

Chapter 53 – Penetrating Trauma to the Hypopharynx and Cervical Esophagus

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The most common mechanisms of penetrating trauma to the hypopharynx and cervical esophagus are civilian violence and iatrogenic injuries, which include peroral instrumentation (i.e., esophagoscopy, dilatation, biopsy, transesophageal echocardiography), as well as anterior cervical spine surgery.

Iatrogenic trauma is the most common cause of perforation of the hypopharynx and cervical esophagus. Transcervical penetrating injuries to the hypopharynx and esophagus are less frequent. However, escalating civilian violence has led to an increased incidence of penetrating injuries to the neck.

EVALUATION AND DIAGNOSIS

Iatrogenic Trauma

Iatrogenic pharyngoesophageal trauma is a rare, but potentially life-threatening complication of multiple surgical procedures. Such injuries to the hypopharynx or cervical esophagus can be broadly categorized into those resulting from either endoscopic procedures or open surgical approaches to the neck. The latter primarily consists of anterior cervical spine surgery, and perforation can occur immediately during the cervical spine surgery or may be delayed months to years after the initial operation.

The incidence of perforation of the cervical pharyngoesophageal segment during diagnostic rigid endoscopy varies from 0.1% to 1%.^[1] The incidence is higher when these procedures are associated with other instrumentation, such as that used for dilatation, biopsy, or retrieval of foreign bodies. Underlying esophageal disease, such as a Zenker diverticulum, malignancy, malnutrition, stricture, and previous radiation therapy, may also increase the risk for endoscopic injury.^[2] The injury is usually identified—or at least suspected—during the procedure or immediately after. The diagnosis is corroborated and treatment is initiated sooner than in patients with transcutaneous injuries, thereby leading to a better outcome.

Patients with subcutaneous emphysema, pneumomediastinum, neck pain, dysphagia, odynophagia, unexplained fever, or tachycardia after endoscopy should be evaluated to rule out perforation. A chest radiograph is essential to confirm free air in the subcutaneous area, mediastinum, or thorax. Imaging of the esophagus with water-soluble contrast material is the preferred method to evaluate a suspected perforation of the hypopharynx or esophagus. Extravasation of a water-soluble contrast agent is quickly cleared by tissues, and thus less inflammation is produced than when barium is used. The sensitivity of these studies varies considerably; for a meglumine diatrizoate (Gastrografin) swallow, it ranges from 75% to 100%.^[3]

Perforation of the esophagus has been well described as a complication of the anterior cervical spinal approach, with a reported incidence ranging between 0.02% and 1.49%.^[4–6] Such perforations can be noted during surgery, in the immediate postoperative period, or years after the original spine surgery.^[7,8] Transmural perforations are the most serious type because they allow esophageal bacteria to invade an otherwise sterile field. Injuries to the serosa are fairly common and are generally of little consequence, other than contributing to postoperative dysphagia.

During surgery the spine surgeon may be concerned that a direct, transmural esophageal injury has occurred. If the surgeon is confident that a significant injury has taken place, an otolaryngologist should be consulted immediately for assistance and confirmation. If a tear is suspected intraoperatively, a diluted solution of methylene blue may be irrigated into a nasogastric tube with a distally placed Foley catheter.^[9] Should the methylene blue leak into the surgical wound, a transmural injury has been identified and appropriate therapy should be instituted. Alternatively, the surgeon may use other colored fluid such as povidone-iodine. If an esophageal perforation is suspected postoperatively, a Gastrografin swallow should be performed immediately to confirm the diagnosis and avoid a delay in treatment.

Other types of iatrogenic trauma, such as perforation of the hypopharynx during endotracheal intubation, placement of a nasogastric tube, or transesophageal echocardiography, are extremely rare.^[10] Perforation of the pharynx during intubation is associated with the use of a stylet during emergency intubations, especially when performed by inexperienced personnel.^[11]

Penetrating Trauma to the Neck

The ABC (airway, breathing, circulation) principles of trauma life support are fundamental to the evaluation and management of any penetrating wound to the neck. Establishing or securing the airway, ventilating, restoring blood volume, and stabilizing the cardiovascular system should be accomplished promptly as an overlapping series of events. Protection and evaluation of the cervical spine are critical components that cannot be overemphasized, because both low-velocity and high-velocity missiles can transfer a significant amount of energy to the cervical spine. Clinical and radiologic evaluation is necessary to rule out damage to the spine. The cervical spine should be evaluated with lateral, anteroposterior, and open-mouth anteroposterior (odontoid) radiographs to demonstrate the entire spine from C1 to the junction of C7 and T1. Computed tomography (CT) may be the preferred study in most institutions but is mandatory if radiographs are not satisfactory or suggest an injury (Fig. 53-1).



Figure 53-1 Axial computed tomography scan demonstrating free air in the deep planes of the neck suggestive of an injury to the aerodigestive tract.

The history and physical examination are also initiated during the resuscitation phase. Knowledge of the circumstances and mechanism of the injury is essential to make an adequate diagnosis. Information regarding the injury, such as a high-velocity versus a low-velocity missile, type of weapon, distance, and trajectory, is important in determining the degree of trauma and injury to surrounding structures.

