Elongated styloid process as a possible cause of distal carotid artery dissection using indwelling shunt: A case report

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ABSTRACT

Background: A dissection beginning from a point distal to the endpoint of the carotid endarterectomy (CEA) is called distal carotid artery dissection (CAD), which is known as one of the significant surgical complications of CEA.

Case Description: We present a case of distal CAD as a perioperative complication after CEA using indwelling shunt. We estimated this pathophysiology to be caused by the mechanical conflict of the inflated balloon with the elongated styloid process.

Conclusion: Since a distal CAD can cause severe, irreversible neurological deficits, preoperative assessment of the styloid process should be routinely performed in CEA.

Keywords: Carotid artery dissection, Carotid endarterectomy, Eagle's syndrome, Elongated styloid process

INTRODUCTION

In carotid endarterectomy (CEA), indwelling intraoperative shunt is commonly used to avoid cerebral ischemia, though the risks and benefits in applying it has long been discussed.⁶¹²¹³ A dissection beginning from a point distal to the endpoint of the endarterectomy is called distal carotid artery dissection (CAD), which is known as one of the significant surgical complications of CEA.⁹¹⁰¹⁶

Vascular Eagle syndrome is a rare condition caused by extra-arterial stress from an elongated styloid process or a calcified styloid ligament and leads to transient ischemic attacks, cerebral ischemia, or CAD.⁴⁵¹¹

Here, we present a case of distal CAD as a perioperative complication after CEA using indwelling shunt, which appears to be caused by an extended styloid process.
CASE DESCRIPTION

A 69-year-old male developed gradual right hand weakness and dysarthria. He had a medical history of hypertension. Brain magnetic resonance imaging (MRI) demonstrated an acute watershed infarction in the left hemisphere. Carotid MRI and computed tomography (CT) angiography confirmed severe stenosis with marked calcification [Figure 1a]. We planned to perform CEA under the administration of aspirin.

We performed CEA under general anesthesia with intraoperative somatosensory evoked potential monitoring, which is a standard practice at our institution. The neck was hyperextended, slightly tilted to the right. As the cerebral cross flow during carotid clamping was suspected to be low, we placed an indwelling arterial shunt (Furui’s Double-Balloon Internal Shunt system, Inter Medical, Aichi, Japan). The shunt was inserted smoothly, the balloon was inflated with 0.4 ml saline and after placement, the patency of the shunt was confirmed. Endarterectomy was completed, and as the distal end of the plaque was smoothly resected, we did not add a tacking suture [Figure 1b]. The arteriotomy was primarily closed with 6-0 Prolene (Ethicon, N], USA).

Postoperatively, no neurological deficit was observed. No new cerebral infarction was confirmed by brain MRI on postoperative day (POD) 1 [Figure 1c]. However, on POD 7, the patient suddenly developed dysarthria and right-sided hemiparesis. Brain MRI showed acute infarction at the left posterior limb of internal capsule [Figure 1d]. The operated segment of the carotid artery was patent without stenosis on CT angiography, while severe stenosis of the left ICA was observed starting 2.5 cm apart from the endpoint of endarterectomy, which suggested postoperative distal CAD [Figure 2a]. The left styloid process was elongated and the height of its tip coincided with the beginning of the dissection. On the axial image, the tip of the elongated styloid process was adjacent to the ICA [Figure 2b]. Carotid artery angiography confirmed distal CAD, which extended about 3 cm distally [Figure 2c]. As the distal portion of the CAD extended over the Blaisdell’s line, we performed carotid artery stenting (CAS). We first placed the Carotid WALLSTENT (Boston Scientific, Natick, MA, USA), measuring 8 × 29 mm, to cover the lesion. As the distal half of the stent was insufficiently expanded, we added Enterprise...
VRD (Codman Neurovascular, Raynham, MA, USA), an intracranial stent measuring 4.0 × 39 mm, to overlap the advanced lesion. Anterograde blood flow was ensured after the second stent placement [Figure 2d].

Dysarthria and right-sided hemiplegia improved after the operation and the postoperative course was uneventful. By dynamic assessment with CT for exploration of the pathogenesis, we reproducibly confirmed the tip of the styloid process approaching toward the ICA by moving the head from the neutral neck position to the extended position [Figures 3a and b]. The patient was discharged home without any deficit.

Patient consent was obtained. IRB/Ethics Committee review/approval is not required.

DISCUSSION

CAD is a rare but well-known complication of CEA, which occurs due to intimal flap detachment at the distal end of the endarterectomy.\(^1\) However, only four cases of distal CAD due to an indwelling shunt have been reported.\(^9,10,16\)

In our case, CAD started at the tip of the elongated styloid process apart from the distal end of the endarterectomy, which coincided to the site where the balloon of the shunt was inflated. We estimated this pathophysiology to be caused by the mechanical conflict of the inflated balloon with the elongated styloid process, an etiology similar to that in the vascular Eagle syndrome.\(^10\)

While indwelling shunt placement is helpful in performing safe manipulation in low ischemic tolerance cases, few severe surgical complications such as common CAD, traumatic ICA aneurysm, and distal ICA rupture have been reported.\(^3,8,15,17\) To prevent surgical complications, a proper maneuver should be used for shunt placement.\(^2,6\)

All operations with reported distal CAD were performed in institutions with extensive experience of indwelling shunts, and the operators reported flawless procedures of shunt placement before the complication, which was not different from our present case.

In a previous case report of vascular Eagle syndrome, Farhat et al. performed a dynamic angiography, which showed focal flow restriction on turning the head to the left, a position that habitually led to a transient ischemic attack. (Farhat) We confirmed the tip of the styloid process reaching toward the ICA by turning the neck from neutral to extended position in postoperative evaluation [Figures 3a and b]. Hence, the neck extension might have also contributed to the conflict of the styloid process and the shunt balloon.

Since the lesion was apart from the distal end of endarterectomy, and extended distal to the Blaisdell’s line, we selected CAS rather than open exploration. There have been reports of CAS for CAD after CEA, in which normal anterograde blood flow was recovered, although the stent deployment is not so easy as it is difficult to identify the correct lumen.\(^1\)

There are two reported cases with late complications after CAS for vascular Eagle syndrome – a stent fracture and intrastent thrombosis.\(^7,14\) Therefore, we should carefully follow-up this patient.

An elongated styloid process may be a risk factor for surgical complication after CEA using an indwelling shunt, we should assess its length and position preoperatively. If an elongated styloid process is detected, the necessity of shunt placement should be discussed and a hyperextended neck position might be avoided to prevent CAD. As styloidectomy can be performed through the same exposure with slight extension of the standard longitudinal incision parallel to the anterior border of the sternocleidomastoid muscle, it might be considered as an option when performing CEA.

CONCLUSION

A case of distal CAD after CEA due to indwelling shunt and elongated styloid process was observed and analyzed. Since a distal CAD can cause severe, irreversible neurological deficits, preoperative assessment of the styloid process should be routinely performed in CEA.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

Figure 3: (a) Computed tomography (CT) shows that the tip of the styloid process (arrow) apart from the internal carotid artery (ICA) (represented by the cross section of the stent) in neutral neck position. (b) Dynamic CT shows that the tip of the styloid process (arrow) comes close to the ICA by neck extension.
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How to cite this article: Suzuki T, Kimura T, Hasegawa H, Irie K, Hong S, Karagiozov K, et al. Elongated styloid process as a possible cause of distal carotid artery dissection after carotid endarterectomy using indwelling shunt: A case report. Surg Neurol Int 2022;13:101.