ABSTRACT

TITLE: Staging of Laryngeal Cancer Endoscopy & Radiology Versus Histopathology

BACKGROUND: clinical staging with the help of history, examination and video direct laryngoscopy have not been able to be accurate. Gross underestimation of cases and small percent of over estimation of staging occurs. This leads to inappropriate management of cases . With the help of CT underestimation of cases have lowered down considerably and a proper management protocol could be arrived.

OBSERVATION AND RESULTS : Clinical staging accuracy is only 33% and Ct staging accuracy with clinical staging is 83%. Thyroid cartilage involvement is identified accurately in 73% by CT. Anterior commissure involvement is identified in 100 % of cases. No early nodal metastasis is identified in clinically NO neck which have produced recurrence.

CONCLUSION: The accuracy of clinical staging in our study of advanced stage laryngeal tumours decreased from supraglottic to glottic to transglottic tumours. Conversely, the staging accuracy of sectional imaging is best in transglottic tumours and similar supraglottic tumours and glottic tumours.

There is gross underestimation of T4a cases clinically, almost 67% . With the help of CT underestimation of T4a cases have come down to 17%. CT therefore prevented most of the clinically underestimated cases from undergoing unnecessary organ preservation modalities like chemoradiotherapy and then salvage Total Laryngectomy. Further CT helped in identifying thyroid cartilage invasion accurately in 73%

of cases which has aided immensely in treatment planning. With addition of MRI, accuracy could still improve and aid in reducing underestimation of cases. Early nodal metastasis is missed by CT.

INTRODUCTION

Studies in surgical pathology with whole organ sectioning of laryngectomy specimens have greatly improved the understanding of the biological behaviour and the patterns of spread of laryngeal cancer. Over the years, a wide range of partial laryngectomy procedures have evolved to include lesions located at different sites and of varied extent , within the scope of conservation laryngeal surgery. Just twenty years ago , one considered partial laryngectomy only for early laryngeal cancer. Today the range procedures is wide enough to include even advanced laryngeal cancer within its scope.

Advances in the imaging technology by way of CT and MRI scanning have contributed further to the success of the voice conservation procedures by accurately determining the extent of the lesions . These sophisticated imaging techniques judge the depth of the tumour and determine the tumour volume factors which are crucial in the selection of the treatment modality.

The ability to achieve uniform dose curves has made radiation therapy a safe undertaking for early lesions of the anterior commissure. For more advanced lesions and large volume disease, where radiation therapy hitherto had only limited success, trials with hyper fractionated treatment to achieve better control rates are progressing.

The comparison of the end results of treatment with different modalities has been possible with an internationally standardized TNM staging accepted by both the UICC and the AJCC has its own fallacies and strength however , is that it is an evolving system.

Despite all these advances in surgery and radiotherapy, for many advanced laryngeal lesions a total laryngectomy, often followed by postoperative radiation therapy is the only alternative that offers a reasonable chance of cure.

Treating such lesions with radical radiation and reserving salvage surgery for the failures is a plan that has saved a few larynx but the cost has often been severely compromised cure rates , especially when follow ups are poor.

In India the population – based registry estimates an annual incidence of nearly 25,000 new cases of cancer of the larynx . Supraglottic cancer is more than twice as common as glottis cancer. Marginal zone cancer (aryepiglottic fold and free border of the epiglottis) are more common than cancers of the false cord and the infrahyoid epiglottis.

Regarding the treatment of laryngeal cancers there are two diverse and disturbing treatment trends that dominate the Indian scene . On the one hand is the heavy leaning and preference for radiation therapy for all laryngeal cancers, early and late , since treatment with radiotherapy offers laryngeal preservation. on the other hand there is the practice of performing total laryngectomy for lesions that would have easily lent themselves to a voice conserving surgical procedure it is here that we need to strike a balance.

REVIEW OF LITERATURE

Pressman study of compartmentalisation of larynx

Pressman conducted a study in 1956 and found out that there are several compartments in larynx. He also described the lymphatic drainage of larynx. He observed that dye injected into ventricle passed above and below the glottis deep to the mucosa and confirmed the space lateral to the ventricle. Hajeck in 1932 observed that laryngeal edema was restricted to localized compartments.

Pressman elaborated on this observation utilizing the dye which was injected under pressure into the larynx. He found that at the level of true and false vocal cords, there was a demarcation of larynx. At the level of supraglottis dye went into the midline and down to the false vocal cords. Dye remained localized in the ventricle when injected except in the saccule region and it migrated to opposite side. In the subglottis, dye remained in the midline from the true vocal cord to the end of cricoid. At the cord level, dye was left in situ for four days to follow its migration. Dye migrated to the inner perichondrium, then it was picked up by the lymphatics within the inferiorlaryngeal vessels and went through the cricothyroid membrane. Pressman further investigated these

compartments using phosphate and described seven separate areas as following-

1. Epiglottic region
2. Marginal epiglottic region
3. Posterolateral supraglotttic region
4. Ventricular region including the inferior surface of vestibular band and superior surface of vocal cord
5. Sacciform region
6. Reinke’s space
7. Subglottic region

According to pressman the dyes injected submucosally in the supraglottis did not spread interior to the ventricle. Fibroelastic membranes within the laryngeal frameworks serves as functional barriers and provides anatomic explanation of these findings.

Fascial planes of larynx

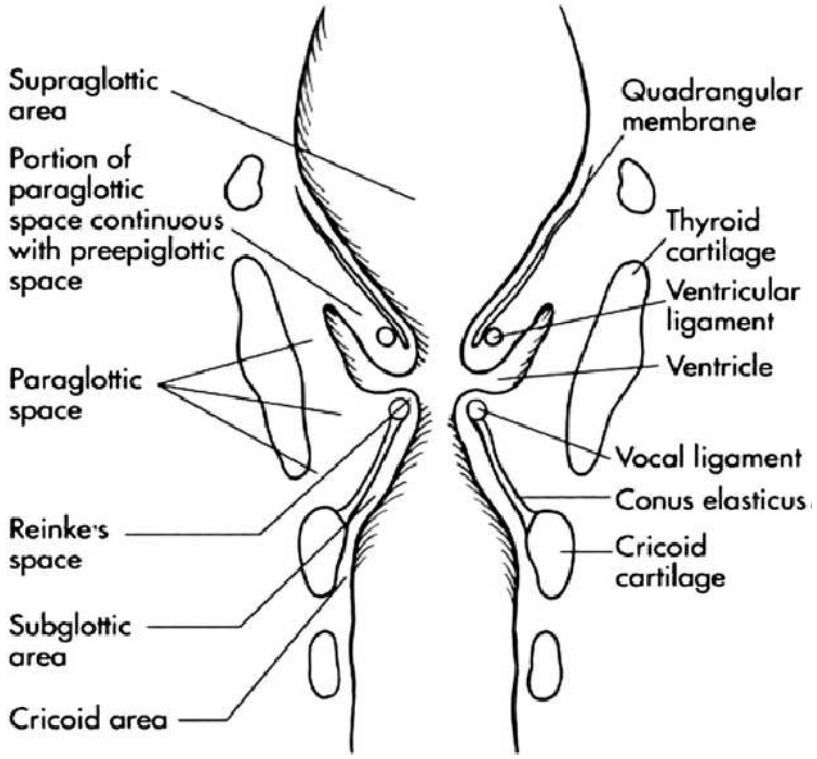


fig.(1) fascial planes of larynx

Reinke's space

The is a submucosal space between the mucosa of the glottis and the underlying vocalis muscle it acts as a bursa allowing the mucosa to slide over the underlying tissues producing fluency in normal speech . Very early glottic cancers remain superficial, rarely penetrating the deeper tissues . The mucosa of the vocal cord can therefore be stripped

off without causing damage to the underlying soft tissues with practically no alteration in the quality of voice.

Preepiglottic space

The pre-epiglottic space is bound superiorly by the hyoepiglottic ligament, anteriorly by the thyroid cartilage and thyrohyoid membrane, and posteriorly by the epiglottis and thyro epiglottic ligament. The cartilage of the epiglottis has numerous perforations that allow transit of tumor from the posterior surface of the epiglottis into the pre epiglottic space. Furthermore, dehiscences in the thyrohyoid membrane created by the superior laryngeal neurovascular bundle allow extension of tumor from the pre-epiglottic space into the neck.

Paraglottic space

Alternatively, tumor may invade in a cephalad-caudal spread via the paraglottic space into all the subsites of the larynx . The paraglottis space is a potential space, and together with the pre-epiglottic space forms, a horseshoe-shaped fatty space around the internal laryngeal structures. The lateral boundaries of the paraglottic space are the thyroid cartilage anteriorly and the mucosa overlying the medial wall of the piriform sinus posteriorly.

Superiorly and medially lie the quadrangular membrane, and the conus elasticus is situated inferiorly. Involvement of the paraglottic space by tumor allows fascial free access to the supraglottic, glottic, and subglottic regions in addition to the soft tissues of the neck.

PATTERN OF TUMOUR SPREAD

Supraglottic tumours

Supraglottic tumours spread preferentially in an upward direction towards the base of the base of the tongue and rarely involve the larynx below the ventricle. This unique pattern of tumour spread renders these tumours suitable for the supraglottic partial laryngectomy . Cancers within each subsite of the supraglottis are distinct in terms of tumour spread and management.

Epiglottic tumours:

Clinically the epiglottis is divided into a suprahyoid and an infrahyoid part , with reference to the level of the hyoid bone . Tumours are proliferative masses with minimal underlying invasion, these tumours tend to be over staged because of their size and ball- valve like obstruction of the airway. If the base or pedicle is narrow they are eminently suitable for endoscopic laser excision.

Tumours of the infrahyoid epiglottis are usually deeply infiltrative in nature. Infrahyoid epiglottic lesions may also grow circumferentially to involve the false cords, aryepiglottic fold. Pre epiglottic space involvement occurs.

Bulky pre – epiglottic space masses undergo central necrosis due to a relative lack of blood supply and generally respond poorly to radiotherapy.Epiglottic tumours rarely invade the thyroid cartilage . Hence, the perichondrium on the superior border of the thyroid cartilage may be safely elevated while performing a supraglottic laryngectomy. Thyroid cartilage invasion occurs late and implies transglottic spread which is an absolute contraindication to supraglottic laryngetomy.

Tumours of the false cord

Cancer of the false cord or ventricular fold are relative uncommon. Tumours from this region spread upwards to involve epiglottis . Posteriorly to involve the aryepiglottic fold and arytenoids and inferiorly to involve anterior commissure . The anterior commissure acts as a barrier to inferior spread. If this is breached there is a high chance of thyroid involvement.

fig.(3) supraglottic tumour through paraglottic space rendering the tumour transglottic

Tumours of the ventricle

Pure ventricular tumours are extremely rare. The true extent of tumour spread is difficult to evaluate as these tumours invade the paraglottic space early, with significant submucous extension, and what is visible on endoscopy may be the proverbial ‘tip of the iceberg ‘most of these tumours are transglottic at presentation . The perichondrium of the thyroid cartilage is infiltrated early and later the cartilage itself . Invasion of the pre – epiglottic space and infrahyoid epiglottis is common. Any

tumour crossing the ventricle in the vertical plane is transglottic . There may be submucous extension onto the medial wall of the pyriform fossa.

Tumours of the arytenoids and aryepiglottic fold

Lesions confined purely to the arytenoids and aryepiglottic fold are uncommon. Cancers in this area usually spill into the adjacent pyriform fossa or post cricoids early in the course of the disease they behave differently from other cancers in the supraglottic larynx and are more like pyriform fossa tumours . These lesions are common in india and are also referred to as marginal zone cancers.

Glottic tumours

Glottis lesions are a heterogenous group of disorders starting from a keratotic lesion, progressing through various grades of atypia (mild, moderate , severe) to an in-situ carcinoma and finally invasive cancer . In – situ carcinoma is limited by the basement membrane of the mucosa. Most glottis cancers arise in the free margin of the anterior two thirds of the vocal cord . Initial spread occurs horizontally towards the anterior commissure.

