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Pathology of the Trachea and Central Bronchi

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A wide variety of disorders can affect the trachea and central bronchi. Computed tomography is the imaging modality of choice in the evaluation of tracheobronchial disease. Tracheobronchial abnormalities are sometimes incidentally detected on routine imaging or when imaging is performed for another reason. Abnormalities of the tracheobronchial tree, however, can be easily missed because they can be subtle. Furthermore, because symptoms in patients with tracheobronchial disorders often overlap symptoms of lung disease, radiologists may focus their attention on the lungs and overlook the tracheobronchial tree. In this article, we review a wide range of tracheobronchial diseases with emphasis on their computed tomographic appearances.

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Introduction and Anatomy

Although the trachea and central bronchi can be visualized with radiography, computed tomography (CT) is the imaging modality of choice in the evaluation of tracheobronchial disease. CT is noninvasive and provides high quality images. Furthermore, multiplanar reformatted images and three-dimensional volume-rendered images can help to assess the degree of luminal narrowing and the length of airway involvement. CT also allows evaluation of extratracheal abnormalities, for example, mediastinal adenopathy or lung nodules.

From inside to outside, the tracheal wall consists of mucosa, submucosa, cartilage or muscle, and adventitia (Fig. 1). Cartilage supports the anterior and lateral tracheal walls (cartilaginous trachea). The posterior tracheal wall (membranous trachea) lacks cartilage and is supported by the thin trachealis muscle. As a result, cartilaginous tracheobronchial disorders (tracheobronchopathia osteochondroplastica [TO] and relapsing polychondritis) spare the posterior wall of the trachea. Other pathologic conditions of the tracheobronchial tree include inflammatory (eg, sarcoidosis, amyloidosis, and Wegener granulomatosis), infectious (eg, bacterial, fungal, and rhinoscleroma), neoplastic (benign and malignant), traumatic, and congenital (eg, Mounier-Kuhn syndrome) disorders. Each of the aforementioned conditions will be reviewed in this article.

Tracheobronchopathia Osteochondroplastica (TO)

TO is a rare, benign condition characterized by osteocartilaginous nodules within the submucosa of cartilage-bearing airways. TO is seen in approximately 1 in 3000 autopsies.[1] The mean age of presentation is 51 years for women and 42 years for men but younger patients can also be affected.[2] Most patients are asymptomatic and the findings are discovered incidentally during bronchoscopy or on CT. Symptoms, when they occur, are due to airway narrowing from intraluminal protrusion of the submucosal nodules; severity of symptoms depends on the degree of airway compromise.[1] TO is usually a diffuse process; however, focal disease has been described. Histologically, TO represents submucosal deposits of abnormal cartilage with mineralization. To explain this process, 2 theories exist: (1) cartilaginous and osseous metaplasia of the

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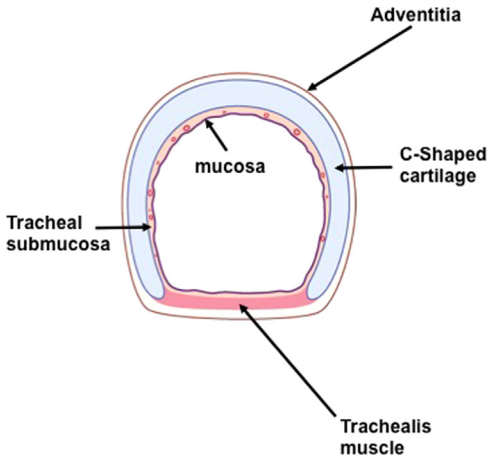

Figure 1 Cross-sectional depiction of trachea. From outside to inside, the trachea consists of mucosa, submucosa, cartilage or muscle, and adventitia. The posterior walls is devoid of cartilage. (Color version of figure is available online.)

submucosal elastic tissue and (2) ecchondrosis and exostosis from the underlying airway cartilage, in which these osseous and cartilaginous deposits in the submucosa are connected to the perichondrium of the cartilaginous rings.[3,4] Radiographic abnormalities may include nodularity and tracheal narrowing. CT is the imaging modality of choice revealing multiple calcified nodules that protrude into the airway lumen. These nodules involve the anterior and lateral walls of the trachea, sparing the posterior membrane (Fig. 2). Underlying tracheal cartilages may appear deformed or focally thickened (or both).[5]

