Microsurgical Removal of a Balloon Embolus From The Middle Cerebral Artery Caused During Endovascular Treatment of Carotid-Cavernous Fistula: Case Report

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Abstract : A complication of treatment of a carotid–cavernous fistula by detachable balloon technique is presented. During occlusion of the fistula, a balloon moved distally and occluded the middle cerebral artery. The patient underwent microsurgical embolectomy of the balloon and simultaneous closure of the fistula by use of fibrin glue. The impact and management of this complication are discussed.

Key Words : Carotid–cavernous fistula, detachable balloon catheter, microsurgical embolectomy

INTRODUCTION

Direct carotid–cavernous fistulas (CCFs) are usually solitary connections between the cavernous carotid artery and the cavernous sinus which mostly occur after trauma due to laceration of the carotid siphon or rupture of its cavernous branches (2,10). They occur not only as the result of a closed head injury associated with a basal skull fracture, but also with penetrating trauma, ruptured cavernous aneurysms, dissections, collagen deficiency diseases and iatrogenic injuries (e.g. percutaneous retrogasserian procedures) (10). These fistulas are associated with ocular–orbital symptoms that are principally due to orbital venous hypertension (4). Treatment of these fistulas has evolved over the past 40 years. The trapping procedure (carotid ligation below and above the fistula) which often failed to obliterate the fistula, has largely been abandoned because of the high risk of stroke and blindness (10). In 1974, Serbinenko and Debrun et al. introduced the method of detachable balloons via the endarterial route, often with preservation of the internal carotid artery for the treatment of CCF (1,14). Controlled particulate embolization, direct surgical repair, closure by use of fibrin glue (Tisseel, Immuno AG, Vienna, Austria) and electrothrombosis are other approaches which have been tried in the treatment of CCF (9,10,11,12).

Some complications of treatment of CCFs by detachable balloon techniques have been reported (1,6,8,13). In our case, a balloon moved distally during occlusion of a CCF and occluded the middle cerebral artery (MCA) causing a serious life–threatening condition and significant neurological deficit which resolved after an emergency intracranial balloon embolectomy through a pterional craniotomy. During the same operation, we injected fibrin glue into the cavernous sinus as a therapeutic approach. Our review of this case forms the basis of this report.

CASE REPORT

A 55 year old right handed female was referred for evaluation of a right pulsating exophthalmus and orbital–cranial bruit which was said to have occurred several months after a minor closed head injury. She was first admitted to a local hospital where in-

itial examination and investigations were made.

She was a healthy woman without prior significant medical problems. Detailed general physical examination was entirely normal. On neurological examination there was mild chemosis and proptosis with increased vascularity of the conjunctiva in the right eye together with edema of the eyelids and paralysis of the sixth nerve (reported diplopia on lateral gaze). Vision was not affected. Fundoscopy revealed dilated and tortuous retinal veins with peripapillar atrophy. Intraocular pressure was mildly elevated in both eyes. Biochemical screening tests were within normal levels.

Skull X–ray did not show any fracture of the frontal or orbital regions. CT scan demonstrated right proptosis with widening of the right superior ophthalmic vein and cavernous sinus (Fig 1). Selective right internal carotid angiography delineated a right, type A internal carotid–cavernous sinus fistula, with drainage into the right superior ophthalmic vein. No external carotid artery feeders to the fistula were present (Fig 2). The left carotid and vertebral angiograms were normal. The left MCA and anterior cerebral artery (ACA) were filled from the right carotid artery.

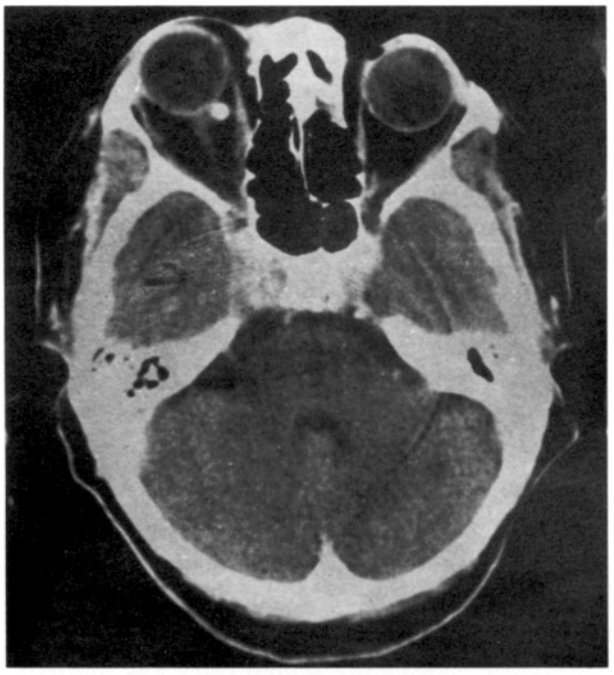

Fig. 1 : Preoperative CT scan demonstrating right proptosis with widening of the right superior ophthalmic venae and cavernous sinus.

