

Stent Graft Repair of Penetrated Injury of the Common Carotid Artery

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Penetrated injury of common carotid artery (CCA) is rare and extremely lethal. Carotid artery injury tends to bleed actively and potentially occlude the trachea. It can cause fatal neurological complications. An accurate diagnosis and adequate treatment are very needed to the successful outcome of the penetrating vascular injury in zone 1, 2, and 3 of the neck. Open surgical treatment is more invasive and complicated than endovascular treatment. We experienced a case with penetrating injury in neck zone 2. Here, we report the case successfully treated with endovascular stent graft technique. [J Trauma Inj 2016; 29: 172-175]

Key Words: Neck trauma, Endovascular stent graft, Common carotid artery injury

I. Introduction

Neck is a so bridge connecting a head and body. In the neck, there are many important structures, such as trachea, esophagus, large vessels, nervous system, cervical spine, endocrine systems, etc. A penetrating trauma in the neck can cause death and critical complications. Among the neck injuries, a carotid artery injury occurs acute and large bleeding which cannot maintain the blood pressure. And it can cause large hematoma to compress the trachea, meaning asphyxia. Immediate diagnosis and proper treatment of the carotid artery injury is essential for survival.(1)

The neck is divided into three distinct zones commonly. Three zones facilitate initial assessment and management based on surgical exploration and hemorrhage control. In Zone 1 and 3, the direct control of injured vessels is difficult, and so angiography should

be performed in cases of penetrating injury.(2) In Zone 2, the proximal and distal control of the penetrated vessels can be easily achieved, so preoperative angiography is not usually performed. But, external penetrated wound according to the zone of neck cannot provide the exact damage of the internal organ of neck. We treated the patient who had penetrating injury of the common carotid artery in Zone 2 by inserting an endovascular stent graft in an urgent interventional angiography. Here, we report the case.

II. Case Report

A 52-year-old woman was brought to the emergency department with stab wound on her left neck. She had been previously diagnosed with alcoholic dementia and depression and taken regular medica-

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tion to treat the disease. She suspiciously attempted suicide with self-inflicted utility knife injury to the neck. She was stuporous mental state, and large bleeding from neck wound. Her blood pressure was 90/70 mmHg with neck compression, but no compression, blood pressure fell down to 40 mmHg. At the time of the patient's visit, her hemoglobin level was measured at



Fig. 1. Angiography showing a large and active contrast media leakage at the common carotid artery.

8,6 g/dl, 30 minutes later, followed up hemoglobin level was 5,7 g/dl. Continuous manual compression of her neck was the risk of asphyxia. Immediate intubation and central catheterization was done with continuous manual compression of left neck. Fluid resuscitation and emergent transfusion was started but active bleeding was continued. There was no time to computed tomography examination, we decided to do the angiography and interventional treatment, if it could. She was brought to angiographic room, and monitored the vital signs. We used local anesthesia to monitor the neurological status of the patient. The right femoral artery was punctured and 4F sheath was placed into the femoral artery to introduce a diagnostic Head-hunter (JSM Angio Catheter) catheter. The presence of contrast leakage was confirmed in the Lt. common carotid artery, which was 3 cm inferior to the angle of the mandible (Fig. 1). A stent graft (GORE® VIABAHN® Endoprosthesis; length 100 mm; diameter 6,6–7,5 mm; W.L. Gore & Associates, INC. USA.) was inserted (Fig. 2). Follow-up angiography showed no more contrast media leakage (Fig. 2). The patient's vital sign was stabilized. Thereafter, with the patient under general anesthesia, the neck laceration site was explored. The laceration wound was 3 cm sized, located 3 cm laterally from mid-trachea, longitudinal shape. We extended the wound about 2 cm, explored



Fig. 2. Viabahn stent graft is deployed at the common carotid artery (A), follow-up angiogram showing no more contrast media leakage (B).



Fig. 3. Surveillance CT scan on the next day of admission.

the wound. The hematoma removed, depth of the wound was about 4 cm. Pre-tracheal ligament was torn, but trachea was intact. Lt. thyroid gland was injured, then the bleeding was controlled with electrocauterization and compression. Another injury was not found. On the next day of admission, CT angiography was performed, the stent was well maintained without any contrast media leakage (Fig. 3). She was discharged home 10 days later without neurological deficits and any other complications. She was followed for 2 years with dual anti-platelet drug therapy with aspirin (100 mg daily) plus clopidogrel (75 mg daily), experienced no complications.

III. Discussion

The neck is one of the most important anatomic area which has high density of vital organ and structures. Penetrating trauma to the neck can cause potentially life-threatening complications. Appropriate and timely management of the neck injuries is critical.

Neck trauma is divided into three anatomical zones,

Zone 1 is defined inferiorly by clavicle, sterna notch and superiorly by cricoids cartilage. Vascular injury management of Zone 1 is very difficult, because surgical access to Zone 1 may require sternotomy or thoracotomy to control the bleeding. Zone 2 is the middle anatomic zone, defined inferiorly by cricoids cartilage and superiorly by the angle of the mandible. Zone 2 is most common site of multiple injuries,(3,4) and most commonly injured structures in the neck are the vessels.(4,5) This zone provides straightforward surgical access, control of the proximal and distal injured vessel is easily approached. Zone 3, the most cephalic anatomic zone, lies between the angle of the mandible and skull base. Surgical access to Zone 3 is difficult because of craniofacial skeleton. Zone 3 may require craniotomy or mandibulotomy, it is not easy to access the bleeding site because of the narrowing view. In Zone 1 and 3, the direct control of injured vessels is difficult, and angiography should be performed in cases of penetrating injury. In Zone 2, the proximal and distal control of the penetrated vessels can be easily achieved, so preoperative angiography is not usually performed. However, in cases of injury, the external neck injury may be different from the internal damages. In other words, the external wound might be in one zone, but internal damage could be in another zones. If a vascular neck injury is suspected even in zone 2, angiography should be performed to ensure the diagnosis and the strategy of treatment.

