

Anatomy, Head and Neck, Larynx, Arytenoid Cartilage

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Introduction

The arytenoid cartilages are paired pyramidal-shaped structures of cartilage found in the larynx, which are essential to the production of vocal sound. They are located on the lateral part of the superior border of the lamina of the cricoid cartilage and help form the cricoarytenoid joint. The arytenoid has the apex directed caudad where the cricothyroid cartilage is arising. The apex gives attachment to the aryepiglottic fold, while the base articulates with the cricoid cartilage lamina by the cricoarytenoid synovial joint. Each arytenoid has three surfaces (medial, posterior, and anterior) and two processes originating from the base. The thin anterior process (vocal process) grows attachment to the vocal ligament, which, in turn, supports the medial edge of the vocal fold. The thick lateral process (muscle process) is the point of attachment of the thyroarytenoid and cricothyroid (lateral and posterior) muscles. The posterior cranial surface receives the fibers of the thyroarytenoid muscle (transverse and oblique), while the medial surface is flat, smooth and covered by the mucosa that constitutes the lateral border of the posterior cricoarytenoid part of the glottis. The anterior surface gives strong attachment to the thyroarytenoid muscle near the base and is attached to the vestibular ligament near its apex [1][2][3].

Structure and Function

The arytenoid cartilages help move the vocal folds allowing tension, relaxation, or approximation of these because the vocal folds, being attached to the arytenoids, move along with them. Several intrinsic laryngeal muscles and ligaments are also attached to the arytenoids and can move them around. As stated above, the arytenoid cartilage articulates with the cricoid ring through several anterior and posterior ligaments forming the capsule of the cricoarytenoid joint. This allows two types of movement: a sliding motion of the arytenoid along its longitudinal axis and a rocking of the arytenoid cartilage throughout vocal fold abduction and adduction. The lateral cricoarytenoid muscle allows around rotation of the arytenoid on the cricoid cartilage, closing the laryngeal airway during deglutition, vocalization, and expiration. The thyroarytenoid muscle supports the arytenoid, which pulls the arytenoid together. The last muscle is likely more important during vocalization than during respiration. The contraction of the posterior cricoarytenoid muscle allows outward rotation of the arytenoid on the cricoid cartilage opening the airway during inspiration.

Embryology

The larynx begins to form around the fourth week of development as an outpocketing of the ventral wall of the primitive foregut called the laryngeal groove (or foregut). The development follows a craniocaudal progression, with the most superior thyroglottic cartilage arising first from the ventral wall of the foregut and the more caudal cricoid cartilage arising from the sixth branchial arch. The cartilages tissues from the fourth and sixth branchial arches merge and form the arytenoid, thyroax, cricoid, corniculate, and triticeal cartilages, except the epiglottis which comes from the third arch. The fifth branchial arch may play a role in the origin of the arytenoid and corniculate cartilages, but due to its rapid degeneration during the human development, its function is still unclear. The laryngeal cartilages, including the epiglottis, separate from the mesenchymal tissue adjacent to the notochord and notochord. In this way, the small foci of cells show a trend toward chondrocytic differentiation. The complete confluence of these foci and the formation of the definitive cartilages occur mostly postnatally. Arytenoid cartilages are of hyaline type (except the vocal process) as well as thyroax and cricoid cartilage, the other cartilages consist of elastic cartilage. Hyaline cartilage will be mostly after the age of 1 year, earlier in men than in women. In contrast to hyaline cartilages, ossification does not occur in elastic cartilage.