Very early cancers are limited to the mucosa without involvement of the underlying muscle because of reinke's space, as the anterior commissure is reached, a dense mass of fibroelastic tissue

(thyroepiglottic ligament , conus elasticus and inner perinchondrium of the thyroid ala) prevent further spread Vertical spread of the tumour upstages it to T_2 and is usually subglottic. inferior spread is limited by the conus elasticus which is a barrier between the glottis and subglottis. This tough membrane is weakest at point where neurovascular bundles enter or exit the larynx. Deep lateral invasion occurs in the paraglottic space with infiltration of the thyroarytenoid muscle and vocal cord fixation. Contiguous spread eventually leads to invasion of the ossified or calcified lower border of the thyroid ala and outside the larynx through the cricothyroid membrane into the strap muscles and thyroid gland . The common may extend superiorly in to the false cord and aryepiglottic old (glottis carcinorna with supraglottic extension).The degree of subglottic extension is vital in planning a conservative vertical hemilaryngectomy . The critical cut off level is limited to the cricoids cartilage which lies 10mm anteriorly and 5mm posteriorly. Primary posterior lesions of the glottis are rare however , the posterior commissure is frequently involved by advanced tumours from other sites . There is rapid invasion of the arytenoids , cricoarytenoid joint and cricoids cartilage . The paraglottic space is then invaded and tumour extends vertically downwards towards the cricothyroid joint. Lateral spread occurs submucosally to involve the apex of the pyriform fossa.

Anterior commissure lesions

Primary tumours of the anterior commissure are uncommon . The anterior Commissure is usually involved by secondary spread when a membranous cord lesion extends across the midline. The anterior commissure is directly attached to the thyroid cartilage without intervening issues by the broyle's tendon. Early invasion of the cartilage is , therefore , common in these tumours. Tumour spread superiorly , involves the base of the epiglottis while inferiorly the tumour exit the cricothyroid memberane and involves the soft tissues of the neck. At one time , patients with glottis lesions involving the anterior commissure were generally advised to undergo surgery because of the fear of early of early cartilage invasion and consequently poor radiotherapeutic response. However , kirschner's study points out that the mass of fibroelastic tissue at the anterior commissure offers a dense barrier to the spread of early glottis cancer . It is now recognized that stage for stage the anterior commissure is not any more readily invaded than any other part of the larynx .

The pattern of tumour growth at the anterior commissure indicates the propensity to invasion of the thyroid cartilage . If tumour extent from the vocal Cord onto the lower portion of the epiglottis at the

anterior commissure , the risk of thyroid cartilage invasion is extremely great .

Glottic cancers crossing the anterior commissure onto the opposite cord can be Treated with an extended hemilaryngectomy. This is feasible if at least one half Of the remaining true cord can be preserved .

Subglottic tumours

Subglottic tumours are rare and account for less than one per cent of all Laryngeal tumours. Tumour spread occurs bilaterally and along the entire Circumference of the subglottis . The cricoids cartilage is involved early because of the absence of an intervening muscle layer . Fixity of the true vocal cords is usually the presenting feature.

Transglottic tumour

Tumors that invove both supraglottis and glottis across the ventricle and Cause cord fixation are defined as transglottic cancers. They are important because they usually present as advanced with the cartilage invasion, extralaryngeal spread or involvement of opposite side and therefore are treated by near total or more often, a total laryngectomy. Tumors of supraglottis can occassionally become transglottic by spread onto the anterior commissure. These tumors are highly aggressive and invade cartilage early. Supra glottic or Glottic tumors with posterior

extension become transglottic by spread on to the cricoarytenoid joint or the inter arytenoid area. Extra laryngeal spread occurs Through the thyroid cartilage, the cricothyroid membrane or the thyrohyoid Membrane.

Tumor thickness as a prognosticator

Tumor thickness has been indirectly correlated with prognosis in laryngeal cancer. A retrospective study of 111 T1-3 laryngeal cancer patients treated with surgery found tumor thickness was significantly related to T, N, and clinical stage as well as pathologic cervical lymphnode metastasis, cartilage invasion, microscopic appearance, perineural invasion, and lymphatic invasion . Dadas and colleagues proved the feasibility of intraoperative assessment of tumor thickness in laryngeal cancer patients by frozen section analysis. e1F4E, a eukaryotic protein synthesis initiation factor elevated in almost all head and neck squamous cell cancers, has been reported to be an even more sensitive prognostic indicator for local recurrences compared with p53.

Staging evolution

The last modification of the AJCC TNM staging protocol occurred in 2002. Although this staging provides prognostic

information, it does not stratify the patients into the various treatment modalities to assist the clinicians. To this end, the American society of clinical oncology formed a multidisciplinary Expert panel to review the current literature available through November of 2005. One finding was the lack of randomized prospective trials to direct evidence-based treatment algorithms. Regardless, the report did recommend that T1 and T2 laryngeal function with should be treated with the intent to preserve the laryngeal function with a single modality. For most T3 and T4 without extensive cartilage invasion, an organ- preservation modality is an appropriate and standard treatment option. However, no organ-Conservation modality offered a survival advantage in comparison to total Laryngectomy.

IMAGING ANATOMY OF LARYNX

Supraglottis

The supraglottic larynx is delimited inferiorly by the superior surface of the true vocal cords. On cross-sectional imaging, the false vocal folds are easily discriminated from the true cords by submucosal presence of fat in the former. The pre-epiglottic space is filled with fat tissue . Robust lymphatic drainage to the high deep cervical chain

contributes to the higher incidence of nodal metastasis at the time of diagnosis of lesions in this region.

Glottis

The vocal folds (true vocal cords) ,anterior and posterior commissures comprise the glottis . Radiologically, the vocal folds are easily distinguished from the false vocal cords by the presence of submucosal soft tissue density attributable to the vocalis muscle. Lymphatic drainage from the glottis itself is sparse, and nodal metastasis from lesions in this region is rare.

Fig. 1. Axial CT images from the supraglottic (A), glottic (B), and subglottic

(C) levels.

(A) Note that submucosal fat (long arrow) is seen in the supraglottic level. The short arrow points to the arytenoid cartilage.

(B) No submucosal fat is apparent at the level of glottis because of the thyroarytenoid muscle (arrow).

C) There is no submucosal tissue in the subglottis at the level of the cricoid ring so that the air column abuts the cartilage (arrows).

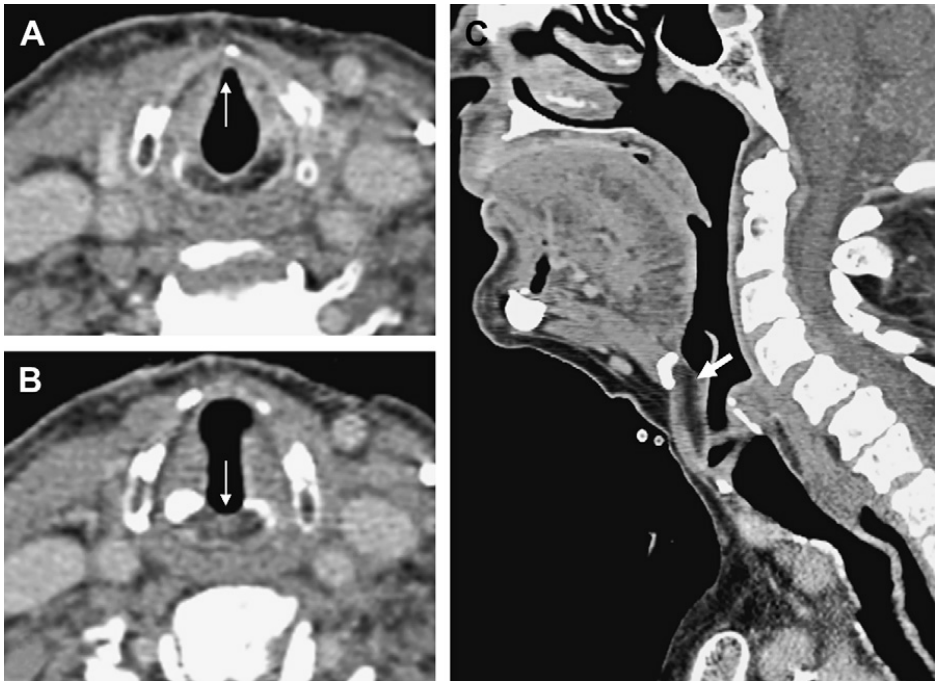


Fig. 2. Axial CT image through the glottis.

Arrows point to the anterior commissure (A) andthe posterior commissure. (B) Note lack of submucosal tissue in these regions.

(C) Sagittal CT shows the pre-epiglottic space (arrow) as a dark area because of low x-ray attenuation of fat.

Subglottis

The endoluminal contour of the subglottis is normally smooth . The presence of subglottic soft tissue should raise suspicion of neoplastic invasion. Lymphatic drainage from the subglottis is sparse, and nodal metastasis from lesions in this region is rare.

Choosing modality of imaging

CT versus MRI

Multichannel CT affords high spatial resolution images that can be reformatted in any desired plane, essentially negating the traditional advantage of MRI because of its multiplanar capability. Superior contrast resolution and multiparametric imaging (eg, T1-weighted, T2-weighted) remain significant advantages of MRI.

CT evaluation is much faster than MRI, substantially reducing or eliminating artifacts of movement attributable to breathing, swallowing, or coughing. MRI is more resource-intensive and less available than CT. Overall, the staging accuracy of MRI in laryngeal cancer is slightly higher, largely because of more accurate assessment of cartilage involvement and paraglottic, pre-epiglottic extension of tumor. CT is still more commonly used compared with MRI for initial staging of laryngeal cancer because of practical advantages, such as cost, speed, and availability.

Positron emission tomography–CT

Studies with sufficiently large numbers of patients investigating the role of positron emission tomography (PET)–CT in staging of laryngeal cancer are lacking. Recent reports by study of "Pohar S, Brown R, Newman N, et al. 2007" suggest that PET evaluation of head and neck cancers may not present sufficient sensitivity or specificity to justify its routine use at the time of initial diagnosis , whereas others have reported that it significantly altered treatment in a substantial number of patients.

RADIOLOGICAL EVALUATION OF LARYNGEAL CANCER

Pre-epiglottic and paraglottic space invasion

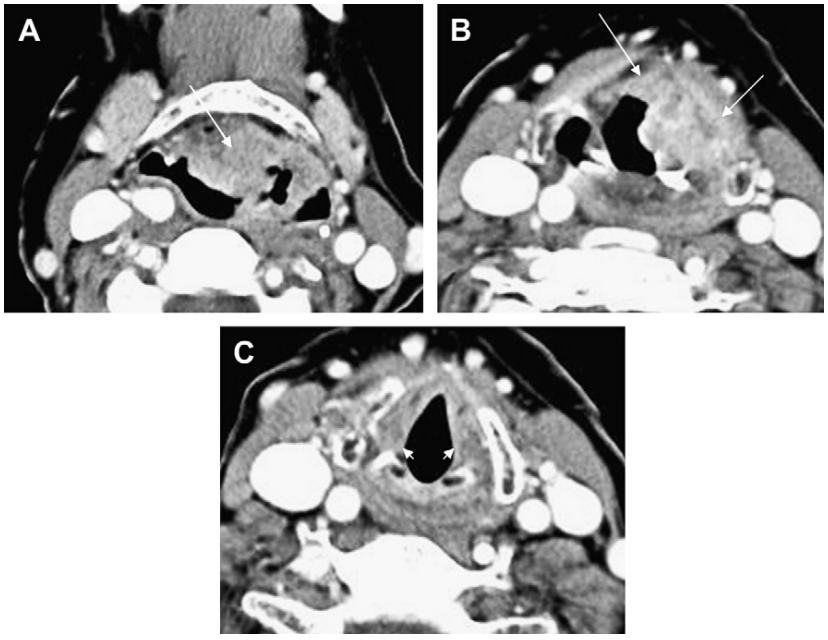
The pre-epiglottic space is readily identified on non contrast T1-weighted MRI or CT, particularly in the sagittal plane, because of its largely fatty contents. On either side, the pre-epiglottic space is continuous with the paraglottic space (also known as the paralaryngeal space). The para glottic space spans between the thyrohyoid membrane, thyroid and cricoid cartilages laterally and between the false and true vocal cords and the elastic cone medially. It contains fat at the level of the false vocal cords. This can be easily identified on axial and sagittal non contrast T1-weighted MRI and CT, because fat tissue has unique imaging features. Invasion of the pre-epiglottic fat by glottic or supraglottic

carcinomas is difficult to appreciate on clinical examination but is often readily appreciated by the head and neck radiologist as replacement of the normal fat on CT or MRI .”Loevner LA, Yousem DM, Montone KT, et al. 1997.” did a study on this and showed above facts.

