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Traumatic Aneurysms of Cerebral Arteries A Study of Five Cases

By

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With 2 Figures

Summary

Five cases of traumatic aneurysms of cerebral arteries are presented, two located at the internal carotid artery, and three at peripheral arterial branches.

The manifestation of the aneurysm was a delayed neurological deterioration due to bleeding from the aneurysm, 4–35 days (mean 21 days) after the head trauma; four patients had an intracerebral haematoma and one patient had a subarachnoid haemorrhage. One patient died from extensive cerebral injuries with the aneurysm untreated. In four cases the aneurysm was treated surgically. Three patients returned to their former occupation and one patient died from late septic complications.

It is concluded that signs of delayed intracranial bleeding after a head trauma should raise the suspicion of an underlying traumatic aneurysm, and in addition to a CT-scan an angiography should be performed.

Keywords: Cerebral aneurysms; cerebral arteries; cerebral haemorrhage; head injury.

Introduction

Traumatic intracranial aneurysms causing intracranial haemorrhage are distinctly rare when compared with other traumatic lesions of intracranial arteries. Until recently there have been about 100 cases reported in the neurosurgical literature.

The aneurysms of traumatic origin can be divided into two main groups according to their pathogenesis; true and false aneurysms. In the former group there has been a partial traumatic disruption of the vascular wall, leaving only the outer adventitial layer intact,

which will constitute the aneurysm sac. In the latter group the vascular wall has been completely disrupted. The rift in the arterial wall is occluded by a blood clot which subsequently becomes organized and, due to haemodynamical stress, is excavated and increases in size. An aneurysm is formed with a wall consisting of a fibrous organized clot⁵.

A mixed aneurysm results from rupture of a true aneurysm giving rise to a secondary false aneurysm⁵.

The arterial trauma can be classified as being either direct or indirect. Direct injury to the arterial wall results from driven in bone fragments, missiles or other penetrating foreign bodies^{3, 5}. Indirect arterial trauma occurs either when a vessel strikes the falx, tentorium or bony prominences or by a shearing component when the intracranial contents are deformed by acceleration and deceleration during the impact^{13, 8, 4}.

Arterial trauma can also result in an occlusion of the vessel due to an intramural haematoma of the arterial wall or due to the formation of a thrombus at the site of a damaged intimal layer^{9, 1}.

In the present paper we will review five cases of aneurysms of cerebral arteries resulting from cranio-cerebral trauma.

Clinical Material and Results

From March 1966 to August 1980 we have seen five patients with ruptured traumatic aneurysms (Table 1). During the same period 667 patients with ruptured congenital aneurysms were admitted to the clinic.

The trauma sustained was in three cases a direct blow to the head by an object; one patient had been assaulted with a hammer, one had been struck by a falling board and another had been hit by a heavy soccer ball. Of the other two patients one had been involved in a car accident as a passenger, her head had struck the interior of the car, the other patient had fallen down from a height of two metres.

In four cases there were associated cranio-cerebral injuries sustained at the time of the traumatic incident (Table 1).

Clinical Symptoms

In all five cases there was an initial depression of consciousness followed by a period during which the neurological condition was stabilized. Two of the patients exhibited completely lucid intervals.

Table 1. Summary of the Five Cases with Traumatic Aneurysms

Age	Sex	Type of trauma	Associated cranio-cerebral injuries	Time interval from trauma to aneurysm bleeding	Location of aneurysm	Type of aneurysm	Surgical treatment	Long term follow up
21	male	hit by soccer ball	—	17 d	frontal ascending artery	true	trapping	recovered
25	male	hit by falling board	fractured base of skull, contusion	15 d	internal carotid artery	false	trapping	slight hemiparesis
42	male	hammer assault	depressed fracture, fractured base of skull, contusion	4 d	internal carotid artery	false	haematoma evacuation	† (10 d)
6	female	car accident	linear skull fracture	35 d	callosomarginal artery	true	ligature	recovered
5	male	fall 2 metres	depressed fracture	33 d	pericallosal artery	true	ligature	† (128 d)

