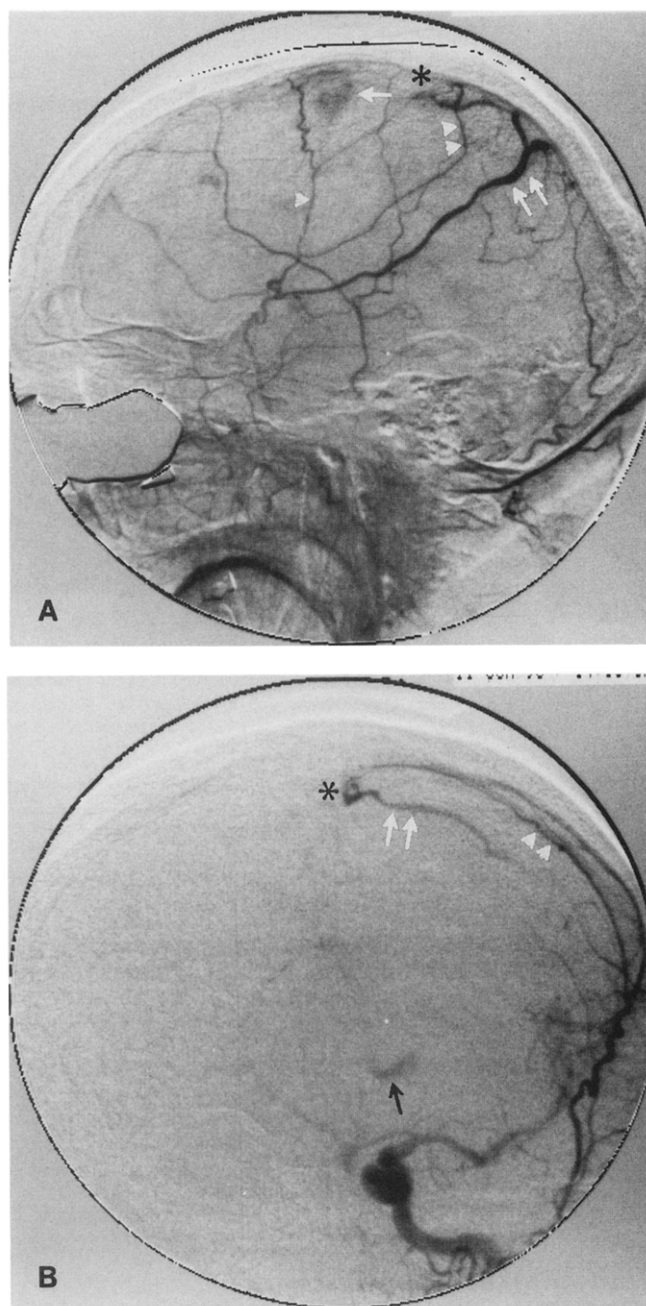


Figure 4. Left external carotid (A) and common carotid (B) angiograms show the anterior branch (white arrowhead) of the hypertrophied middle meningeal artery supplying the small meningioma, noted as a persistent blush (white arrow). The small dural arteriovenous fistula (asterisk) adjacent to the superior sagittal sinus at the parietal convexity is fed by the posterior branch (white double arrowheads) of the middle meningeal artery and drained away from the superior sagittal sinus by an early filling cortical vein (white double arrows). The giant aneurysm is also demonstrated (black arrow).

move the meningioma or dural arteriovenous fistula because of his advanced age and because both lesions were small, asymptomatic, and (in the case of the meningioma) not associated with mass effect. The patient gradually made a complete neurologic recovery with the exception

of a slight, persisting expressive dysphasia. Postoperative CT showed small hypodensities in the left frontal and left precentral gyrus compatible with sequelae of mass effect.

Discussion

Clinical Presentation and Treatment

Nine cases of giant distal anterior cerebral artery aneurysms have previously been reported (Table 1) [5,7,14,16,18,20,22,26]. The aneurysms originated from the pericallosal or callosomarginal artery in six cases [5,14,18,20,22,26] and from the division of an azygos anterior cerebral artery into two pericallosal arteries in three others [7,16]. Our case, the tenth, is unique in that the giant pericallosal aneurysm was associated with a smaller aneurysm and a dural arteriovenous fistula. Ours is only the third report to address the usefulness of MRI in assessing giant distal anterior cerebral artery aneurysms.

The incidence of all giant aneurysms is low (5%–13%), and female patients predominate [20]. However, seven of nine patients (one report did not include gender or age) with giant aneurysms of the distal anterior cerebral artery were male, and were older (mean 59 ± 10.2 years, median 59, range 41–72) than the females (mean 24.5 ± 6.4 years, median 24.5, range 20–29).