The hypopharynx and cervical esophagus are located deep in the neck, posterior to the airway, anterior to the spine, and medial to the great vessels. The intimate association of these different structures makes an isolated injury to the hypopharynx or cervical esophagus a rare event. These injuries are commonly associated with vascular and airway trauma.^[1,11–15] Conversely, a penetrating injury to the pharyngoesophagus should be suspected in the presence of vascular or airway trauma.

A history of hoarseness, dysphagia, odynophagia, or hemoptysis suggests a penetrating injury to the upper aerodigestive tract. The physical examination should be thorough and address the possibility of other

associated injuries requiring intervention. Findings such as subcutaneous emphysema or saliva or bubbling fluids arising from the wound on swallowing also suggest injury to the upper aerodigestive tract and are indications for surgical exploration. Fiberoptic examination may reveal a hematoma, lacerations, blood, associated laryngotracheal injuries, or vocal cord palsy. The presence of a hematoma, cranial nerve or brachial plexus deficits, or injury to the contralateral pleura (e.g., contralateral pneumothorax) suggests a significant injury and is also an indication for exploration. Chest CT corroborates the presence or absence of free air, pleural fluid, a widened mediastinum, pneumothorax, and skeletal injury.

Patients with symptoms suggestive of injury to the hypopharynx or cervical esophagus but with no absolute indication for exploration should be evaluated with an esophagogram. Esophagography enhanced with a water-soluble contrast agent is the preferred imaging study to evaluate a possible transcervical penetrating injury to the hypopharynx or esophagus. Alternatively, if the patient has an isolated neck wound, a solution of methylene blue may be given by mouth to observe any extravasation into the neck wound. A negative esophagogram does not completely rule out an injury. The incidence of false-negative studies is as high as 20%.^[3,12] Rigid endoscopic examination complements the imaging studies and upgrades the sensitivity of the evaluation. Fiberoptic flexible esophagoscopy is not reliable in assessing injury to the proximal esophagus and hypopharynx.^[3]

MANAGEMENT

The critical prognostic factor in the management of pharyngoesophageal perforations is the time elapsed between injury and initiation of therapy.^[2,16,17] Thus, a high index of suspicion and rapid evaluation and diagnosis are paramount. A delay in management of more than 24 hours has been shown to significantly increase morbidity and mortality.^[2] Historically, surgical exploration with primary closure or resection was advocated for all suspected cases of pharyngoesophageal injury. More recently, there has been a trend toward more conservative management that focuses on broad-spectrum antibiotics, no oral intake, and abscess drainage.^[2,18,19]

Medical Treatment

Iatrogenic perforation or stab wounds without any other associated injuries may be managed conservatively by inserting a nasogastric tube and permitting no food by mouth for 3 to 5 days.^[1,20,21] Broad-spectrum antibiotics (e.g., clindamycin, ampicillin-sulbactam) that provide coverage against flora of the upper aerodigestive tract are administered throughout this period. An antibiotic mouthwash (e.g., clindamycin phosphate [Cleocin], 900 mg per 1000 mL of a 0.9% saline solution) can be used to diminish the bacterial count of the oral cavity and thus that of saliva. Antibiotic mouthwashes should not be used for longer than 3 days to prevent the selective growth of bacterial pathogens.

Controlling or preventing infection with antibiotics and, if necessary, drainage essentially converts a contaminated neck or chest wound to a salivary fistula.^[18] Adequate nutrition is fundamental to promote rapid and adequate healing of the injury. In the rare instance in which a nasogastric tube cannot be placed, the patient may be nourished with a gastrostomy tube. After closure of the salivary fistula, a follow-up esophagogram will corroborate complete healing of the pharyngoesophagus.

Surgical Treatment

Surgical management includes esophagoscopy, cervical exploration, repair, and drainage. This surgical approach is advocated for injuries not amenable to medical treatment. The indications and timing for surgical repair are controversial and depend on many factors, including the time from injury to initial evaluation, the mechanism and extent of injury, the experience of the surgeon, and the presence of grafts or hardware.

Preoperative Planning

The patient should have blood typed and cross-matched in preparation for any unsuspected vascular injuries. If exploration or endoscopy is necessary, it is performed under general anesthesia. Flexible direct laryngoscopy is required to evaluate the airway before induction of anesthesia and intubation. If possible, the patient is allowed to ventilate spontaneously, because positive pressure ventilation by mask may precipitate or exacerbate subcutaneous emphysema and pneumothorax. If the airway is compromised by hematoma, edema, or secretions, a tracheotomy is performed under local anesthesia. The use of nitrous oxide is detrimental because it can lead to expansion of the air trapped within tissue planes. Significant changes in blood pressure should be avoided.

Surgical Technique

Esophagoscopy is helpful to assess the site of entry and extent of injury, even in patients with clear indications for exploration.^[3]

A horizontal incision following a neck crease is preferable to a diagonal incision for cosmetic reasons and because

it provides bilateral exposure if needed (Fig. 53-2). Placement of the incision varies with the level of the injury. High hypopharyngeal injuries are approached through an incision placed at the level of the midthyroid ala. Injury to the lower hypopharynx (i.e., apex of the piriform sinus) or cervical esophagus may be approached through an incision at the lower edge of the cricoid cartilage. The incision should extend from the anterior edge of the sternocleidomastoid muscle to the midline. It can be extended to the anterior edge of the contralateral sternocleidomastoid muscle, if necessary, for bilateral exposure.

