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Usefulness of Local Manual Compression with Cerebral Angiography for Bleeding from the Origin of the ICA with Upper Airway Stenosis after Carotid Artery Stenting

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Abstract

Background: Symptomatic hemorrhage of the Internal Carotid Artery (ICA) associated with CAS is rare. A case of upper airway stenosis due to hemorrhage at the origin of the ICA after CAS is reported along with a review of the literature.

Methods: The patient was an 86-year-old man who suddenly noticed dysarthria and was transported to our hospital. On MRI, cerebral infarction was observed, along with stenosis of the right ICA. The infarction was considered to have been caused by the stenosis, so CAS was performed. An attempt was made to cross the stenotic lesion by the Spider FX using an microwire several times. Final angiography after deployment of a CASPER RX showed no abnormal findings, including acute in-stent occlusion or stenosis. Two hours after returning to the room, he noticed dyspnea; there was subcutaneous swelling of the neck from the right mandible to the supraclavicular region, and the pharyngeal fiberscope showed stenosis of the hypopharyngeal space. Emergency intubation was performed. Contrast-enhanced CT showed extravasation at the stenting site and a surrounding hematoma. Extravasation at the origin of the ICA was confirmed by angiography. A subcutaneous hematoma caused by intraoperative wire perforation was diagnosed. The skin was marked directly above the area of hemorrhage under angiography, and the area was manually compressed for one hour. On angiography just after compression, there was no extravasation.

Results: The patient's condition stabilized.

Conclusion: Manual compression with angiography after intubation is effective in cases of perforation of the ICA during intraoperative wire manipulation.

Keywords: CAS; Stent; Stroke; CT

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Abbreviations

CAS: Carotid Artery Stenting; CT: Computed Tomography; MRI: Magnetic Resonance Imaging; ICA: Internal Carotid Artery; ECA: External Carotid Artery; DAPT: Dual Antiplatelet Therapy

Introduction

Intracerebral hemorrhage due to hyperperfusion syndrome is a well-known symptomatic complication of Carotid Artery Stenting (CAS), but there are few reports of hemorrhage in the cervical region [1,2]. A case of hemorrhage from the cervical carotid artery after CAS for symptomatic ICA stenosis, which caused upper airway stenosis, is presented along with a review of the literature.

Material and Methods

The patient was an 86-year-old man who suddenly noticed dysarthria and was transported to our hospital. On Magnetic Resonance Imaging (MRI), cerebral infarction of the right occipital lobe and insular cortex was observed, along with stenosis of the right ICA. He was admitted to our hospital and started on antiplatelet therapy with aspirin 100 mg and prasugrel 3.75 mg. Carotid echocardiography showed a hyperintense stenotic lesion at the origin of the right ICA, and Peak Systolic Velocity (PSV) was increased to 192 cm/s. Computed Tomography (CT) showed calcification, and angiography showed 80% stenosis based on the NASCET criteria (Figure 1). It was thought that the stenosis was due to calcification, and CAS was performed under distal protection

on the 14th day. Preoperative antiplatelet efficacy was confirmed by the VerifyNow System (Accriva Diagnostics, San Diego, CA). VerifyNow by Aspirin Reaction Units (ARU) was 391 and by P2Y12 Reaction Units (PRU) was 175. This showed the good effect of DAPT. At operation, under general anesthesia, an attempt was made to cross the stenotic lesion by a Spider FX (Medtronic, Minneapolis, MN, USA) using an Asahi Chikai 200 cm (Asahi Intecc, Aichi, Japan) several times, but this was difficult due to obstruction, because the Spider FX was caught in the lateral wall of the origin of the ICA. An Echelon-10 microcatheter (eV3, Medtronic, Irvine, CA, USA) was passed through the lesion with a Radifocus Guide Wire GT (Terumo, Leuven, Belgium), and a spider was deployed. A Gateway 2 mm × 12 mm balloon catheter (Stryker Neurovascular, Kalamazoo, MI, USA) was pre-dilated, and a CASPER RX stent 10 mm × 20 mm (Microvention, Terumo, Tustin, CA, USA) was deployed. Posterior dilation was performed with an Rx-Genity 7 mm × 20 mm (Kaneka Inc, Osaka, Japan). Final angiography showed improvement of the stenosis and no in-stent occlusion, but slight notch formation was observed at the origin of the ICA. This was diagnosed as a dissection, but it was thought that the lesion would be treated by the stent. Since there was no significant change in the lesion on repeat imaging 5 min later, it was decided to observe it (Figure 2). After returning to the room, the patient had no problems. However, 2 h later, he developed difficulty breathing. There was subcutaneous swelling of the cervical region from the right mandible to the supraclavicular region, and stenosis of the nasopharyngeal space was observed on pharyngeal fiberscopy. It was thought that the patient had upper airway stenosis due to cervical subcutaneous swelling, so emergency intubation was performed to secure the airway. Cervical vascular echocardiography was performed, but the stenting area was poorly visualized with artifacts. After neutralizing the anticoagulant effect of heparin with protamine 50 mg, contrast-enhanced CT was performed and showed extravasation at the stenting lesion and hematoma around it (Figure 3A). The neck was immediately compressed, and angiography was performed. Contrast leakage from the origin of the ICA was seen (Figure 3B). A subcutaneous hematoma caused by intraoperative wire perforation was diagnosed, and additional local compression was considered necessary. Under X-ray, the skin directly above the area of hemorrhage was marked, and the area was compressed manually for one hour. The final angiography showed no leakage, and hemostasis was observed. Repeat angiography was performed the next day, which confirmed that there was no rebleeding (Figures 3C-3E), and the patient was extubated.

