



ELSEVIER



CrossMark

Canadian Association of Radiologists Journal 66 (2015) 30–43

CANADIAN  
ASSOCIATION OF  
RADIOLOGISTS  
JOURNAL

[www.carjonline.org](http://www.carjonline.org)

Thoracic and Cardiac Imaging / Imagerie cardiaque et imagerie thoracique

## The Wonderful World of the Windpipe: A Review of Central Airway Anatomy and Pathology

David A. Lawrence, MD<sup>a,\*</sup>, Brittany Branson, MD<sup>b</sup>, Isabel Oliva, MD<sup>c</sup>, Ami Rubinowitz, MD<sup>b</sup>

<sup>a</sup>Department of Radiology and Medical Imaging, University of Virginia School of Medicine, Charlottesville, Virginia, USA

<sup>b</sup>Department of Diagnostic Radiology, Yale University School of Medicine, New Haven, Connecticut, USA

<sup>c</sup>Medical Imaging, University of Arizona College of Medicine, Tucson, Arizona, USA

### Abstract

A variety of pathologic processes can involve the central airways. Abnormalities may either diffusely or focally involve the tracheal or mainstem bronchial walls. Diseases that diffusely involve the tracheal wall can be subclassified as sparing the membranous trachea or circumferentially involving the tracheal wall. Focal diseases of the trachea and mainstem bronchi include benign and malignant causes. Additionally, congenital and acquired morphologic abnormalities of the trachea will be reviewed.

### Résumé

Les voies aériennes centrales peuvent être touchées par divers processus pathologiques. Ainsi, les parois de la trachée ou des axes bronchiques peuvent présenter des anomalies diffuses ou localisées. Les affections diffuses de la paroi de la trachée se divisent en deux sous-catégories selon qu'elles épargnent la membrane trachéale ou entraînent des atteintes circonférentielles de la paroi de la trachée. Pour leur part, les affections localisées de la trachée et des axes bronchiques peuvent être d'origine bénigne ou maligne. Enfin, nous examinerons certaines anomalies congénitales et acquises touchant les structures de la trachée.

© 2015 Canadian Association of Radiologists. All rights reserved.

*Key Words:* Tracheobronchial pathology; Central airway abnormalities; Tracheal neoplasms

A variety of diseases may affect the trachea and mainstem bronchi, ranging from neoplastic to inflammatory to congenital. The clinical manifestations of these diseases are frequently protean, including symptoms such as cough, hemoptysis, dyspnea, and wheezing. Often, these patients are misdiagnosed with asthma or chronic obstructive pulmonary disease (COPD).

The central airways can be evaluated with computed tomography (CT), which can detect widening or narrowing of the airway, airway wall thickening, the location of the abnormality to guide interventions, as well as associated findings in the mediastinum or lung parenchyma. However, CT is inferior to bronchoscopy in evaluating mucosal abnormalities and may underestimate disease extent.

In this article, we review the anatomy of the central airways and describe different pathologic conditions of the

central airways. We have tailored our approach to central airway abnormalities by grouping them into either diffuse or focal tracheal wall thickening, as well as morphologic abnormalities of the central airways.

### Anatomy

The trachea consists of 4 layers, including an inner mucosal layer, a submucosal layer, cartilage and muscle (specifically the trachealis muscle), and an outer adventitial layer, which includes lymphatics and connective tissue (Figure 1). The anterior trachea is composed of 16-22 C-shaped cartilaginous rings that are linked by annular ligaments of fibroconnective tissue (Figure 2) [1]. The function of the rings is to support the trachea during expiration. The posterior tracheal wall lacks cartilaginous support; only the trachealis muscle, a thin band of smooth muscle, supports it. The posterior aspect of the trachea is also known as the membranous portion of the trachea.

The trachea is approximately 10-12 cm in craniocaudal dimension, extending from the inferior aspect of the cricoid

\* Address for correspondence: David A. Lawrence, MD, Department of Radiology and Medical Imaging, University of Virginia School of Medicine, Box 800170, Charlottesville, Virginia 22908, USA.

E-mail address: [David.Lawrence@virginia.edu](mailto:David.Lawrence@virginia.edu) (D. A. Lawrence).

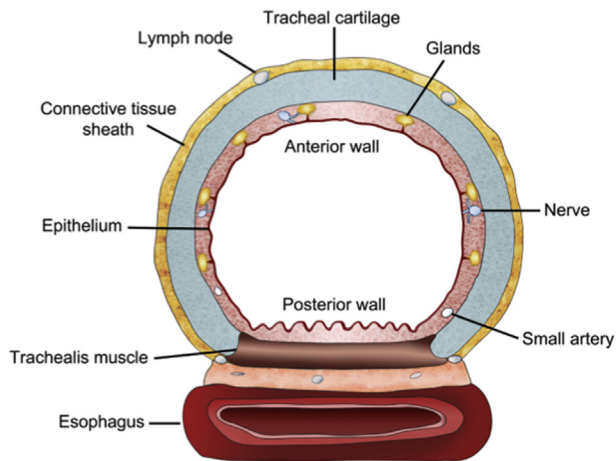


Figure 1. Tracheal wall anatomy. Note the horseshoe-shaped cartilaginous ring extending along the anterior and lateral walls of the trachea. The mucosa and submucosa are difficult to delineate on computed tomography in a normal trachea. This figure is available in colour online at <http://carjonline.org/>.

cartilage to the carina. The normal coronal diameter of the trachea is 13–25 mm in men and 10–21 mm in women, and the normal sagittal diameter is 13–27 mm in men and 10–23 mm in women [2]. On CT, the normal tracheal wall is 1–3 mm thick, delineated by the luminal air and mediastinal fat or lungs. Calcification of the cartilage can be associated with senescent changes, particularly in older women [3].

