



Tracheal Diverticula

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Extraluminal paratracheal air bubbles are occasionally seen on computed tomography (CT) studies that include the thoracic inlet (ie, CT of the neck, of the cervical spine, and of the chest). In most cases, these paratracheal air bubbles are tracheal diverticula (TD), sometimes also referred to as tracheal pouch, tracheocele, and tracheogenic cyst. TD are most commonly seen at the right posterolateral aspect of the upper trachea at the level T1-T3. Because of their typical location and appearance, they are easily recognized and should not be confused with pneumomediastinum or other causes of air bubbles in the same region. This article describes the prevalence, possible pathophysiology, and associated complications of TD and illustrates the spectrum of their appearance on CT.

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Introduction

Tracheal diverticula (TD) are outpouchings from the tracheal wall. Previously assumed to be a rare entity, these structures are currently observed with increasing frequency on computed tomography (CT), probably because of the improvements in spatial resolution of multidetector CT and in the use of thin slices. TD appear as small air bubbles, typically along the right posterolateral wall of the trachea at the level of the thoracic inlet. Most diverticula range in size from 1-25 mm,^{1,2} and the larger ones may be multiloculated. Although, by definition, TD are connected to the trachea, the connecting stalk is often tiny and not clearly demonstrated on CT. Most TD are asymptomatic. However, a tracheal diverticulum may act as a reservoir for secretions that may spill over into the tracheobronchial tree, predisposing affected patients to cough and pulmonary infection.^{3,4} TD have also been reported as presenting with various other clinical presentations including painful neck swelling, cervical abscess, dyspnea, stridor, dysphagia, and hoarseness.⁵

This article reviews the pathophysiology, clinical significance, imaging findings, and treatment options of TD.

Anatomy

TD are outpouchings from the tracheal wall that are lined by ciliated columnar epithelium. The size of diverticula varies and

ranges from 1-30 mm in the axial plane and from 5-25 mm in the vertical plane.^{1,2,6} TD commonly occur along the right posterolateral aspect of the upper trachea at the level of T1-T3 vertebral bodies. The predilection to this part of the trachea is presumably because this space is unprotected as compared with the left side, which is protected by the aortic arch and esophagus.^{1,2,7}

By strict definition, a diverticulum would have a communication with the airways, which can sometimes be very small. In a series documenting the appearance of TD at autopsy, an opening of a pinhead size was seen in the lumen of the trachea at the junction of the cartilage rings and tracheal muscle opposite the midpoint of each TD.⁷ At fiberoptic bronchoscopy and surgery, the orifice of the communication between the diverticulum and the trachea appears as a tiny, well-circumscribed hole in the tracheal wall.^{8,9} Although bronchoscopy is useful in confirming the diagnosis, the communication is often not visible, for example, diverticula with a very narrow opening or those joined to the trachea by just a fibrous tract.⁴ A recent case report documenting the pathologic specimen of a resected tracheal diverticulum specimen described a 2.4 × 1.5 × 0.8 cm³ tan brown multiloculated or cystic structure. The cyst wall measured 0.1 cm in thickness. An opening of 0.2 cm in diameter was noted on one aspect of the lesion though the opening was not seen during surgery.⁹

Pathophysiology

TD may be congenital or acquired. Congenital TD are thought to represent a vestigial supernumerary lung or aborted abnormally high division of the primary lung bud. They contain all normal layers of the tracheal wall and are therefore

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true diverticula.^{10,11} Acquired TD develop from mucosal herniation, believed to be due to increased intraluminal pressure causing outbulging through a weak part in the tracheal wall, which is devoid of any cartilaginous rings. Another mechanism that has been proposed for its development is cystic distension of the mucous gland ducts.^{7,11,12} Acquired diverticula are lined by respiratory-type ciliated columnar epithelium but do not contain other elements of the tracheal wall, such as smooth muscle and cartilage.^{9,10}

Prevalence

The overall prevalence of TD was found to be approximately 1% in an autopsy series published in 1953 by MacKinnon,⁷ who documented this condition in 8 cases in 867 routine serial autopsies. With the advent of CT, these structures have become visible more frequently and several studies that assessed the prevalence of TD on CT documented a much higher prevalence, ranging between 2% and 4%.^{1,2,13,14} In all, 2 recent studies have documented an even higher prevalence of 8%.^{15,16} This difference probably stems from the high spatial resolution multidetector CT and from the use of thin slices.