Results

The patient's respiratory condition stabilized, and he was discharged home on the 23rd day of his illness.

Discussion

Ecker et al. reported a case of bleeding from a branch of the external carotid artery after CAS [3,4]. The bleeding was caused by guidewire perforation of an artery branching from the external carotid artery or balloon dilation at the ascending pharyngeal artery. Iatrogenic perforation of a branch of the external carotid artery is a serious life-threatening complication in endovascular revascularization procedures on the carotid artery, and it is thought to occur secondarily by manipulating a wire or catheter in these small vessels. Wires are usually used to guide diagnostic catheters into the external carotid artery. To avoid arterial perforation, the surgeon must pay attention to the tip shape of the wire when accessing such distal vessels [5]. In a previous report, a wire used for navigation perforated the superior thyroid artery and caused difficulty breathing after the patient returned to the room. After performing emergency intubation, angiography showed bleeding from the same artery, and

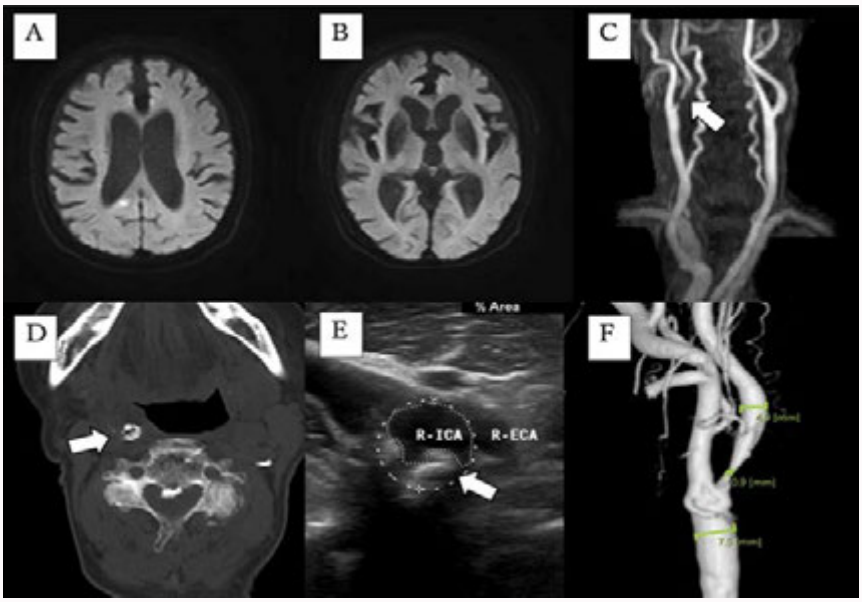

Figure 1: Imaging examination of a representative case.
The patient is an 86-year-old man who noticed dysarthria and was transported to our hospital. MRI shows cerebral infarction in the right occipital lobe and severe stenosis of the right cervical internal carotid artery. CT shows calcification of the internal carotid artery, and carotid echocardiography shows hyperintense plaques. CAS was performed on the 14th day.
A) MRI-DWI. Cerebral infarction at the right occipital lobe is observed. B) MRI-DWI. Infarction is also confirmed at the right isthmus. C) MRA. Severe stenosis is observed at the origin of the right internal carotid artery (arrow). D) Cervical CT. Calcification is observed at the right internal carotid artery (arrow). E) Carotid echocardiography. Hyperintense plaque is observed in the stenotic area. F) Cerebral angiography. Stenosis is observed. The stenosis is 80% based on the NASCET criteria.

