

Recognition and Management of Life-Threatening Tracheovascular Fistulae and How to Prevent Them



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KEYWORDS

- Tracheal operations • Laryngectomy • Innominate artery • Carotid artery • Vascular fistula
- Hemoptysis • Diagnosis • Management

KEY POINTS

- Tracheovascular fistulae occurring after airway surgery are usually associated with life-threatening hemorrhage.
- In most such cases, a sentinel episode of hemoptysis will have occurred a few hours before the massive bleeding.
- Prevention of this complication is usually possible.
- Management requires division of the involved blood vessel which can be associated with ischemic strokes.

INTRODUCTION

It is the close anatomic relationship of the trachea to the innominate artery and thyroidea ima artery anteriorly, common carotid arteries laterally, and left brachiocephalic vein anteroinferiorly that is responsible for potential risk of tracheal stoma or tracheal anastomotic suture line eroding into a major artery or vein. The risk is increased in the presence of anomalous high position of the major vessels in the root of the neck like often seen in young woman. The risk for vascular erosion is

also promoted by the adherence of the major vessel to the trachea at these sites. This may occur in anterior neck operations after previous radiation therapy for laryngeal cancer; pharyngocutaneous fistula complicating laryngectomy; local sepsis caused by soilage after cervical tracheostomy; failure to interpose viable healthy tissue, such as thymic pericardial fat pad or omentum between major cervico-mediastinal arteries and tracheal anastomotic suture lines, and incorrect positioning of the anterior mediastinal tracheostomy after cervical exenteration.

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The blood vessel that is most frequently involved in the postoperative complication of tracheovascular fistula is the innominate artery (tracheoinnominate fistula [TIF]). This can occur after cervical tracheostomy open or percutaneous, cervical exenteration and anterior mediastinal tracheostomy, laryngectomy, and after complex segmental tracheal resections.^{1,2} It is uncommon to encounter erosion of either carotid arteries or innominate vein as the cause of trachea-vascular fistulae although there are anecdotal cases reported in the literature. It is important, however, to now of their possible occurrence as a complication of proximal airway surgery.

Because tracheovascular fistula is an uncommon postoperative complication, it is nearly impossible to document its true incidence in the medial literature. What is known is that the incidence of TIF is between 0.1% and 1% after standard cervical tracheostomy, and it averages 0.3%. Although tracheovascular fistula develops most often between 7 and 14 days after tracheostomy, its occurrence may be delayed by several months. Fortunately, it became rare in tracheal resections after discontinuation of use of tracheal prosthesis for reconstruction and strict adherence to the surgical principles of resection and primary reconstruction.

Only case reports exist about TCF after laryngectomy, most being related to the presence of a pharyngocutaneous fistula. Fistulization of the trachea into the left brachiocephalic vein is even more rare, reported as anecdotal cases, and the most likely cause is unrecognized venous injury when performing cervical tracheostomy in the presence of vein that is abnormally located high in the neck.^{3,4}

PATHOGENESIS OF TRACHEOVASCULAR FISTULAE

To have good surgical understanding of the factors that predispose to the formation of a tracheovascular fistula, it is necessary to know the normal tracheal anatomy and its relationship with other structures located in the root of the neck and antero-superior mediastinum as well as possible anomalous locations of the common carotid arteries, the brachiocephalic trunk (innominate artery), thyroidea ima artery, and the left brachiocephalic vein.^{5,6}

The trachea begins as a continuation of the larynx at the lower border of the cricoid cartilage. As it descends it becomes more deeply placed so that at the base of the neck it lies 2 to 4 cm from the skin. Superficial relations are skin; superficial fascia; the investing layer of deep fascia splitting

above the sternum to enclose the suprasternal space; sternohyoid and sternothyroid muscles; pretracheal fascia; and the isthmus of the thyroid gland, which overlies its second, third, and fourth rings. Veins that lie superficial to the trachea are (1) anastomosing veins connecting the two anterior jugular veins; (2) an anastomosing vein connecting the two superior thyroid veins, above the thyroid isthmus; and (3) the inferior thyroid veins descending vertically from the isthmus. The innominate artery and left innominate vein are the anterior relations of the trachea in the lower neck or commonly behind the upper manubrium sternum, as also may the thymus gland.

The left common carotid artery arising from the aortic arch and the right common carotid artery arising from the innominate artery posterior to the right sternoclavicular joint ascend in the neck contained in the carotid sheath just lateral to the trachea.⁷

Because the fistula develops as a postoperative complication, factors involved in causation are varied including anomalous position of the major vessels in the operative field thereby promoting the vessel to become adherent to the trachea at the anastomosis suture line or stomal opening; impairment of tissue healing caused by preoperative radiation treatment of laryngeal cancer; previous neck operation for radical lymph node dissection and laryngectomy and consequent risk for pharyngocutaneous fistula formation; and local sepsis, surgical technical errors, or the disease process itself in the root of the neck and the anterior superior mediastinum.

PREDISPOSING FACTORS TO CONSIDER IN THE DEVELOPMENT OF TRACHEOVASCULAR FISTULA

Inadequate Surgical Awareness of Variation in the Normal Anatomic Relationships in the Root of the Neck

Lack of familiarity with anatomic course of the brachiocephalic trunk (innominate artery), common carotid arteries, and the left brachiocephalic vein and variation in their position is important when the operation is to be performed in the root of the neck or in the anterior superior mediastinum. Failure to appreciate the anatomic variations in arterial or venous courses and their sometimes anomalous positions in the root of the neck and anterior superior mediastinum increases the risk for arterial or venous injury and delayed erosion and fistulization. Equally important is to be aware of the presence of uncommon thyroidea ima arterial branch of the innominate artery ascending anterior to the trachea and becoming a source of

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