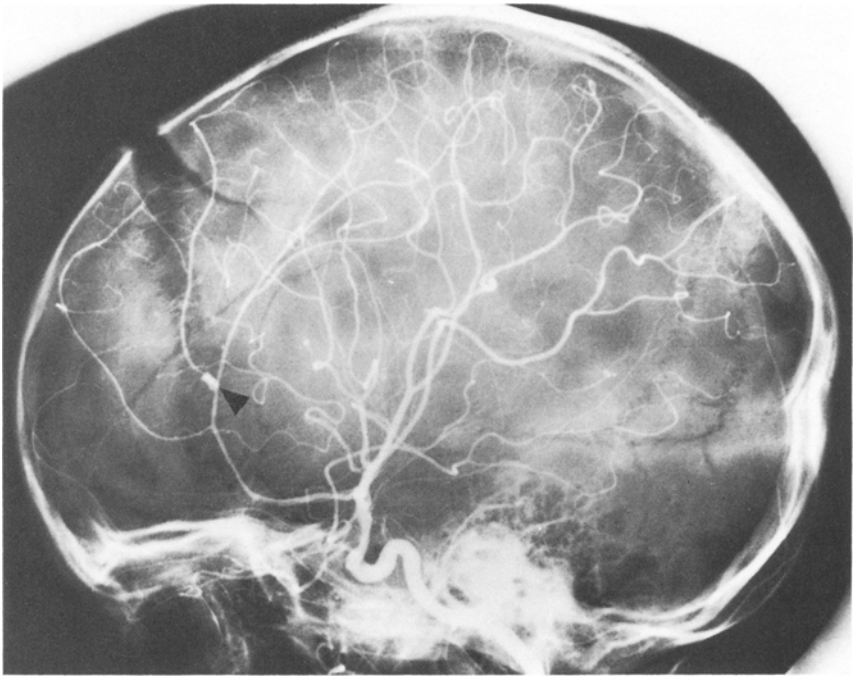


Fig. 1. Carotid angiography, showing a traumatic aneurysm of the pericallosal artery (arrow)

A sudden obvious deterioration in neurological condition occurred in all five patients, leading to the diagnosis of the traumatic aneurysms. In the two most severely injured patients extensor rigidity appeared. In one patient the bleeding was indicated by a gradual depression of consciousness from stupor to coma and appearance of a hemiparesis. As for the remaining two patients, having exhibited completely lucid intervals, one developed seizures and the other developed severe headache followed by loss of consciousness. The time intervals from trauma to the aneurysmal bleeding are demonstrated in Table 1.

Radiology

Radiographs of the skull were obtained in all five cases, showing basilar skull fractures in three cases. In two of these patients there were also compound depressed fractures and the third patient had a

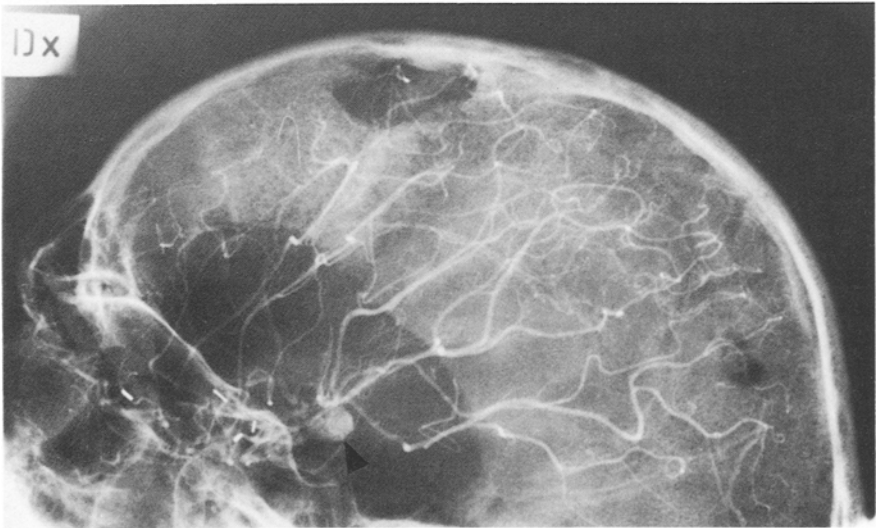
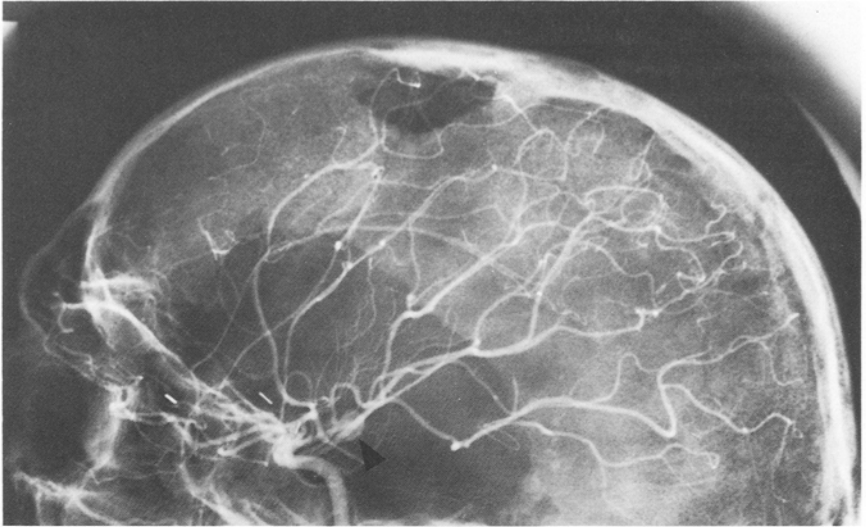


