



CASE REPORT

A case of penetrating neck injury in zone II treated with combined endovascular and surgical management

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Abstract

Background: We report a case of zone II penetrating neck trauma with active bleeding in which endovascular treatment was performed prior to neck exploration to identify and control the bleeding point.

Case Presentation: A man in his 50s presented to our emergency department in hemorrhagic shock stemming from a penetrating knife wound injury to the right side of his neck. He was bleeding massively from the right neck wound and oral cavity. Cervical angiography showed bleeding from the right external carotid artery and intimal injury to the right internal carotid artery. Balloon occlusion at the common carotid artery origin and distal to the injured internal carotid artery controlled active bleeding. During vascular balloon occlusion, definitive hemostatic treatment was achieved through ligation of the proximal external carotid artery.

Conclusion: Neck exploration combined with endovascular treatment may be one option as a treatment strategy for patients with zone II penetrating neck injury.

KEYWORDS

endovascular management, hard sign, neck exploration, penetrating neck injury, zone II

INTRODUCTION

Management for penetrating neck injury (PNI) is based on an anatomic zone-based classification.^{1,2} Immediate neck exploration is necessary for patients with hemodynamically unstable PNI, irrespective of the zone. However, neck exploration can be challenging when there is active bleeding in the surgical field, and controlling bleeding through surgical procedures alone may prove impossible.

Endovascular management benefits hemodynamically stable patients with zone I and zone III PNI.¹ However, the usefulness of endovascular treatment for zone II PNI (between the cricoid cartilage and the angle of the mandible) remains unclear. We report a case of a hemodynamically unstable zone II PNI with hard signs in which bleeding was successfully controlled using a combination of endovascular treatment and neck exploration.

CASE PRESENTATION

A man in his 50s was brought to the emergency department in shock due to a self-inflicted PNI with a kitchen knife having a blade length of 12 cm and the knife already removed. The patient's vital signs on arrival were as follows: level of consciousness by Glasgow Coma Scale (GCS) E1V1M4, oxygen saturation 96% on 15 L/min of oxygen by mask, respiratory rate 20/min, blood pressure measurement not measurable (slightly palpable pulse in the radial artery), pulse rate 135 beats/min, and body temperature 37.0°C.

He had a 7-cm stab wound in zone II on the right side of his neck with active bleeding from the wound and oral and nasal cavities. Emergency cricothyrotomy was performed to maintain his airway, and systolic blood pressure temporarily increased to about 100 mmHg with manual compression of the wound and massive blood transfusion. Due to severe

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bleeding from the vascular injury into the cervical wound and oral cavity, identifying the bleeding vessel and performing hemostatic procedures was challenging. We also considered the possibility of zone III PNI. Therefore, we decided to perform neck angiography before neck exploration.

Neck angiography revealed bleeding from the origin of the right external carotid artery and irregularity of the arterial lumen with >25% narrowing of the right internal carotid artery (Figure 1). Both vascular injuries were located in zone II, close to the boundary between zones II and III. A balloon test occlusion was performed to confirm that right cerebral blood flow was visible from the contralateral internal carotid artery and posterior communicating artery. Endovascular balloon occlusion of the internal carotid artery and common carotid artery allowed control of bleeding from the wound (Figure 1).

Following bleeding control with endovascular balloon occlusion, neck exploration was performed, and the transected origin of the external carotid artery was ligated for complete hemostasis. Total balloon occlusion time was 38 min, including the time for the balloon test occlusion. Additionally, neck exploration revealed a laryngeal injury, which was repaired with sutures (Figure 2). The total blood transfusion volume was 26 units of red cell concentrates, 34 units of fresh frozen plasma, and 20 units of platelet concentrates.

The patient was weaned from mechanical ventilation on day 6 after admission. His level of consciousness had

improved to GCS E4V5M6, and he had mild left upper and lower extremity paralysis. The injury portion of the right internal carotid artery was repaired with a carotid artery stent on day 7 after admission under the administration of an antiplatelet agent (Figure 1). Head magnetic resonance imaging on day 8 showed a scattered acute cerebral infarct pattern in the right cerebral hemisphere (Figure 3).

He was diagnosed as having schizophrenia after admission and transferred to the psychiatric department for inpatient treatment on day 22. On day 109, he was discharged home with left upper limb paralysis with manual muscle test grade 4 and mild sensor dysfunction.

DISCUSSION

This report presents a patient who successfully stopped the bleeding and saved the patient's life for a zone II PNI with endovascular balloon occlusion prior to neck exploration. Management of PNI is categorized by each of the three anatomic zones.¹ Emergent neck exploration is the first priority treatment strategy for all hemodynamically unstable PNI patients with hard signs such as airway compromise, active bleeding, and hemorrhagic shock as seen in the present case.