Anterior and posterior commissures

Between the attachment sites of the vocal cords to the thyroid cartilage is a ‘‘bare’’area, wherein the laryngeal mucosa abuts the thyroid cartilage. This is known as the anterior commissure. The mucosa covering the posterior wall of the glottis between the arytenoid cartilages is known as the posterior commissure. There is no submucosal tissue present in the anterior and posterior commissures, which are bounded by air inside and cartilage outside, simplifying the detection of tumor involvement. If no tissue is seen in these regions, tumor extension can reliably be excluded. When there is visible soft tissue in the region of the anterior or posterior commissure, tumor infiltration is considered, although physiologic apposition of the vocal cords and edema can give similar appearance. Simple bulging of the vocal cord mass into these regions should not be overinterpreted as invasion . Endoscopic evaluation of the mucosal extent of disease in the anterior and posterior commissures is more reliable than imaging, however, submucosal extent, particularly in the form of thyroid cartilage invasion or extension through the cricothyroid membrane, is common once the anterior commissure is

involved and often escapes clinical detection . Extension of a vocal cord tumor to the anterior commissure does not change the T-staging but may affect survival and choice of treatment method, because surgical exposure of this region with endoscopic tools may be challenging and vertical laryngectomies would require a more extended approach. Involvement of the posterior commissure constitutes a contraindication for supracricoid partial laryngectomy.



Axial CT images through the supraglottis (A, B) and the glottis (C).

There is a bulky supraglottic mass with involvement of the pre-epiglottic and paraglottic spaces (arrows in A and B). At the level of the glottis (arrows in C), no abnormal tissue is seen; tumor is confined to the supraglottic larynx (T3) and is amenable to partial supraglottic laryngectomy.

Subglottic spread

Imaging plays an essential role in assessment for subglottic spread of disease, because this region is difficult to evaluate endoscopically. Imaging with CT or MRI can reliably identify subglottic extension, because the subglottis normally is lined by a thin layer of mucosa. Any additional soft tissue in this region should be treated as suspicious for neoplastic involvement. This evaluation is easier in the coronal plane but can be accomplished with similar accuracy in the axial plane . The conus elasticus, a tough collagenous membrane, extends from the true vocal cord to the superior margin of the cricoid cartilage and forms the lower border of the paraglottic space. As a barrier to the spread of tumor, the conus elasticus diverts submucosal tumor extension laterally, away from the cricoid cartilage. Likewise, tumors spreading along the mucosa usually spare the paraglottic region in the subglottis because of the conus elasticus.

Once tumor extends below the conus elasticus, it can infiltrate the cricoid cartilage with relative ease, making it necessary to perform a total laryngectomy. Thus, it is critical to assess tumor extent in relation to the superior ring of the cricoid cartilage . Visualizing tumor within the cricoid ring is a clear indication of subglottic extension. Craniocaudal tumor extent below the free edge of the true vocal cord of 10 mm anteriorly and 5 mm posteriorly can be tolerated.

Fig. (A, B) Axial CT images show asymmetric fullness of the right true vocal cord and the anterior commissure (long arrows), giving the impression that the tumor extends to the anterior commissure.

(B) Short arrow points to the pyramidal lobe of the thyroid, mimicking extralaryngeal extension of glottic cancer.

(C) MRI shows the anterior extent of tumor (arrow) without involvement of the anterior commissure.

Cartilaginous invasion

Cartilaginous invasion limits the probability of adequate response to radiation and increases the probability of radiation-induced necrosis. cartilage invasion increases radiation induced necrosis. Therefore, the presence or absence of cartilaginous invasion is an important data point for therapeutic decision making, and the presence of cartilaginous

invasion often justifies extensive surgery that might not be undertaken otherwise. Because the cartilaginous structures are largely inaccessible to clinical examination, assessment of the possibility of cartilaginous invasion before treatment is the responsibility of the radiologist.

Unfortunately, the imaging characteristics of hyaline cartilage are variable. Ossification of the cartilaginous structures of the larynx increases with age but varies and may be asymmetric. Whereas ossified cartilage demonstrates high attenuation on CT at the outer and inner cortices with relatively lower attenuation, medullary space nonossified cartilage demonstrates attenuation similar to that of other soft tissue structures. On MRI,the cortical signal depends on the presence or absence of calcification, andthe fatty medullary signal demonstrates T1 hyperintensity with intermediate signal on T2-weighted images. This variability can complicate imaging evaluation because of corresponding inhomogeneity of density and signal on CT and MRI, respectively, presenting a challenge to noninvasive evaluation.

Further complicating matters, reactive changes within cartilage may occur without the presence of neoplastic invasion, resulting in overestimation of disease extent, particularly with MRI. Regardless, contrast enhancement is not a normal feature of cartilage on MRI or CT . Either technique should be able to aid in the differentiation of inner

cortical invasion (T3) from involvement of inner and outer cortices and extralaryngeal spread (T4).

As noted in the preceding phrases, MRI allows for excellent soft tissue contrast and has been viewed as superior to CT for detection of cartilaginous invasion. MRI demonstrates increased T2 signal and low to intermediate T1 signal, with abnormal enhancement in cases of replacement of infiltration of hyaline cartilage. Although these signs are quite sensitive, inflammatory and reactive peritumoral changes may have an identical appearance, limiting specificity. Some investigators suggest that inflammatory reaction may be distinguished by greater T2 signal . Given the inherent sensitivity of MRI and consequent high negative predictive value, it has generally been preferred over CT at the time of initial evaluation .

Becker and colleagues studied the CT evaluations of 111 patients and describe CT signs with high specificity, including the presence of lysis or erosion (93% specificity) or extralaryngeal spread of neoplasm (95%) specificity. Because these signs depend on relatively advanced disease, their sensitivity is understandably low. Conversely, the presence of sclerosis within a cartilaginous structure is relatively sensitive, but the specificity of this sign varies with location, being lower in the thyroid cartilage (40% specificity) than in the cricoid and arytenoid cartilages (76%–79% specificity).

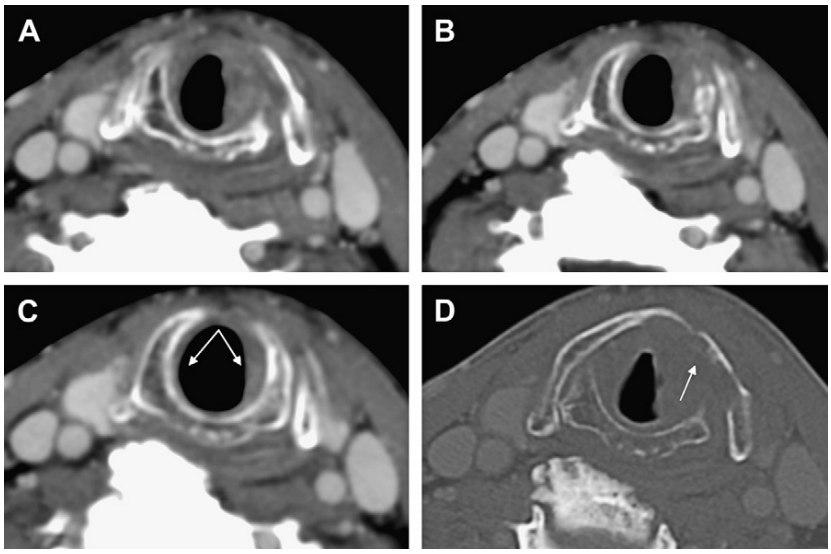


Fig. . Glottic cancer with subglottic extension and cartilage involvement. (A–C)

Three axial CT images with a soft tissue window reveal subglottic extension of patient's glottic tumor.(C) Identification of tumor within the cricoid ring (arrows) indicates subglottic extension and a need for total laryngectomy.

Normally, there should not be any soft tissue thicker than 1mm in this region. (D) Axial CT image with a bone window through the level of the thyroid cartilage shows erosion of the inner cortex of the cartilage (arrow) over a large area, indicating tumor extent. Compare with the smooth surface of the right thyroid ala

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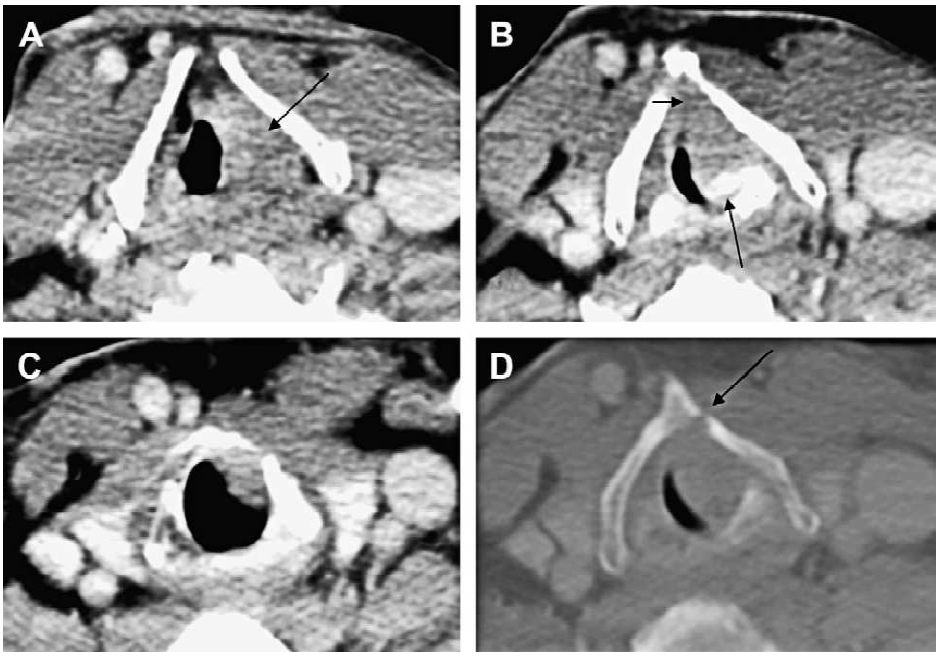


Fig. Transglottic tumor with thyroid and arytenoid cartilage invasion. Axial CT images show paraglottic (A), glottic (B, D), and subglottic (C) tumor extension.

(A) At the supraglottic level there is a soft tissue mass (arrow) replacing the paraglottic fat. (B)At the level of the glottis, tumor grows posteriorly to the posterior commissure. Note sclerosis of the arytenoid cartilage, indicating invasion (long arrow). Medial displacement of the arytenoid suggests cricoarytenoid involvement. The anterior commissure is spared (short arrow).

Extension of tumor to the subglottic level is obvious on imaging as normally no soft tissue thicker than 1mm is seen in this region. There is a focal lytic lesion in the inner surface of the thyroid cartilage (arrow) on

bone windows that corresponded to through-andthrough cartilage involvement on pathologic examination.

Prevertebral involvement

Involvement of the prevertebral fascia by tumor renders the tumor unresectable.