The clinical presentation of distal anterior cerebral artery giant aneurysms is variable. The onset of symptomatology is usually rapid. Nine of 10 patients were admitted to hospital and diagnosed with a frontal giant aneurysm within 10 days of the initial symptoms. One female patient, however, had symptoms for 6 weeks before diagnosis and underwent a burrhole biopsy procedure for diagnosis of a suspected frontal tumor [18].

Distal anterior cerebral artery giant aneurysms may produce mass effect [7,18,22], hemorrhage [5,20,26], or ischemia [7,14] from compression of adjacent arteries or embolization of platelets or thrombus [4,8,28]. One patient presented with bacterial meningitis and was found to have an infected giant aneurysm of the azygos anterior cerebral artery [16]. Our patient had relatively rapid onset of dementia with features of akinetic mutism, most likely from expansion of the giant aneurysm producing bifrontal compression [4,22,24]. There was no evidence of subarachnoid hemorrhage on CT or at surgery.

Seven of the nine previously reported giant aneurysms were operated [5,7,16,18,20,22,26]. Techniques of operation included clipping of the aneurysmal neck with evacuation of thrombus [5,7,20], resection of the aneurysmal sac with or without clipping of feeding vessel(s) [16,18,22], and resection of the sac with end-to-end anastomosis of the anterior cerebral artery [26]. In

Table 1. *Giant Distal Anterior Cerebral Artery Aneurysms*

Characteristics			Number (n = 10)
Patients			
	Age (y)		
	<i>Mean</i>	<i>Range</i>	
Males	59 ± 10.2	41-72	7
Females	24.5 ± 6.4	20-29	2
Clinical presentation (symptomatology)			
Mass lesion (<i>headache, seizure, dementia, personality changes, anosmia, incontinence, incoordination</i>)			4
Subarachnoid hemorrhage			3
Transient ischemic attack (<i>hemiparesis, ataxia, vertigo, vision loss</i>)			2
Mycotic aneurysm (<i>bacterial meningitis</i>)			1
Origin			
Pericallosal artery			7
Azygos anterior cerebral artery			3
Operation			
Neck clipped, sac resected			4
Neck clipped, thrombus evacuated (sac not resected)			3
Sac resected, end-to-end anastomosis			1
Unoperated			2
Outcome			
<i>Operated patients</i>			
Cured			6
Coma			1
Died			1
<i>Unoperated patients</i>			
Symptom free			2

our case the anterior communicating artery aneurysm and left pericallosal artery were clipped by the same approach. It was necessary to clip the pericallosal artery supplying the giant aneurysm, because no neck was discernible, and the aneurysm filled briskly so that arterial supply had to be interrupted before resection. A bypass was not necessary because of extensive collateral flow from the left middle cerebral artery across the anterior border zone. The aneurysm was resected subsequently through an interhemispheric approach.

Pathologic examination of all the operated aneurysms revealed that they were partially thrombosed and calcified.

Radiological Investigation

Giant aneurysms of the distal anterior cerebral circulation may mimic a frontal or callosal tumor on CT, appearing as a partially calcified mass with little or no contrast enhancing features; or they may suggest an intracerebral hematoma if thrombosis or hemorrhage within the aneurysmal sac is relatively recent [1,6,11,12,14,18,19,

21,23]. MRI is more specific than CT in diagnosing giant anterior cerebral artery aneurysms and better demonstrates their relationship to the surrounding brain. Cerebral angiography is essential in characterizing the fine details of these aneurysms and of the remainder of the cerebral circulation. Only angiography demonstrated an unsuspected smaller aneurysm of the anterior communicating artery complex and the dural arteriovenous fistula in our case. Angiography also demonstrated the arterial filling of the giant aneurysm, the slow filling of the left anterior cerebral artery, and the extensive compensatory collateral supply from the left middle cerebral artery across the anterior border zone that was crucial in the eventual clipping of the distal anterior cerebral artery and uneventful resection of the giant aneurysm.

Conclusions

We conclude that giant distal anterior cerebral artery aneurysms can be successfully treated; that angiography, CT, and MRI have specific values; and that all may be required to adequately define the aneurysm, its relation-

ship to cerebral tissue, and possible associated pathology. The role of MR angiography in the assessment of giant aneurysms remains to be elucidated.