Blood Supply and Lymphatics

Blood supply to the arytenoid, as well as the entire larynx, is derived from the superior and inferior thyroid arteries. The superior thyroid artery branches from the external carotid artery and gives the superior laryngeal artery. The superior laryngeal artery accompanies the internal branch of the superior laryngeal nerve through the thyrohyoid membrane to supply the supraglottic region. It ends in the anatomical network in front of the cricothyroid membrane. The inferior thyroid artery comes off the thyrovascular trunk, itself originating from the subclavian artery and gives a terminal small cutaneous artery that accompanies the terminal segment of the recurrent laryngeal nerve. This vessel supplies the infraglottic larynx and gives two terminal small artery branches. The first branch supplies the posterior cricoarytenoid muscle, and the second passes along the lower border of the cricoid cartilage. Both of the two terminal branches give many anastomotic arteries to the terminals of the superior laryngeal artery. The drainage of the supraglottic structures (lingual, aryepiglottic folds, arytenoid, and false cords) follows the superior laryngeal and superior thyroid vessels. Thus, the lymphatics flow from the periglottic areas through the thyrohyoid membrane to and primarily in the deep jugular chain around the carotid bifurcation.

Nerves

The superior laryngeal nerve supplies sensory fibers to the mucosa of the supraglottis and the upper surface of the glottis. It also sends the motor nerve for the cricothyroid muscle, while the recurrent laryngeal nerve carries the sensory fibers from the mucosa of the subglottis and the lower surface of the vocal folds. The superior laryngeal nerve is also the motor nerve for all the intrinsic laryngeal muscles except the cricothyroid muscle.

- #### Muscles
- Several muscles are involved in arytenoid cartilage movement:
- The cricothyroid is a bilaterally paired and symmetrical muscle, arising from the anterior and lateral surfaces of the cricoid arch by two heads of origin. One inserts into the lower end of the thyroax cartilage, and the other inserts into the inferior horn of the thyroax cartilage. It is the only tensor muscle of the larynx, its action elevates the cricothyroid arch and depresses the thyroax lamina when activated. This directly decreases the cricothyroid space, which increases the length of the vocal folds, leading to a lengthening and stiffening of the vocal folds.
 - The thyroarytenoid muscle is bilobed and symmetrically paired. It attaches anteriorly on the midlateral plane of the internal face of the thyroax cartilage. Posteriorly it attaches to the vocal and muscular processes of each arytenoid cartilage. The thyroarytenoid muscle inflates and slightly adducts the vocal folds, which can result in changing the amplitude of vibration of the vocal folds.
 - The posterior cricoarytenoid muscle are paired muscles that take origin from the central ridge on the back of the cricoid cartilage to insert into the muscular process of the arytenoid cartilage. They are the main abductors of the vocal folds. By moving the arytenoid cartilages laterally, they abduct the vocal folds and thereby open the rima glottidis. Their action opposes the lateral cricoarytenoid muscles.
 - The lateral cricoarytenoid muscle attaches along the superior border of the lateral cricoid cartilage and sends its fibers to the muscular process of the arytenoid. This muscle is the main antagonist of the posterior cricoarytenoid. It rotates the arytenoid medially, representing the main adductor of the vocal folds and closing the rima glottidis.
 - The oblique arytenoid muscle passes diagonally from the muscular process of one arytenoid cartilage to the superior pole of the opposite one, abducting arytenoid cartilages and closing the rima glottidis.
 - Some fibers of the oblique arytenoid travel along the quadrangular membrane in the aryepiglottic fold as the aryepiglottic muscle. Both this muscle and the oblique arytenoid muscle help to close the slit of the larynx during deglutition.
 - The interarytenoid muscle is the only unpaired intrinsic muscle of the larynx and consists of both transverse and oblique fibers. The transverse fibers insert in the posterior end of each arytenoid and run horizontally, while the oblique fibers attach to each arytenoid apex and run obliquely to attach to the posterior face on the opposite side. Contraction of this muscle brings together the arytenoid cartilages and closes the posterior portion of the glottis.

Physiologic Variants

Arytenoid sclerosis may be seen on a CT scan as a normal variant in 13% of symptom-free patients who do not have laryngeal carcinoma. This finding is more common in women than in men, and there is a left-side predominance. The arytenoid cartilage can rarely be fused between the two arytenoid cartilages inside the ligament, extending between the superior border of the cricoid and the two arytenoid cartilages. This is a nodular of hyaline cartilage [4][5].

