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CASE REPORT

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Surgical strategy for airway management and bleeding control in penetrating neck injury in zone II: A case report

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Abstract

We report the case of a 33-year-old man with a self-inflicted neck wound with severe hypopharynx injury, and hemorrhagic shock, which was well managed by a trauma surgeon trained in esophageal surgery. Training in cervical lymph node dissection for esophageal cancer could be useful in the management of penetrating neck injuries.

KEYWORDS

hypopharyngeal injury, laryngopharyngeal repair, neck trauma, penetrating neck injury, zone II

1 | INTRODUCTION

Penetrating neck injuries account for 5%–10% of all trauma cases in the United States,[1] and their mortality rate is reported to be as high as 10%.[2] The most common mechanism of injury worldwide is a stab wound from a violent assault, followed by gunshot wounds, self-harm, road traffic accidents, and other high-velocity objects.[3,4] Difficulties in the evaluation and management of penetrating neck injuries are due to the complicated anatomy of the area, in which dense concentrations of the vital vascular, aerodigestive, and nervous systems are located in a very small space.[1,4–6] Although knowledge of the anatomy and function of the neck is essential for appropriate physical assessment and diagnostic and therapeutic interventions for neck injuries, the number of cervical operations required for 5 years of surgical training is 25 in the United States, whereas it is only 10 in Japan. While it is difficult to experience a sufficient number of cases of penetrating neck injuries, expeditious decision-making is often required to prevent catastrophic airway, vascular, or neurologic sequelae.[4] Herein, we report a case of penetrating neck injury that was successfully managed using knowledge of esophageal surgery.

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2 | CASE REPORT

A 33-year-old male called the police and suggested committing suicide, and later cut his neck with a kitchen knife in front of a police officer. When emergency medical service personnel arrived, the patient was seized by police officers. The cut wound on his neck was more than 20 cm in length and the glottis could be observed directly through the wound; moreover, his blood pressure was unmeasurable. Therefore, compression was applied to the neck wound, and the patient was rushed to our emergency room.

On arrival at the hospital, his Glasgow Coma Scale score was E4V1M4, heart rate was 160 bpm, blood pressure was unmeasurable, and peripheral oxygen saturation was 40% while using a reservoir mask with 10 L of oxygen. On visual examination, a transverse cut of approximately 20 cm in length was observed on the caudal side of the hyoid bone. The posterior wall of the hypopharynx was exposed and the epiglottis was visible. The right and left sternocleidomastoid muscles were partially transected, with a large volume of blood clots on the right side of the neck and persistent arterial and venous bleeding.

Tracheal intubation was performed through the wound, with consideration to the posterior wall of the hypopharynx, and cricoid cartilage. The laboratory data obtained immediately after intubation are shown in Table 1. Arterial blood gas analysis revealed severe lactic acidosis suggesting critical circulatory failure. Hence, immediate hemostatic surgery was initiated simultaneously while preparing transfusion products according to the massive transfusion protocol. Although it was challenging to determine the normal anatomy due to massive bleeding and clots, we were able to achieve temporary hemostasis with mosquito forceps because the bleeding was not from the main trunk of the right common or internal carotid artery (Figure 1). Afterward, a tracheotomy was performed between the third and fourth tracheal rings before definitive hemostasis could be attained. After removal of the intubation tube inserted from the wound (Figure 2), the right common carotid artery, right internal carotid artery, right external carotid artery, and right internal jugular vein were secured with vascular tape, being careful not to injure the right vagus nerve. The bleeding vessels were then identified; the right lingual artery, right facial artery, and veins were considered the right common facial vein, right external jugular vein, and right superior thyroid vein, respectively (Figure 3). All vessels were ligated with the assumption that there would be no functional problems after ligation. Additionally, the right submandibular and parotid glands were ligated to achieve hemostasis. However, the right hypoglossal nerve could not be identified. After hemostasis was achieved, the mucosa of the hypopharynx was ligated and sutured; the hypoglossal muscle group was also sutured to repair the pharynx (Figure 4). These decision-making and procedures were provided by a trauma surgeon trained in esophageal surgery. Although understanding the anatomy was quite difficult due to massive hemorrhage and hematoma, using the knowledge of cervical lymph node dissection in esophageal surgery, identification of the injured vessels could be achieved promptly. Furthermore, hypopharynx was successfully repaired using the knowledge of total pharyngo–laryngo–cervical esophagectomy reconstruction in esophageal surgery. The operation time was 2 h and 3 min with a total blood loss of 5000 g. A total of 4 and 8 units of red cell concentrate (RCC) and fresh frozen plasma (FFP), respectively, were transfused. A full-body

TABLE 1 Laboratory data after intubation in the emergency room.