Unfortunately, the determination of prevertebral involvement is best achieved by intraoperative observation. Radiologic detection of prevertebral involvement is problematic. There is a small amount of fat tissue within the retropharyngeal space that can be identified on MRI and CT in most individuals. A lack of obliteration of this fat plane is a good indicator for lack of prevertebral involvement . Obliteration of the fat plane, conversely, does not reliably predict prevertebral tumor involvement unless obvious tumor bulk is present.

Carotid artery involvement

Unless the carotid artery is resected, extralaryngeal spread of tumor to infiltrate carotid artery renders the tumor inoperable. Not all tumors abutting the carotid infiltrate the adventitia, however. The determination of resectable from unresectable tumors relies heavily on imaging findings. If tumor contacts more than 270* of the circumference of the carotid, the likelihood of invasion is high and these tumors are deemed unresectable. Contact less than 180* has a low likelihood of tumor

invasion. In cases with contact 180 *and 270*, the radiologic distinction is not as reliable.

Radiologic findings and the choice of method of treatment

Patient preference has a significant bearing on the type of treatment chosen. In era of an increasing variety of treatment options, including traditional surgical, minimally invasive, and nonsurgical options with voice-conserving approaches, the assessment of tumor extent with respect to certain critical structures that affect the treatment method has become even more important. Virtually all surgical and nonsurgical procedures can be modified depending on the special circumstances of each tumor. Stage 4a tumors are generally considered resectable, whereas stage 4b tumors are not . Prevertebral or mediastinal extension and invasion of the carotid artery upgrade tumors to T4b. The negative predictive value of preservation of retropharyngeal fat signal on MRI for prevertebral involvement is greater than 90%. Unfortunately, the positive predictive value of loss of retropharyngeal fat signal is approximately 60%.

Thus, overall imaging diagnosis of lack of prevertebral involvement is reliable, whereas unless there is gross tumor in this region, the presence of prevertebral involvement is not.

Horizontal supraglottic partial laryngectomy

A horizontal supraglottic partial laryngectomy (SPL) can be performed for many supraglottic cancers. This procedure spares the arytenoids and true vocal cords and removes the supraglottic structures, including a portion of the thyroid cartilage, with the plane of resection at the level of the laryngeal ventricles. Tumor extension below the laryngeal ventricle and substantial cartilage involvement would contraindicate this surgical procedure .

Supracricoid partial laryngectomy with cricohyoido(epiglotto)pexy If there is transglottic extension of a supraglottic cancer or supraglottic extension of cricohyoido(epiglotto)pexy [SCPL CH(E)P] procedure may be an option. Although the functional outcome of this procedure is not as good as that of SPL, it may be the only alternative to total laryngectomy. SCPL CH(E)P preserves at least one of the arytenoids. Contraindications to this surgical procedure include bilateral arytenoid involvement, posterior commissure disease, hyoid bone involvement, and subglottic extension beyond the upper margin of the cricoid ring. Invasion of the pre-epiglottic space is a contraindication for SCPL CH(E)P but not for supracricoid partial laryngectomy with cricohyoidopexy (SCPL CHP) .

Vertical hemilaryngectomy

When the tumor is confined to one side of the larynx, a vertical hemilaryngectomy may be performed. This surgical procedure removes the ipsilateral cord and up to the anterior one third of the contralateral cord as necessary. Determination of the presence and degree of extension across the anterior commissure is critical in this scenario. Contraindications include involvement greater than the anterior one third of the contralateral cord, cricoarytenoid joint involvement, and subglottic extension below the upper margin of the cricoid ring .

Lymphatic drainage of the larynx and nodal metastasis

With a single lymph node involved by metastatic disease, the prognosis is said to be reduced by half. Criteria that suggest metastatic involvement of a lymph node include enlarged size, abnormal shape, necrosis, and extracapsular spread. The sensitivity of CT and MRI in detecting nodal metastasis is higher than clinical examination and lower than PET. Unfortunately, the negative predictive value of imaging, including PET, is not sufficiently high to reassure the surgeon and avoid neck dissection.

Decisions regarding neck dissection in lesions staged as N0 (by imaging and examination) depend on the presumed risk for nodal metastasis and the comfort level of the surgeon and patient. The risk for

nodal metastasis can be estimated on the basis of the site, depth, and extent of the primary tumor. A higher N-grading score is associated with a higher rate of treatment failure. Extranodal extension predicts a worse outcome independent of the N-grading score. For glottic cancer, large tumor volume, anterior commissure involvement,ventricle involvement, and cartilage involvement are associated with higher rates of treatment failure. The only independent risk factor that is consistent among studies is cartilage involvement, which is identified by CT as inner cortex irregularity and by MRI as signal change.

One study classified glottic tumors as being adjacent to and away from the thyroid cartilage inner cortex and demonstrated a worse local control rate for the lesions that contact the cartilage independent of the status of cortical irregularity . The study done by "Murakami R, Furusawa M, Baba Y, et al. 2000"

PRIMARY AND SALVAGE TOTAL LARYNGECTOMY

The results of early laryngectomies of previous century were disastrous because of aspiration, pneumonia, hemorrhage, sepsis, mediastinitis, and fistula formation . In 1892, Solis-Cohen devised the principle of suturing the trachea to the skin . Also in the late nineteenth century, Gluck and Sorensen added to the principle of diverting the trachea to the skin and introduced primary reconstruction of the pharynx. Over time, not only has the procedure of TL been modified, but

there is also an increasing emphasis on voice and swallowing preservation and. In 1980, Singer and Blom introduced the tracheoesophageal puncture (TEP) and valved prosthesis, restoring speech after TL. Eventually, the concept of organ preservation was introduced, and partial laryngeal surgical procedures and chemoradiation protocols became the treatment of choice when possible. Despite these advances, TL still has a role in the treatment of patients who have advanced laryngeal cancer.

Indications

The indications for a TL have decreased as organ preservation strategies have mandated a paradigm shift. In 1991, the Department of Veterans Affairs Laryngeal Cancer Study Group demonstrated that induction chemotherapy with cisplatin plus fluorouracil followed by radiation therapy allowed preservation of the larynx in 64% of patients without affecting survival when compared with TL and adjuvant radiotherapy . In 2003, Forestiere and colleagues showed that concurrent chemotherapy with cisplatin and radiotherapy resulted in higher laryngeal preservation rates, better loco-regional control rate, and similar overall survival when compared with induction chemotherapy followed by radiation and radiation therapy alone. In this study, patients who had large-volume T4 disease, defined as tumors with greater than 1cm invasion of the base of tongue or gross cartilage invasion, were excluded.

Primary TL

Indicated in advanced disease that is not amenable to partial laryngectomy, concurrent chemoradiation, or radiotherapy alone. Specifically, tumors that penetrated through cartilage, invasion into the extralaryngeal soft tissue of the neck, and extensive involvement of the base of tongue are suitable for this procedure.

Non-neoplastic indications

Include laryngeal dysfunction with life-threatening aspiration or chondro-radionecrosis of the larynx. Also, pulmonary status and medical comorbidities, cognitive function may define the treatment options for a given patient.

Salvage TL

Indicated for chemoradiation, radiation, or partial laryngeal surgical failures.

Salvage laryngectomy was required in 16% of patients treated with concurrent chemoradiation and 31% of patients treated with radiotherapy alone . Salvage TL can be technically more difficult and carries a higher postoperative complication rate.

MANAGEMENT OF NECK

The larynx drains into levels 2 to 4 pretracheal and paratracheal lymph nodes within the neck. Advanced laryngeal cancers have an overall 30% of occult neck metastasis . Patients who have supraglottic and advanced glottic with clinically N0 neck should undergo elective treatment of the neck by either neck dissection or radiotherapy . Supraglottic tumors have a significant propensity for bilateral neck metastasis, and bilateral necks should be addressed . Patients with N1 disease who are treated with definitive chemoradiotherapy require a neck dissection for incomplete clinical response .

Neck dissection arguably is required for patients with N2 or N3 disease who are treated with definitive chemoradiotherapy . For salvage surgery, the decision to perform a neck dissection should be based on CT staging of the neck, as most patients who are radiologically staged N0 are unlikely to harbor occult nodal disease.

AIMS & OBJECTIVES

AIM

To evaluate the accuracy of staging of advanced laryngeal cancer done in patients who underwent total laryngectomy by comparing staging by endoscopy &radiology with histopathology

OBJECTIVES

1. To evaluate clinically underestimated case

2. To evaluate & analyse cartilage involvement radiologically & histopathologically & to device predictive indicators of cartilage involvement preoperatively if possible

MATERIALS

STUDY PLACE : Rajiv Gandhi Government General Hospital, Chennai – 600003.

COLLABORATING DEPARTMENT : Upgraded Institute of otorhinolaryngology

STUDY DESIGN **:** prospective and retrospective

STUDY PERIOD **:** AUGUST 2011 TO OCTOBER 2013

ETHICAL CLEARANCE **:** obtained

INCLUSION CRITERIA

All cases of laryngeal cancer who underwent total laryngectomy with or without neck dissection / total or hemithyroidectomy which includes radio recurrent cases and primary cases **.**

EXCLUSION CRITERIA

Patients who underwent total laryngopharyngo oesophagectomy and total laryngopharyngectomy.

INVESTIGATION:

1.Endoscopy

2.Direct Laryngoscopy

3.computed tomography

4. ultrasound neck

5. Fnac of neck node

6. biopsy of the specimen preoperatively

7. histopathological analysis of node and specimen postoperatively

8. complete blood investigations

DATA COLLECTION : Clinical

BENEFIT TO THE COMMUNITY:

1.Improved treatment protocol for advanced Laryngeal cancer patients .

2.Management of neck more effectively in laryngeal cancer patients.

3.Improve the possibility of voice conservation procedures.

CONFLICT OF INTEREST : NIL

FINANCIAL SUPPORT : NIL

PRINCIPAL INVESTIGATOR : Dr. S.Vignesh MS (ENT) post graduate

METHODOLOGY

The study was conducted in the tertiary care Rajiv Gandhi Government general hospital and madras medical college in the department of upgraded institute of otorhinolaryngology.

Patients with advanced stages of laryngeal cancer who came to upgraded institute of otorhinolaryngology are evaluated. Supraglottic . transglottic ,glottic and subglottic tumours, radiorecurrent tumours are staged clinically with help of endoscopy.

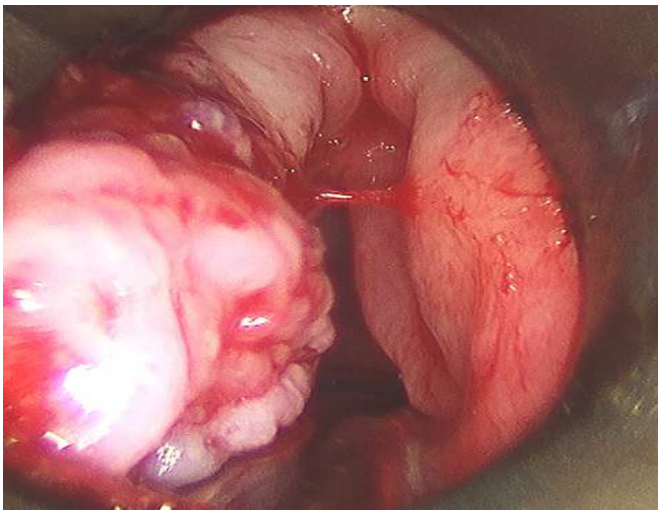
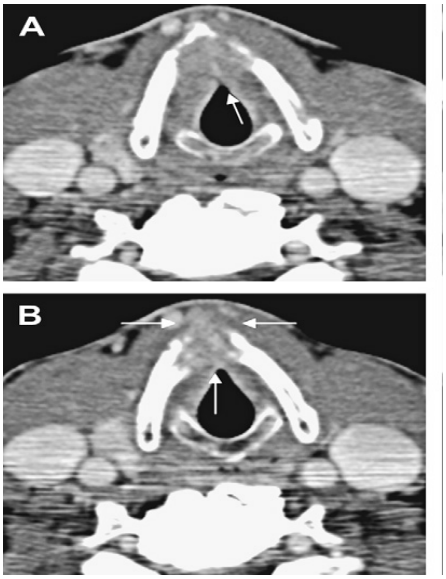


Fig shows T3 supraglottic cancer taken during operative endoscopy

Patients who are staged T3/T4a clinically with or without secondaries neck are sent for radiological examination . CT is done in all cases . MRI not done. Chest xray , usg neck & abdomen to asees the neck nodes and Second primaries. Radiological staging of laryngeal cancer done.