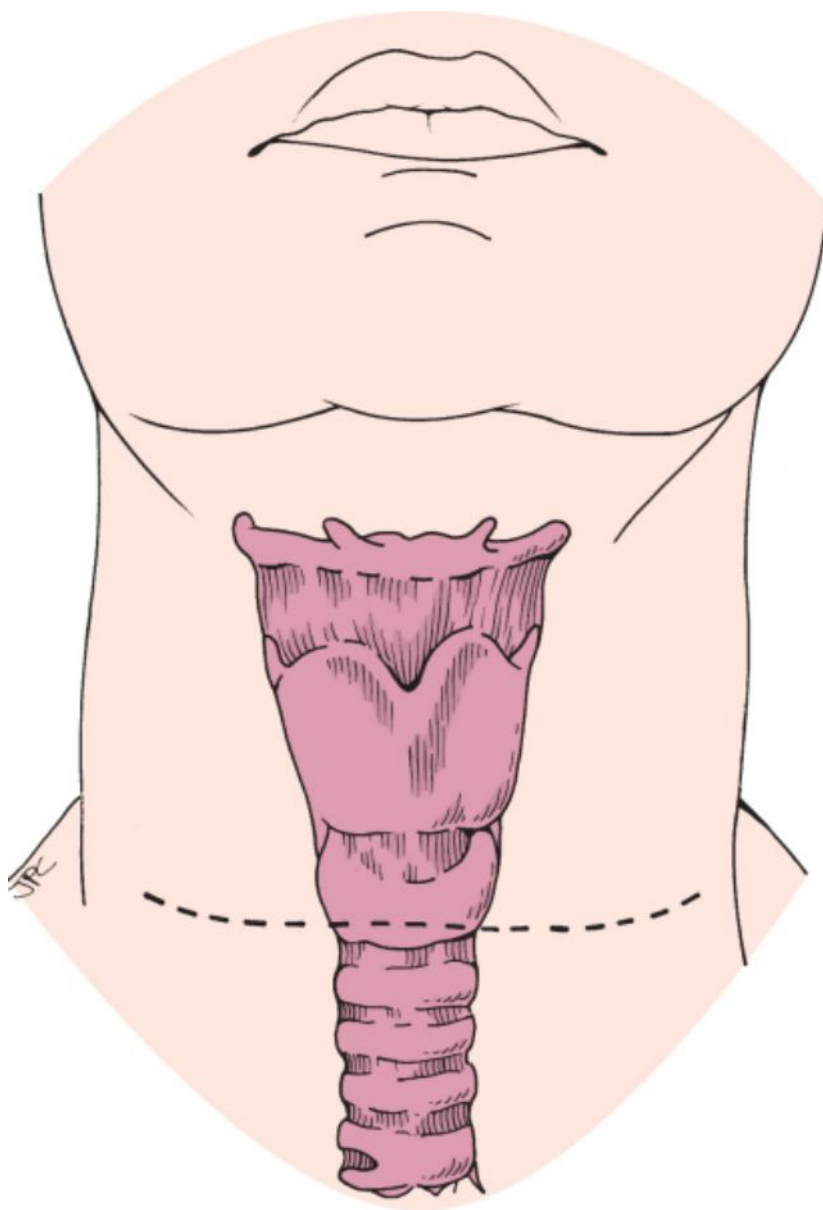


Figure 53-2 Transverse cervical incision at the level of the inferior edge of the cricoid cartilage. This incision provides bilateral access to the pharyngoesophageal area. However, it can be adapted to a particular need according to the level of injury and laterality.

Subplatysmal flaps are elevated superiorly to the level of the hyoid bone and inferiorly to the level of the clavicle. The sternocleidomastoid muscle is dissected from the strap muscles. The carotid sheath and its contents are retracted laterally (Fig. 53-3), and the great vessels can be exposed to confirm the presence or absence of any injuries. With a combination of blunt and sharp dissection the prevertebral space is exposed. A double-pronged retractor is placed at the posterior edge of the thyroid ala, and the laryngotracheal complex is rotated anteromedially (Fig. 53-3). This maneuver provides access to the retropharyngeal space to avoid inadvertent injury. The position of the superior laryngeal nerve, which courses medial to the carotid artery and pierces the lateral margin of the thyrohyoid membrane, as well as the entry point of the recurrent laryngeal nerve lateral to the cricothyroid joint, should be kept in mind to avoid inadvertent injury.

