

Case Report

Oculocardiac reflex induced by catheterization of the distal ophthalmic artery: Case Report

Makoto SAKAMOTO¹⁾ Takashi WATANABE¹⁾ Tetsuji UNO²⁾ Hirotaka INAGAKI²⁾

1) Department of Neurosurgery, Tottori University

2) Department of Neurosurgery, Tottori Prefectural Central Hospital

●Abstract●

Objective: Oculocardiac reflex sometimes occurs as a result of pressure on the eye or traction of the intraorbital surrounding structures during ophthalmic surgery. This can result in bradycardic arrhythmia and cardiac arrest. A case of oculocardiac reflex due to catheterization for an anterior cranial fossa dural arteriovenous fistula (DAVF) is reported.

Case Report: A 45-year-old man was incidentally diagnosed with an anterior cranial fossa DAVF by magnetic resonance angiogram. Bilateral carotid angiograms revealed the DAVF was supplied by bilateral anterior ethmoidal arteries. An attempt was made at transarterial embolization using a liquid embolic material. The DAVF was mainly supplied by the left anterior ethmoidal artery, however tortuosity of its arterial origin prevented catheterization with a microcatheter. Therefore catheterization was attempted using the right ophthalmic artery. The microcatheter was advanced to an area more distal in the third segment of the right ophthalmic artery to avoid ophthalmic complications. When the microcatheter had been advanced as distally as possible to be close to the shunt point of the DAVF, the patient's pulse rate gradually decreased and temporary cardiac arrest occurred just after the patient complained of eye pain. Immediately after pulling back the microcatheter, the pulse rate began to gradually increase for about 20 seconds. Ultimately, the attempt at transarterial obliteration of the fistula was abandoned.

Conclusion: To our knowledge, this is the first report describing a patient that developed an oculocardiac reflex as a result of catheterization of the distal ophthalmic artery. Operators attempting catheterization into the distal ophthalmic artery need to be familiar with this phenomenon.

●Key Words●

anterior cranial fossa dural arteriovenous fistula, oculocardiac reflex, ophthalmic artery

<Correspondence Address : 36-1, Nishicho, Yonago, Tottori, Japan E-mail : sakamako@grape.med.tottori-u.ac.jp>

(Received January 25, 2008 : Accepted March 8, 2008)

Introduction

An oculocardiac reflex is sometimes elicited by pressure on the eye or traction of the intraorbital surrounding structures during ophthalmic surgery^{4,10)}, or orbit-facial trauma⁶⁾. The afferent arc of the oculocardiac reflex reaches the brain stem via the nasociliary nerve¹²⁾. Here is reported, what we believe to be the first case where catheterization of the ophthalmic artery elicited an oculocardiac reflex during endovascular procedures for an anterior cranial fossa DAVF.

Case Presentation

A 45-year-old man was incidentally diagnosed with an anterior cranial fossa DAVF by magnetic resonance angiogram (Fig. 1). Bilateral carotid angiograms revealed an anterior cranial fossa DAVF supplied by bilateral anterior ethmoidal arteries draining to the frontal cortical vein (Fig 2, 3A B). Direct obliteration of the fistula by craniotomy is the most common treatment for anterior cranial fossa DAVF,

however this patient preference was for endovascular obliteration of the fistula. Thus application of transarterial embolization using a liquid embolic material was attempted. After catheterization of a guiding catheter (Envoy 6 Fr Cordis Miami, FL, USA) to the left internal carotid artery, insertion of a microcatheter (Excelsior SL-10, Boston Scientific, Natick, MA, USA) with microguidewire (Transend EX floppy, Boston Scientific, Natick, MA, USA) to the left ophthalmic artery was attempted, as the left anterior ethmoidal artery mainly supplied the DAVF. However, attempts to catheterize the left ophthalmic artery were prevented by a bend at its origin (Fig. 2). Catheterization to the third segment of the right ophthalmic artery was then attempted in order to protect the central retinal artery (Fig. 3A B). When the microcatheter was introduced to the origin of the anterior ethmoidal artery (Fig. 4), the patient's pulse rate gradually decreased and temporary cardiac arrest occurred immediately after the patient complained of eye pain. Immediately after pulling back the microcatheter, the

