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Vertebral Artery Injury: Case Report and Review of Operative Approaches

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Traumatic injury to the upper third of the neck, cephalad to the angle of the mandible, distorts the complexity of normal anatomy and underscores the importance of preoperative arteriography when possible. This report describes the case of a young man who was brought to the Emergency Room of our hospital suffering from a severe gunshot wound to the cervical spine, vertebral artery, and maxillofacial skeleton. His injury was successfully managed by combining a standard arterolateral incision with a procedure that has been described for exposing retromaxillary tumors. This operative technique provided the surgeon with direct access to the injury, controlled the loss of blood, and permitted repair of accompanying pharyngeal and facial injuries. Our report also reviews the technical considerations and pertinent surgical anatomy of this rare combination of injuries.

Vertebral artery injuries caused by low velocity missiles and other penetrating objects constitute 2-3% of vascular injuries to the neck and have a mortality rate as high as 50-70% (1,2). Recent review articles have discussed current concepts in evaluation and surgical management of such lesions (1,3-6). Preferably, preoperative assessment of the injured area should include arteriography and esophagraphy and esophagoscopy, as indicated. However, since approximately 10% of patients with neck wounds require immediate operation, usually because of uncontrolled bleeding, the delay necessary to obtain such studies is inadvisable.

Our case involves massive, uncontrolled hemorrhage from the vertebral artery which was managed successfully by using a mandibular splitting technique for rapid exposure. According to Wood, Roux in 1839 described this technique for tumors of the tongue (7). The pertinent anatomy of this injury and various operative exposures are diagrammed and discussed to familiarize surgeons with this difficult problem.

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Case Report

A 21-year-old man arrived at Henry Ford Hospital in profound shock from a single gunshot wound to the base of the right neck. The entrance wound was at the right posterolateral base of the neck, and the exit wound was at the left upper lip and maxilla. Obvious tissue damage was present in the oropharnyx, tongue, and left maxilla (Fig. 1). His neck on the right side was grossly distended. During aggressive resuscitation, his vital signs were unstable, and he moved all extremities. His life-threatening hemorrhage from the mouth could not be controlled by nasal tracheal intubation and pharyngeal packing. The patient was immediately transferred to the operating room while fluid volume and blood replacement were continued.

An incision made in the neck along the anterior border of the sternocleidomastoid muscle revealed no injury to the carotid sheath structures. However, a large hematoma distorted all structures medial and posterior to the carotid sheath at its cephalad aspect. The profuse bleeding in the oral cavity, which was coming from a posterior pharyngeal tear, could not be controlled by proximal compression of the carotid vessels and at the origin of the right vertebral artery at the subclavian artery. Only direct pressure at the site of hemorrhage yielded any demonstrable effect.

A rapid midsaggital osteotomy of the mandible provided access to the retropharyngeal bleeding (Fig. 2). Myotomy of the right superior pharyngeal constrictor, through the prevertebral fascia, was performed to increase exposure. The major hemorrhage was deep to the damaged vertebral body and its accompanying costotransverse process. Sub-

