COMPARATIVE STUDY BETWEEN CT AND LARYNGOSCOPY IN EVALUATION OF CANCER LARYNX

Thesis

Submitted in Partial Fulfilment for the M.D. Degree
In Radio-Diagnosis

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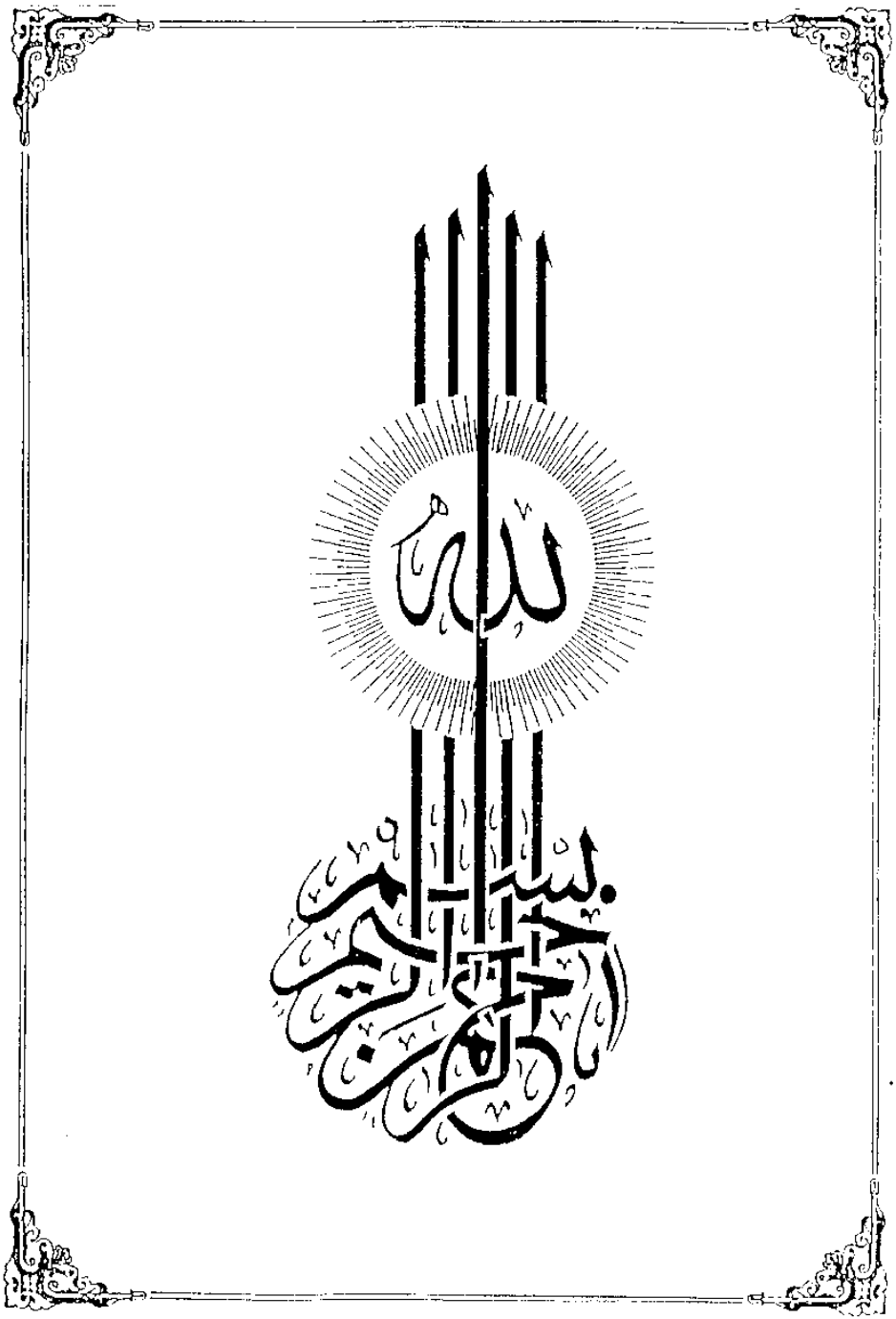
FACULTY OF MEDICINE