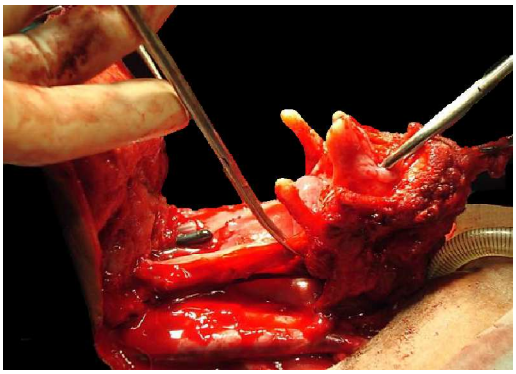
Fig shows cartilage involvement and extralaryngeal spread



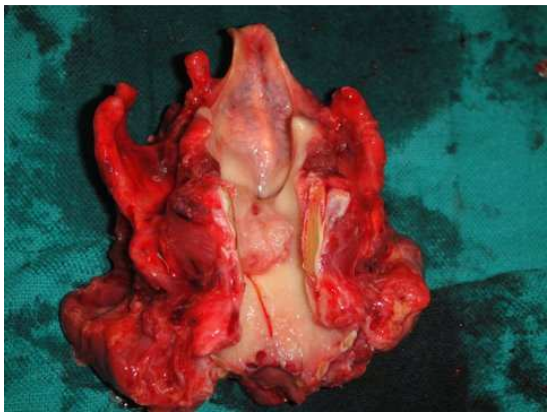
patients with or without tracheostomy prior with their informed consent if fit for surgery are taken up for total laryngectomy with or without neck dissection.

Site of tracheostomy (high, mid, low) if done are not taken in to study as variables. Most of the (Clinical & radiologically) T3 cases with taken for laryngectomy had opposite side of laryngeal involvement.

Total laryngectomy procedure:



Laryngectomy specimen for histopathology sent in every case after assessing tumour extension macroscopically



Histopathological analysis:

Whole organ serial sections were studied in axial plane and final histopathological staging arrived which is compared with radiological and clinical staging (AJCC , TNM)

STATISTICAL ANALYSIS

Distribution of the variables was assessed by kolmogrov-smirnov tests. Pearson's chi square was applied to all categorical variables. Fischer's Exact was applied wherever required. Chi square for trends was applied for ordinal data. A p value less than 0.05 was taken as significant. SPSS version16.0 was used for analysis.

Frequency Tables and analysis

Total no. of cases of total laryngectomy - 31

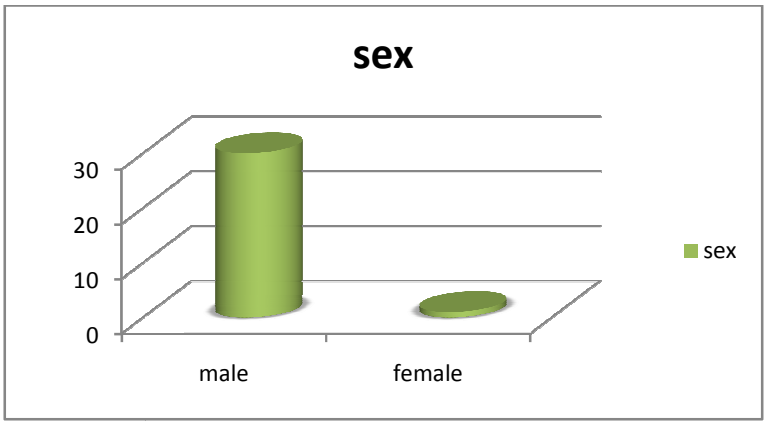
AGE

	N	Minimum	Maximum	Mean	Std. Deviation
Age	31	34	67	55.71	9.151
Valid N (listwise)	31				

Mean age of patients who underwent laryngectomy – 55 yrs

Sex

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	30	96.8	96.8	96.8
	Female	1	3.2	3.2	100.0
	Total	31	100.0	100.0	



Among 31 patients 30 were male and 1 was a female .

TUMOUR LOCATION

Supraglottic

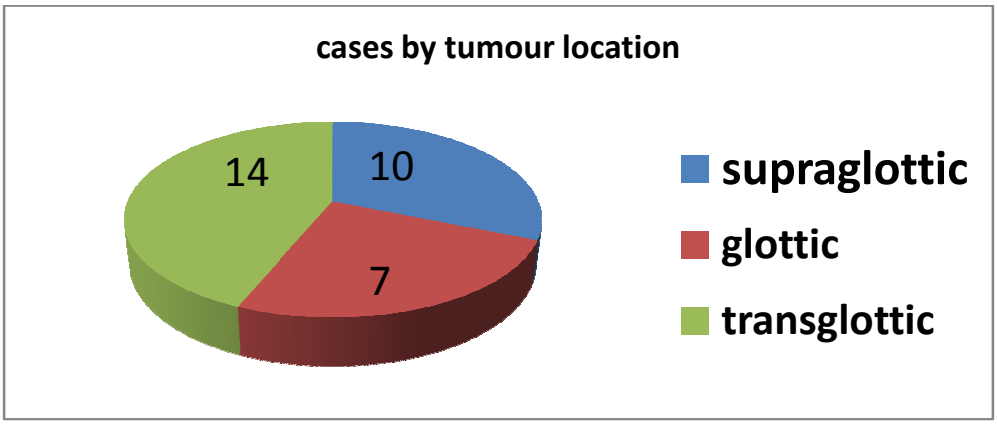
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	10	32.3	32.3	32.3
	No	21	67.7	67.7	100.0
	Total	31	100.0	100.0	

transglottic

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	14	45.2	45.2	45.2
	No	17	54.8	54.8	100.0
	Total	31	100.0	100.0	

Glottic

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	7	22.1	22.1	22.1
	No	23	74.2	74.2	100.0
	Total	31	100.0	100.0	



The variables were compared in terms of clinical/endoscopic staging, radiological staging, histopathological staging. Variables for clinical staging are involvement of arytenoids, marginal zone, subglottis, ventricles, extralaryngeal spread, cases that were staged T3 and T4a and nodal status.

Variables that are compared for radiological staging are involvement of arytenoids, anterior commissure, thyroid cartilage, cricoid cartilage, extralaryngeal spread, T3 and T4a staging and nodal status. All variables that are for radiological staging are compared with histopathological staging.

In addition procedures that are done along with total laryngectomy like neck dissection, total thyroidectomy and hemithyroidectomy are also taken into account. Also nodal recurrence is also taken as a variable and compared with respective tumours along with neck dissection. Here radiological variables

CT are given suffix ® and histopathological variables are given prefix (p) .

Frequency table for variables of **clinical evaluation & staging**

arytenoid

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	7	22.6	22.6	22.6
	No	24	77.4	77.4	100.0
	Total	31	100.0	100.0	

ant. Commisure

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	17	54.8	54.8	54.8
	No	14	45.2	45.2	100.0
	Total	31	100.0	100.0	

marginal Zone

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	10	32.3	32.3	32.3
	No	21	67.7	67.7	100.0
	Total	31	100.0	100.0	

ventricle

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	24	77.4	77.4	77.4
	No	7	22.6	22.6	100.0
	Total	31	100.0	100.0	

subglottis

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	4	12.9	12.9	12.9
	No	27	87.1	87.1	100.0
	Total	31	100.0	100.0	

Extralaryngeal spread

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	1	3.2	3.2	3.2
	No	30	96.8	96.8	100.0
	Total	31	100.0	100.0	

stageT3

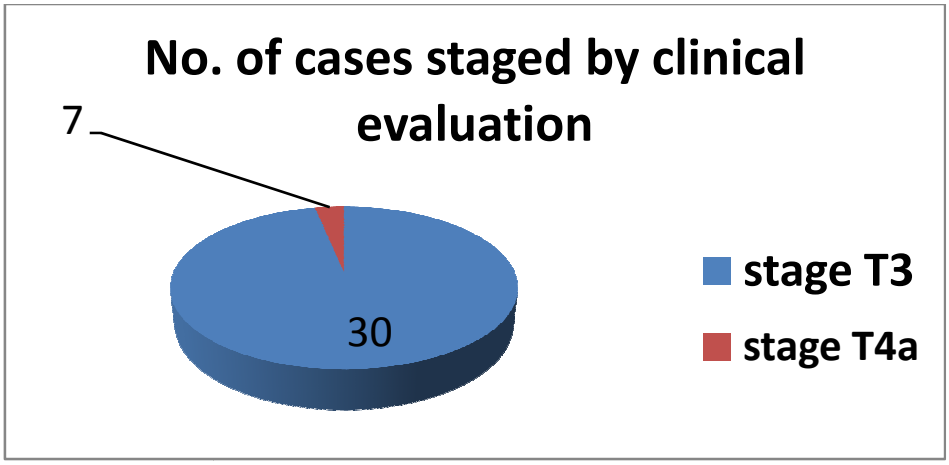
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	30	96.8	96.8	96.8
	No	1	3.2	3.2	100.0
	Total	31	100.0	100.0	

stageT4a

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	1	3.2	3.2	3.2
	No	30	96.8	96.8	100.0
	Total	31	100.0	100.0	

Stage T3- 30 cases (96.8%)

Stage T4a- 1 case(3.2%)



N staging by clinical evaluation

Nodal staging0

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	30	96.8	96.8	96.8
	No	1	3.2	3.2	100.0
	Total	31	100.0	100.0	

Nodal staging1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	1	3.2	3.2	3.2
	No	30	96.8	96.8	100.0
	Total	31	100.0	100.0	

Nodal staging2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	31	100.0	100.0	100.0

Total number of cases staged N0-30(96.8%)

Total number of cases staged N1-1(3.2%) N2-0

FREQUENCY TABLE FOR PARAMETERS OF RADIOLOGICAL STAGING

arytenoid.R

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	13	41.9	41.9	41.9
	No	18	58.1	58.1	100.0
	Total	31	100.0	100.0	

thyroid.R

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	18	58.1	58.1	58.1
	No	13	41.9	41.9	100.0
	Total	31	100.0	100.0	

cricoid.R

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	4	12.9	12.9	12.9
	No	27	87.1	87.1	100.0
	Total	31	100.0	100.0	

subglottis.R

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	10	32.3	32.3	32.3
	No	21	67.7	67.7	100.0
	Total	31	100.0	100.0	

paraglottic.R

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	25	80.6	80.6	80.6
	No	6	19.4	19.4	100.0
	Total	31	100.0	100.0	

preepiglottic sp.R

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	31	100.0	100.0	100.0

extralaryngeal spread

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	2	6.5	6.5	6.5
	No	29	93.5	93.5	100.0
	Total	31	100.0	100.0	

Nodal staging with radiological evaluation.