Complete blood count data		**Biochemistry data**	
WBC	7800/μl	T-Bil	1.33 mg/dl
Seg	69.1%	D-Bil	0.21 mg/dl
Eo	0.1%	ALP	67IU
Baso	0.3%	AST	30IU
Mono	6.7%	ALT	84IU
Lymph	23.8%	LDH	219IU
RBC	386×10^4/μl	Γ-GTP	47IU
Hb	12.1 g/dl	CPK	293IU
Hct	35.7%	BUN	8.7 mg/dl
PLT	30.8×10^4/μl	Cre	1.48 mg/dl
		Na	137 mEq/l
		Cl	95 mEq/l
		K	4.1 mEq/l
		Alb	4.1 g/dl
		CRP	0.18 mg/dl
Coagulation data		**Arterial blood gas values**	
PT(%)	83%	pH	7.166
PT-INR	1.12 mg/dl	pCO2	39.1 mmHg
APTT	23.3 sec	pO2	417.1 mmHg
Fibrinogen	260 mg/dl	HCO_3^-	13.8 mmol/l
D-dimer	2.6 μg/ml	B.E	-13.8 mmol/l
		Lactate	9.5 mmol/l

Abbreviations: APTT, Activated partial thromboplastin time; ALT, Alanine aminotransferase; Alb, Albumin; ALP, Alkaline phosphatase; AST, Aspartate aminotransferase; B.E, Base excess; Baso, Basophil; BUN, Blood urea nitrogen; CRP, C-reactive protein; CPK, Creatine phosphokinase; Cre, Creatinine; D-Bil, Direct- Bilirubin; Eo, Eosinophil; Hct, Hematocrit; Hb, Hemoglobin; LDH, lactate dehydrogenase; Lymph, lLymphocytes; Mono, Monocyte; PLT, Platelet; PT-INR, Prothrombin Time-International Normalized Ratio; PT, Prothrombin Ttime; RBC, Red blood cell; seg, Segment cell; T-Bil, Total-Bilirubin; WBC, White blood cell; Γ-GTP, γ-Glutamyl transpeptidase.

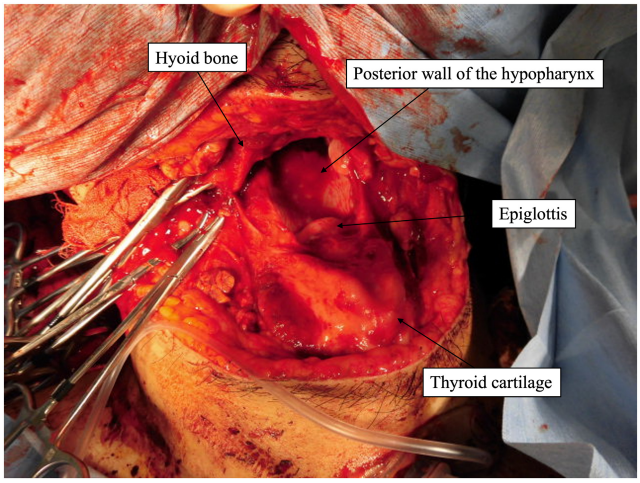

FIGURE 1 Neck wound after tracheostomy and temporary hemostasis using a mosquito pean. The posterior wall of the hypopharynx is recognized and the epiglottis can be observed. The top image shows the cephalic side, and the bottom image shows the caudal side.

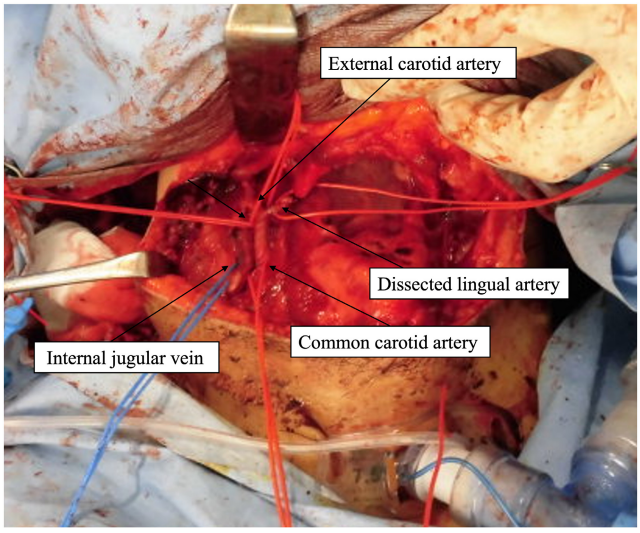

FIGURE 2 Using vascular tape, the right internal carotid artery, external carotid artery, common carotid artery, and right internal jugular artery were secured. The top of the image shows the cephalic side, and the bottom shows the caudal side.