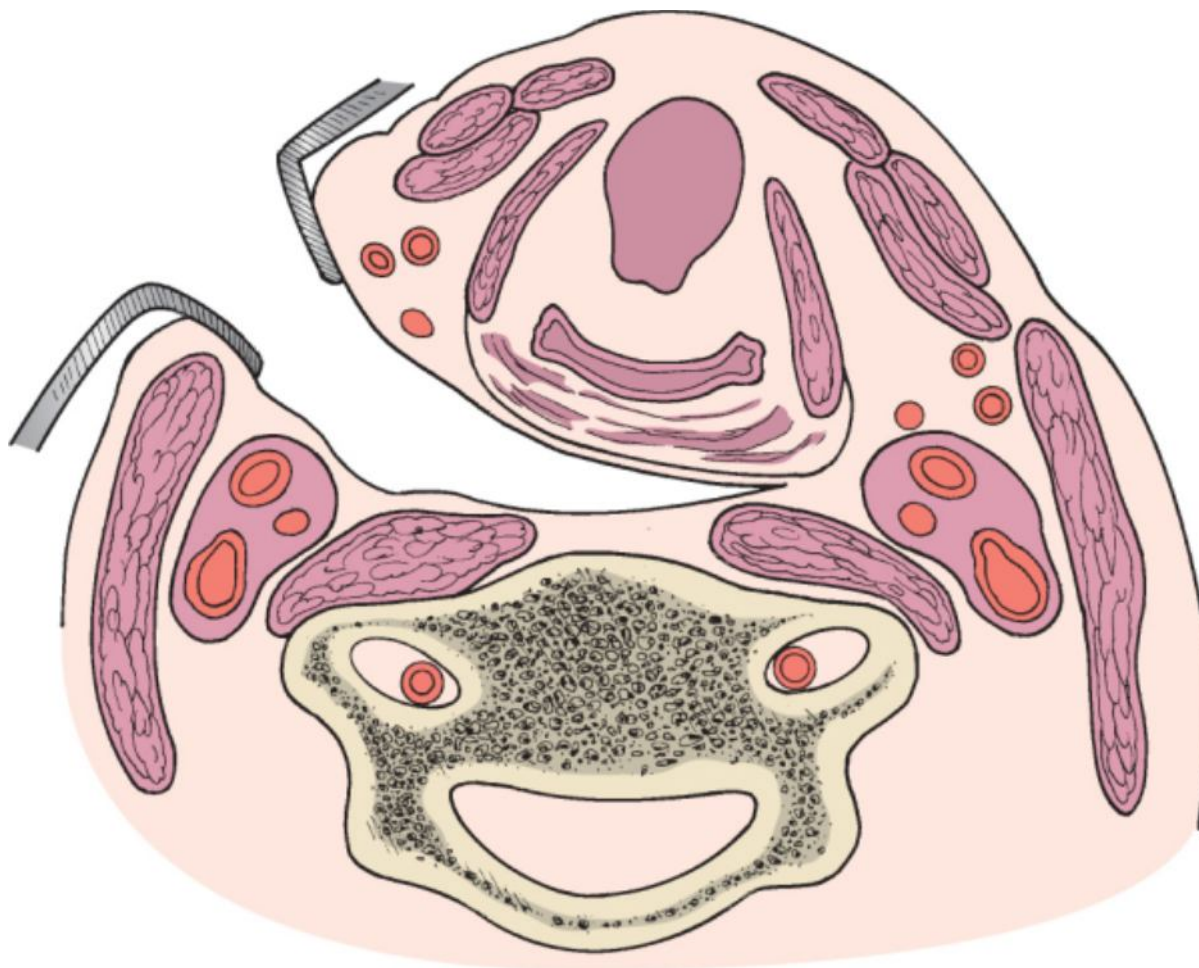


Figure 53-3 Axial view of the surgical route to the pharyngoesophagus (retropharyngeal space). The retractor at the *left* is displacing the sternocleidomastoid muscle and the contents of the carotid sheath. The retractor at the *right* is rotating the larynx in an anteromedial direction.

The perforation is commonly identified by following the track of the penetrating weapon (Fig. 53-4). When the perforation is not visible, air or water may be insufflated into the pharynx and the wound observed for a leak. The perforation is then repaired with a double-layer technique, and an inverting stitch with absorbable suture is used to repair the mucosa. The inferior constrictor or esophageal muscles are approximated with interrupted stitches. A suction drain is left in the prevertebral space. If the pleural space has been contaminated, chest tube drainage may also be required.^[18] Mediastinitis mandates aggressive therapy, probably with a thoracotomy for débridement and drainage.