Fig. 2. Above and below: Carotid angiography demonstrating a traumatic aneurysm of the internal carotid artery (arrow); and the angiographical feature of a false aneurysm, namely, slow emptying of the aneurysm sac

linear skull fracture. Two patients had no radiological signs of skull fracture.

Carotid angiography was performed when signs of neurological deterioration appeared. In all cases, the angiography demonstrated the aneurysm (Fig. 1), and in four cases an associated intracerebral haematoma was seen.

The location of the aneurysm is seen in Table 1.

In three of our patients the angiograms demonstrated the features of a false aneurysm, with late filling in the arterial phase and slow emptying (Fig. 2).

A CT-scan was done in the most recent case, showing an intracerebral haematoma in the right frontal lobe, but the aneurysm was not visualized.

Treatment

One patient required an emergency operation because of a compound depressed fracture and severe cerebral lacerations. Four days later a false internal carotid artery aneurysm with an associated haematoma was diagnosed. The haematoma was evacuated but, due to the patient's almost moribund condition, we deferred from treating the aneurysm, which was subsequently shown to be a false traumatic aneurysm.

The remaining four aneurysms were operated on. There were two false and two true aneurysms. In one patient the aneurysm was clipped. The remaining three cases were treated by trapping the aneurysm and evacuating an associated haematoma.

Long Term Follow Up

Two patients have returned to full working activity. One patient with a slight hemiparesis, is working part-time in his former occupation.

There were two deaths. The patient with the untreated internal carotid artery aneurysm died due to his extensive cerebral lacerations. Another patient died in septicaemia after four months in a vegetative state.

Discussion

Traumatic aneurysms can be caused by either a penetrating or a blunt trauma. Regarding the former, there have been reports of a great diversity of penetrating agents^{2, 6}. In all our cases there was a blunt trauma to the head, with a severity reflected by the accompanying lesions such as skull fractures, cerebral contusions

and lacerations. The frequent association between traumatic intracranial aneurysms and other forms of intracranial pathology is a well known fact¹⁰. The early post-traumatic course is dependent on these injuries and not on the developing traumatic aneurysm.

The clinical history in the typical case is a post-traumatic coma with a subsequent lucid interval of varying duration from hours to days, followed by a sudden deterioration. In general the lucid interval is more prolonged and the onset of deterioration is more sudden than in other intracranial post-traumatic complications⁷. This is in agreement with two of our cases.

In the three of our patients who did not regain consciousness before the secondary deterioration, the signs of bleeding from the aneurysm were deepening coma and/or development of extensor rigidity.