contrast-enhanced CT scan confirmed that the neck injury site was hemostatic and there were no other organ injuries. Afterward, the patient was admitted to the intensive care unit (ICU).

On postoperative day (POD) 8, a CT scan showed no evidence of abscess formation in the neck; therefore, the right side neck drain was removed. On POD 15, swallow angiography was performed, which revealed no leakages (Figure 5). Afterward, swallowing rehabilitation was initiated. Although swallowing rehabilitation was continued, a laryngeal fiberoptic examination was performed because the dysphagia persisted. Since the cough and swallowing reflexes were weak, oral intake was judged to be difficult, and gastrostomy was placed on POD 72. Finally, the patient was transferred to a psychiatric hospital 180 days after surgery. 1 year and 4 months after being discharged from the hospital, swallowing was possible, and speech had improved to a satisfactory level.

3 | DISCUSSION

Herein, we reported a case of penetrating neck injury that was managed by applying the knowledge and the skill of esophageal cancer surgery training.

Penetrating neck injuries are usually described in terms of their location in one of the three anatomical zones, as described by Monson (Figure 6).[1,7–10] In the case presented in this report, the patient had a zone II penetrating neck injury with shock, persistent bleeding, and airway emergencies. In this case, airway management and hemorrhage control were feasible with rapid airway clearance, and identification and ligation of blood vessels. In addition, the larynx was dissected and the posterior wall of the hypopharynx required repair. However, postoperatively, the patient's swallowing function declined, necessitating the creation of a gastrostomy. Although the cause was unclear, the shape and height of the wound did not indicate damage to the recurrent laryngeal nerve, but the right superior laryngeal and right hypoglossal nerves may have been transected. The lingual pterygoid, hyoid, and supratrochlear muscles were also transected, suggesting impaired swallowing coordination, which may have been one of the causes of this patient's ongoing dysphagia.

The neck is anatomically complex and is generally managed by head and neck surgeons and otolaryngologists during a scheduled surgery. However, since there are often cases of penetrating cervical injury that require urgent airway management, hemostasis, and laryngeal repair, trauma surgeons should also be familiar with the anatomy and treatment strategy. In the United States, the 5-year surgical training requires a resident to possess experience as an operating surgeon or first assistant in 850 cases. Of these, 25 cases must be performed on the neck; tracheostomy, thyroid surgery, and vascular surgery of the neck are common procedures for many residents. Furthermore, surgical training in the United States does not include training in otorhinolaryngology or head and neck surgery. Similarly, in Japan, 320 cases are required in the 5-year surgical training program, irrespective of whether the resident is an operating surgeon or a first assistant. Only 120 cases should be performed as an operator. Furthermore, the required number of experienced surgeries for cervical cases is only 10, and, in these cases, being the operator or assistant is not relevant. Thus, Japanese