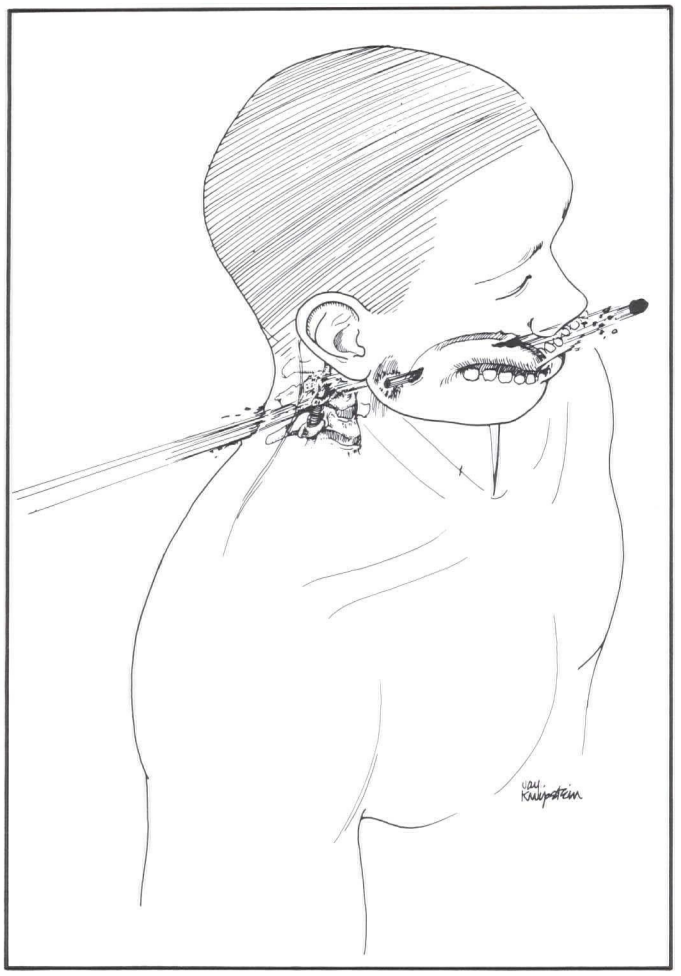

Fig. 1
Schematic drawing showing trajectory of the bullet through the transverse process of C-3, right vertebral artery, the body of the tongue, and left maxilla.

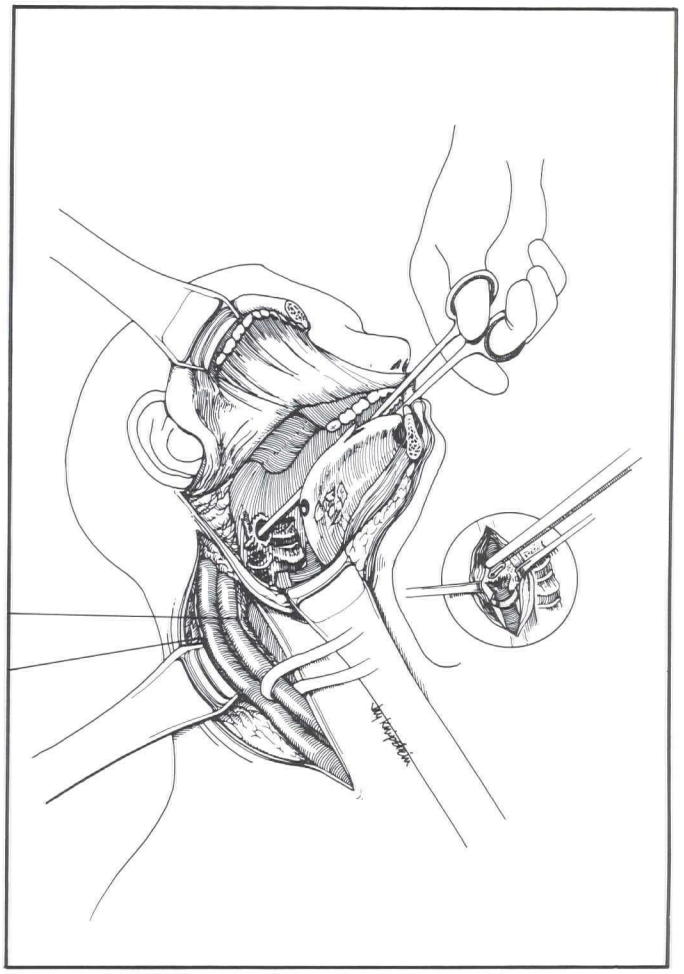

Fig. 2
Disarticulation of right hemimandible superiorly and direct clamping of right vertebral artery.

sequent exposure revealed thrombosis of the proximal vertebral artery. The arterial hemorrhage was retrograde from the distal end of the transected vertebral artery. Both ends were ligated. Additional profuse venous bleeding from the medullary portion of the vertebral body was controlled with bone wax. A portion of the injured cervical vertebra was removed from the body of the tongue, and the soft tissue and osseous injuries were appropriately repaired. A tracheostomy was performed, and the submandibular and supraclavicular areas were drained through separate lateral incisions.

Postoperative cervical spine radiographs confirmed the injury to C-3. Contrast x-rays 14 days postoperatively showed that the patient was able to swallow normally with no disturbance in his esophagus. Significant findings on arteriography 18 days postoperatively revealed that the midportion of the right vertebral artery was occluded with refilling in the distal portion by collaterals from the thyrocervical trunk. There was no evidence of AV fistula formation (Fig. 3).

Twelve months postoperatively, the patient's only neurological deficit is to the skin of the neck on the anterior side.