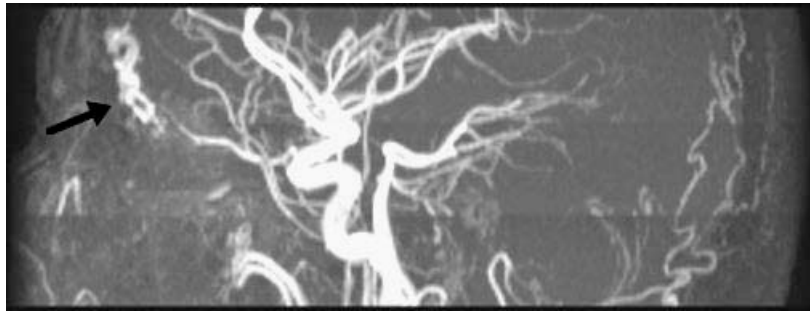


Fig. 1 Lateral projection of a magnetic resonance angiogram indicates an anterior cranial fossa DAVF. The dilated frontal cortical vein is visualized (arrow).



Fig. 2 Left carotid angiogram, lateral view, indicates a DAVF at the anterior cranial fossa fed by the anterior ethmoidal artery and drained by the dilated frontal cortical vein. The origin of the left ophthalmic artery is markedly kinked (arrow).

pulse rate began to increase gradually for about 20 seconds. This phenomenon repeated itself during 3 such attempts. Atropine sulfate was administered and again the microcatheter attempted to be advanced more distally, however the same reflex occurred. The microcatheter was pulled back slightly, so as not to elicit the oculocardiac reflex and the microcatheter was positioned as distally as possible to avoid retinal complication. A super-selective angiogram at the catheter position indicated an inferior muscular artery and the terminal segment of the third portion of the right ophthalmic artery (Fig. 5). A provocation test was attempted using 2% lidocaine, however the patient complained of diplopia and an abducting eye movement was observed. Anisocoria and blepharoptosis were not observed, therefore temporary partial oculomotor nerve palsy was diagnosed. It was also postulated that the inferior division of the oculomotor nerve

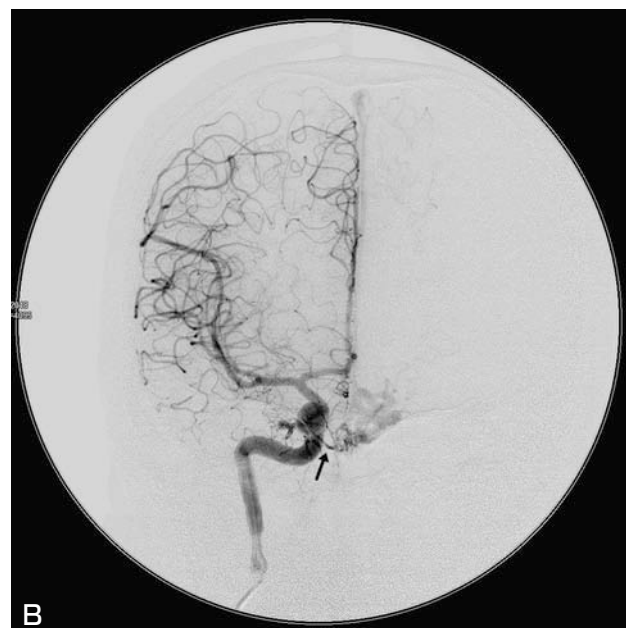
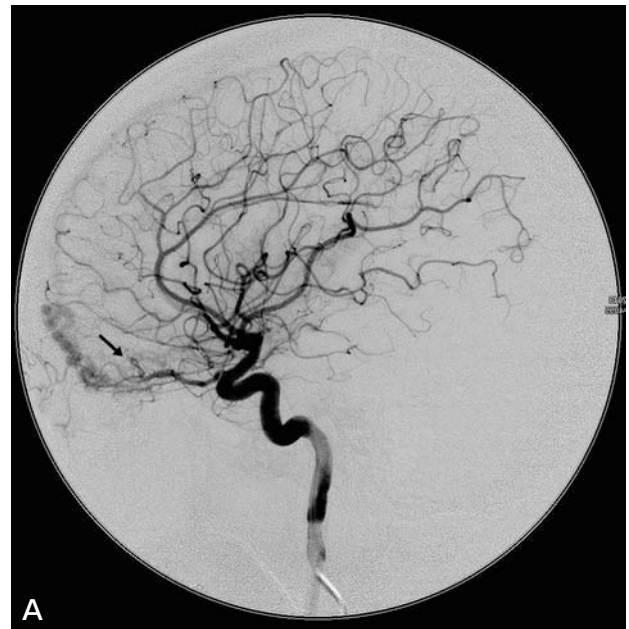