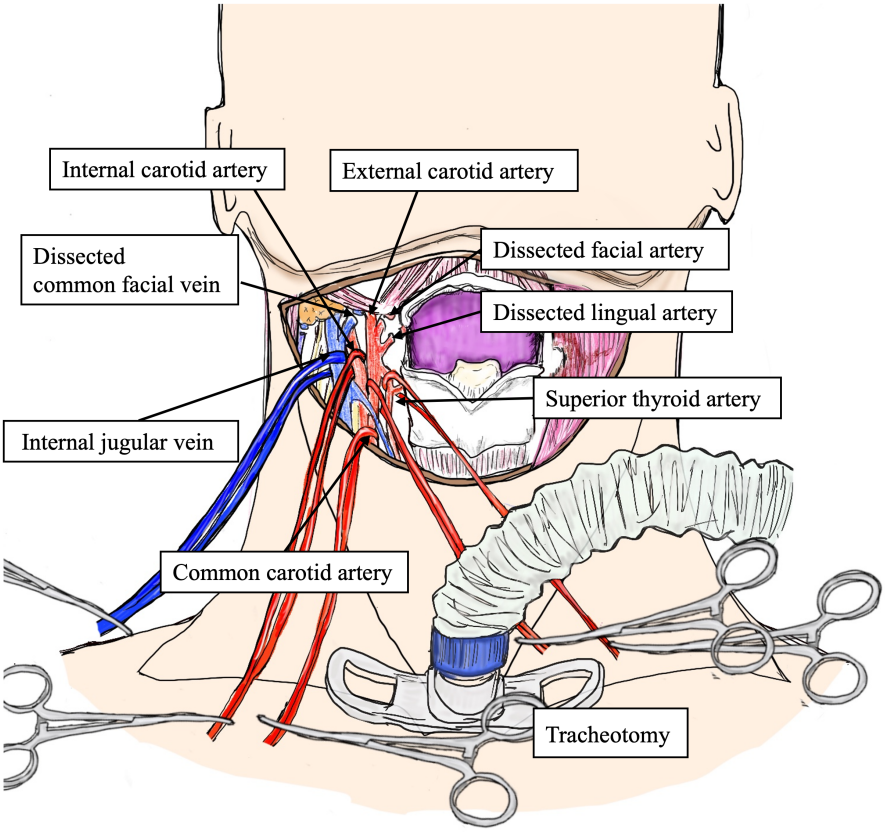

FIGURE 3 This illustration is presented for depicting the major blood vessels that were secured and those that had been dissected. The top of the image shows the cephalic side, and the bottom shows the caudal side.

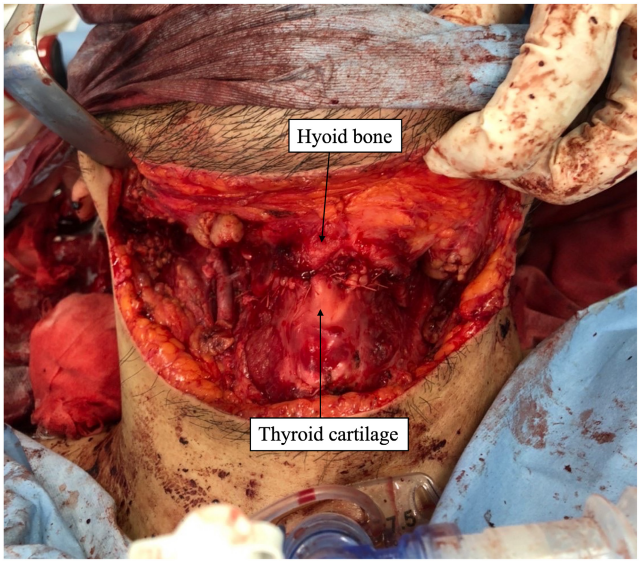

FIGURE 4 The mucosa of the hypopharynx was ligated and sutured with 3-0 vicryl and the hypoglossal muscle group was sutured with 3-0 vicryl to repair the pharynx. The top of the image shows the cephalic side, and the bottom shows the caudal side.

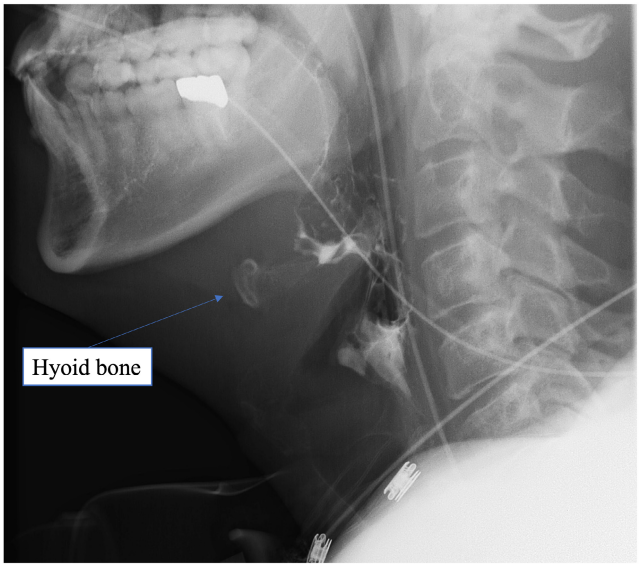

FIGURE 5 Swallow angiography, performed on POD 15, shows no leakages.

surgeons often have little experience with cervical cases. In addition, it is difficult to learn about perforated cervical injuries in Japan because the number of such cases is not as large as that in trauma centers in the United States.