Endovascular procedures are typically recommended only for patients with hemodynamically stable zone I and III PNIs, whereas neck exploration is generally recommended

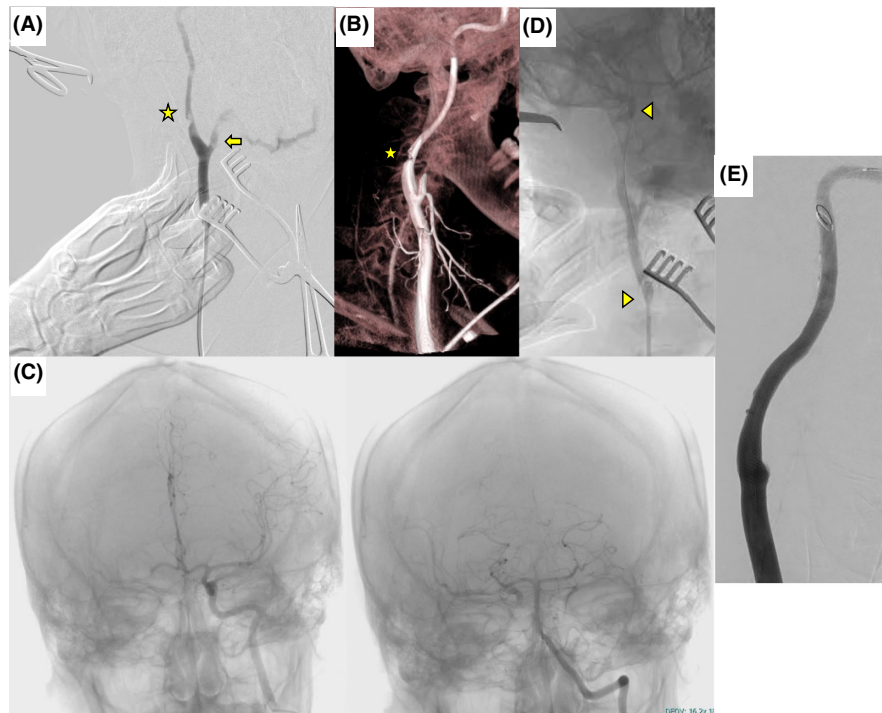


FIGURE 1 Angiographic views. (A) Neck angiography revealed bleeding from the origin of the right external carotid artery (arrow) and irregularity of the arterial lumen with >25% narrowing of the right internal carotid artery (star). (B) Three-dimensional digital subtraction angiography after ligation of the right external carotid artery. (C) Collateral circulation from the anterior communicating artery and posterior communicating artery was confirmed by left common carotid artery angiography and left vertebral artery angiography. (D) Successful control of bleeding from the external carotid artery by endovascular balloon occlusion of the common and internal carotid arteries (arrowhead). (E) The traumatic dissection of the right internal carotid artery was repaired with a carotid artery stent on day 7 after admission.