Fig. 3
 A : Right carotid angiogram, lateral view, also indicates a DAVF at the anterior cranial fossa fed by the anterior ethmoidal artery. The anterior ethmoidal artery is markedly kinked (arrow).
 B : Anteroposterior right carotid angiogram indicates a DAVF fed by the anterior ethmoidal artery (arrow).



Fig. 4 Super-selective angiogram via the right ophthalmic artery shows a tortuous feeding artery and a dilated draining vein. Catheterization to the origin of the anterior ethmoidal artery induced an oculocardiac reflex (arrow).



Fig. 5 Super-selective angiogram via a microcatheter placed slightly proximal to the former position (Fig. 4) did not elicit the oculocardiac reflex. The inferior muscular artery (black arrow) and the terminal third segment (white arrow) are visualized. A provocation test at this catheter position elicited temporary partial oculomotor nerve palsy.

supplied by the inferior muscular artery was affected by the 2% lidocaine. The oculomotor nerve palsy resolved within thirty minutes, however further attempts at transarterial obliteration of the fistula were abandoned. Direct surgical obliteration was performed three months later.

Discussion

Oculocardiac reflex has been reported to occur as a result of pressure on the eye or traction of the surrounding structures. Intraoperatively, it occurs most often during strabismus surgery¹⁰, however peri-orbital fracture⁶, blepharoplasty⁸, and clamping of the optic nerve during enucleation¹¹ have also been reported as causes of this phenomenon. Bradycardia², electrocardiographic changes⁹, and asystole³ have also been described after diagnostic angiography, however these were possibly in response to contrast media. In this case, advancing a microcatheter distal to the third segment of the ophthalmic artery elicited bradycardia and asystole, with withdrawal of the microcatheter immediately ameliorating the symptoms. To our knowledge, this is the first case of the elicitation of the oculocardiac reflex during an endovascular procedure.

Initially, this symptom was not recognized as an oculocardiac reflex, thus several attempts were made at what is actually a dangerous catheterization. Every procedure was performed

under the same circumstances. As the patient complained of ocular pain each time, this pointed towards the phenomenon being an oculocardiac reflex. The reproducibility of the phenomenon triggered by catheter manipulation and ocular pain occurrence prior to the cardiac response support this hypothesis. The most common manifestation of this reflex is sinus bradycardia, however sometimes asystole can occur¹³.

Suitable treatments include cessation of catheter manipulation and administration of an intravenous anticholinergic drug¹². However, in this case, after administration of an anticholinergic agent, the same procedure again induced the oculocardiac reflex.

The afferent arc of the oculocardiac reflex reaches the brain stem via the ophthalmic division of the trigeminal nerve that consists of frontal, lacrimal, and nasociliary nerves. The nasociliary nerve is usually implicated as the V1 branch involved in eliciting the oculocardiac reflex¹². As the third segment of the ophthalmic artery was anatomically located close to the nasociliary nerve and ciliary ganglion, it is likely that either direct or indirect compression of the nasociliary nerve or ciliary ganglion caused the oculocardiac reflex during catheterization into the distal ophthalmic artery. Specifically, the excessive tortuosity of the distal portion of the right anterior ethmoidal artery in this case may have more easily induced an oculocardiac reflex.