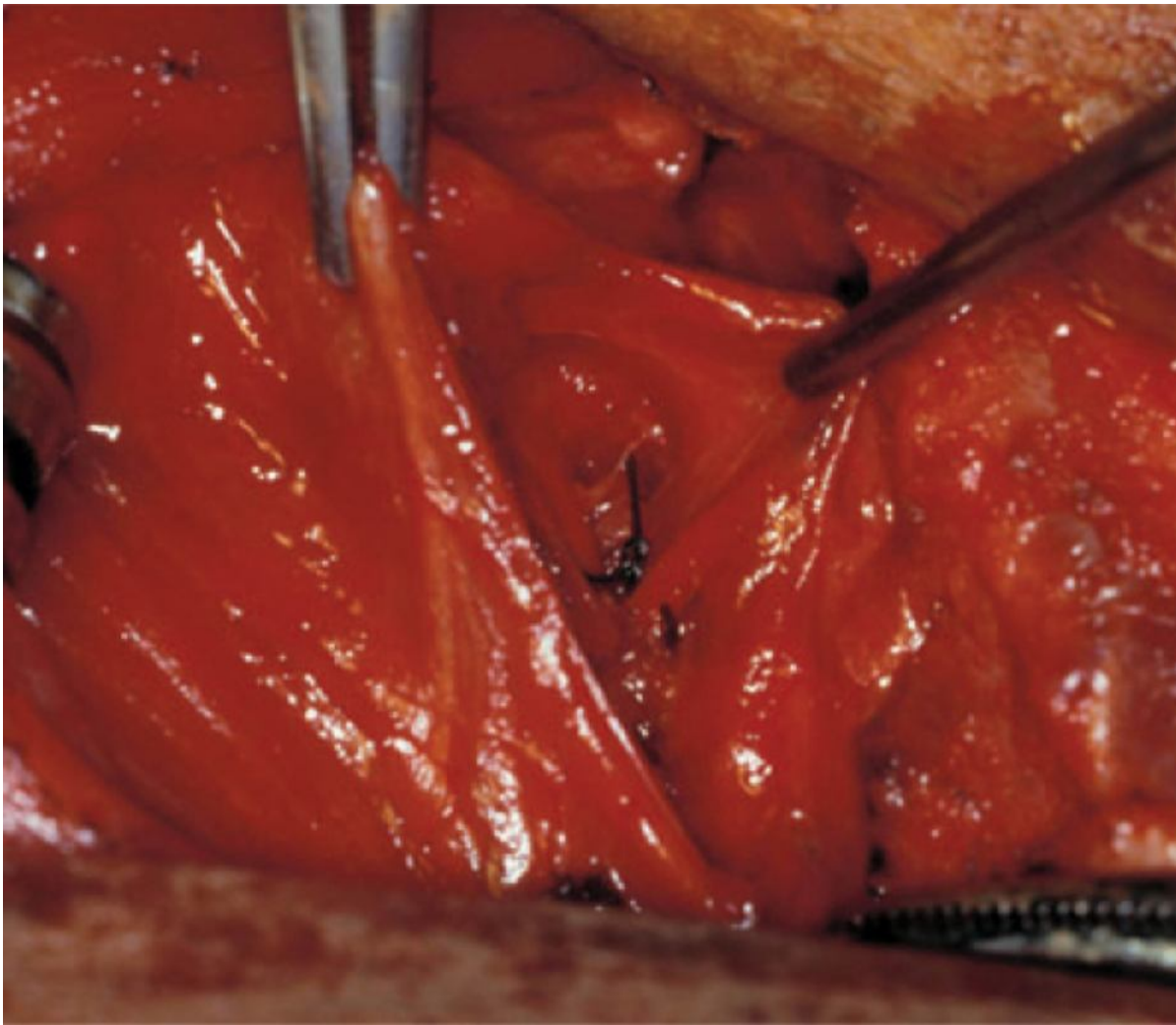


Figure 53-4 Penetrating injury to the hypopharynx.

Perforations older than 24 hours are usually associated with edematous and friable tissue that is not amenable to primary repair. In these cases, a strap muscle myofascial transposition flap may be used to buttress the wound. Similarly, an inferiorly based sternocleidomastoid muscle flap, popularized by Conley and Gullane in 1980, provides a safe and effective method of repair with low morbidity.^[4,22] A pedicled pectoralis major flap and a free omental flap have also been advocated.^[23,24]

Special Circumstances

When a vascular injury requires primary repair or grafting, drainage should be brought to the contralateral side, away from the injured vessel (Fig. 53-5).^[13]