N0 – 30(96.8)

N1 – 1(3.2%)

N2 - 0

Nodal staging1.R

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	1	3.2	3.2	3.2
	No	30	96.8	96.8	100.0
	Total	31	100.0	100.0	

Nodal staging2.R

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	31	100.0	100.0	100.0

T staging with radiological evaluation

T3-9(29%)

T4a – 22(71%)

stageT3.R

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	9	29.0	29.0	29.0
	No	22	71.0	71.0	100.0
	Total	31	100.0	100.0	

stageT4.R

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	22	71.0	71.0	71.0
	No	9	29.0	29.0	100.0
	Total	31	100.0	100.0	

SND

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	7	22.6	22.6	22.6
	No	24	77.4	77.4	100.0
	Total	31	100.0	100.0	

Selective neck dissection done in 7out of 31 cases

Total thyroidectomy

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	30	96.8	96.8	96.8
	No	1	3.2	3.2	100.0
	Total	31	100.0	100.0	

Total no.of cases of total thyroidectomy done- 30/31 (96.8%)

hemithyroidectomy

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	1	3.2	3.2	3.2
	No	30	96.8	96.8	100.0
	Total	31	100.0	100.0	

No.of cases of hemithyroidectomy- 1/31 (3.2%)

Frequency table for histopathological evaluation

p ant.comm.H

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	19	61.3	61.3	61.3
	No	12	38.7	38.7	100.0
	Total	31	100.0	100.0	

Subglottic involvement – 17/31 (54.8)

p subglottis.H

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	17	54.8	54.8	54.8
	No	14	45.2	45.2	100.0
	Total	31	100.0	100.0	

Paraglottic involvement- 27/31 (87.1%)

p paraglottic.H

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	27	87.1	87.1	87.1
	No	4	12.9	12.9	100.0
	Total	31	100.0	100.0	

p preepiglottic.H

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	31	100.0	100.0	100.0

Thyroid cartilage involvement- 22/31(71%)

p thyroid .H

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	22	71.0	71.0	71.0
	No	9	29.0	29.0	100.0
	Total	31	100.0	100.0	

Cricoids cartilage involvement- 7/31(22.6%)

p cricoid.H

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	7	22.6	22.6	22.6
	No	24	77.4	77.4	100.0
	Total	31	100.0	100.0	

Arytenoids involvement- 8/31(25.8)

p arytenoid.H

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	8	25.8	25.8	25.8
	No	23	74.2	74.2	100.0
	Total	31	100.0	100.0	

Extralaryngeal tissue involvement- 2/31 (6.5%)

p extralaryngeal tissues.H

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	2	6.5	6.5	6.5
	No	29	93.5	93.5	100.0
	Total	31	100.0	100.0	

Node stage N0- 6/7(85.7%)

p Nodal staging0.H

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	6	19.4	85.7	85.7
	No	1	3.2	14.3	100.0
	Total	7	22.6	100.0	
Missing	System	24	77.4		
Total		31	100.0		

Nodal stage N1 – 1/7(14.3%)

p Nodal staging1.H

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	1	3.2	14.3	14.3
	No	6	19.4	85.7	100.0
	Total	7	22.6	100.0	
Missing	System	24	77.4		
Total		31	100.0		

Nodal stage N2- 0

p Nodal staging2.H

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	7	22.6	100.0	100.0
Missing	System	24	77.4		
Total		31	100.0		

T stage pT3 – 8/31 (25.8%)

staging.PT3

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	8	25.8	25.8	25.8
	No	23	74.2	74.2	100.0
	Total	31	100.0	100.0	

T stage pT4 – 23/8(74.2%)

staging.PT4

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	23	74.2	74.2	74.2
	No	8	25.8	25.8	100.0
	Total	31	100.0	100.0	

Nodal recurrence – 7/31 (22.6%)

nodal Recurrence

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	7	22.6	22.6	22.6
	No	24	77.4	77.4	100.0
	Total	31	100.0	100.0	

Comparison of radiological parameters with histopathology

ant.comm.R * p ant.comm.H Crosstabulation

			p ant.comm.H		
			Yes	No	Total
ant.comm.R	Yes	Count	19	4	23
		% of Total	61.3%	12.9%	74.2%
	No	Count	0	8	8
		% of Total	.0%	25.8%	25.8%
Total		Count	19	12	31
		% of Total	61.3%	38.7%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	6.718[b]	1	.010		
Continuity Correction [a]	1.219	1	.270		
Likelihood Ratio	3.359	1	.067		
Fisher's Exact Test				.127	.127
Linear-by-Linear Association	6.501	1	.011		
N of Valid Cases	31				

a. Computed only for a 2x2 table

b. 3 cells (75.0%) have expected count less than 5. The minimum expected count is .13.

CT in terms of comparison of anterior commissure with Histopathology

Sensitivity – 100%

Specificity – 66%

Positive predictive value – 82.6%

arytenoid.R * p arytenoid.H Crosstabulation

			p arytenoid.H		
			Yes	No	Total
arytenoid.R	Yes	Count	6	7	13
		% of Total	19.4%	22.6%	41.9%
	No	Count	2	16	18
		% of Total	6.5%	51.6%	58.1%
Total		Count	8	23	31
		% of Total	25.8%	74.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.975[b]	1	.160		
Continuity Correction[a]	.585	1	.444		
Likelihood Ratio	1.698	1	.193		
Fisher's Exact Test				.212	.212
Linear-by-Linear Association	1.911	1	.167		
N of Valid Cases	31				

a. Computed only for a 2x2 table

b. 2 cells (50.0%) have expected count less than 5. The minimum expected count is .90.

Sensitivity- 75%

Specificity- 69.5%

PPV- 46%

thyroid.R * p thyroid .H Crosstabulation

			p thyroid .H		
			Yes	No	Total
thyroid.R	Yes	Count	16	2	18
		% of Total	51.6%	6.5%	58.1%
	No	Count	6	7	13
		% of Total	19.4%	22.6%	41.9%
Total		Count	22	9	31
		% of Total	71.0%	29.0%	100.0%

Sensitivity – 72.7%

Specificity- 77.7%

PPV - 88.8%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	6.691[b]	1	.010		
Continuity Correction[a]	4.777	1	.029		
Likelihood Ratio	6.849	1	.009		
Fisher's Exact Test				.017	.014
Linear-by-Linear Association	6.475	1	.011		
N of Valid Cases	31				

a. Computed only for a 2x2 table

b. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 3. 77.

cricoid.R * p cricoid.H Crosstabulation

			p cricoid.H		
			Yes	No	Total
cricoid.R	Yes	Count	2	2	4
		% of Total	6.5%	6.5%	12.9%
	No	Count	5	22	27
		% of Total	16.1%	71.0%	87.1%
Total		Count	7	24	31
		% of Total	22.6%	77.4%	100.0%

Sensitivity – 28%

Specificity- 91%

PPV - 50%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.975[b]	1	.160		
Continuity Correction[a]	.585	1	.444		
Likelihood Ratio	1.698	1	.193		
Fisher's Exact Test				.212	.212
Linear-by-Linear Association	1.911	1	.167		
N of Valid Cases	31				

a. Computed only for a 2x2 table

b. 2 cells (50.0%) have expected count less than 5. The minimum expected count is .90.

subglottis.R * p subglottis.H Crosstabulation

			p subglottis.H		
			Yes	No	Total
subglottis.R	Yes	Count	10	0	10
		% of Total	32.3%	.0%	32.3%
	No	Count	7	14	21
		% of Total	22.6%	45.2%	67.7%
Total		Count	17	14	31
		% of Total	54.8%	45.2%	100.0%

Sensitivity – 58.8%

Specificity- 100%

PPV - 100%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	12.157[b]	1	.000		
Continuity Correction[a]	9.614	1	.002		
Likelihood Ratio	15.951	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	11.765	1	.001		
N of Valid Cases	31				

a. Computed only for a 2x2 table

b. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 4. 52.

paraglottic.R * p paraglottic.H Crosstabulation

			p paraglottic.H		
			Yes	No	Total
paraglottic.R	Yes	Count	24	1	25
		% of Total	77.4%	3.2%	80.6%
	No	Count	3	3	6
		% of Total	9.7%	9.7%	19.4%
Total		Count	27	4	31
		% of Total	87.1%	12.9%	100.0%

Sensitivity- 88.8%

Specificity- 75%

PPV- 96%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	9.111[b]	1	.003		
Continuity Correction[a]	5.477	1	.019		
Likelihood Ratio	7.127	1	.008		
Fisher's Exact Test				.016	.016
Linear-by-Linear Association	8.817	1	.003		
N of Valid Cases	31				

a. Computed only for a 2x2 table

b. 2 cells (50.0%) have expected count less than 5. The minimum expected count is .77.

preepiglottic sp.R * p preepiglottic.H Crosstabulation

			p preepiglottic.H	
			No	Total
preepiglottic sp.R	No	Count	31	31
		% of Total	100.0%	100.0%
Total		Count	31	31
		% of Total	100.0%	100.0%

Chi-Square Tests

	Value
Pearson Chi-Square	.[a]
N of Valid Cases	31

a. No statistics are computed because preepiglottic sp.R and p preepiglottic.H are constants.

Pre epiglottic space 100% specific

extralaryngeal spread R & p extralaryngeal tissues.H Crosstabulation

			p extralaryngeal tissues.H		
			Yes	No	Total
extralaryngeal spread	Yes	Count	1	1	2
		% of Total	3.2%	3.2%	6.5%
	No	Count	1	28	29
		% of Total	3.2%	90.3%	93.5%
Total		Count	2	29	31
		% of Total	6.5%	93.5%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	6.718[b]	1	.010		
Continuity Correction[a]	1.219	1	.270		
Likelihood Ratio	3.359	1	.067		
Fisher's Exact Test				.127	.127
Linear-by-Linear Association	6.501	1	.011		
N of Valid Cases	31				

a. Computed only for a 2x2 table

b. 3 cells (75.0%) have expected count less than 5. The minimum expected count is .13.

PPV- 50%

Comparison of clinical staging T3 with CT (R) and Histopathology (p)

Clinical stageT3 * stageT3.R *(Supraglottic)

Crosstab

Supraglottic				stageT3.R Yes	stageT3.R No	Total
Yes	stageT3	Yes	Count	5	5	10
			% of Total	50.0%	50.0%	100.0%
	Total		Count	5	5	10
			% of Total	50.0%	50.0%	100.0%
No	stageT3	Yes	Count	4	16	20
			% of Total	19.0%	76.2%	95.2%
		No	Count	0	1	1
			% of Total	.0%	4.8%	4.8%
	Total		Count	4	17	21
			% of Total	19.0%	81.0%	100.0%

Result : clinical T3 in supraglottic is 50% accurate with CT

stageT3 * stageT3.R * transglottic

Crosstab

transglottic				stageT3.R Yes	stageT3.R No	Total
Yes	stageT3	Yes	Count	2	12	14
			% of Total	14.3%	85.7%	100.0%
	Total		Count	2	12	14
			% of Total	14.3%	85.7%	100.0%
No	stageT3	Yes	Count	7	9	16
			% of Total	41.2%	52.9%	94.1%
		No	Count	0	1	1
			% of Total	.0%	5.9%	5.9%
	Total		Count	7	10	17
			% of Total	41.2%	58.8%	100.0%

Result :Clinical T3 is only 14% accurate with radiology in transglottic tumours

Clinical stageT3 * CT stageT3.R * Glottic

Crosstab

Glottic				stageT3.R		Total
				Yes	No	
Yes	stageT3	Yes	Count	2	4	6
			% of Total	25.0%	62.5%	87.5%
		No	Count	0	1	1
			% of Total	.0%	12.5%	12.5%
	Total		Count	2	5	7
			% of Total	25.0%	75.0%	100.0%
No	stageT3	Yes	Count	7	17	24
			% of Total	30.4%	69.6%	100.0%
	Total		Count	7	17	24
			% of Total	30.4%	69.6%	100.0%

Result is clinical staging accuracy is 28.5 % with radiology in T3 glottic tumours

Clinical stageT3 * staging.PT3 * Supraglottic

Crosstab

Supraglottic				staging.PT3		Total
				Yes	No	
Yes	stageT3	Yes	Count	5	5	10
			% of Total	50.0%	50.0%	100.0%
	Total		Count	5	5	10
			% of Total	50.0%	50.0%	100.0%
No	stageT3	Yes	Count	3	17	20
			% of Total	14.3%	81.0%	95.2%
		No	Count	0	1	1
			% of Total	.0%	4.8%	4.8%
	Total		Count	3	18	21
			% of Total	14.3%	85.7%	100.0%