Training in esophageal cancer surgery can be an advantageous method for trauma surgeons in Japan to manage neck injuries efficiently. Cervical lymph node dissection for esophageal cancer surgery, which is rare in the United States, may be useful in training surgical residents in Japan to improve their knowledge of neck anatomy and their clinical experience of associated surgical techniques. Unlike in Europe or the United States, cases of esophageal cancer in Japan and East Asia are often squamous cell carcinomas. Accordingly, because cervical lymph node

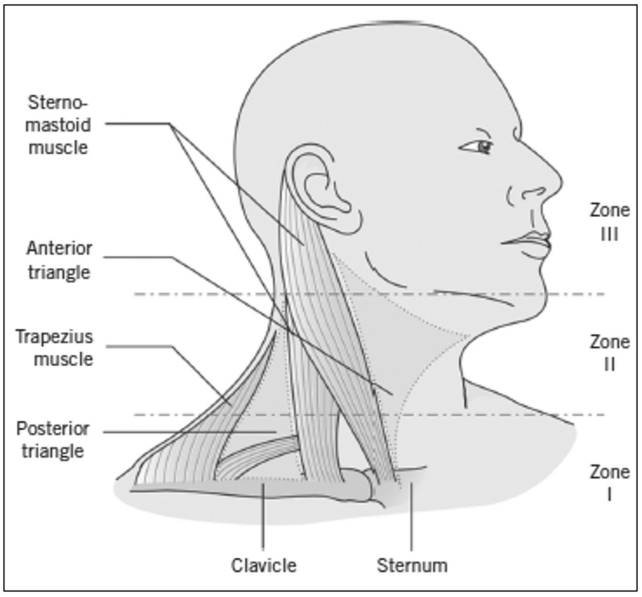

FIGURE 6 Classification of anatomical zones of the neck (Monson, 1969). Zone I extends from the clavicles to the cricoid; zone II from the cricoid to the angle of the mandible, and zone III from the angle of the mandible to the skull base.

metastasis is common, it is standard in Japan to perform a three-field lymph node dissection of the cervical, thoracic, and abdominal regions. Cervical lymph node dissection involves dissection of cervical paraesophageal and supraclavicular lymph nodes. This leads to training in the exposure and identification of major vessels and nerves in the cervical zone II. In addition to subtotal esophageal resection, we often perform partial cervical esophagectomy and total pharyngo–laryngo–cervical esophagectomy, allowing us to better handle the larynx, pharynx, cervical esophagus, and trachea. While scheduled head and neck surgery does not generally include the cervicothoracic region, surgical procedures in the region is quite common in esophageal surgery; hence, such knowledge and experience can be relevant in the management of zone III trauma. Furthermore, esophageal surgery is part of gastroenterology surgery. Moreover, training in esophageal surgery will lead to familiarity with the anatomy of the thoracic and abdominal region, as well as the neck, which could be useful in managing cases of abdominal trauma. It includes the training surgeons to deal with a wide range of gastrointestinal tracts, such as reconstruction using gastrotomy tube or colon.

4 | CONCLUSION

The treatment of penetrating neck injuries requires familiarity with the anatomy and treatment strategies for airway management, hemostatic procedures, and reconstruction. We encountered a case of penetrating neck injury that required urgent airway management and hemostasis, and was well managed by a trauma surgeon trained in the field of esophageal cancer.

AUTHOR CONTRIBUTIONS

Akira Endo: Writing – review and editing. **Hiroyuki Sonobe:** Investigation. **Fumitaka Saida:** Investigation. **Kyuhei MIyakawa:** Investigation. **Fumino Takedatsu:** Investigation; resources. **Keisuke Suzuki:** Investigation. **Kiyoshi Murata:** Writing – review and editing. **Yasuhiro Otomo:** Writing – review and editing.

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CONFLICT OF INTEREST

The authors have no conflict of interest to declare.

DATA AVAILABILITY STATEMENT

All data generated during this study can be accessed through direct communication with the corresponding author and through the agreement of all research team members.

ETHICS STATEMENT

The manuscript was approved by the Ethics Committee of Tsuchiura Kyodo General Hospital and Matsudo General Hospital.

CONSENT

Written informed consent was obtained from the patient to publish this report.

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