Carotid Dissection

Cerebral Air Embolism and Vasospasm after Carotid Revascularization: A Case Report

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Keywords

Complication · Air embolism · Carotid stenting · Vasospasm

Abstract

Cerebral air embolism can be of venous and arterial origin and cause severe medical complication. Vasospasm is a severe complication of carotid artery stenting. We report a 63-year-old male with severe carotid artery stenosis who suddenly died due to acute myocardial infarction during carotid artery stenting. His brain computed tomogram showed a remarkable amount of air in the gyriform spaces, and the cerebral angiogram showed vasospasm in the internal carotid artery resulting from stent manipulation. Presence of gyriform air could be caused by air entering the catheter due to sudden collapse after acute myocardial infarction and severe carotid vasospasm.

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Introduction

Carotid revascularization surgeries, endarterectomy, and stenting are known to be technically demanding and associated with learning curves. When compared with endarterectomy, carotid artery stenting (CAS) has promising efficacy due to an acceptable complication rate [1]. Cerebral air embolism [2] and vasospasm [3] during CAS are not common and

represent severe complications. It is mostly associated with an iatrogenic complication of invasive procedures, especially catheter insertion. Air emboli can be induced by both arterial and venous entry. Our previous review of patients with venous catheter-related cerebral air embolism has demonstrated that the presence of gyriform air on brain computed tomography (CT), old age, initial conscious disturbance, and hemiparesis may predict unfavorable outcomes [4]. It is reported that 0.2% (4 out of 1,418 cases) of the neurovascular interventional procedures had cerebral air embolism, but no air embolism was seen in diagnostic cerebral angiography [2]. Herein, we report a rare case of cerebral air embolism and vasospasm after CAS, resulting in mortality.

Case Presentation

A 63-year-old male had hypertension under medication control. He had suffered from intermittent dizziness since June 2019, with left-eye amaurosis fugax. Due to frequent episodes of intermittent dizziness and mild unsteadiness, he visited our hospital. Brain CT showed silent left corona radiata lacunar infarct, and carotid ultrasound revealed left internal carotid artery (ICA) 87% diameter stenosis. He was advised to admit for angiography survey to evaluate the feasibility of carotid revascularization. Cerebral angiogram confirmed left ICA tight stenosis with ostial stenosis of the bilateral vertebral arteries (right: 60% and left: 65%).

After admission, the patient was given adequate hydration and dual antiplatelets with aspirin and clopidogrel. Under local anesthesia, an 8F sheath was inserted from the right groin area. Boston FilterWire EZ with an umbrella was opened at the distal portion to ICA stenosis, followed by angioplasty with a 5 × 20 mm Sterling balloon (Boston Scientific) at 8 bar. Then, an 8 × 40 mm Protege stent (Medtronic) was deployed at the stenotic segment with subsequent post-stent balloon dilation. Immediately after the procedure, sudden collapse and bradycardia were noted. After cardiac resuscitation and intubation, a cardiovascular doctor was urgently consulted, and beside cardiac echo disclosed poor cardiac function. Brain CT was performed, and air was found inside all cisterns and sulci (Fig. 1b, c). Under the suspicion of large acute myocardial infarction, the patient expired 4 h after the stenting procedure. On retrospective review of the cerebral angiograms, vasospasm resulting from stent manipulation was found at the distal cervical ICA (Fig. 1e).

Discussion and Conclusion

Several rare complications have been reported during or a few days after CAS. A large pseudoaneurysm was found in the cervical ICA due to carotid wall injury caused by the guiding catheter during the procedures [5]. Partial opening of a carotid Wallstent was caused by displacement of its metal ring marker, which thus hindered complete expansion of the stent [6]. A carotid stent was not expanded due to a detached stent sheath [7]. Nitinol stent fracture was noted during CAS [8]. Contralateral cerebral embolism occurred after CAS for extracranial carotid stenosis [9]. Infection of the inserted carotid stent caused rupture of the carotid artery [10]. Cerebral vasospasm was noted after CAS [3]. However, the most serious rare complication of CAS could be acute in-stent thrombosis, which might result from inadequate or ineffective antiplatelet therapy. It is suggested that patients prepared for CAS should start

antiplatelet therapy before CAS and test for aspirin and clopidogrel resistance to prevent this complication [11].

The CAS complications of cerebral embolism and vasospasm usually occurred during catheter, wire, or sheath manipulation through the aortic arch and carotid artery, resulting in transient ischemia, nondisabling stroke, major stroke, or fatal stroke [2, 3, 12]. Air emboli sources could be due to pressurized arterial flush lines connected to ICA catheters and sudden hypotension or cerebral vasospasm with air subsequently entering the ICA catheter [2]. Hyperbaric oxygen therapy for air embolism [2] and fasudil hydrochloride to relieve cerebral vasospasm [3] may be the treatment of choice. These complications may be related to the interventionist's skill, institutional proficiency, and experience encompassing factors such as patient selection, device selection, adjunctive medical management, and reviews of lessons learnt from collegial reviews of all complications. It is suggested that rigorous training and credentialing requirements in evaluating endovascular devices and surgical procedures may improve the "learning" curve to obtain better safety of CAS [1].

Symptomatic cerebral air embolism and vasospasm are rare events during neuro-interventional procedures. Analysis of the etiologies of these infrequent complications may permit us to improve the quality of CAS.

Statement of Ethics

This research complies with the guidelines for human studies and was conducted ethically in accordance with the World Medical Association Declaration of Helsinki. The patient's guardians gave informed consent to publish the case (including publication of images).

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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Author Contributions

Tsong-Hai Lee: conceived and prepared the manuscript. Ho-Fai Wong: reviewed the manuscript.

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Fig. 1. **a** Pre-stenting brain CT shows no evidence of gyriform air. **b, c** Post-stenting brain CTs reveal evidence of gyriform air. **d** Pre-stenting cerebral angiogram demonstrates the stenotic area (arrow) and radiopaque nitinol loop of the FilterWire (arrowhead) in the left ICA. **e, f** Post-stenting cerebral angiograms indicate the stenotic area with the stent in situ (arrows), vessel spasm (large arrowheads), and radiopaque nitinol loop of the FilterWire (small arrowheads) in the left ICA.