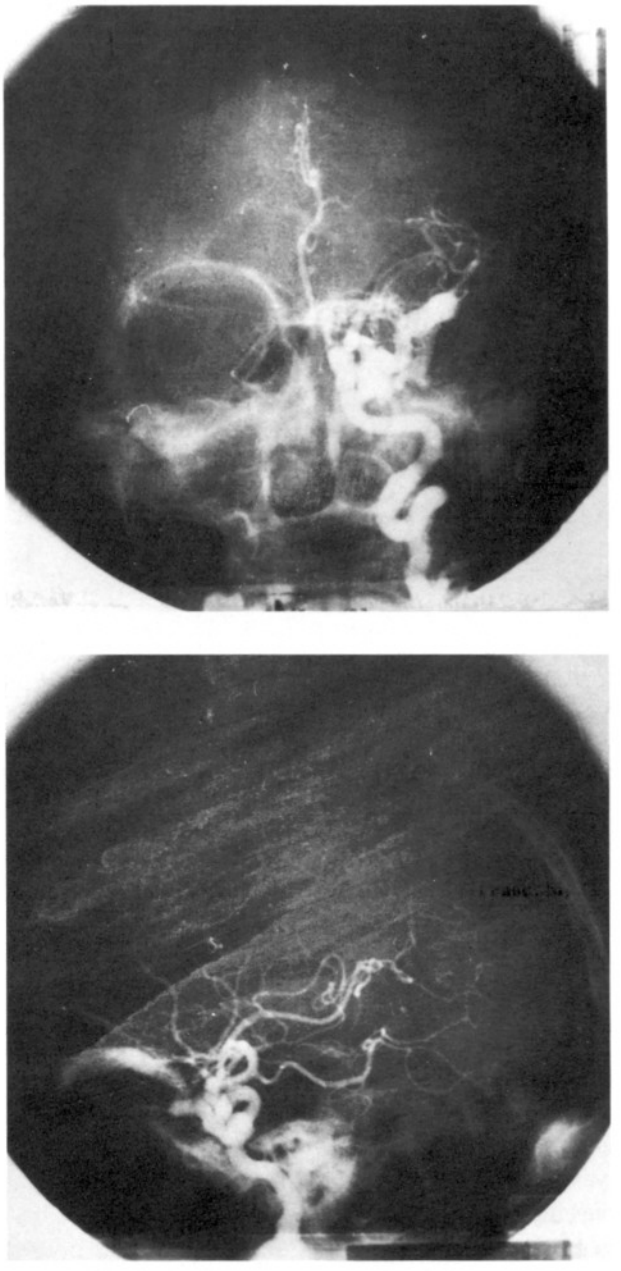

Fig. 2a, 2b : Preoperative angiogram of the right internal carotid artery demonstrating type A CCF.

Percutaneous catheterization of the right internal carotid artery (ICA) was performed ten days later in the Neuroradiology Department by direct puncture using a No:6 French introducer catheter (Ingenor, Paris, France) under local anaesthesia. A flow–directed coaxial detachable balloon system as described by Debrun et al(7) was employed to occlude the fistula. A No:16 balloon was introduced into the fistula and was detached. Control angiography

demonstrated persistent filling of the fistula and carotid branches. So another balloon was then introduced to occlude the fistula, which was unsuccessfully displaced into the supraclinoid ICA. Control angiography revealed that the ICA was completely occluded distal to the posterior communicating artery junction by the second balloon while the fistula remained patent (Fig. 3). The left ICA angiography did not reveal any collateral flow.