Result: clinical T3 is 50% accurate with pT3 supraglottic

Clinical stageT3 * staging.PT3 * transglottic

Crosstab

transglottic				staging.PT3 Yes	staging.PT3 No	Total
Yes	stageT3	Yes	Count	2	12	14
			% of Total	14.3%	85.7%	100.0%
	Total		Count	2	12	14
			% of Total	14.3%	85.7%	100.0%
No	stageT3	Yes	Count	6	10	16
			% of Total	35.3%	58.8%	94.1%
		No	Count	0	1	1
			% of Total	.0%	5.9%	5.9%
	Total		Count	6	11	17
			% of Total	35.3%	64.7%	100.0%

Result : 14% accuracy in transglottic T3

Clinical stageT3 * staging.PT3 * Glottic

Crosstab

Glottic				staging.PT3 Yes	staging.PT3 No	Total
Yes	stageT3	Yes	Count	2	4	6
			% of Total	25.0%	62.5%	87.5%
		No	Count	0	1	1
			% of Total	.0%	12.5%	12.5%
	Total		Count	2	5	7
			% of Total	25.0%	75.0%	100.0%
No	stageT3	Yes	Count	6	17	23
			% of Total	26.1%	73.9%	100.0%
	Total		Count	6	17	23
			% of Total	26.1%	73.9%	100.0%

Clinical glottis T3 vs pT3 is 33% accurate

CT(R) T3 Vs Histopathological PT3 supraglottic

stageT3.R * staging.PT3 * Supraglottic Crosstabulation

Supraglottic				staging.PT3 Yes	staging.PT3 No	Total
Yes	stageT3.R	Yes	Count	4	1	5
			% of Total	40.0%	10.0%	50.0%
		No	Count	1	4	5
			% of Total	10.0%	40.0%	50.0%
	Total		Count	5	5	10
			% of Total	50.0%	50.0%	100.0%
No	stageT3.R	Yes	Count	1	3	4
			% of Total	4.8%	14.3%	19.0%
		No	Count	2	15	17
			% of Total	9.5%	71.4%	81.0%
	Total		Count	3	18	21
			% of Total	14.3%	85.7%	100.0%

Result CT T3 stage is 80% accurate with pT3

stageT3.R * staging.PT3 * transglottic

Crosstab

transglottic				staging.PT3 Yes	staging.PT3 No	Total
Yes	stageT3.R	Yes	Count	0	2	2
			% of Total	.0%	14.3%	14.3%
		No	Count	2	10	12
			% of Total	14.3%	71.4%	85.7%
	Total		Count	2	12	14
			% of Total	14.3%	85.7%	100.0%
No	stageT3.R	Yes	Count	5	2	7
			% of Total	29.4%	11.8%	41.2%
		No	Count	1	9	10
			% of Total	5.9%	52.9%	58.8%
	Total		Count	6	11	17
			% of Total	35.3%	64.7%	100.0%

Most of the cases of clinical T3 transglottic became radiological T4 so the table becomes statistically insignificant.

stageT3.R * staging.PT3 * Glottic

Crosstab

Glottic				staging.PT3 Yes	staging.PT3 No	Total
Yes	stageT3.R	Yes	Count	1	3	4
			% of Total	12.5%	12.5%	25.0%
		No	Count	1	2	3
			% of Total	12.5%	62.5%	75.0%
	Total		Count	2	5	8
			% of Total	25.0%	75.0%	100.0%
No	stageT3.R	Yes	Count	4	3	7
			% of Total	17.4%	13.0%	30.4%
		No	Count	2	14	16
			% of Total	8.7%	60.9%	69.6%
	Total		Count	6	17	23
			% of Total	26.1%	73.9%	100.0%

Result CT glottis T3 is 25 % accurate and 50% sensitive

Clinical stageT4a * CT stageT4.R * Supraglottic

Crosstab

Supraglottic				stageT4.R Yes	stageT4.R No	Total
Yes	stageT4a	No	Count	5	5	10
			% of Total	50.0%	50.0%	100.0%
	Total		Count	5	5	10
			% of Total	50.0%	50.0%	100.0%
No	stageT4a	Yes	Count	1	0	1
			% of Total	4.8%	.0%	4.8%
		No	Count	16	4	20
			% of Total	76.2%	19.0%	95.2%
	Total		Count	17	4	21
			% of Total	81.0%	19.0%	100.0%

Result : 50% accuracy

clinical stageT4a * CT stageT4.R * transglottic

Crosstab

transglottic				stageT4.R Yes	stageT4.R No	Total
Yes	stageT4a	No	Count	12	2	14
			% of Total	85.7%	14.3%	100.0%
	Total		Count	12	2	14
			% of Total	85.7%	14.3%	100.0%
No	stageT4a	Yes	Count	1	0	1
			% of Total	5.9%	.0%	5.9%
		No	Count	9	7	16
			% of Total	52.9%	41.2%	94.1%
	Total		Count	10	7	17
			% of Total	58.8%	41.2%	100.0%

Only one clinical T4a case is present so comparision is statistically will not produce any meaning full result but in gross most of the cases are underestimated

Clinical stageT4a *CT stageT4.R * Glottic

Crosstab

Glottic				stageT4.R Yes	stageT4.R No	Total
Yes	stageT4a	Yes	Count	1	0	1
			% of Total	12.5%	.0%	12.5%
		No	Count	5	1	6
			% of Total	62.5%	25.0%	87.5%
	Total		Count	6	1	7
			% of Total	75.0%	25.0%	100.0%
No	stageT4a	No	Count	16	8	24
			% of Total	69.6%	30.4%	100.0%
	Total		Count	16	8	24
			% of Total	69.6%	30.4%	100.0%

Result : 14% accurate

Clinical stageT4a * histopathology staging.PT4 * Supraglottic

Crosstab

Supraglottic				staging.PT4 Yes	staging.PT4 No	Total
Yes	stageT4a	No	Count	5	5	10
			% of Total	50.0%	50.0%	100.0%
	Total		Count	5	5	10
			% of Total	50.0%	50.0%	100.0%
No	stageT4a	Yes	Count	1	0	1
			% of Total	4.8%	.0%	4.8%
		No	Count	17	3	20
			% of Total	81.0%	14.3%	95.2%
	Total		Count	18	3	21
			% of Total	85.7%	14.3%	100.0%

Result : 50% accurate

Clinical stageT4a * histopathological staging.PT4 * transglottic

Crosstab

transglottic				staging.PT4 Yes	staging.PT4 No	Total
Yes	stageT4a	No	Count	12	2	14
			% of Total	85.7%	14.3%	100.0%
	Total		Count	12	2	14
			% of Total	85.7%	14.3%	100.0%
No	stageT4a	Yes	Count	1	0	1
			% of Total	5.9%	.0%	5.9%
		No	Count	10	6	16
			% of Total	58.8%	35.3%	94.1%
	Total		Count	11	6	17
			% of Total	64.7%	35.3%	100.0%

Result : only 14% accurate

Clinical stageT4a * histopathological staging.PT4 * Glottic

Crosstab

Glottic				staging.PT4 Yes	staging.PT4 No	Total
Yes	stageT4a	Yes	Count	1	0	1
			% of Total	12.5%	.0%	12.5%
		No	Count	5	1	6
			% of Total	62.5%	25.0%	87.5%
	Total		Count	6	1	7
			% of Total	75.0%	25.0%	100.0%
No	stageT4a	No	Count	17	7	24
			% of Total	73.9%	26.1%	100.0%
	Total		Count	17	7	24
			% of Total	73.9%	26.1%	100.0%

Result : only one case of clinical T4a which was accurate.

CT stageT4.R * staging.PT4 * Supraglottic

Crosstab

Supraglottic				staging.PT4 Yes	staging.PT4 No	Total
Yes	stageT4.R	Yes	Count	4	1	5
			% of Total	40.0%	10.0%	50.0%
		No	Count	1	4	5
			% of Total	10.0%	40.0%	50.0%
	Total		Count	5	5	10
			% of Total	50.0%	50.0%	100.0%
No	stageT4.R	Yes	Count	15	2	17
			% of Total	71.4%	9.5%	81.0%
		No	Count	3	1	4
			% of Total	14.3%	4.8%	19.0%
	Total		Count	18	3	21
			% of Total	85.7%	14.3%	100.0%

Result : 80% accurate

CT stageT4.R * staging.PT4 * transglottic

Crosstab

transglottic				staging.PT4 Yes	staging.PT4 No	Total
Yes	stageT4.R	Yes	Count	10	2	12
			% of Total	71.4%	14.3%	85.7%
		No	Count	2	0	2
			% of Total	14.3%	.0%	14.3%
	Total		Count	12	2	14
			% of Total	85.7%	14.3%	100.0%
No	stageT4.R	Yes	Count	9	1	10
			% of Total	52.9%	5.9%	58.8%
		No	Count	2	5	7
			% of Total	11.8%	29.4%	41.2%
	Total		Count	11	6	17
			% of Total	64.7%	35.3%	100.0%

Result :83 % accurate

stageT4a.R * staging.PT4 * Glottic

Result : 83% accurate

Crosstab

Glottic				staging.PT4 Yes	staging.PT4 No	Total
Yes	stageT4.R	Yes	Count	5	1	6
			% of Total	62.5%	12.5%	75.0%
		No	Count	1	0	1
			% of Total	12.5%	12.5%	25.0%
	Total		Count	6	1	7
			% of Total	75.0%	25.0%	100.0%
No	stageT4.R	Yes	Count	14	2	16
			% of Total	60.9%	8.7%	69.6%
		No	Count	3	5	8
			% of Total	13.0%	17.4%	30.4%
	Total		Count	17	7	24
			% of Total	73.9%	26.1%	100.0%

SND * Nodal Recurrence Crosstabulation

			Nodal Recurrence		
			Yes	No	Total
SND	Yes	Count	1	6	7
		% of Total	3.2%	19.4%	22.6%
	No	Count	6	18	24
		% of Total	19.4%	58.1%	77.4%
Total		Count	7	24	31
		% of Total	22.6%	77.4%	100.0%

Result – 1/7 cases of selective neck dissection had recurrence

Supraglottic * Nodal Recurrence

30% of cases have nodal recurrence. Of these cases one clinically N1 neck not done Selective Neck Dissection.

Crosstab

			Nodal Recurrence		
			Yes	No	Total
Supraglottic	Yes	Count	3	7	10
		% of Total	9.7%	22.6%	32.3%
	No	Count	4	17	21
		% of Total	12.9%	54.8%	67.7%
Total		Count	7	24	31
		% of Total	22.6%	77.4%	100.0%

Transglottic * Nodal Recurrence

29 % of Clinically N0 neck have recurrence in transglottic tumours

Crosstab

			Nodal Recurrence		
			Yes	No	Total
transglottic	Yes	Count	4	10	14
		% of Total	12.9%	32.3%	45.2%
	No	Count	3	14	17
		% of Total	9.7%	45.2%	54.8%
Total		Count	7	24	31
		% of Total	22.6%	77.4%	100.0%

Glottic * Nodal Recurrence

There are no nodal recurrence in glottis cases.

Supraglottic * Selective Neck Dissection

50% of cases of supraglottic tumours underwent selective neck dissection of which one had nodal recurrence.

Crosstab

			SND		
			Yes	No	Total
Supraglottic	Yes	Count	5	5	10
		% of Total	16.1%	16.1%	32.3%
	No	Count	2	19	21
		% of Total	6.5%	61.3%	67.7%
Total		Count	7	24	31
		% of Total	22.6%	77.4%	100.0%

Transglottic * Selective Neck Dissection

14 % of clinically N0 neck have been done selective neck dissections.