Relapsing Polychondritis

Relapsing polychondritis (RP) is an uncommon episodic and recurrent systemic inflammatory disorder characterized by destructive and inflammatory lesions of cartilaginous and proteoglycan-rich structures.[6,7] The disorder affects all ethnic groups with most cases occurring between the fifth and sixth

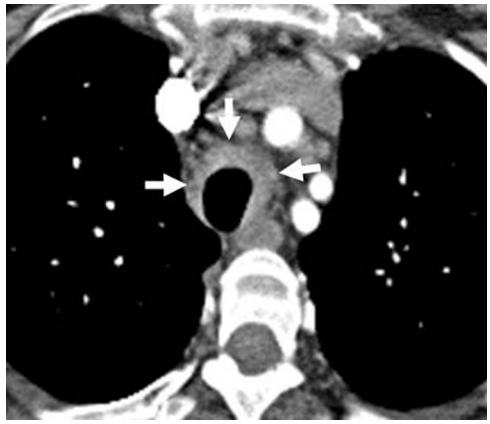

Figure 3 Relapsing polychondritis in a 57-year-old female with chest pain. Axial CT image demonstrates smooth thickening of cartilaginous trachea (arrows) with sparing of the posterior membrane.

decades. Some studies have demonstrated a female to male ratio of up to 3:1, whereas others have shown no gender differences.[7] The pathogenesis of RP is not well understood. Most authors favor an autoimmune-mediated response against collagen or other proteins found in cartilaginous tissue.[8] Diagnosis is clinical based on criteria modified by Michet et al.[9] The most common clinical feature is auricular chondritis, seen in up to 95% of patients. Inflammatory ocular involvement and mono or polyarthritis are also prevalent occurring in 50%-67% and 52%-85%, respectively.[6-9]

Laryngotracheal involvement is noted in up to 67% of patients and is a major cause of morbidity and mortality.[7] Patients with laryngotracheal involvement present with hoarseness, productive cough, shortness of breath, and stridor and wheezing. The value of radiography is limited; however, it may show decreased caliber of the tracheal air column or uneven or nodular calcification of tracheal cartilage. CT is an important imaging tool in the evaluation of these patients. The most common finding on CT is increased attenuation of the tracheal wall. Classic findings include diffuse, smooth thickening of the tracheal wall with sparing of the posterior membrane (Fig. 3). This may lead to narrowing of the affected airway. Repeated

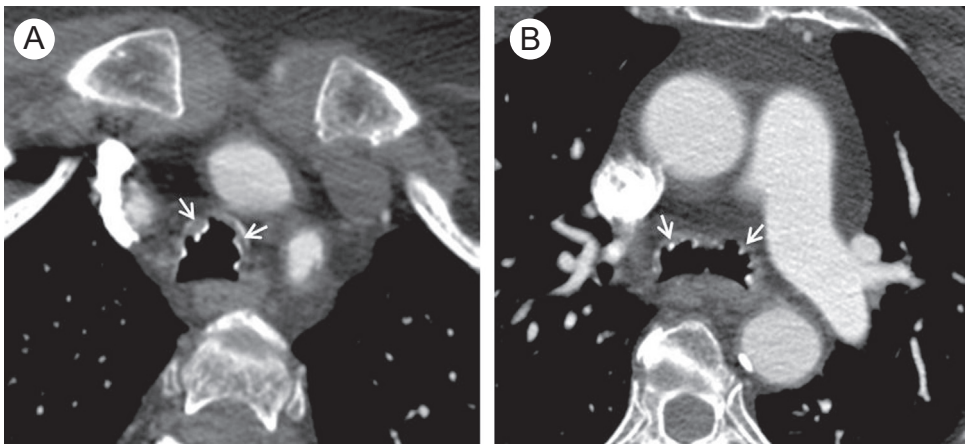

Figure 2 Tracheobronchopathia osteochondroplastica. Axial CT images showing calcific nodules arising from the tracheal cartilage in (A) and right and left bronchial cartilage in (B) (arrows). Note that the nodules spare the posterior membrane.