Role of hemithyroidectomy during total laryngectomy for laryngeal carcinoma patients

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Abstract

This study aimed to asess the incidence of thyroid gland involvement, factors favoring TGI, indications of hemithyroidectomy, and postoperative complications. It is a prospective analytical study that was performed at the otorhinolaryngology Head and Neck surgery departement, Kasr El Aini Hospital, Cairo University during the period from October 2012 to August 2014. It included 40 patients who were diagnosed T 3 or T 4 laryngeal carcinoma and candidate for total laryngectomy with at least hemithyroidectomy. Statistical analysis was carried out to determine the incidence of thyroid gland invasion clinically, radiologically and histopathologically in laryngeal carcinoma and to correlate it with site and stage of the primary tumor vocal cord fixation, subglottic extension, and prior radiation. Our study included 40 patients; 37 were males (92.5%). The mean age was 61.1 years. We found 4 cases (10%) had thyroid gland invasion by laryngeal carcinoma all were males (100%), two cases (5%) had colloidal nodules and one case (2.5%) had follicular adenoma.

Keywords

Carcinoma Patients, Hemithyroidectomy, *Laryngectomy, CRT,CT*

Contents

List of Abbreviations

Abbreviations	***What they stand for***
AJCC	American Joint Committee on Cancer
CNS	Centeral nervous System
CRT	*Chemoradiotherapy*
CT	Computed Tomography
DVT	Deep venous thrombosis
Fig	Figure
FNAC	*fine-needle aspiration cytology*
HPV	Human papilloma virus
ICA	Internal carotid artery
ICU	Intensive Care Unit
LC	Laryngeal carcinoma
MRI	Magnetic Resonance Imaging
PET	*Positron emission tomography*
PGS	*Paraglottic space*
RT	Radiotherapy
SCC	Squamous Cell Carcinoma
SD	Standerd deviation
SGE	Subglottic extension
TG	Thyroid gland
TGI	Thyroid gland invasion
TL	Total laryngectomy
TSH	Thyroid stimulating hormone
WHO	World Health Organization

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Anatomy of the Larynx, Trachea and Thyroid gland

The Larynx

A detailed understanding of laryngeal embryology and anatomy is necessary to understand patterns of spread of laryngeal cancer and help understand its clinical behavior (**Cummings et al., 2012**).

Development

Embryologically, the supraglottic part of the larynx arises from the third and the fourth branchial arches, while the glottic and subglottic portions are derived from the sixth arch.

The first appearance of the respiratory tract occurs at approximately 21 days during embryogenesis as an evagination or a vertical groove of the cephalic portion of the foregut **(O'Rahilly et al., 1984).**

The respiratory groove begins to close and with the formation of the arytenoids, the closure becomes complete **(Fechner and Mills, 1997).**

The tracheobronchial diverticulum stalk develops by 3rd week, The cephalic end develops into the glottis and infraglottis, and the rest becomes the trachea which becomes separated from esophagus at 4^{th} – 5^{th} week by tracheoesophageal septum **(Zaw-Tun et al., 1985).**

Above the respiratory primordium, pharyngeal mesoderm compresses the foregut lumen cranially. This mesoderm also raises an epiglottic and two arytenoid swellings in the pharyngeal floor at the level of the fourth pouches **(O'Rahilly and Muller 2001).**

The triangular laryngeal caecum is bounded by these swellings and grows caudally between the lamina and epiglottis. The epithelial lamina separates cephalocaudally, connecting the laryngeal caecum with the pharyngoglottic duct to form the laryngeal vestibule; when the separation is complete, the vestibule is continuous with the infraglottic cavity. Meanwhile, bilateral pouches arising from the caudal end of the caecum form the ventricles, the lower lips of which become the vocal folds **(Zaw-Tun et al., 1985).**

The vestibule and ventricles receive sensory innervations from the internal branch of the superior laryngeal nerve of the fourth arch, while sensation to the infraglottic larynx is from the recurrent laryngeal nerve of the sixth arch **(Doménech-Mateu & Sañudo 1990).**

Pharyngeal mesoderm surrounding the laryngeal cavity gives rise to the laryngeal cartilages and intrinsic musculature. The laryngeal cartilages are derived from the fourth and sixth pharyngeal arches **(O'Rahilly and Muller 2001).**

The cricoid arises from 6^{th} branchial arch at 5^{th} week of gestation and chondrifies at 6^{th} week bilaterally from a single centre in the ventral arch of a precartilaginous template which encircles the infraglottic cavity, and on meeting forms the dorsal lamina. Each arytenoid chondrifies from a single centre and each lamina of the thyroid cartilage chondrifies from two **(Doménech-Mateu & Sañudo 1990).**

At birth, the epiglottis is close to the soft palate, this proximity can close off the oral cavity, so protecting the airway during suckling when breathing and drinking occurs simultaneously **(O'Rahilly and Muller 2001).**

Laryngeal Skeleton

The larynx is an air passage, extends from the tongue base to the trachea. It opens above into the laryngopharynx and forms its anterior wall; below, it continues into the trachea. It lays opposite the third to sixth cervical vertebrae, although it is higher in children and adult females **(Terracol et al., 1965).**

Its major functions are lower airway protection, respiration, and phonation (**Pressman 1942).**

It projects ventrally in the neck and is covered anteriorly by skin, fasciae and the hyoid depresssor muscles **(Terracol et al., 1965).**

Its average measurements in adults are:

In males: length 44 mm, transverse diameter 43 mm, sagittal diameter 36 mm.