TD seem to affect both genders with a similar prevalence.^{2,13,15} However, several studies found that TD were more prevalent among women,^{16,17} whereas others documented a higher prevalence in men.¹⁴

Appearance of TD on CT

The appearance of TD varies, depending on their size and contents. Most TD are at the right posterolateral aspect of the upper trachea (Figs. 1 and 2), with left-sided diverticula being exceedingly rare (Fig. 3).^{1,2} Diverticula can be single (Figs. 1 and 3-5) or multiple (Fig. 2). Small diverticula often appear as small air bubbles, measuring less than 10 mm, surrounded by a very thin wall (Figs. 1-3). The larger ones may reach up to 30 mm, and they occasionally have a thick wall and contain debris with soft tissue density (Figs. 4-6). Occasionally, there is very little air within the diverticulum and it

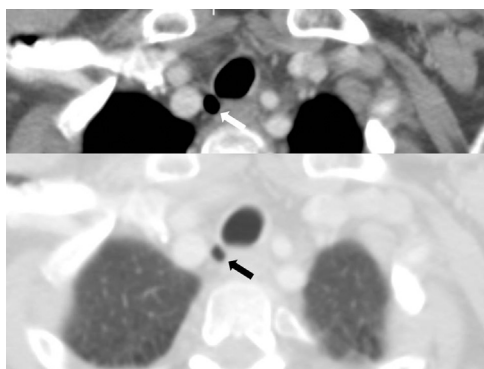


Figure 1 A tracheal diverticulum in a 57-year-old woman with breast cancer. Axial section at the level of T3 in soft tissue and lung windows shows a 1.0-cm diverticulum along the right posterolateral wall of the upper trachea in the right (arrow). Note emphysematous changes in the lung apices, suggestive of chronic pulmonary disease.

then appears as a round soft tissue nodule, which is indistinguishable from a mediastinal lymph node (Fig. 4).⁶ A communicating stalk between the diverticulum and the trachea is seen in approximately 50% of TD (Figs. 2, 5A, 6A).^{2,6,15,17} It is postulated that the connecting stalk is often not visible on CT because of its small size. Larger TD sometimes have a multilobular appearance with intracystic lace-like septations (Fig. 5C and D) and may show several vertical communicating channels, as also seen on autopsy.^{2,7} Interval increase in size and number of TD over various time intervals has been reported (Fig. 5).⁶

Clinical Significance

Most TD are asymptomatic and discovered incidentally; however, they may be associated with a wide range of clinical presentations.

Infection

MacKinnon, who reported 10 cases of TD studied on autopsy, found that mucoid or mucopurulent fluid was expressed into the trachea when pressure was applied to the diverticula. This suggests that the contents within these outpouchings have become infected and that the diverticula may thus serve as a reservoir of infected mucus.⁷

TD have been reported to be the underlying cause for recurrent respiratory tract infections, sometimes associated with intermittent episodes of streaky hemoptysis.¹²

Additional evidence that TD may become infected has recently been reported in a case describing avid fluorodeoxyglucose (FDG) uptake in a right mediastinal mass.¹⁸ An FDG PET/CT scan was performed for staging purposes in a patient with a known chronic lymphoproliferative disease. It revealed intense FDG activity at the periphery of a mediastinal mass lesion that had a relatively hypometabolic center. Correlation with a prior chest CT scan revealed the presence of a TD, which at that time had the typical appearance of a diverticulum and contained air. The mediastinal mass proved to be an abscess that was drained.¹⁸ We encountered a similar case when a patient with cystic fibrosis (CF) presented with a retrosternal fluid collection following bilateral lung transplant. A tagged white blood cell scan was performed to assess whether the postsurgical collection was infected. The scan revealed intense FDG uptake in a right paratracheal tracheal diverticulum, indicating infection (Fig. 6). No radiotracer uptake was seen within the retrosternal collection.

Associated Pulmonary Diseases

Chronic Pulmonary Disease

Diverticula are presumed to develop from mucosal herniation through a weak point as a result of increased intraluminal pressure, such as occurs in chronic cough. Several researchers have assessed the association between TD and chronic pulmonary disease, but this association remains controversial. In MacKinnon's autopsy series, all 10 patients with TD had a history of chronic cough of many years' duration.⁷

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