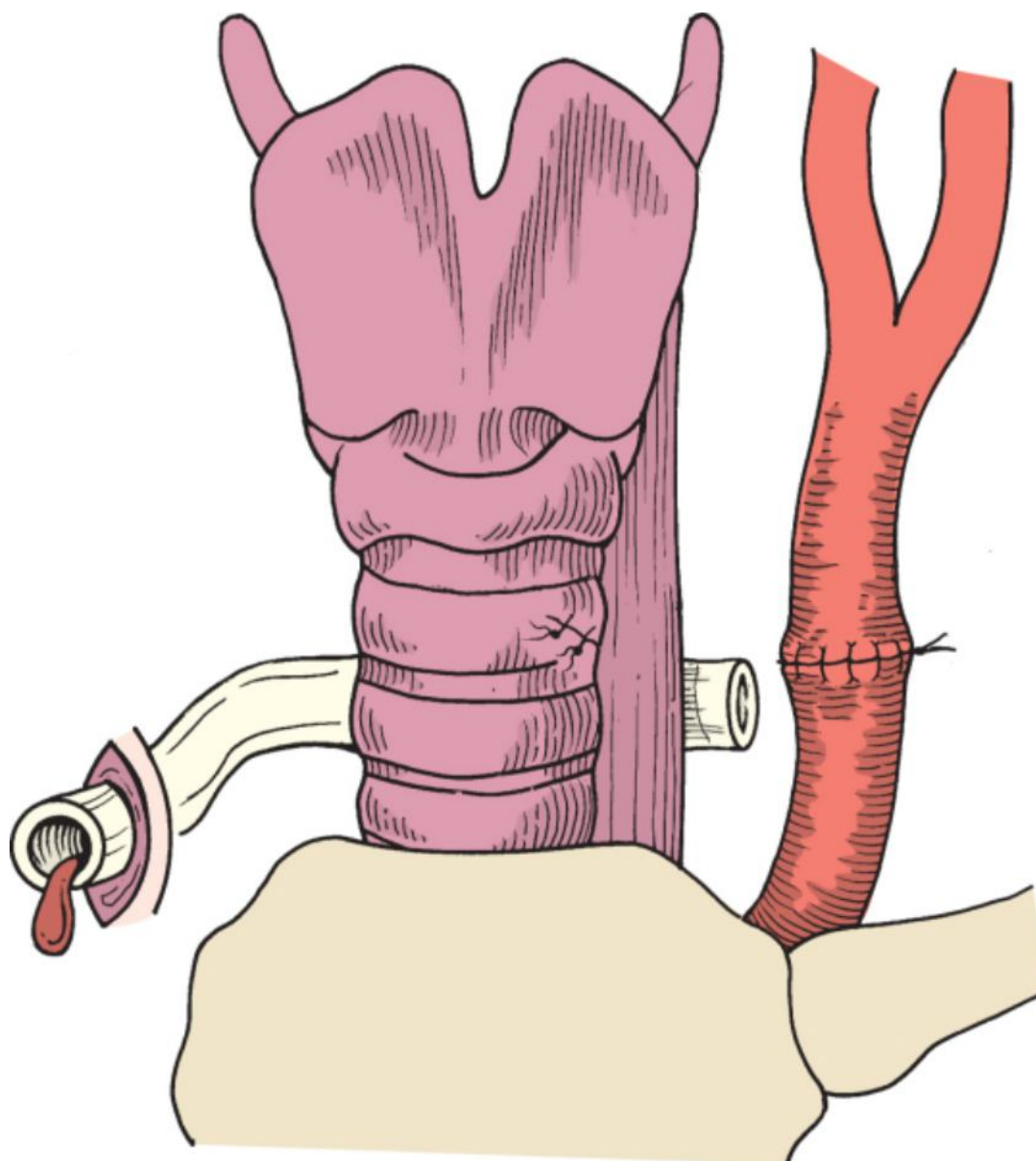


Figure 53-5 Tracheoesophageal injury associated with a carotid injury after repair. The drain should not be in contact with the vascular or esophageal repair. A suction drain is preferred unless there is leakage of air from the airway.

Associated tracheal injuries may be repaired primarily or left to close by secondary intention. A thyrohyoid muscle flap interposition between the tracheal and esophageal injury is advisable to prevent a tracheoesophageal fistula when both structures are injured at adjacent sites.^[13,14,25] To mobilize this flap, the insertion of the thyrohyoid muscle is transected with the cautery. The muscle is dissected from the ipsilateral sternohyoid and cricothyroid muscles. Dissection at the lateral boundary of the muscle is avoided to preserve the blood supply, which arises from the superior thyroid artery. The motor nerve from the descending ansa cervicalis can be transected or crushed with a hemostat to paralyze the muscle during the healing period (Fig. 53-6).

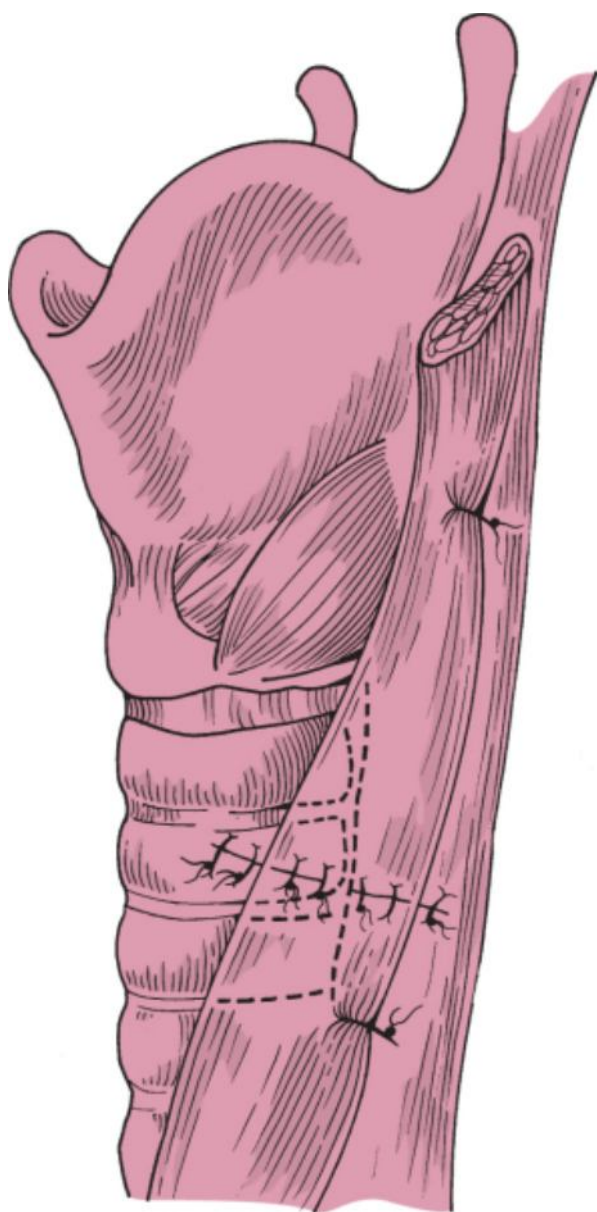


Figure 53-6 Tracheoesophageal injury repaired primarily and reinforced with a strap muscle pedicle flap.