Most patients with anterior cranial fossa DAVFs have suffered a cerebral hemorrhage, and so there are not many difficulties from occluding the fistula by direct surgery. Therefore, this condition is usually treated by direct obliteration of the fistula by craniotomy, rather than endovascular treatment¹⁾. However, in this case, the patient was completely asymptomatic and preferred to be treated endovascularly. Endovascular treatment of anterior cranial fossa DAVFs has been shown to have a small but clinically significant risk for vision impairment, even if the provocative test is not positive, and endovascular embolization alone is not always curative⁷⁾. TAE with NBCA has been applied to DAVF that are not accessible by percutaneous transvenous catheterization. TAE with NBCA requires techniques that involve wedging a microcatheter into a main feeder so that the NBCA penetrates into the fistula, and preparatory devascularization of other minor feeders to avoid fragmentation of the glue column by competing inflow⁵⁾. However, in this case these techniques could not be achieved intraoperatively. The excessive tortuosity of the right anterior ethmoidal artery might have been inadequate if evaluated preoperatively, thus catheterization of the anterior ethmoidal artery induced an oculocardiac reflex. To prevent complications such as retinal ischemia and oculocardiac reflex, and to achieve complete obliteration of the fistula, operators need to very carefully consider the vasculature of the lesion, including the tortuosity and multiplicity of the feeding arteries. However, surgical management of anterior cranial fossa DAVF remains the treatment of choice, as there is no risk to vision. A surgical approach is also highly effective in obliterating the fistula and providing a good clinical outcome. Direct surgical obliteration was eventually undertaken for this case.

During embolization via the ophthalmic artery, such as for tumor embolization, arteriovenous malformation or a DAVF, an oculocardiac reflex can occur. Operators attempting catheterization into the distal ophthalmic artery need to be familiar with this phenomenon and be prepared to treat this complication.

Conclusion

Elicitation of oculocardiac reflex during endovascular treatment of an anterior cranial fossa DAVF was observed. Catheterization to the distal ophthalmic artery, such as for treatment of a feeder embolization of a tumor or embolization

of an arteriovenous malformation, may similarly induce this reflex. To our knowledge, this is the first report of an oculocardiac reflex being elicited during an endovascular procedure.

References

- 1) Abrahams JM, Bagley LJ, Flamm ES, et al: Alternative management considerations for ethmoidal dural arteriovenous fistulas. *Surg Neurol* 58:410-6, 2002.
- 2) Aronson M, Klein HO, Rubin IL: Bradycardia associated with carotid angiography. *N Y State J Med* 71:369-372, 1971.
- 3) Berczi V, Elfleet E, Turner D, et al: Adverse cardiac events as a result of high volume contrast injection during rotational arch aortography. *J Vasc Interv Radiol* 16:558-559, 2005.
- 4) Bosomworth PP, Ziegler CH, Jacoby J: The oculocardiac reflex in eye muscle surgery. *Anesthesiology* 19:7-10, 1958.
- 5) Kiyosue H, Hori Y, Okahara M, et al: Treatment of intracranial dural arteriovenous fistulas: current strategies based on location and hemodynamics, and alternative techniques of transcatheter embolization. *Radiographics* 24:1637-1653, 2004.
- 6) Kosaka M, Asamura S, Kamiishi H: Oculocardiac reflex induced by zygomatic fracture; a case report. *J Craniomaxillofac Surg*. 28:106-109, 2000.
- 7) Lawton MT, Chun J, Wilson CB, et al. Ethmoidal dural arteriovenous fistulae: an assessment of surgical and endovascular management. *Neurosurgery* 45:805-810, 1999.
- 8) Matarasso A: The oculocardiac reflex in blepharoplasty surgery. *Plast Reconstr Surg* 83:243-250, 1989.
- 9) Mitsumori M, Hayakawa K, Abe M: ECG changes during cerebral angiography; a comparison of low osmolality contrast media. *Eur J Radiol* 13:55-58, 1991.
- 10) Moonie GT, Rees DL, Elton D: The oculocardiac reflex during strabismus surgery. *Can Anaesth Soc J* 11:621-632, 1964.
- 11) Munden PM, Carter KD, Nerad JA: The oculocardiac reflex during enucleation. *Am J Ophthalmol* 111:378-379, 1991.
- 12) Slade CS, Cohen SP: Elicitation of the oculocardiac reflex during endoscopic forehead lift surgery. *Plast Reconstr Surg* 104:1828-1830, 1999.
- 13) Sorenson EJ, Gilmore JE: Cardiac arrest during strabismus surgery; a preliminary report. *Am J Ophthalmol* 41:748-752, 1956.