At angiography it is possible to differentiate a true traumatic aneurysm from a congenital aneurysm by its more peripheral location, by not being situated at an arterial branching point, and often by the absence of a neck⁴. These were the facts in two of our cases. False aneurysms fill late in the arterial phase, opacify less and empty more slowly than other aneurysms⁴. The three false traumatic aneurysms in our material had these characteristics on the preoperative angiograms.

The objective of the treatment is obliteration of the aneurysm, when possible by clipping it¹². In the two cases with false traumatic aneurysms this was not accomplished due to either a too broad base of the aneurysm and/or the aneurysm wall being too fragile. In these cases a trapping of the aneurysm was performed with no apparent adverse effects. One of the true traumatic aneurysms was clipped. The other was trapped because of difficulties in dissecting the neck of the aneurysm.

It seems important to us that the possibility of a traumatic aneurysm is taken into consideration when a patient, after a head injury, undergoes a late neurological deterioration. At present the only way of establishing the exact diagnosis is by angiography.

A surgical mortality of approximately 22% has been reported¹⁰. This should be compared with a mortality rate of almost 50% in cases left untreated¹⁰. Mortality is three times less likely if the aneurysm is diagnosed before it has ruptured, compared with diagnosis after rupture⁷. These figures emphasize the importance of an early diagnosis of such lesions, which might be difficult with the increasing use of CT-scan as the only means of radiological evaluation in head injured patients.

Although cerebral aneurysms due to trauma are very infrequent, they are of great practical importance in that they are amenable to surgical cure with a reasonable surgical mortality when diagnosed early. The possibility of a traumatic aneurysm should be considered in all patients with a delayed sudden deterioration in neurological condition after a head injury. In this situation a CT-scan showing an intracerebral haematoma or a subarachnoid haemorrhage should be followed by an angiography in order to disclose the presence of a traumatic aneurysm as a source of bleeding.

References

1. Arabi, B., McQueen, J. D., Traumatic internal carotid occlusion at the base of the skull. *Surg. Neurol.* 10 (1978), 233—236.
2. Acosta, C., Williams, P. E., jr., Clark, K., Traumatic aneurysm of the cerebral vessels. *J. Neurosurg.* 36 (1972), 531—536.
3. Asari, S., Nakamura, S., Yamado, O., *et al.*, Traumatic aneurysm of peripheral cerebral arteries. Report of two cases. *J. Neurosurg.* 46 (1977), 795—803.
4. Benoit, B. G., Wortzman, G., Traumatic cerebral aneurysms. Clinical features and natural history. *J. Neurol. Neurosurg. Psychiat.* 36 (1973), 127—138.
5. Burton, C., Velasco, F., Dorman, J., Traumatic aneurysm of a peripheral cerebral artery. Review and case report. *J. Neurosurg.* 28 (1968), 468—474.
6. Carothers, A., Orbitofacial wounds and cerebral artery injuries caused by umbrella tips. *J.A.M.A.* 239 (1978), 1151—1152.
7. Fleischer, A. S., Patton, J. M., Tindall, G. T., Cerebral aneurysms of traumatic origin. *Surg. Neurol.* 4 (1975), 233—239.
8. Handa, J., Shimizu, Y., Matsuda, M., *et al.*, Traumatic aneurysm of the middle cerebral artery. *Am. J. Roentgenol. Radium Ther. Nucl. Med.* 109 (1970), 127—129.
9. Krishnan, K. L. L., Kanaka, T. S., Bala, S., Posttraumatic middle cerebral artery occlusion: case report and review. *Angiology* 28 (1977), 648—652.
10. Parkinson, D., West, M., Traumatic intracranial aneurysms. *J. Neurosurg.* 52 (1980), 11—20.
11. Rumbaugh, C. L., Bergeron, R. T., Talalla, A., Kurze, T., Traumatic aneurysms of the cortical cerebral arteries: radiographic aspects. *Radiology* 96 (1970), 49—54.
12. Schneider, R. C., Gosch, H. H., Taren, J. A., *et al.*, Blood vessel trauma following head and neck injuries. *Clin. Neurosurg.* 19 (1972), 312—354.
13. Smith, K. R., jr., Bardenheimer, J. A., 3rd. Aneurysm of the pericallosal artery caused by closed cranial trauma. Case report. *J. Neurosurg.* 29 (1968), 551—554.

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