AIN SHAMS UNIVERSITY

1990

Dedication

To my parents and grandparents



Acknowledgement

I wish to express my sincere gratitude to Professor MOHAMED SAMI EL-BEBLAWI, *Head of Radiology Department, Ain Shams University, for his patience, continuous support and valuable comments throughout this work.*

I also wish to thank Dr. YOUSSEF HAMED ZAKI, *Assistant Professor of Radiodiagnosis, Ain Shams University, and Dr.* MOHAMED ZAKI HELAL, *Assistant Professor of E.N.T., Ain Shams University, for their guidance, support and ecouragement.*

Dr. KHALED TALAAT, *Lecturer of Radiology, Ain Shams University, Deserves a special mention for his genuine interest, stimulating suggestions, help and co-operation that made the accomplishment of this work possible.*

Last but not least, I wish to acknowledge the effort of FREDDIE *who handled the manuscripts of this work professionally with rare patience and enthousiasm.*

CONTENTS

INTRODUCTION AND AIM OF THE WORK

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Approximately 20% of all malignant tumours of the head and neck originate in the larynx. Carcinoma of the larynx is, in fact, the second most common neoplasm of the respiratory tract and is superseded only by carcinoma of the lung *(Unger et al., 1987)*. With appropriate treatment laryngeal cancer does, however, have a generally favorable prognosis with overall 5-years survival rate of 67% *(Cummings et al., 1986)*.

Therapy for malignant laryngeal tumours is dependent on the precision of the initial staging of the disease. The decision between radiation therapy, conservation therapy or total laryngectomy requires a very accurate delineation of tumour extent to provide the simplest, least invasive form of therapy while avoiding treatment failure *(Ogura and Biller, 1969)*.

Direct laryngoscopy has been used in clinical practice for almost a century and is considered by many clinicians to be the single most valuable tool for diagnosing and staging laryngeal cancer.

The introduction of computed tomography (CT) in 1972 has revolutionized laryngeal radiology by providing the possibility of exquisite soft tissue and framework imaging presented in an axial format to provide the clinician with information that could not be obtained by clinical examination, thus rapidly gaining acceptance as the imaging modality of choice for the larynx.

The aim of this work is to compare CT and direct laryngoscopy in the evaluation of laryngeal cancer emphasizing the advantage and limitations of each of these modalities with special emphasis made on the potential impact of their findings on patient management.

ANATOMY OF THE LARYNX

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A detailed knowledge of laryngeal anatomy and its appearance in the transverse plane is essential for accurate interpretation of CT scans of the larynx.

The larynx lies within the visceral compartment of the neck, being continuous with the hypopharynx above and the trachea below, with a vertical extent corresponding to the 4^{th}, 5^{th} and 6^{th} cervical vertebrae in the adult. The average length of the larynx is 44 mm in males and 36 mm in females *(Newton et al., 1988).*

The larynx is situated within the neck between paired structures, including the sternocleidomastoid muscles, suprahyoid and infrahyoid strap muscles and carotid sheaths. The larynx itself is also formed mainly of paired structures, so that alteration of its normal symmetry is useful in recognizing pathological conditions *(Mancuso and Hanafee, 1985)*, however, a degree of normal asymmetry must be appreciated in order to avoid misinterpretation *(Glazer and Sagel, 1980).*

The larynx consists of an articulated cartilagenous skeleton, with ligaments, muscles and soft tissues combining to form a sphincter at the entrance to the lower airway.

Discussion of the normal anatomy of the larynx is divided into considerations of the laryngeal skeleton, laryngeal membranes and ligaments, laryngeal muscles and laryngeal cavity with emphasis on the CT appearance of laryngeal structures at different levels.

The hyoid bone and piriform sinuses are not anatomically part of the larynx, but their intimate contact with the larynx (the piriform sinuses actually lie within the confines of the laryngeal skeleton despite being part of the hypopharynx) justifies their inclusion in the discussion of laryngeal anatomy.