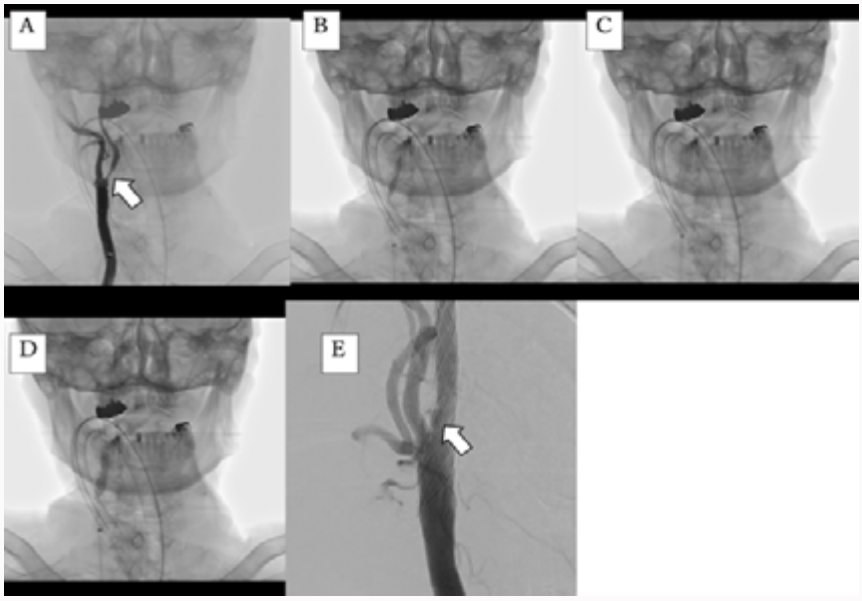

Figure 2: Intraoperative findings of CAS. A) Cervical common carotid angiography. A stenotic area is identified (arrow). B) Pre-dilatation. C) Full deployment of the CASPER stent. D) Post-dilatation. E) Postoperative angiography. Acute in-stent occlusion or plaque protrusion is not observed. Notch formation is confirmed at the bifurcation (arrow). This is suspected dissection.

Figure 3: A) Contrast-enhanced CT of the neck. Extravasation is observed at the stenting site (arrow). B) Angiography. Extravasation is observed. C) Manual compression (arrow). D) After manual compression. Obvious extravasation is not seen (arrow). E) The next day, angiography confirms hemostasis.

emergency surgery was done to remove the hematoma and ligate the superior thyroid artery [6]. In cases of bleeding distal to the external carotid artery, coil embolization is also performed [6]. Bleeding from a branch of the external carotid artery sometimes compresses the trachea and requires intubation for respiratory support. When extravasation is confirmed, it is most important to keep the patient's airway open [6]. Endovascular treatment using stents has been recently reported to be effective as an alternative to conventional surgery for perforation or rupture of the carotid artery and other neurovascular emergencies [7]. Bleeding from the ICA due to dissection after post-dilatation has been reported, and stenting has been used to treat such bleeding [2]. According to the case reports of endovascular stenting in the treatment of ICA injuries from 1994 to 2020, endovascular stenting was most frequently used for blunt mechanisms of injury (77.0%), including pseudoaneurysm (60.2%), arteriovenous fistula (16.8%), dissection (14.2%), occlusion (2.7%), intimal flap (0.9%), and aneurysm (0.9%) [8]. In this case, a stent had already been implanted in the perforated area, which means that the same treatment as in previous reports had already been performed. However, in the present case, the perforation was not treated by stenting alone. Risk factors for vascular perforation include hypertension, diabetes mellitus, chronic renal failure, and all other comorbidities that promote calcification of the ICA, which leads to increased atherosclerosis [9]. Anatomical deformities and tortuosity of blood vessels may predispose to

vascular perforation, especially when straight-tipped wires are used [9]. The modifiable and nonmodifiable risk factors for ectopic vascular complications have been reported, and the nonmodifiable factors were vascular calcification, tortuosity, severe stenosis, and advanced age [7,10]. Since the present case patient was elderly, had pre-existing hypertension and diabetes mellitus, and had calcification of the stenosed ICA, multiple risk factors for vascular perforation were observed. In addition, DAPT and antithrombotic medications such as heparin may be related to easy bleeding.

In the aforementioned case report, since bleeding from the external carotid artery caused respiratory symptoms after the patient returned to the room, a hematoma formed by bleeding from the ICA was also thought to have caused airway stenosis. In the present case, the bleeding occurred at the origin of the ICA, and since the patient had already deployed stent, it was thought that it would be difficult to stop the bleeding with the treatment methods described in previous reports [5-7], such as coil embolization and ligation. In the present case, it was possible to achieve a good outcome by performing local manual compression while confirming the bleeding point by angiography. We believe that this technique is useful because the presence or absence of extravasation can be confirmed by examination during and immediately after the compression. Although many treatments for bleeding from the ECA have been reported, bleeding from the ICA has been less frequently reported. Manual compression and hemostatic treatment of the neck may cause airway obstruction or stenosis due to compression, but in the present case, the patient was intubated to secure the airway, and thus the airway's safety was ensured. In the case of a similar procedure, it is important to intubate the patient to ensure a safe procedure.

Conclusion

Manual compression with angiography after intubation is useful in cases of intraoperative wire perforation of the ICA.

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