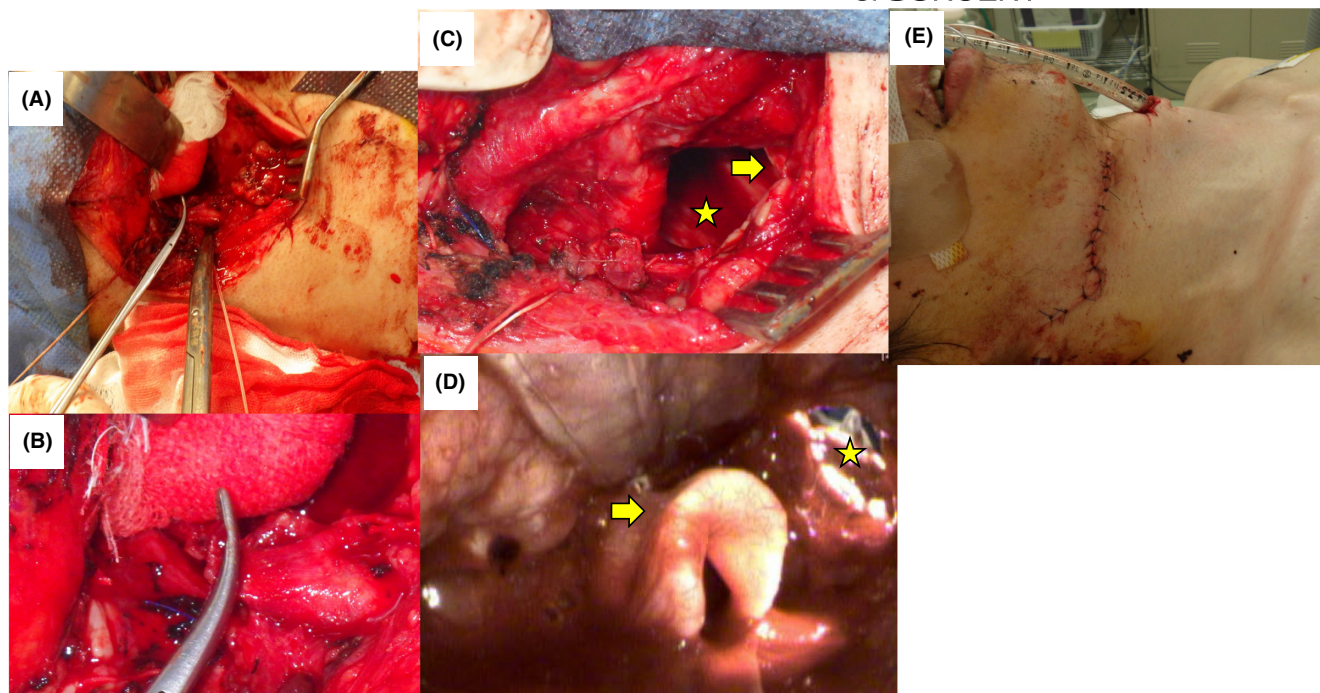


FIGURE 2 Wound on the right neck. (A) Hemostasis of the right external carotid artery origin with forceps. (B) Enlarged right external carotid artery origin in (A). (C) The wound on the right neck extended to the larynx (star). The epiglottis (arrow) is visible through the wound. (D) Wound viewed from laryngeal side. The epiglottis is visible in the center (arrow). The right wall of the larynx is injured and open to the outside of the wound (star). (E) Suturing and closure of the wound.

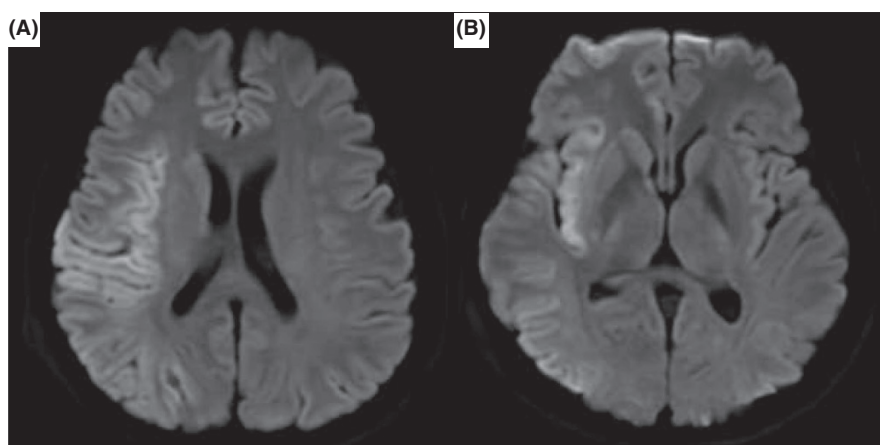


FIGURE 3 MRI views. (A, B) Head MRI on day 8 showed a scattered acute cerebral infarct pattern in the right cerebral hemisphere.

for hemodynamically stable zone II PNI patients. In patients with hemodynamically stable PNI, evaluation with computed tomography angiography (CTA) is recommended, and treatment management should be considered for each zone. CTA has been reported to be useful for identifying the injured vessel³ and avoiding unnecessary neck exploration.⁴ In our case, massive bleeding from the wound and overflow into the oral cavity made it difficult to identify the bleeding vessel and control the bleeding through neck exploration alone. Performing CTA prior to neck exploration was also challenging because manual compression hemostasis could not be released. Therefore, we decided to perform angiography prior to neck exploration to identify the injured vessels

and implement temporary intravascular balloon occlusion. This strategy proved effective and allowed for appropriate hemostatic procedures.

Kaslow et al. reported a case of zone II PNI in a patient who was managed with endovascular treatment alone for an internal carotid artery injury.⁵ The strategy of performing cervical angiography prior to neck exploration may be a useful treatment option for some zone II patients with massive bleeding.

Our patient was complicated with sporadic right cerebral infarctions that resulted in left hemiparesis. Possible causes of cerebral infarction include reduced blood flow due to manual neck compression and balloon occlusion or

artery-to-artery embolization from the stenotic site caused by the internal carotid artery injury. Although tolerance to cerebral ischemia caused by internal carotid artery occlusion varies from person to person, the occlusion time in balloon test occlusion is typically 20–30 min,^{6,7} and the 38-min occlusion time in our case is rather long. Maintaining cerebral blood flow is a critical concern for PNI patients, especially when endovascular procedures are performed. Ensuring adequate cerebral perfusion is essential to prevent ischemic complications.

Intravascular occlusion using endovascular devices in patients with PNI is a high-risk treatment for large cerebral infarctions. This procedure should not be undertaken lightly, especially when lower-risk hemostatic options are available or when the physician lacks sufficient experience.

CONCLUSION

We reported a case of zone II PNI with massive bleeding in which hemostasis was safely achieved using endovascular treatment prior to neck exploration. Even in zone II PNI with hard signs, a strategy of performing endovascular procedures prior to neck exploration may be a viable treatment option.

CONFLICT OF INTEREST STATEMENT

Dr. Jun Oda is the Editor-in-Chief of the journal and the co-author of this article. They were excluded from the peer-review process and all editorial decisions related to the acceptance and publication of this article. Peer review was handled independently by AMS Journal editorial office and Dr. Kuwagata as the Editor to minimize bias.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ETHICS STATEMENT

Approval of the research protocol: N/A.

Informed consent: Informed consent was obtained from the patient's family.

Registry and the registration no. of the study/trial: N/A.

Animal studies: N/A.

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