Laryngeal Skeleton

Three large single cartilages (cricoid, thyroid, epiglottic) and three small paired cartilages (arytenoid, corniculate, cuneiform) comprise the laryngeal skeleton.

The cricoid and thyroid cartilages provide the major supporting framework of the larynx. The epiglottic cartilage helps to protect the airway from aspiration. The arytenoid, corniculate and cuneiform cartilages form struts within the larynx that support the intrinsic laryngeal soft tissues.

The cartilages have a unique appearance at each level within the larynx providing for rapid orientation of any given laryngeal CT section *(Mancuso and Hanafee, 1985).*

Calcification of laryngeal cartilages varies widely, generally being more extensive in men and progressing with age *(Archer et al., 1978).*

Cricoid Cartilage

The cricoid cartilage is the foundation of the larynx. It is shaped like a signet ring and is the only complete cartilagenous ring in the airway *(Last, 1972).*

The lamina is the broader posterior portion measuring 2 to 3 cm vertically, the cricoid arches slope inferiorly from their junction with the lamina to join and close the ring anteriorly where they measure 5 to 7 mm in height. This sloping creates a gap between the cricoid and thyroid cartilage which is filled in by the conus elasticus *(Hollinshead, 1968).*

The facets for the cricoarytenoid joints sit atop the shoulders of the cricoid lamina. The upper-most portion of the cricoid lamina marks the level of the true vocal cords.

The cricothyroid joints are formed by the inferior horns of the thyroid cartilage articulating with the posterolateral aspect of the cricoid arch, with a normal separation of approximately 1.5 mm between the two. These joints identify the low subglottic region.

In adults, the cricoid cartilage usually appears completely mineralized on CT scans. It typically has a calcified surface and low density center analogus to the cortex and medullary space of long bones *(Mancuso and Hanafee, 1985).*

Thyroid Cartilage

The thyroid cartilage is the largest of the laryngeal cartilages. It is open posteriorly and composed of two laminae that meet at an acute angle anteriorly in the midline being indented superiorly by the thyroid notch. Normal paramedian thinning of the thyroid laminae may be seen anteriorly. The V-shaped contour of the laminae is an unmistable land mark at the level of the true vocal cords, a rounded contour is noted more caudally. The infrahyoid strap muscles are seen as soft-tissue bands anterior and parallel to the thyroid laminae *(Lee et al., 1988).*

Posteriorly, the thyroid laminae are elongated superiorly and inferiorly to form the cornua or horns. The superior horns provide attachment for the hyothyroid ligament which contains the tiny calcified tricticeal cartilages. The inferior horns articulate medially with the sides of the cricoid cartilage at the cricothyroid joint *(Last, 1972).*

Calcification of the thyroid cartilage varies with age and sex, generally being symmetrical, more in males and increasing with age. the most common pattern of calcification is that of a well-defined cortical shell surrounding a medullary cavity. Focal areas of calcification may occur causing confusion in the diagnosis of neoplastic destruction *(Archer and Yeager, 1979).*

Epiglottic Cartilage

The epiglottis forms the anterior wall of the laryngeal vestibule. The epiglottic cartilage extends within the epiglottis to a level above the hyoid bone. it is leaf shaped with its narrow base, the petiole, attached via the thyroepiglottic ligament to the thyroid lamina just below the thyroid notch. The epiglottis is broadest at its free portion just above the hyoid bone level providing attachment for the hyoepiglottic ligament coursing anteriorly within the pre-epiglottic space deep to the hyoid bone.