A second esophageal injury involving the thoracic segment requires cervical esophageal diversion.^[13] The cervical esophagus is mobilized, and the injured area is externalized as a loop esophagostomy for a controlled salivary fistula (Figs. 53-7 and 53-8).

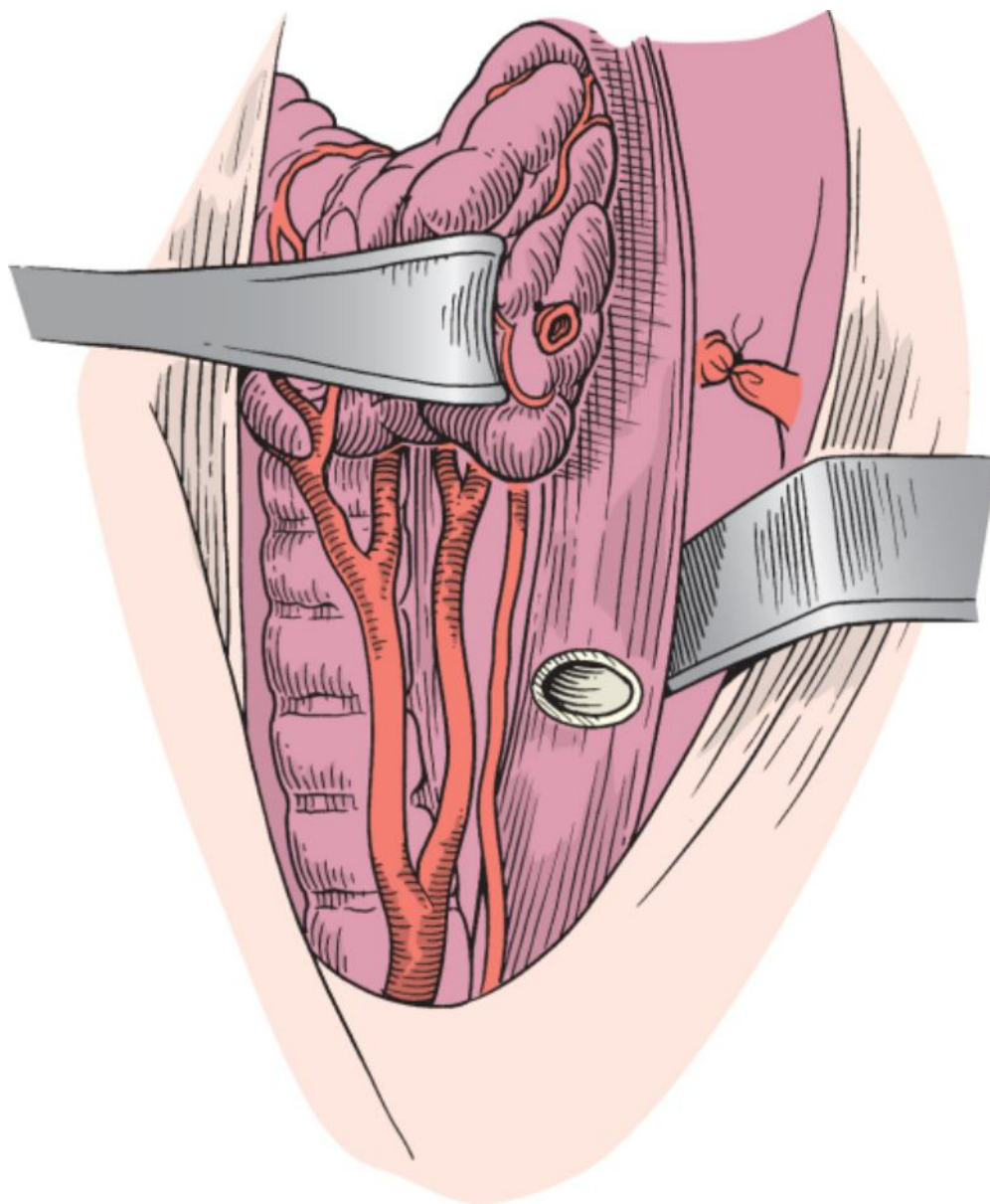


Figure 53-7 The thyroid gland has been mobilized medially (i.e., the middle thyroid veins have been ligated and transected), and the esophagus has been mobilized from the trachea. An esophagostomy is opened, and the esophageal mucosa will be sutured to the skin.