References

- Byrd SE, Bentson JR, Winter J, Wilson GH, Joyce PW, O'Connor L. Giant intracranial aneurysms simulating brain neoplasms on CT. *J Comput Assist Tomogr* 1978;2:303-7.
- Bull J. Massive aneurysms at the base of the brain. *Brain* 1969;92:535-70.
- Creissard P. Les anevrysmes geants. *Neurochirurgie* 1980;26:309-31.
- Cuatico W, Cook AW, Tyshchenko V, Khatib R. Massive enlargement of intracranial aneurysms following carotid ligation. *Arch Neurol* 1967;17:609-13.
- Drake CG. Giant intracranial aneurysms: experience with surgical treatment in 174 patients. *Clin Neurosurg* 1979;26:12-95.
- Golding R, Peatfield RC, Shawdon HH, Rice H, Edwards JM. Computer tomographic features of giant intracranial aneurysms. *Clin Radiol* 1980;31:41-8.
- Hayashi M, Kobayashi H, Kawano H, Handa Y, Kabuto M. Giant aneurysm of an azygos anterior cerebral artery: report of two cases and review of the literature. *Neurosurgery* 1985;17:341-4.
- Hoffman WF, Wilson CB, Townsend JJ. Recurrent transient ischemic attacks secondary to an embolizing saccular middle cerebral artery aneurysm: case report. *J Neurosurg* 1979;51:103-6.
- Hosobuchi Y. Direct surgical treatment of giant intracranial aneurysms. *J Neurosurg* 1979;51:743-6.
- Laitinen L, Snellman A. Aneurysm of the pericallosal artery: a study of 14 cases verified angiographically and treated mainly by direct surgical attack. *J Neurosurg* 1960;17:447-58.
- Lau S, Bannan E, Tress B. Pseudotumor of the corpus callosum due to subarachnoid hemorrhage from pericallosal aneurysm. *Neuroradiol* 1984;26:67-9.
- Lavyne MH, Kleefield J, Davis KR. Giant intracranial aneurysms of the anterior circulation: clinical characteristics and diagnosis by computer tomography. *Neurosurgery* 1978;3:356-63.
- Locksley HB. Report on the Cooperative Study of Intracranial Aneurysms and Subarachnoid Hemorrhage: Section V, Part II. Natural history of subarachnoid hemorrhage, intracranial aneurysms and arteriovenous malformations: based on 6368 cases in the Cooperative Study. *J Neurosurg* 1966;25:219-39.
- Maiuri F, Corriero G, D'Amico L, Simonetti L. Giant aneurysm of the pericallosal artery. *Neurosurgery* 1990;26:703-6.
- McKissock W, Paine KWE, Walsh LS. An analysis of the results of treatment of ruptured intracranial aneurysms: Report of 772 consecutive cases. *J Neurosurg* 1960;17:762-76.
- Mishima K, Watanabe T, Sasaki T, Saito I, Takakura K. An infected partially thrombosed giant aneurysm of the azygos anterior cerebral artery. *Noushinkei Geka* 1990;18:475-81.
- Morley TP, Barr HWK. Giant intracranial aneurysms: diagnosis, course and management. *Clin Neurosurg* 1969;16:73-94.
- O'Neill M, Hope T, Thomson G. Giant intracranial aneurysms: diagnosis with special reference to computerised tomography. *Clin Radiol* 1979;31:27-36.
- Petit-Perrin D, Vignaud J, Aubin ML. Computed tomography of giant aneurysms. *Ann Radiol* 1980;23:641-45.
- Pia HW, Zierski J. Giant cerebral aneurysms: problems in treatment. In: Pia HW, Langmaid C, Zierski J, eds. *Cerebral aneurysms. Advances in diagnosis and therapy.* Berlin/Heidelberg/New York: Springer-Verlag, 1979:336-42.
- Pinto RS, Cohen WA, Kricheff II. Giant intracranial aneurysms. Rapid sequential computed tomography. *AJNR* 1982;3:495-99.
- Pozzati E, Nuzzo G, Gaist G. Giant aneurysm of the pericallosal artery: case report. *J Neurosurg* 1982;57:566-69.
- Schubiger O, Valavanis A, Hayek J. Computed tomography in cerebral aneurysms with special emphasis on giant intracranial aneurysms. *J Comput Assist Tomogr* 1980;4:24-32.
- Schubiger O, Valvanis A, Wichman W. Growth mechanism of giant intracranial aneurysms: demonstration by CT and MR imaging. *Neuroradiology* 1987;29:266-71.
- Sindou M, Keravel Y. Les anevrysmes geants intracranien: approches therapeutiques. *Neurochirurgie* 1984;30(suppl 1):1-114.
- Smith RR, Parent AD. End-to-end anastomosis of the anterior cerebral artery after excision of a giant aneurysms: case report. *J Neurosurg* 1982;56:577-80.
- Sundt TM Jr, Piepgras DG. Surgical approach to giant intracranial aneurysms. Operative experience with 80 cases. *J Neurosurg* 1979;51:731-42.
- Sutherland GR, King ME, Peerless SJ. Platelet interactions within giant intracranial aneurysms. *J Neurosurg* 1982;56:53-61.
- Yasargil MG, Carter LP. Saccular aneurysms of the distal anterior cerebral artery. *J Neurosurg* 1974;40:218-23.