Technique of Rapid Mandibular Splitting

A full thickness incision down to the bone is made from the middle of the lower lip to the mental protuberance and rapidly extended inferior and parallel to the inferior mandibular border to the antegonial notch caudad to the level of the facial nerve (Fig. 4). With minimal periosteal evaluation, a midsaggital complete osteotomy is performed (with or without removing central incisor teeth). The mucosa of

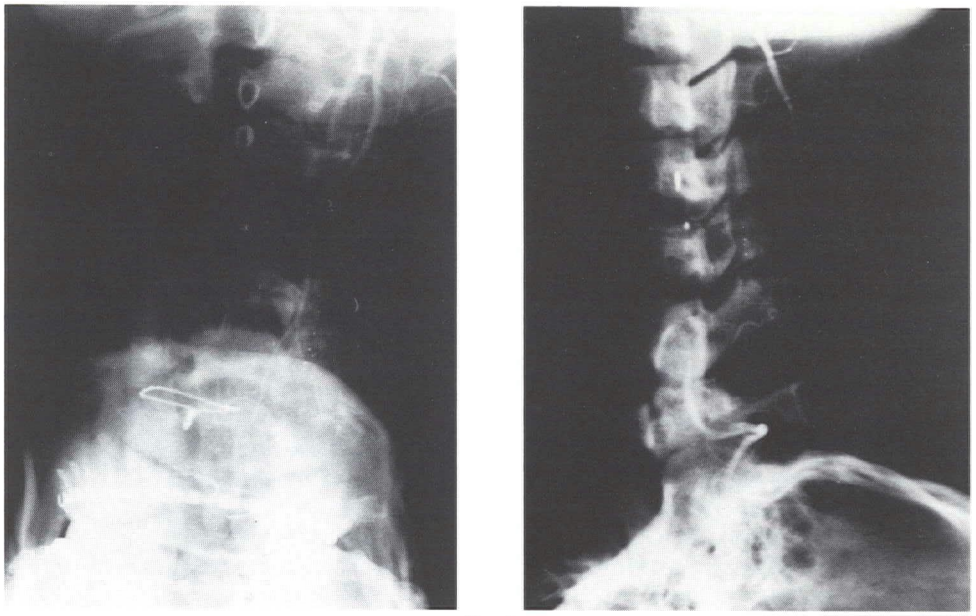

Fig. 3
Postoperative Arteriograms
Left: Surgical occlusion of right vertebral artery at C-3. Right: Retrograde filling of right vertebral artery occluded at superior border of C-3.

the floor of the mouth and mylohyoid muscle are incised close to the medial mandibular cortex with medial retraction of the tongue and sublingual structures to the level of the second molar tooth. This protects the lingual nerve and submandibular duct (Fig. 5). The entire hemimandible may then be dislocated and rotated laterally. The submandibular gland and duct may be retracted inferiorly. Although not done in this patient, exposure of the oropharynx, thus obtained, may be increased and modified by transecting the palatoglossus and palatopharyngeal musculature. The lingual nerve and tonsillar arteries would necessarily be sacrificed. In this way, it is possible to obtain wide exposure of the posterior pharyngeal wall with acceptable morbidity.

Discussion

Several operative approaches to the three extracranial divisions of the vertebral artery, based on the descriptions by Henry (8), have recently been reviewed. In one approach, proximal vertebral artery injuries are accessible by a transverse supraclavicular incision. However, in most instances, the standard anterolateral incision along the anterior border of the sternocleidomastoid muscle is sufficient. If needed, a "hockey-stick" mastoid extension of this incision will facilitate exposure of the distal extracranial course of the artery (Fig. 6). There is also a posterior approach to the cervical portion of the artery by a midline incision (9). However, musculature, articulating processes, and inability to visualize other neck structures limit this approach in emergency, trauma situations.

Lore (10) has described variations of mandibular splitting for head and neck tumor and carotid vascular exposure. Similar approaches have been described for gaining access to the tongue, floor of the mouth, and oropharyngeal tumors (11-13). Additional anatomic considerations include the proximity of the lingual nerve and artery, the submandibular duct, the facial artery, and the mandibular branch of the facial nerve (Fig. 7) (14). Of the tonsillar arteries, only branches of the lingual artery that run in the palatoglossal fold are encountered by this technique in the oral pharynx. Running transversely at the base of the fauces are the lingual nerve anteriorly and the lingual artery posteriorly.