The epiglottis rarely calcifies as it is elastic cartilage, however, with high resolution scanners, discontinuous calcific plaques can sometimes be detected. The position of the epiglottic cartilage must otherwise be inferred from its anatomic location *(Moss et al., 1983).*

Arytenoid Cartilages

The paired pyramidal arytenoid cartilages articulate with the superior edge of the cricoid lamina. The small, tapering vocal processes project anteriorly from the base of the arytenoids to attach to the vocalis muscles and are the best landmarks for defining the level of the true vocal cords. The top of the cricoid cartilage can be seen between the arytenoids at this level. the foot processes of the arytenoid cartilages project superiorly at the level of the false vocal cords, whereas

the muscular processes extend posterolaterally towards the thyroid laminae with a normal separation of 2 mm or less *(Lee et al., 1988).*

During quiet respiration, with the true cords relaxed the arytenoids are abducted, with phonation or valsalva maneuver, the arytenoid cartilages adduct and rotate medially approaching the midline narrowing or completely closing the rima glottidis *(Newton et al., 1988).*

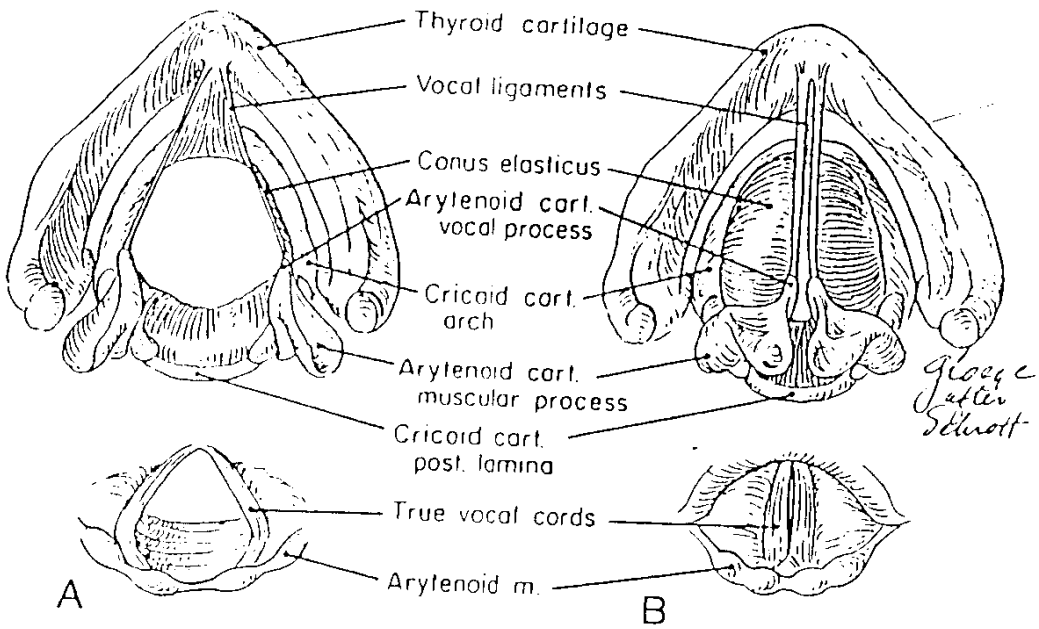

Fig. (1): Views from above of the cricothyroid complex made during quiet respiration (A) and phonation (B) with accompanying endoscopic views *(Mancuso and Hanafee, 1985).*

The arytenoids are very often densely and homogeneously calcified, often appearing on CT to be the most radiodense structures in the laryngeal skeleton *(Mancuso and Hanafee, 1985).*

Corniculate and Cuneiform Cartilages

The small paired corniculate cartilages articulate with the apices of the arytenoid cartilages.

The cuneiform cartilages are located anterolateral to the arytenoid cartilage within the aryepiglottic folds *(Newton et al., 1988).*

Hyoid Bone

The hyoid bone is tri-partite having a central body and two wings, each containing a greater and a lesser horn. The body lies transversely in front of the pre-epiglottic space and valleculae. The greater horns extend posterolaterally to encompass the lower hypopharynx and the entrance to the piriform sinuses. On CT scans a normal linear lucency may be seen between the body and greater horns. This represents a fibrous connection and should not be confused with a fracture.