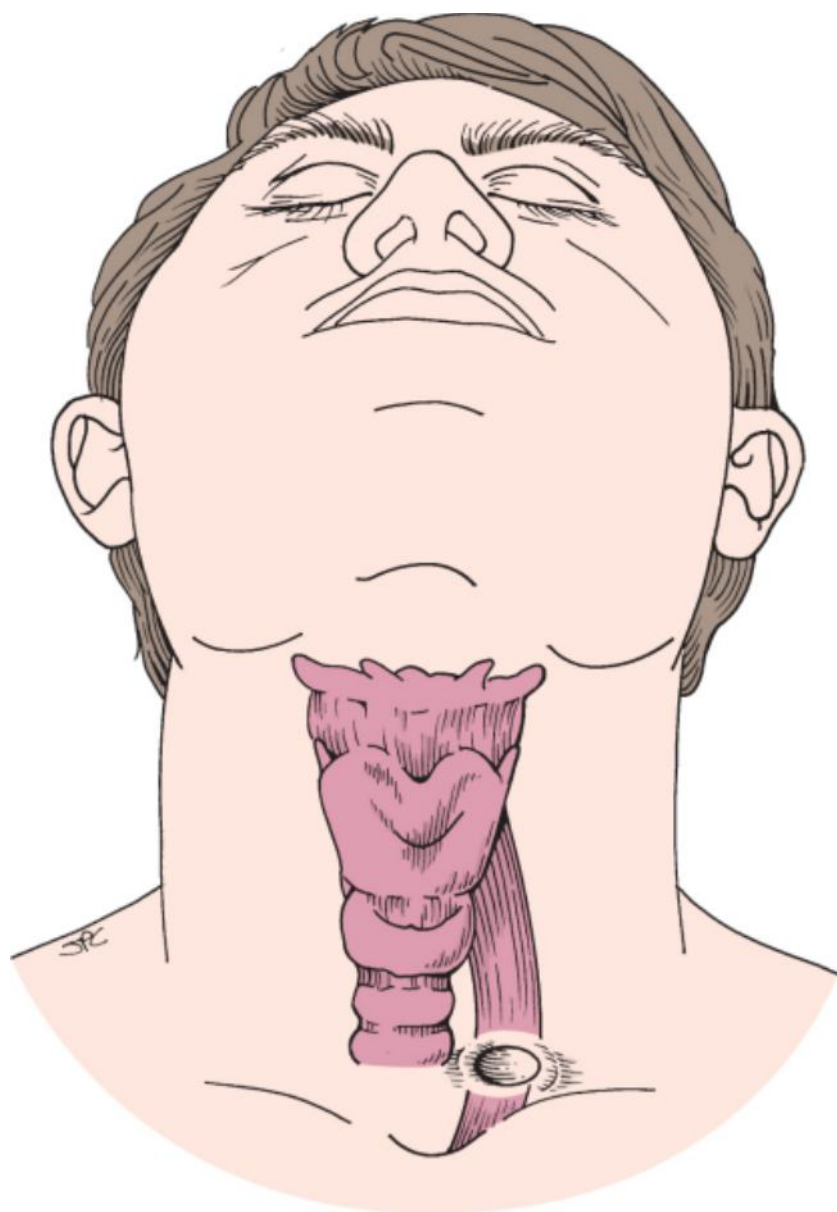


Figure 53-8 Esophagostomy after completion.

POSTOPERATIVE MANAGEMENT

Antibiotics are continued for a minimum of 24 hours after exploration and repair. Nothing is allowed by mouth, and enteral nutrition is continued by nasogastric or gastrostomy tube unless abdominal injuries mandate parenteral hyperalimentation. Antireflux medications are mandatory because gastroesophageal reflux will produce a severe inflammatory reaction and further tissue necrosis. We prefer to administer a proton pump inhibitor. The suction drain is kept in place until healing is verified by a Gastrografin swallow and the patient has resumed oral intake. Early and adequate drainage of the wound is probably the most important factor affecting the incidence of complications.

COMPLICATIONS

The most common complications are associated with a salivary leak. Patients in whom cellulitis or an abscess develops while being managed conservatively require incision and drainage. Whenever possible, the wound should be drained with a closed-suction device. This type of drainage is more effective in evacuating secretions and promoting apposition of tissues than a Penrose drain and is resistant to retrograde bacterial contamination. Broad-spectrum antibiotics are continued until the cellulitis is resolved. Delayed diagnosis may allow the infection to spread into the mediastinum. Mediastinitis mandates aggressive therapy with a probable thoracotomy for débridement and drainage.

A salivary fistula without cellulitis in the presence of a well-drained wound usually heals within 2 weeks. Adequate

nutrition should be maintained with tube feedings or total parenteral nutrition to promote healing.

PEARLS

- Iatrogenic injuries to the hypopharynx and cervical esophagus from endoscopic procedures and anterior neck surgery are uncommon but potentially life-threatening.
- A swallow imaging study with a water-soluble contrast agent plays a key role not only in making a prompt diagnosis of perforation but also in determining the success of treatment and resumption of oral intake.
- During anterior neck surgery, suspicion of a pharyngoesophageal injury can be confirmed by placing a distal Foley catheter balloon and irrigating methylene blue or povidone-iodine solution through a proximally placed nasogastric tube.
- Most injuries that are diagnosed early (within the first 24 hours) can be managed conservatively with broad-spectrum antibiotics, nothing by mouth, and close observation.
- More extensive or late-diagnosed injuries may require surgical therapy, including abscess drainage, primary closure, and/or local flap coverage.

PITFALLS

- Underlying esophageal disease significantly increases the risk for iatrogenic trauma to the hypopharynx and esophagus.
- Delay in diagnosis of more than 24 hours from the time of injury can significantly increase morbidity and mortality.
- The proximity of the hypopharynx and esophagus to the airway, cranial nerves, and major vessels mandates a high index of suspicion and thorough evaluation to avoid missing associated airway compromise or vascular injury.
- Positive pressure mask ventilation may precipitate or exacerbate subcutaneous emphysema and pneumothorax.
- A nonhealing fistula and failure of treatment may signify inadequate drainage of a contaminated neck or chest collection.

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