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Case report

Tracheal and main bronchial diverticula simulating pneumomediastinum following a motor vehicle collision $^{*, \div \div}$

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ABSTRACT

Tracheal and bronchial diverticula are outpouchings arising from the trachea or bronchus. We present a case of a 35-year-old female who presented to the emergency department following a motor vehicle accident and was found to have multiple round, air-filled structures within the mediastinum on computed tomography of the thorax, concerning for pneumomediastinum. The patient had a negative fluoroscopic esophagography and subsequent imaging indicated tracheal and bronchial diverticula. While they are often asymptomatic and incidentally found, tracheal and bronchial diverticula may be misdiagnosed as pneumomediastinum, especially in the setting of blunt or penetrating trauma to the thorax.

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Introduction

Pneumomediastinum is the presence of anomalous gas in the mediastinum. While there are many causes of pneumomediastinum, it is frequently associated with surgery, asthma, increased intrathoracic pressure, or blunt or penetrating traumatic injury [1]. Symptoms include retrosternal chest pain exacerbated by deep inspiration, dyspnea, odynophagia, and cough. In the setting of thoracic trauma, radiography or computed tomography (CT) of the thorax may be used to rapidly assess for pneumomediastinum, which may be demonstrated as subcutaneous emphysema, gas surrounding the major arteries or their branches, gas outlining the tracheal and bronchial wall or pericardium, or gas between the parietal pleura and diaphragm [1]. We present a patient found to have tracheal diverticula mimicking pneumomediastinum following a motor vehicle collision.

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Fig. 1 – CT of the thorax in axial plane demonstrating multiple air-filled rounded structures adjacent to the trachea and bronchial lumens (yellow arrows). Air-filled pockets within the esophagus are labeled with blue arrows.

Case presentation

A 35-year-old female with no significant past medical history presented to the emergency department (ED) as a level 2 trauma following a motor vehicle collision without loss of consciousness. The patient was an unhelmeted driver of a motorbike when she made impact with a car travelling approximately 40 miles per hour. The patient was hypertensive and had low oxygen saturation readings en route to the ED. On physical exam, the patient had a boggy hematoma on her posterior scalp and subcentimeter laceration on her occiput that was tender to palpation. The patient denied chest pain, shortness of breath and was devoid of chest tenderness or overt indications of chest trauma upon examination. Laboratory evaluation revealed an elevated blood alcohol concentration of 0.30 g/dL and low hemoglobin (9.5 g/dL) and hematocrit (29.3%).

Chest radiography did not indicate acute intrathoracic pathology. CT of the head revealed a small subarachnoid hemorrhage overlying the inferior frontal region within the perisylvian region. CT of the spine did not show acute fracture or spondylolisthesis and CT of the abdomen and pelvis did not reveal free fluid within the abdomen. CT of the thorax (Fig. 1 and Fig. 2) demonstrated prominence of the main pulmonary artery. There was a linear hypodensity extending across the lumen of the main pulmonary artery extending into the right pulmonary artery, concerning for traumatic injury. The mediastinum had multiple rounded and airfilled structures adjacent to the trachea and bilateral mainstem bronchi, concerning for pneumomediastinum. No evidence of obvious tracheal or bronchial rupture was noted. To further evaluate the potential pulmonary artery dissection, a follow-up cardiac-gated CT angiography of the thorax (Fig. 3 and Fig. 4) was obtained to limit the amount of motion artifact. The cardiac-gated study demonstrated no evidence of pulmonary dissection; however, multiple rounded air-filled sacs were once again seen in the mediastinum. Due to the cardiac gating, these air-filled sacs were more thoroughly evaluated and were determined to be communicating with the tracheal and main bronchial lumen bilaterally, suggesting diverticula. Fluoroscopic esophagography (Fig. 5) demonstrated normal peristalsis throughout the esophagus without evidence of extraluminal contrast leak or retention. There was no evidence of esophageal strictures, filling defects, or outpouchings.

The patient remained hemodynamically stable and was discharged 48 hours after the accident. The patient followed up with neurosurgery for her subarachnoid hemorrhage approximately one month after discharge. At that time, she denied any significant complaints. CT of the head prior to the appointment demonstrated complete resolution of the subarachnoid hemorrhage.

Discussion

Tracheal diverticula are congenital or acquired outpouchings lined by ciliated columnar epithelium arising from the tracheal wall that have direct communication with the lumen of the trachea [2]. These outpouchings occur most commonly in the right posterolateral aspect of the upper trachea, which is thought to occur due to the absence of anatomic protection (compared to the left lateral aspect of the trachea protected by the aortic arch and esophagus) [2,3]. Since congenital diverticula contain all normal layers of the tracheal wall, they are therefore true diverticula and thought to represent vestigial supernumerary lung or an aborted high division of the primary lung bud. Acquired tracheal diverticula develop from mucosal herniation secondary to increased intraluminal pressure at a weak portion of the tracheal wall [2,4]. For this reason, acquired diverticula are only lined by respiratory-type ciliated columnar epithelium.

Originally thought to be rare entities, their diagnosis is becoming increasingly more prevalent (4%-8%) given the more frequent thoracic imaging and improved spatial resolution of multidetector CTs [2,5,6]. Bronchial diverticula are less



Fig. 2 – CT of the thorax in the coronal plane demonstrating multiple air-filled rounded structures adjacent to the trachea and bronchial lumens (yellow arrows). Air-filled pockets within the esophagus are labeled with a blue arrow.