The hyoid bone is attached to the thyroid cartilage by the thyrohyoid membrane and to the epiglottis by the hypoepiglottic ligament. It is suspended in the neck between the suprahyoid and infrahyoid strap muscles *(Last, 1972).*

The hyoid bone indicates the transition from fixed to free portion of the epiglottis and therefore, the upper aspect of the pre-epiglottic space. It also marks the lower level of the jugulodigastric group of lymph nodes *(Mancuso and Hanafee, 1985).*

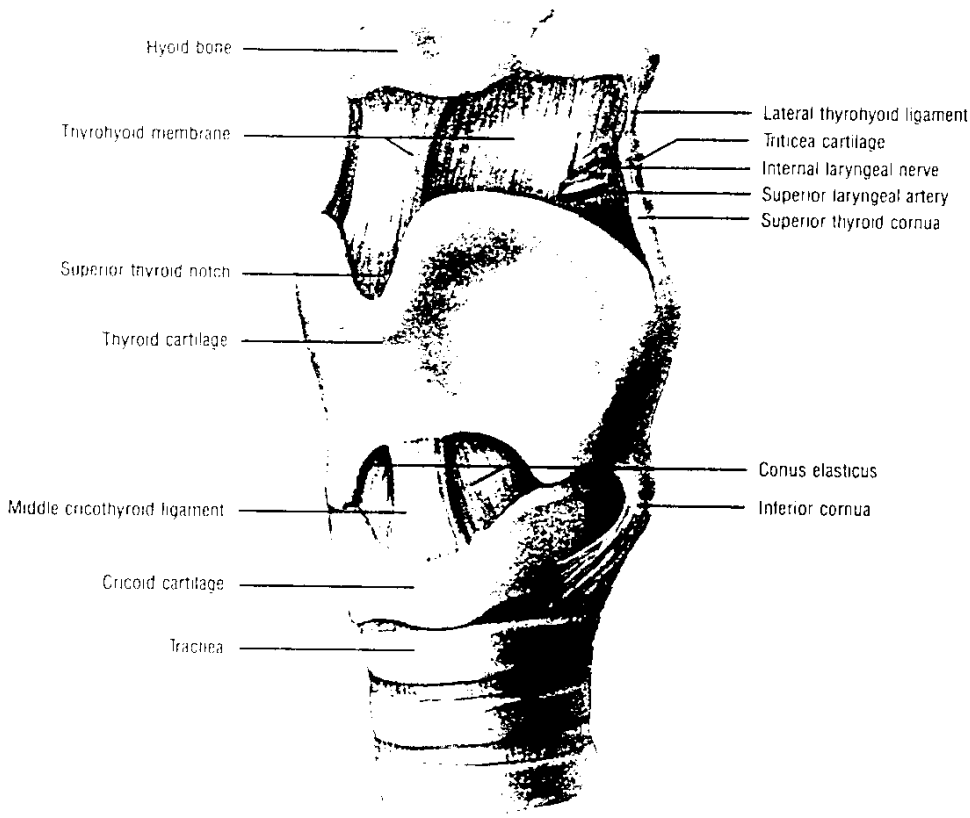

Fig. (2): **Cartilages and ligaments of the larynx anterolateral view.** The ligaments of the larynx are either extrinsic, those connecting the thyroid cartilage and epiglottis with the hyoid bone, and the cricoid cartilage with the trachea; and intrinsic, those which connect the several cartilages of the larynx to each other. Extrinsic ligaments consist of the thyrohyoid membrane and the medial and two lateral thyrohyoid ligaments. The cricothyroid membrane or conus elasticus is composed of yellow elastic tissue and forms one of the primary intrinsic ligaments of the larynx. It consists of an anterior and two lateral portions. The anterior part or middle cricothyroid ligament is thick and strong and connects the anterior parts of the thyroid and cricoid cartilages. The lateral portions of the conus elasticus are thinner and lie beneath the mucous membrane of the larynx, extending from the superior border of the cricoid cartilage to the inferior margin of the vocal ligaments with which they are continuous *(Newton et al., 1988).*