Endovascular treatment is less invasive approach than open surgery. Open surgery for carotid arterial injury is reconstruction which includes interposition graft, patch angioplasty and extracranial-intracranial bypass. Surgical approach for carotid arterial injury needs the proximal and distal vascular access, it means the incision is extended. And open surgery involves a relatively high stroke risk and mortality rate of 9%.(6) Cranial nerves injuries occurred in 2,2-2,4%. Otherwise, endovascular treatment does not require the additional incisions and vascular clamp.

Endovascular treatment is a useful tools for accurate diagnosis and consecutive treatment. In our case, the carotid arterial injury was diagnosed by angiography, and endovascular stent graft treatment was performed continuously. Our trauma center has the hybrid oper-

ating room, in there, the patients can have the radiologic diagnosis and treatment, also surgical treatment consecutively. Her injury of carotid artery was found by angiography, and then treated by endovascular stent graft, continuously received the surgical exploration. The surgical exploration has several benefits after radiologic intervention. Surgical field is more clear, because massive hemorrhage is controlled, and compression is no more needed. Proper incision can be performed, additional incision for proximal and distal vascular control is not necessary. It could be lower the wound infection rate, and cerebral infarction caused by compressing and cross-clamping of carotid artery. The patient's vital sign is more stabilized before surgical exploration. In our case, endovascular stent graft was applied fortunately. However, in some cases, endovascular treatment is unavailable, depending on the status of the vascular injury. But angiographic diagnosis is very helpful decision making, what to do the next. Surgical treatment could be the next plan.

There was still controversy on adjuvant anti-coagulation/anti-platelet after endovascular treatment. According to 2011 Guideline on the management of patients with extracranial carotid and vertebral artery disease, recommendation for management of patients undergoing carotid artery stenting is dual anti-platelet therapy with aspirin and clopidogrel (Class I, level of Evidence C).(8) It recommends using the medications before and after carotid artery stenting. But it is not for traumatic patients, preoperative anti-platelet is usually unnecessary. We used the dual anti-platelet therapy only postoperatively. Yuk Law et al recommended a period of dual anti-platelets and life-long clopidogrel after stent graft placement.(9)

IV. Conclusion

Penetrating injury of common carotid artery is very rare and extremely lethal. Fast and exact diagnosis

is very needed, and so thus the perfect treatment. Angiography suggests the accurate diagnosis and the next treatment of options even in zone 2. Endovascular stent graft is less invasive than surgery. And it has several benefits for consecutive surgical procedure. Angiography and endovascular stent graft technique should be considered in cases which suspects large vessel injury of any zone of neck.

REFERENCES

- 1) Kim JP, Kim JW, Ahn SK, Jeon SY. A case of the zone III neck injury by impalement of a metal stick. *Korean J Otolaryngol-Head Neck Surg* 2003; 46: 610-2.
- 2) Siegrist B, Steeb G. Penetrating neck injuries. *South Med J* 2000; 93: 567-70.
- 3) Bumpous JM, Whitt PD, Ganzel TM, McClane SD. Penetrating injuries of the visceral compartment of the neck. *Am J Otolaryngol* 2000; 21: 190-4.
- 4) Mahmoodie M, Sanei B, Mozaeni M, Namgar M. Penetrating neck trauma : Review of 192 cases. *Arch Trauma Res* 2012; 1: 14-8.
- 5) Sriussadaporn S, Pak-Art R, Tharavej C, Sirichindakul B, Chiamanathapong S. Selective management of penetrating neck injuries based on clinical presentations is safe and practical. *Int Surg* 2001; 86: 90-3.
- 6) El-Sabrou R, Cooley DA. Extracranial carotid artery aneurysms: Texas Heart Institute experience. *J Vasc Surg* 2000; 31: 702-12.
- 7) Alaraj A, Wallace A, Amin-Hanjani S, Charbel FT, Aletich V. Endovascular implantation of covered stents in the extracranial carotid and vertebral arteries: Case series and review of the literature. *Surg Neurol Int* 2011; 2: 6.
- 8) Thomas G. Brott, MD, Jonathan L. Halperin, MD, Suhny Abbara, MD, J. Michael Bacharach, MD, John D. Barr, MD, Ruth L. Bush, MD, et al. 2011 ASA/ ACCF/AHA/AANN/AANS/ACR/CNS/SAIP/SCAI/SIR/SNIS/SVM/SVS Guideline on the management of patients with extracranial carotid and vertebral artery disease. *Circulation* 2011; 124: 489-532.
- 9) Yuk Law, Yiu Che Chan, Stephen W. Cheng. Endovascular repair of giant traumatic pseudoaneurysm of the common carotid artery. *World J Emerg Med* 2015; 6: 229-32.