The standard anterolateral incision along the anterior border of the sternocleidomastoid muscle is a familar approach and has great versatility in treating neck trauma. This incision can be extended in a posterior, hockey-stick fashion for greater exposure at the posterior base of the skull. In our case, it was combined with a modified transoral mandibular osteotomy for successfully controlling a transected vertebral artery and repairing accompanying facial injuries.

Acknowledgments

The illustrations were drawn by Jay Knipstein of the Medical Arts Department of Henry Ford Hospital.

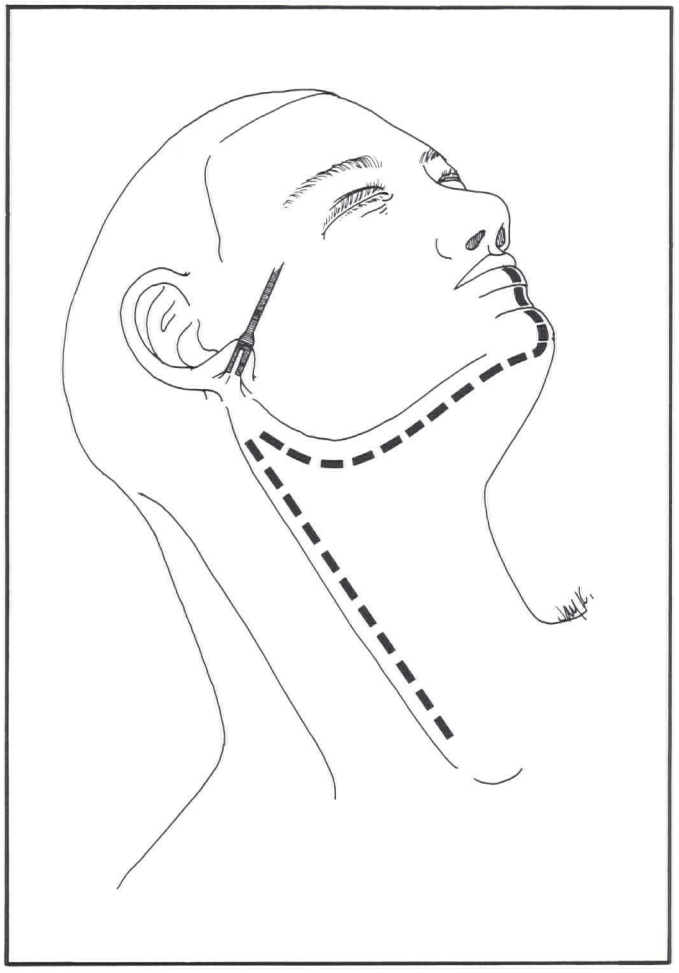

Fig. 4
Appropriate incision for transoral approach to injured vertebral artery.