Fig. 3 – Cardiac-gated CT angiography of the thorax in the axial plane demonstrating numerous round and air-filled structures (red arrows) adjacent to the trachea and bilateral mainstem bronchi. Air within the esophagus is labeled with blue arrows.

studied. A study by Polverosi et al. found that out of 5,400 CT examinations of the thorax, only 5 patients had radiologic evidence of diverticula arising from the right mainstem bronchus or bilateral main bronchi [7]. Both tracheal and bronchial diverticula may occur concurrently. Kurt et al. reported that approximately 20.4% of patients with a tracheal diverticulum had evidence of at least one bronchial diverticulum [8].

While most acquired and congenital diverticula are asymptomatic, they may serve as a reservoir of infected mucus and may be the underlying cause of recurrent respiratory tract infections or streaky hemoptysis [9,10]. Patients may also report various symptoms such as odynophagia, dyspnea, stridor, dysphagia, or hoarseness [2]. Rarely, patients may present with dysphonia secondary to compression of the recurrent laryngeal nerve [11,12].

CT is the best imaging modality to detect diverticula of both the trachea and bronchi. Three-dimensional imaging allows the radiologist to evaluate the location, size, contour, and wall thickness of the diverticula. The characteristic findings of diverticula include a thin-walled, air-filled sac along the tra-



Fig. 4 – Cardiac-gated CT angiography of the thorax in the coronal plane demonstrating numerous round and air-filled structures (red arrows) adjacent to the trachea and bilateral mainstem bronchi. Air within the esophagus is labeled with blue arrows.



Fig. 5 – Fluoroscopic esophagography demonstrating normal flow of contrast through the esophagus without extraluminal extravasation of contrast.

cheal or bronchial lumen. Communication of the air sac with the tracheal or bronchial lumen may or may not be seen as its presence depends on the thickness and location of each crosssectional image. CT may aid in determining if the diverticula are congenital or acquired based on the presence or absence of cartilage and the size of the neck of the diverticula. Acquired diverticula are typically larger and have a wider communication with the lumen [11]. CT may also be useful for detecting complications such as diverticular wall inflammation, perforation, or abscess formation.

Tracheal and bronchial diverticula may vary greatly in size, with some measuring upwards of 30 mm. Larger diverticula occasionally have thick diverticular walls and often contain soft tissue density structures, which may replace air densities often seen in tracheal or bronchial diverticula [2]. This may make distinguishing the diverticula from a mediastinal lymph node difficult [13]. Larger diverticula may also have a multilobular appearance with intracystic lace-like septations and contain several communication channels [3,9]. The size and number of diverticula may increase over time [13].

Tracheal and bronchial diverticula may mimic other more serious entities that present as extraluminal paratracheal air, such as pharyngoesophageal (Zenker) diverticulum, apical herniation of the lung, apical paraseptal blebs or bullae, or pneumomediastinum [3,6]. CT of the thorax is useful in ruling out and differentiating between other common causes of extraluminal paratracheal air. A finding that supports a benign etiology includes an air density in the classic location for tracheal and bronchial diverticula, such as the right posterior paratracheal region at the thoracic inlet but located distant from the pulmonary pleura. Other findings that support diverticula include rounded diverticular walls to help differentiate diverticula from emphysematous changes, as well as direct visualization of a communication stalk with the trachea or bronchi. Given that it may be difficult to distinguish between a digestive or respiratory causes of pneumomediastinum, gastroesophageal studies (often fluoroscopic esophagography), are often needed to rule out a digestive etiology, such as a pharyngoesophageal (Zenker) diverticulum or esophageal rupture [14].

In a trauma setting, the importance in delineating airway diverticula from other life-threatening injuries, such as pneumomediastinum, becomes imperative in order to decrease patient morbidity and mortality. Evaluation of diverticula in the mediastinum may be accomplished with conventional CT. Due to the proximity of the heart to the mediastinum, cardiacgated studies may be considered to help minimize motion artifact and degradation and allow radiologists to more easily evaluate mediastinal structures. In our case, the cardiac-gated CT of the thorax allowed the radiologist to properly identify the air-sac connection with the adjacent airway, thereby establishing the diagnosis of air-way diverticula as opposed to pneumomediastinum. This finding was further confirmed with a negative fluoroscopic esophagography. Nevertheless, radiologists must remember that not all cases of air-filled foci outside of the tracheobronchial tree are true pneumomediastinum. Consideration of other benign etiologies, such as tracheal diverticula, will decrease the morbidity and mortality associated with further radiological testing and unnecessary exposure to radiation.

Conclusion

Tracheal and bronchial diverticula are most commonly incidentally found when imaging of the thorax is completed for another reason. They are either congenital or acquired outpouchings of the trachea or bronchi and are best seen on CT. Radiologic evidence supporting diverticula over other causes of air in the mediastinum include rounded sacs in the right posterior paratracheal region with direct visualization of the communication to the tracheal or bronchial lumen.

Patient consent

No consent obtained for this case report as this is a retrospective study with no patient identifiers.

"Formal consents are not required for the use of entirely anonymized images from which the individual cannot be identified - for example, x-rays, ultrasound images, pathology slides or laparoscopic images, provided that these do not contain any identifying marks and are not accompanied by text that might identify the individual concerned."

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