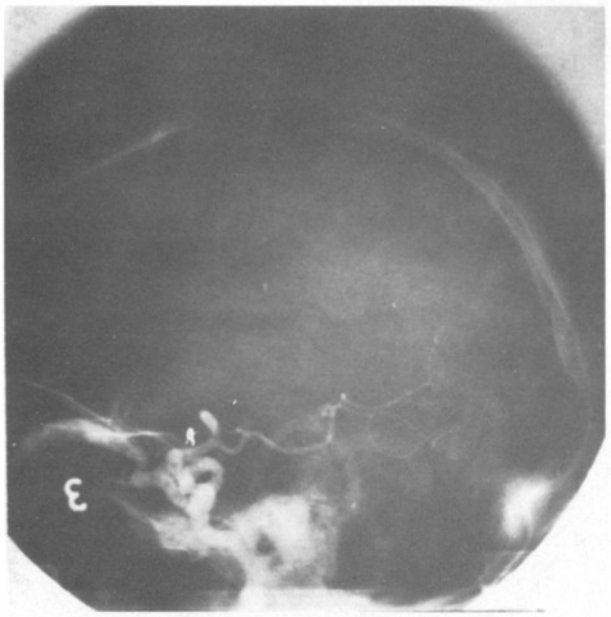

Fig. 3 : Angiogram of the right ICA demonstrating total occlusion of the ICA and branches distal to the posterior communicating artery junction, after migration of the balloon. The black arrow points to the balloon.

Shortly after, the patient became somnolent. On examination left hemiplegia with central facial palsy was noted. At this point, pentobarbital anaesthesia was induced, intubation was carried out and the patient was taken to the operating room without delay. A right pterional craniotomy was performed exposing the right optic nerve and ICA. Though the right ICA appeared normal, the vascular branches distal to the MCA bifurcation were extremely pale and non pulsating. The inflated ballon could be seen lodged in the MCA bifurcation. Temporary microvascular clips (Yaşargil Phynox aneurysm clip, Aesculap, Tuttingen, Germany) were used to occlude the proximal and distal branches of the MCA. Under 25X magnification, 2–3 mm. linear arteriotomy was performed and the balloon was deflated and removed. The arteriotomy was then closed with one suture of 8/0 nylon and reinforced by fibrin glue. Microvascular clips were removed. The MCA and branches refilled and appeared normal. No bleeding was seen at the arteriotomy site . Patency was restored at the MCA bifurcation three hours after the embolic occlusion had occurred. Then the ICA and ophthalmic artery were exposed. A temporary microvascular clip was used to occlude the supraclinoid ICA, but not the ophthalmic artery. The triangle of Parkinson was exposed and 2 cc of fibrin glue was injected directly into the cavernous sinus. At this point the cervical ICA was temporarily occluded by the anaesthesiologist. The temporary microvascular clip was removed. Engorgement of the cavernous sinus decreased.

Following surgery the patient was moved to the intensive care unit and intubated for the next 12 hours. She was treated with intravascular volume expansion, calcium channel blockers (nimodipine) and antiedema therapy. During this time, she was awake and able to move her left side. The following day the neurological deficit gradually cleared except for a slight paresis on the left. No orbital bruit was audible. Postoperative ophthalmological examination was no different from the preoperative study. Control CT scanning showed narrowing of the right cavernous sinus and the superior ophthalmic vein. A second CT scan, fifteen days later showed a small hypodensity at the nucleus caudatus and around the capsula interna. Control angiography demonstrated persistent filling of the fistula but the cavernous sinus and the superior ophthalmic vein were clearly narrowed. It also exposed competent flow of both hemispheric vessels and patency of the right MCA bifurcation (Fig 4).

The patient was discharged 25 days after surgery without significant neurological deficit. In follow up she refused any further interventional angiography.

DISCUSSION

As CCF is not a life–threatening lesion, the goal of therapy should be preservation or improvement of vision, (return of the orbit and its contents to normal) and elimination of the bruit (1,3,4,5). Therefore therepeutic endeavours should carry low morbidity and mortality. There are two basic forms of therapy for CCF : the first is to sacrifice the ICA, and the second –a more desirable method– is obliteration of the fistula while maintaining patency of the internal carotid artery (1).