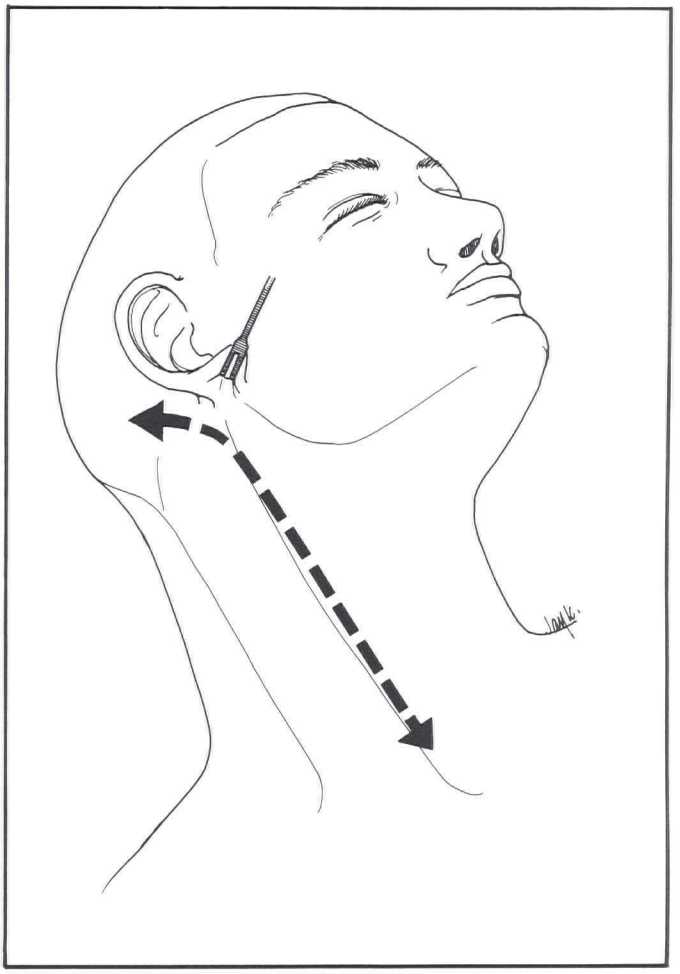

Fig. 6
Hockey-stick incision described by Henry (7) to allow wide exposure on lateral approach.

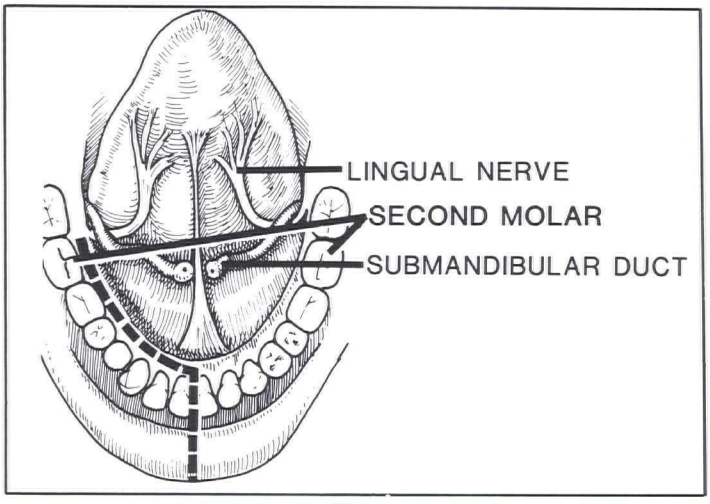

Fig. 5
Intraoral incision lateral to the lingual nerve and submandibular duct. Limiting the incision to the level of the second molar avoids injury to the lingual nerve.

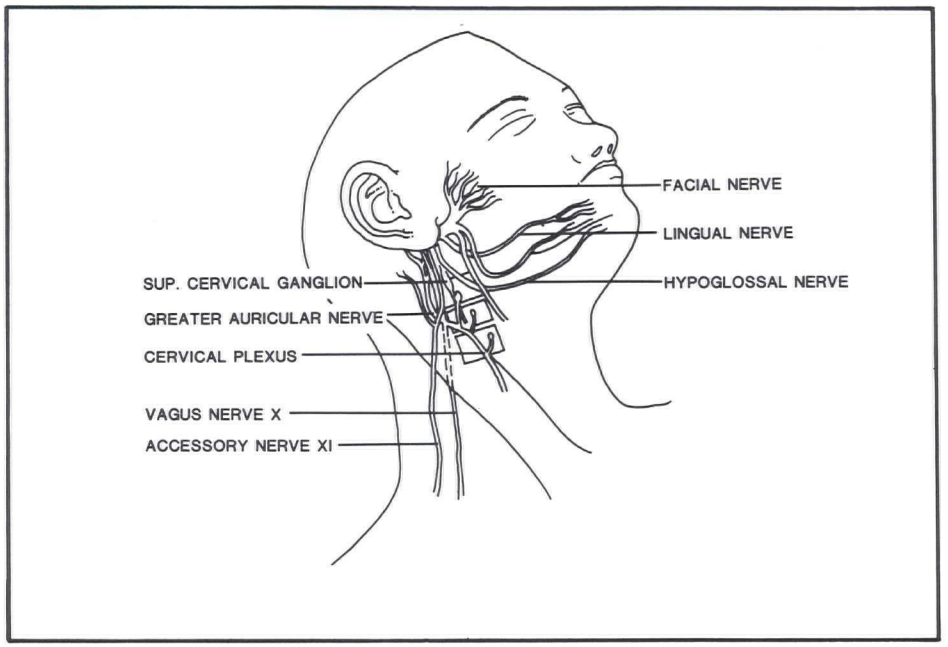

Fig. 7
Cervical nerves exposed by lateral approach and relationship of facial nerve to inferior border of mandible.

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