In females: length 36 mm, transverse diameter 41 mm, sagittal diameter 26 mm (**Eckel et al., 1994**).

The hyoid bone

The hyoid bone is intimately associated with the larynx, although it is regarded as a separate structure with distinctive functional roles**.** It is connected to the intrinsic laryngeal cartilages by the thyrohyoid membrane and muscles as well as by the median and lateral thyrohyoid ligaments. Via the hyoid bone, the larynx is linked to the suprahyoid muscles and to the floor of the mouth. In addition, it is linked to the styloid process of the temporal bone by the stylohyoid ligament **(Doual et al., 2003).**

Laryngeal Cartilages

Cartilages form the skeletal framework of the larynx. They are interconnected by ligaments and fibrous membranes, and moved by a number of muscles **(O'Rahilly and Muller 2001).**

The laryngeal cartilages comprise the single cricoid, thyroid and epiglottic cartilages, and the paired arytenoid, cuneiform and corniculate cartilages. **(Armstrong and Netterville, 1995). Fig1**

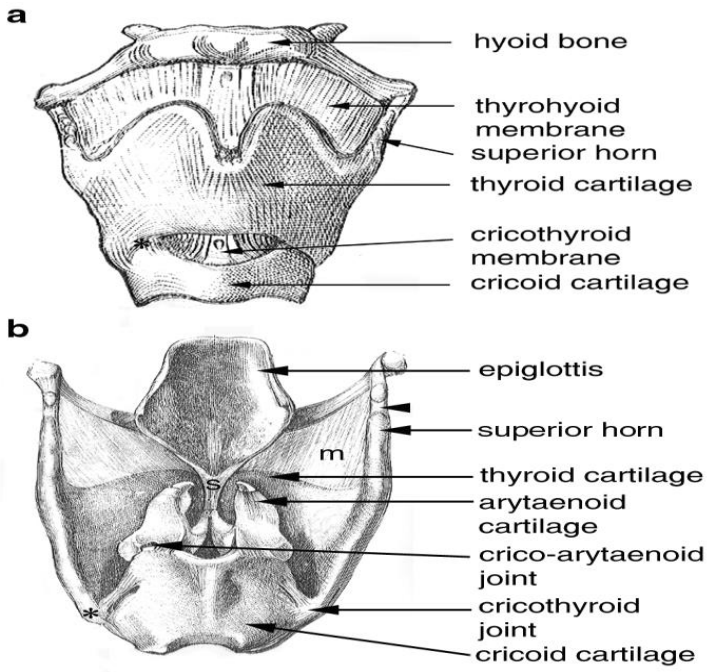

Fig1: Laryngeal skeleton. (a) Ventral aspect, (b) dorsal aspect (**Rosen and Simpson 2008)**.

Thyroid Cartilage

It is the largest cartilage, and composed of two rectangular laminaefused anteriorly in the midline with incomplete fusion superiorly forms the thyroid notch. Attached to each lamina posteriorly are the superior and inferior cornua. The superior cornua articulate with the greater horns of the hyoid bone, while the inferior cornua form a synovial joint with the cricoid cartilage (cricothyroid joint) **(Sellars & Keen 1978).**

The sternothyroid and the thyrohyoid strap muscles attach to the anterior surface of the thyroid laminae at the oblique line. The inferior pharyngeal constrictor muscles insert on the posterior edge of each thyroid lamina **(Bannister et al., 1995).**

In the upper part of the angle at the inner surface, the thyro-epiglottic ligament is attached; below this, near the midline, the paired vestibular and vocal ligaments and the thyro-arytenoid muscles are attached. The thyrohyoid membrane is attached along the superior border of each lamina. It is connected to the cricoid cartilage by the anterior (median) cricothyroid ligament. The level of the vocal fold lies closer to the lower border of the thyroid cartilage lamina and not at its midpoint **(Bannister et al., 1995).**

The Cricoid Cartilage

It is signet ring-shaped and considered the skeletal foundation of the larynx, as it is the only laryngeal cartilage to encircle completely the airway.