The superior aspect of the manubrium separates the extrathoracic and intrathoracic portions of the trachea [4]. During expiration, CT images will demonstrate physiologic anterior bowing of the posterior noncartilaginous aspect of

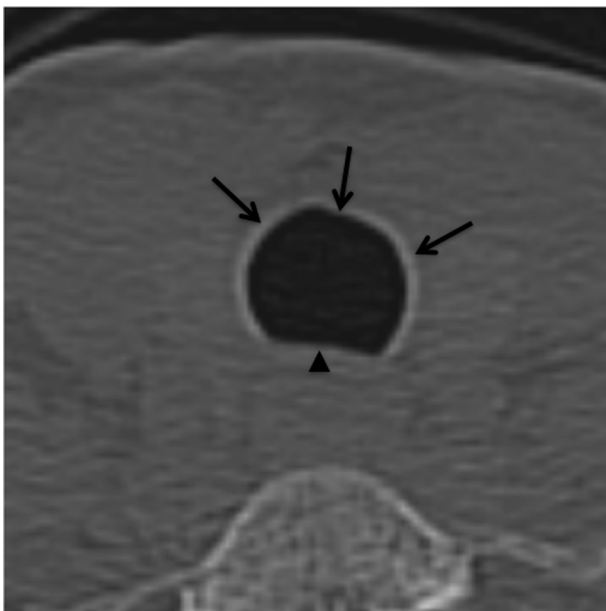


Figure 2. Normal tracheal anatomy on computed tomography. Axial computed tomography image of the trachea with bone windows demonstrates the anterior cartilaginous ring (arrows) as well as the membranous posterior wall of the trachea where the trachealis muscle is located (arrowhead).

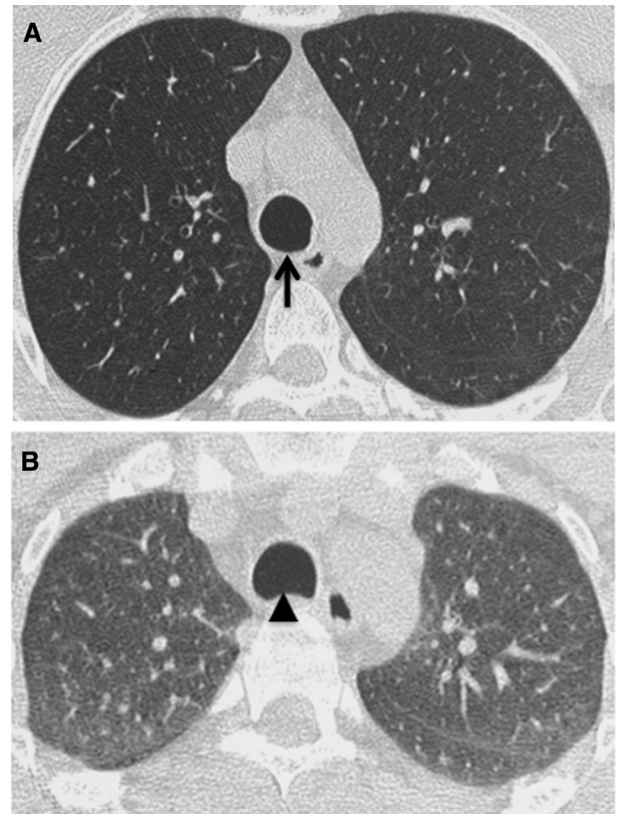


Figure 3. Normal inspiratory and expiratory computed tomography images. On inspiration (A), note that the membranous wall of the trachea bows posteriorly (arrow). On expiration (B), the membranous wall bows anteriorly (arrowhead). Note that the anterolateral walls change little in their morphologic appearance, due to the cartilaginous support.

the intrathoracic trachea with little change in contour of the anterolateral tracheal wall (Figure 3).

The mainstem bronchi are histologically similar, but have different morphologic features. The right mainstem bronchus courses posteriorly and superiorly to the right pulmonary artery (eparterial), while the left mainstem bronchus courses laterally and inferiorly in relation to the left pulmonary artery (hyarterial). The right mainstem bronchus is shorter, has a more vertical course, and originates more superiorly than the left mainstem bronchus.

### Imaging Techniques

Given the widespread availability of multidetector CT (MDCT) imaging, various 3-dimensional imaging techniques of the airways have become more readily available in recent years. While it is beyond the scope of this paper to review every postprocessing technique available, certain techniques are worth mentioning. As Boiselle et al. [5] explain, there are limitations with only reviewing axial CT images, including decreased sensitivity for detecting subtle airway stenoses, underestimating the craniocaudal extent of an airway stenosis, difficulty displaying the complex 3-dimensional relationship of the airways, and inadequate evaluation of airways that are oriented obliquely to the axial plane.

Download English Version:

<https://daneshyari.com/en/article/4220629>

Download Persian Version:

<https://daneshyari.com/article/4220629>

[Daneshyari.com](https://daneshyari.com)