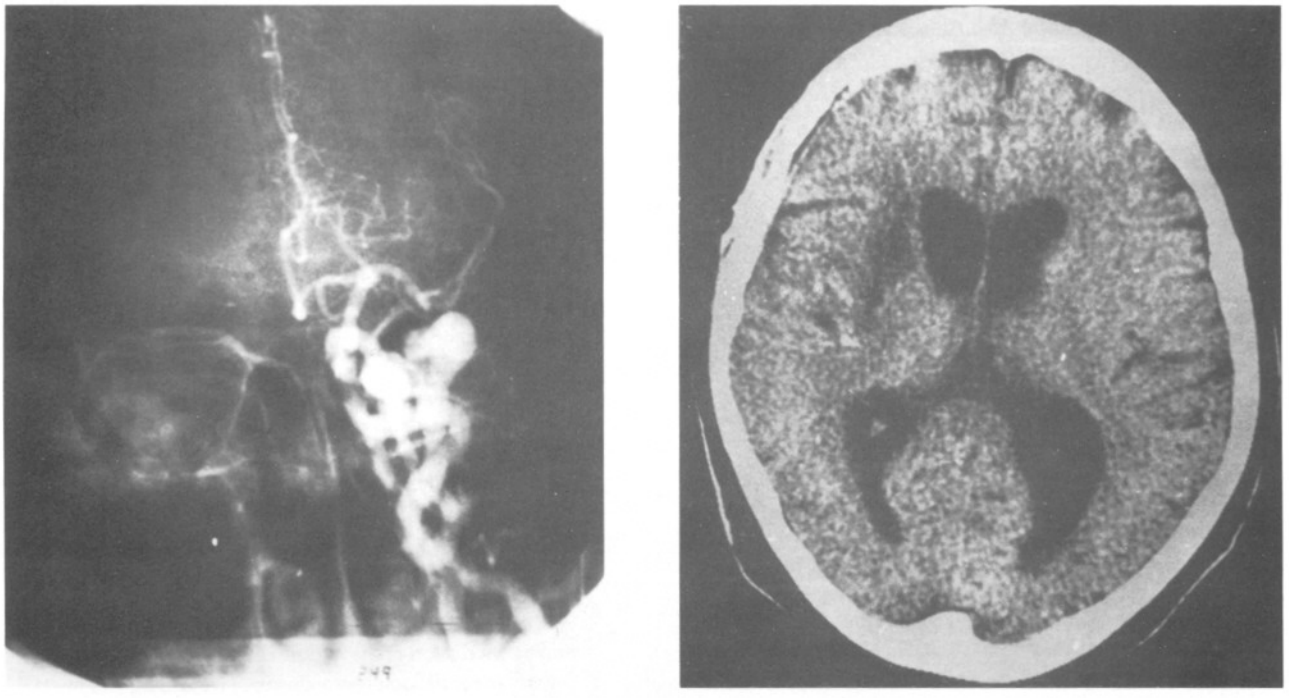

Fig 4 : (A) Postoperative control angiography demonstrating competent flow of both hemispheric vessels and patency of the right MCA bifurcation. (B) Control CT scan shows small hypodensity.

Complications of detachable balloon technique in the treatment of CCFs have been relatively infrequent, but Barrow et al. reported several problems in the treatment of traumatic CCFs(1). These authors noted one case of acute and complete occlusion of the left MCA, presumably from a platelet embolus originating from the catheter tip. This patient was treated with volume expansion and heparin. Other complications reported were cavernous sinus thrombosis and balloon rupture in the cavernous sinus without arterial embolization of the fragments (1,6,8,13).

Linksey et al. have recently reported one case of embolic occlusion of the MCA after ICA balloon test occlusion (13). They treated this patient by an emergency embolectomy followed by surgical repair of the ICA. Chalif et al. have recently reported a case in which distal migration of a balloon occluded the ICA (6). We believe this present report is the second case in the literature which was successfully treated.

At the Neuroradiology Department of Istanbul Faculty of Medicine transvascular obliteration of carotid cavernous fistulae have been accomplished with detachable balloon catheter technique since 1983. Using this technique we have treated 22 patients with CCFs (15). And we have not experienced anything close to the major complication which formed the basis of this present report. During the procedure the detached balloon migrated distally occluding the intracranial bifurcation of the middle cerebral artery. This resulted in a serious life–threatening condition and significant neurological deficit that cleared after an emergency intracranial balloon embolectomy through a pterional craniotomy.

Several factors probably contributed to the successful outcome of this case. It is well known that the likelihood of infarction after ischaemia is dependent on both the degree of reduced blood flow and the duration of the ischemia. The fact that the angiogram showed the balloon in the ICA bifurcation, whereas during operation it was found in the MCA bifurcation, leads us to believe that the balloon moved to the MCA in the interval between the angiography and the operation, thus restoring patency in the perforating branches of the MCA in less than three hours. Finally, optimizing our patient's medical management, including pentobarbital anaesthesia, early hydration and volume expansion, calcium channel blockers (nimodipine) may have limited the

amount of damage caused during the 3 to 4 hours ischaemia, or may have enlarged the window of time available to us for successful revascularization with a good outcome.

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