The inferior border of the cricoid is joined to the first tracheal cartilage by the cricotracheal ligament. The superior border of the cricoid runs obliquely up and back, giving attachment anteriorly to the thick median part of the cricothyroid ligament, and laterally to the membranous lateral parts of the cricothyroid ligament **(Sellars & Keen 1978).**

Cricoid has a narrow curved anterior arch and a broad, flatter posterior lamina. The posterior lamina is quadrilateral in outline. It has a posterior median vertical ridge, to

which the oesophageal muscle fibres (muscularis externa) are attached by a tendon. Lateral to it the fibres of the posterior crico-arytenoid muscle. The cricothyroid muscle is attached to the external aspect and behind this, the cricopharyngeus part of the inferior pharyngeal constrictor **(Bannister et al., 1995).**

The Epiglottis Cartilages

The epiglottis is an oblong, feather-shaped fibroelastic cartilage projecting obliquely upwards behind the tongue and hyoid body, and in front of the laryngeal inlet.

Its free end, is broad and round is directed upwards, while its attached part, or stalk (petiolus) is long and narrow, and is connected by the elastic thyro-epiglottic ligament to the back of the laryngeal prominence just below the thyroid notch.

Its sides are attached to the arytenoid cartilages by aryepiglottic folds and its free upper anterior surface is connected to the tongue and the lateral pharyngeal walls by a median glosso-epiglottic and two lateral glosso-epiglottic folds. On each side of the median fold is a depression, the vallecula. The lower part of the anterior surface is connected to the hyoid bone by an elastic hyo-epiglottic ligament, and separated from the thyrohyoid membrane by adipose tissue **(Bannister et al., 1995).**

The cartilage is pitted posteriorly by small mucous glands and perforated by branches of the internal laryngeal nerve **(Bannister et al., 1995).**

The major function of the epiglottis is to prevent aspiration during swallowing. The epiglottis is displaced posteriorly by tongue base contraction and laryngeal elevation **(Fink et al., 1979).**

The Arytenoid Cartilages

The arytenoid cartilages are paired, pyramidal cartilages that are placed on the lateral part of the cricoid lamina's superior border at the back of the larynx at the

cricoarytenoid joint. Each is pyramidal, with three surfaces, two processes, a base and an apex **(Sellars & Keen 1978).**

The posterior surface is triangular, smooth and concave, is covered by the transverse arytenoid muscle. The anterolateral surface is convex and rough; on it, a crest curves back, down and then forwards to the vocal process. The medial surface is narrow, smooth, and flat; it is covered by mucosa and forms the lateral boundary of the intercartilaginous part of the rima glottidis) **(Bannister et al., 1995).**

The base is concave, with a smooth surface for articulation with the cricoid lamina. Its prominent lateral muscular process projects backwards and laterally, giving attachment to the posterior crico-arytenoid muscle behind and the lateral cricoarytenoid in front. To its pointed anterior angle (the vocal process), projecting horizontally forward, is attached the vocal ligament. The apex curves backwards and medially to articulate with the corniculate cartilage **(Sellars & Keen 1978).**

Corniculate Cartilages

The cartilages are paired conical nodules of elastic fibrocartilage that articulate with the apices of the arytenoid cartilages, prolonging them posteromedially and move with, the corresponding arytenoid. The soft tissue of the aryepiglottic folds covers these cartilages **(Bannister et al., 1995).**

Cuneiform Cartilages

They are small, elongated, club-like nodules paired, fibroelastic cartilages that sit laterally to each of the arytenoids, and are completely embedded within the aryepiglottic folds. These likely serve to provide additional structural support to the aryepiglotticfolds **(Bannister et al., 1995).**

Tritiate Cartilages (Cartilago Triticea)

The tritiate cartilages are two small nodules of elastic cartilage situated one on either side above the larynx within the posterior free edge of the thyrohyoid membrane, about halfway between the superior cornu of the thyroid cartilage and the tip of the hyoid's greater cornu. They may serve to strengthen this connection **(Bannister et al., 1995).**

Microstructure of Laryngeal Cartilages

The corniculate, cuneiform, tritiate and epiglottic cartilages and the apices of the arytenoids are composed of elastic fibrocartilage with little tendency to ossify or calcify. The thyroid, cricoid and greater part of the arytenoids consist of hyaline cartilage and may undergo mottled calcification or ossification as age advances **(Doménech-Mateu & Sañudo 1990).**

Laryngeal Musculature

The muscles of the larynx are divisible into extrinsic and intrinsic groups. The extrinsic muscles are responsible for moving it vertically during phonation and swallowing; they include the thyrohyoid and sternothyroid muscles, and the thyropharyngeus and cricopharyngeus components of the inferior pharyngeal constrictor **(Claassen and Werner, 1992).**

Intrinsic Laryngeal Muscles

They are confined to the larynx in their attachment **(Claassen and Werner, 1992). Fig 2.**

The intrinsic muscles of the larynx are responsible for altering the position of the vocal folds by changing the orientation of the muscular and vocal processes of the