Crosstab

			SND		
			Yes	No	Total
transglottic	Yes	Count	2	12	14
		% of Total	6.5%	38.7%	45.2%
	No	Count	5	12	17
		% of Total	16.1%	38.7%	54.8%
Total		Count	7	24	31
		% of Total	22.6%	77.4%	100.0%

Glottic * Selective Neck Dissection

No cases

RESULTS OF STATISTICAL ANALYSIS

Total no . of cases of total laryngectomy - 31

Mean age of the study population- 56

96.8% of the study population are male

1 Female case is of supraglottic tumor without neck dissection and recurrence.

Tumor location :

1. Supraglottic tumours -32.3% (10 cases)
2. Transglottic - 45.2% (14 cases)
3. Glottic - 25.8% (7 cases)

Variables of clinical staging that were comparable were arytenoids, anterior commisure and subglottis, nodalstatus, T stage

Clinical evaluation	**Radiological evaluation(CT)**	**Histopathology (**comparing variables with CT)
Arytenoids – 7(22%)	Arytenoids– 13 (41.9%)	8(25.8%)
Marginal zone – 10(32.3%)	Anterior comm.- 19(61.2%)	19(61.3%)
Ant.commissure- 17(54.8%)	Paraglottic space- 25(80.6%)	27(87.1%)
Ventricle – 24 (77.4%)	Preepiglottic space-0	0
Subglottis- 4 (12.9%)	Subglottis-	17 (54.8%)

	10(32.3%)	
Extra laryngeal spread – 1 (3%)	Extra laryngeal spread-2(6.5%)	1(3.2%)
	Thyroid cartilage-18(58.1)	22(71%)
	Cricoids cartilage-4(41.9%)	7(22.6%)
T3 – 30(96.8)	T3- 9 (29%)	8(25.8)
T4a- 1(3.2)	T4a- 22(71%)	23(74.2)
N0 – 30 (96.8)	N0- 30	6/7
N1- 1 (3.2)	N1- 1	1/7
N2- 0	N2-0	0

- Total number of selective neck dissections were 7.
- 30 cases out of 31 had total thyroidectomy done of which one case of transglottic tumour was reported to have papillary ca. thyroid infiltrating larynx.
- one case of hemithyoidectomy done without any tumour involvement.
- Total nodal recurrences with minimum 6 months follow up were 7 / 31 of which 3/7 were supraglottic and 4/7 were transglottic. One of 3 nodal recurrence of supraglottic tumour came even after the selective neck dissection on the same side and from one N1 neck which neck was not surgically operated.

Comparative results of CT with histopathological findings:

CT results	Sensitivity %	Specificity %	PPV %
Ant.commissure	100	66	82.6
Arytenoids	75	69.5	46
Thyroid	72.7	77.7	88.8
Cricoids	28	91	50
Subglottis	58.8	100	100
Paraglottic space	88.8	75	96
Preepiglottic space	No involvement in any case	100	
Extra laryngeal tissue spread	100	100	100

CT sensitivity of tumour involvement in descending order in comparison with histopathology

- Ant. Commissure> paraglottic space > arytenoids> thyroid cartilage > subglottis > cricoids
- 30% of supraglottic tumours and 28.5% transglottic tumours with most of them with clinically N0 neck had nodal recurrences

Clinical Staging Vs Histopathological Staging

Tumour location	Under estimation	Accurate	Over estimation
Supraglottic	5	5	Nil
Transglottic	11	3	Nil
Glottis	5	2	Nil
Total	21/31	10	Nil
%	70%	33%	

Radiological Staging Vs Histopathological Staging

Tumour location	Under estimation	Accurate	Over estimation
Supraglottic	**1**	**8**	**1**
Transglottic	**2**	**10**	**2**
Glottis	**3**	**3**	**1**
Total	**6**	**21**	**4**
%	**19%**	**67%**	**13%**

DISCUSSION

Clinical staging alone in advanced laryngeal tumours has failed to correctly estimate true limits of tumour in large percentage of cases. In our present study accurate clinical staging done in **10** out of **31** cases **(33%).**Accuracy of CT scan imaging overall in tumour staging in our study is **(83%)**. These findings are quite similar to those reported by

S.No	**Year**	Author	Comparision of Results			
			Literature		My Study	
			Accuracy of staging			
			clinical	**CT**	clinical	CT
1.	**1986**	**Pillsbury and kirchner**	**43%**	**76%**	**33%**	**83%**
2.	**1986**	**Katasonis et al**	**62%**	**82%**		
3.	**1991**	**Vogl et al**	**54%**	**84%**		
4.	**1989**	**Sulfaro et al**	**49%**	**71%**		
5.	**1996**	**Thabet et al**	**52%**	**68%**		
6.	**1996**	**Becker**	**58%**			
7.	**1997**	**zbaren**	**57%**			
8.	**1999**	**Ferri T**	**51%**	**70%**		

Pillsbury and Kirchner (clinical 43%), Katsantonis et al (1986), who reported preoperative CT and clinical staging accuracy of **82%,**

62%, respectively. **Vogl et al (1991)** reported preoperative clinical staging accuracy of 54% for laryngeal carcinomas. This is little different from that obtained by **Sulfaro et al (1989)** , who found the accuracy of the clinical vs CT staging for laryngeal carcinomas was **49% , 71%** respectively**. Thabet et al (1996)**, reported overall accuracy by clinical evaluation **52%** and CT scan **68%. Becker (1997)** ,**and Zbaren (1996)** reported preoperative clinical staging accuracy for laryngeal carcinomas of **58% 57.5%** respectively. **Ferri T(1999)** found the staging accuracy of laryngoscopy vs CT scan was **51.3% , 70.1%,** respectively.

Differences in our results from those of previous studies might be explained by the presence of a large number of superficial and small mucosal tumors in their series which lowered CT accuracy.

Evaluation of clinical tumour staging accuracy stratified by tumour location. In our study low accuracy in staging glottis tumours **35%**. This does not agree with by **Thabet et al (1996)** ,who reported similar results and found high accuracy in staging glottic tumours **(85%)** by clinical evaluation. **Katsantonis et al (1986)** who reported a very reliable clinical staging for glottic tumours, offering **93%** accuracy. In our study all our glottis tumours are of advanced stage with involvement of cartilage so clinical accuracy is very much low.

In our series we found lower accuracy in staging supraglottic tumours was **(50%). Thabet et al (1996),Katsantonis et al (1986)**

reported preoperative clinical staging accuracy of **45%**, **74%** for supraglottic tumours respectively. In our series, the accuracy of clinical evaluation in staging transglottic tumours was **(20%)**. This is not comparable with that of by **Katsantonis et al** , who found clinical evaluation accuracy of **45%** for transglottic tumours , but comparable with that obtained by **Thabet et al** ,who reported very low accuracy in staging transglottic tumours **(31%).**

In our series, we found by means tumour location there was very high accuracy in staging supraglottic and transglottic ,glottis tumours **(80%), (85%), (85%)** respectively in comparison with histopathological staging: **Katsantonis et al** (1986) showed also high CT scan staging accuracy of **83%** for supraglottic, and **88%** for transglottic tumors. **Thabet et al (1996**) reported preoperative CT staging accuracy of **68%** for supraglottic, and **88%** for transglottic tumors. Katsantonis et al **(74%)**, and higher than **Thabet et al** (1996) who reported lower accuracy **(46%)** in staging glottic tumors. In our series the clinical staging accuracy decreased from supraglottic to glottic to transglottic tumors, whereas CT scan staging became significantly more in transglottic and similar in glottis and supraglottic tumours . Similar results observed by **Katsantonis et al (1986), Ferri T (1999), Thabet et al (1996)**.

All clinical/ endoscopic staging errors consisted of an underestimation that resulted from a failure to identify involvement of paraglottis, preepiglottic space and destruction of laryngeal cartilage with extralaryngeal tumour invasion. So many pT4 tumours were underestimated clinically. Detection of cartilage involvement is important since it precludes laryngeal conservation surgery in many cases and is associated with risk of necrosis, perichondritis and tissue edema with radiotherapy.

In our study underestimation staging by clinical evaluation is **70%**. **Harrison (1970)** ,reported clinical evaluation underestimation of the lesion extent in **40%** of his patients. **Pillsbury and Kirchner (1979**) reported underestimation of **40%** of all tumors in their series, including **. Sulfaro et al (1989**) reported underestimation for **51%** of laryngeal tumours. In **Thabet et al (1996)** underestimation for all tumors was **58%** . In our study radiological underestimation is **19%** and **over estimation is 13%**. This is comparable to results obtained by: **Katsantonis et al (1986)** , and less than that reported by **Thabet et al,** understaging in **20%** of cases and overstaging in **12%** of cases. In our series, CT scan was taken about two weeks after biopsy.

The anterior commisure and the subglottic region are often hidden by bulky tumours evaluating endoscopically. It is the preferential way for cancer extension to the anterior angle of thyroid cartilage, to the

subglottic wedge space and to the cricothyroid membrane. In our study anterior commisure involvement is missed by endoscopy in 2 cases and all the 2 missed cases were diagnosed by CT. Sensitivity is 100% and specificity is 66% by CT imaging. The results are similar with **Zbaren M.Becker et al (1997)** .

CT sensitivity of paraglottic space is 88 %. Results are similar and comparable with **KirchnerJA, Cornog JL, Holmes study** (1987). Tumours arising in the ventricle invade first in the paraglottic space and then both the supraglottic and subglottic region which are missed by endoscopic evaluation.

Pre epiglottic space was not involved in any of the cases and CT was with 100% specificity. Our results are slightly better for these spaces than given in literature.

According to literature, CT accurately demonstrates gross cartilage invasion, but fails to detect minor invasion in many cases. This has been proved in study done by Becker M, Zbaren P (1995). The ability of CT to detect tumour invasion in cartilage varies with reported sensitivities of 46 to 66 percentages and specificities of 84 to 94 percentage(Becker M, Zbaren P). In our study it is sensitivity of Thyroid cartilage 72.7%, cricoid cartilage 28%, Arytenoid cartilage 75%. The irregular pattern of Thyroid cartilage calcification doesnot match with tumour invasion nor normal and pathology cartilage differentiated on

basis of density values(Hoover LA, Calcaterra, 1984 study). Arytenoid and Cricoid cartilage however can show a symmetric irregular sclerosis that suggest cartilage invasion. MRI shows nonossified and ossified cartilage better than CT. In the literature overall sensitivity of MRI in detection of neoplastic cartilage invasion is 89% and specificity between 82%-88%. Although MRI has better sensitivity it has low specificity due to severe inflammatory changes, fibrosis and extra medullary hematopoiesis within the cartilage that result in high false positive rate. In contrast CT has high false negative rate.

Among the 31 cases clinically N0-30, N1-1. Nodal metastasis is reported only in one case of supraglottic tumor and patient was not treated for neck surgically was sent to radiotherapy after laryngectomy had recurrence of node in the same side of the tumor within 6 months. Other 6 cases of nodal recurrence were two supraglottic and four transglottic tumors. Among the seven cases, one case of selective neck dissection of supraglottic tumor had nodal recurrence. Glottic tumors did not have any nodal recurrence. Selective neck dissection was done for 7 cases. 5 supraglottic, 2 transglottic tumors. Our study shows out of 24 cases of Supraglottic and Transglottic tumors with mostly N0 neck had 7 nodal Recurrences (29%) after Surgery+Radiotherapy.

LIMITATIONS OF STUDY

1. Tracheostomy whether done or not is not taken into consideration.

2. Tumour volume / thickness or depth not assessed.

3. Delay of 1- 2 weeks of time between surgery and CT evaluation.

CONCLUSION

The accuracy of clinical staging in our study of advanced stage laryngeal tumours decreased from supraglottic to glottic to transglottic tumours.

Conversely, the staging accuracy of sectional imaging is best in transglottic tumours and similar supraglottic tumours and glottic tumours.

There is gross underestimation of T4a cases clinically, almost 67% . With the help of CT underestimation of T4a cases have come down to 17%. CT therefore prevented most of the clinically underestimated cases from undergoing unnecessary organ preservation modalities like chemoradiotherapy and then salvage Total Laryngectomy.

Further CT helped in identifying thyroid cartilage invasion accurately in 73% of cases which has aided immensely in treatment planning. With addition of MRI, accuracy could still improve and aid in reducing underestimation of cases.

Nodal recurrences in N0 neck shows CT fails to identify early nodal metastasis.

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