Surgical Considerations

Endoscopic arytenoidectomy with or without cordectomy became the most accepted intervention for the permanent bilateral vocal cord paralysis at the end of the 20th Century to enlarge the stenois airway and practically replaced the external laryngeal methods. Removal of arytenoid cartilage (i.e., arytenoidectomy) is a permanent and irreversible procedure, by which the glottal inlet is expanded in its transverse area, providing a larger airway for respiration. Lateralization of the arytenoid and/or the attached vocal fold has emerged as an alternative surgical approach for permanent bilateral vocal cord paralysis with good success rates. Due to its irreversible nature, lateralization has greater success than other conventional surgical options based on the fact that it enlarges the airway avoiding damage to the voicing mechanism of the larynx, thus preserving the physiologic adductive functions (vocalization and deglutition) by removal of the procedure. Arytenoid cartilage mounted on the cricoid ring, with a functioning recurrent laryngeal nerve and lateral and posterior cricoarytenoid muscles from the cricoarytenoid joint is a functional unit critical to phonatory and sphincteric functions of the larynx. According to this concept, surgeons should pay attention to the management of laryngeal cancer for the organ preservation, they should be able to maintain physiological functions of the larynx, namely speech, respiration, and swallowing, without compromising the long-term control of cancer.

Clinical Significance

Laryngeal contact granuloma is a common disorder that occurs on the medial surface of the arytenoid cartilage, precisely around the vocal process. It is usually believed to be primarily caused by gastroesophageal or laryngopharyngeal reflux, mechanical injury, and vocal cord abuse or misuse. This anatomic region is particularly prone to being irritated and thus responding with the exaggerated healing that produces inflammatory granulation tissue. Hence, most granulomas occur in this location [6].

Anterior or posterior arytenoid dislocation subsequent to intubation is repeatedly reported in anesthetic practice. The arytenoid and cricoarytenoid joint are relatively fragile and vulnerable to injury during laryngoscopy. This results in one of the most frequent post-anesthetic complaints, hoarseness, and also one of the most severe, airway compromise. The diagnosis of arytenoid cartilage dislocation should be considered in all cases of vocal fold hypermobility and immobility using videofluoroscopy or even CT scans to allow an early diagnosis and treatment to normalize or improve joint mobility.

Erythema of the mucosa over the arytenoid cartilages is a common finding during laryngoscopy often related to chronic inflammatory changes, especially the laryngopharyngeal reflux. However, this finding alone tends to make the diagnosis of laryngopharyngeal reflux doubtful because it can vary based on the light source, endoscope type, and video monitoring use.

Other Issues

Cricothyroidal arthritis (CA) occurs as a systemic manifestation of rheumatoid arthritis. Symptoms of CA include laryngeal fullness when swallowing and speaking, hoarseness, and dyspnea. It can be a cause of recurrent upper airway obstruction in rheumatoid arthritis. On endolaryngoscopy, abductoid vocal cords are a significant finding. The laryngoscopic findings include myositis of the intrinsic laryngeal muscle, mucosal edema, hyperemia, swelling and inflammation of the mucosal folds, arytenoid, and aryepiglottic folds and epiglottis, and immobility of the cricothyroid joint [7]. The cricothyroid joint can also be affected in dermatomyositis [8]. Thus, pathology of the cricothyroid can be a sign of underlying systemic disease. Additionally, arytenoid chondritis develops following trauma to the mucosa of the arytenoid cartilage or due to invasion of bacteria into the cartilage [11].

Review Questions

- Assess the anatomic relation of the arytenoid cartilage.

The Larynx, the cartilages of the larynx. Posterior view, Epiglottis, Thyroid, Arytenoid, Cricoid. Contributed by Gray's Anatomy Plates

The arytenoid cartilage in relation to the larynx. Contributed from Wikimedia User: Aastam070 (CC BY-SA 3.0 https://creativecommons.org/licenses/by-sa/4.0/deed/en)

Diagram of arytenoid adduction procedure, lateral view. Contributed from Wikimedia User: Donald Zhang (CC BY-SA 4.0 https://creativecommons.org/licenses/by-sa/4.0/)

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