

The Diagnostic Accuracy of the Clinical Examination and the Computed Tomography Findings in Patients with Laryngeal Carcinoma who Undergone Total Laryngectomy

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Total Larenjektomi Yapılmış Larenks Kanseri Hastalarda Klinik ve Radyolojik Tanı Doğruluklarının Karşılaştırılması

Amaç: Larengeal karsinomun tedavi öncesi doğru şekilde değerlendirilmesi tedavi seçiminde olduğu kadar değişik tedavi yöntemlerinin sonuçlarının karşılaştırılması açısından da önemlidir. Bu çalışmada tedavi öncesi mikrolaringoskopik bulgular ve bilgisayarlı tomografi (BT) bulgularıyla histopatolojik bulguların birbirleriyle uyumlu olup olmadıklarını araştırdık.

Gereç ve Yöntem: Bu çalışmada derin larengeal tutulum ya da ekstralarengeal yayılımı olan 35 hasta (34 erkek, 1 kadın) incelendi. Her bir hastanın anamnezi, klinik muayenesi (mikrolaringoskopi ve biyopsi dahil) ve BT incelemesi yapıldı. Cerrahi spesmenler aksiyel BT planına paralel şekilde kesildi. Histolojik bulgular, klinik ve BT bulgularıyla karşılaştırıldı. Her bir tanısız yöntemin preterapötik değerlendirmeye olan etkisi incelendi.

Bulgular: Klinik değerlendirme, tümörün larengeal kartilajlara ve ekstralarengeal yumuşak dokulara invazyonunu saptamada tek başına başarısız bulundu; evreleme doğruluk yüzdesi düşüktü (%57). Klinik değerlendirme BT ile kombine edildiğinde ise evreleme doğruluğu anlamlı olarak arttı (%86).

Sonuç: Derin larengeal yapılar ve ekstralarengeal dokuların tutulumunu saptamada klinik, endoskopik ve radyolojik bulguların interdisipliner biçimde ele alınması zorunludur.

Anahtar Sözcükler: Larengeal kanser, larenks endoskopisi, larenks bilgisayarlı tomografisi, larenks tüm organ kesitleri.

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Abstract

Objectives: An accurate pretherapeutic evaluation of laryngeal carcinoma is required for treatment planning as well as for evaluation and comparison of the results of different treatment modalities. The purpose of our study was to determine whether microlaryngoscopic findings and CT imaging correlate with histopathological findings or not.

Material and Methods: In this study, thirty-five cases of laryngeal cancer with deeply invading up to the limits of larynx or extralaryngeal extension were studied. Each patient had a history, clinical evaluation (including microlaryngoscopy and biopsy), and CT examination. The surgical specimens were cut in whole-organ slices parallel to the plane of the axial CT images. The histological findings were compared with the clinical and CT findings. The impact of each diagnostic method on pretherapeutic evaluation was analyzed.

Results: Clinical evaluation alone failed to identify tumour invasion of the laryngeal cartilages and of the extralaryngeal soft tissues, resulting in a low staging accuracy (57%). The combination of clinical evaluation and an additional CT imaging resulted in significantly improved staging accuracy (86%).

Conclusion: An interdisciplinary evaluation of clinical, endoscopic, and radiological findings is mandatory to detect the involvement of deep laryngeal or extralaryngeal tissues.

Key Words: Laryngeal neoplasm, laryngeal endoscopy, CT imaging of larynx, whole organ sections of larynx.

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Introduction

The pretherapeutic evaluation is the most important factor in treatment planning of laryngeal carcinoma. The limitation of clinical and endoscopic tumour evaluation to assess the exact tumour extension of laryngeal carcinomas is well recognized. Deep tumour extension, such as infiltration of paraglottic space (PGS), preepiglottic space (PES), cartilaginous skeleton, and extralaryngeal structures cannot be evaluated by endoscopy. Confronted with preoperative computed tomography (CT), clinical, endoscopic and pathological data, the evaluation of the in-depth extension (paraglottic spaces, preepiglottic space, cartilaginous skeleton, extralaryngeal planes, base of tongue, etc.) enables the surgical team to increase the indications of conservation surgery of larynx.¹

The purpose of the present study was to assess the accuracy of the preoperative CT and clinical evaluation by comparing the clinical and imaging findings of each modality with histological cross-sections of the total laryngectomy specimens and to analyze the impact of these diagnostic modalities on pretherapeutic evaluation of laryngeal carcinoma.

Materials and Methods

The patients included 34 men and one woman with ages ranging from 42 to 70 years (mean age, 58.3). All the laryngeal cancer cases were studied on regarding the depth of invasion to larynx or the extralaryngeal extension. Each patient had a history, clinical evaluation including direct microlaryngoscopy and biopsy, and CT examination.

Histopathologic examination was done after the operation. All patients underwent total laryngectomies. Tissues were fixed in 10% buffered formalin for 48 h. Decalcification was achieved in 10% buffered formic acid solution for approximately 7-10 days. Specimens were then immersed in 70% alcohol, and embedded in a paraffin block for routine processing. Repeated microtome sections of 4-5 µm thickness were made until pathological slides corresponding to the CT sections were obtained. These sections were mounted on glass slides that

had previously been thinly coated with albumin-glycerine. Finally all slices were stained with hematoxylin-eosin.

Horizontal slides of histopathology corresponding to the CT sections were selected and compared with CT scans.

CT Technique: The CT examinations were performed with TOSHIBA-Xvision CT scanner. Patients were placed in the supine position with the neck slightly hyperextended. The area between the base of the tongue and first tracheal ring was determined for scanning of the lateral projection view. Scans were obtained using 5-mm thick axial sections. In selected cases, such as glottic tumours, additional scans with thin collimation (2-mm) were obtained. Intravenous non-ionic contrast material was administered as a 100-ml bolus infusion just before scanning to facilitate detection of metastatic lymph nodes in the neck.

All CT scans were reviewed by the radiologist (Y. Bükte, MD) without knowledge of the clinical and pathological examination.

The lesions were staged for tumour (T) according to AJCC (American Joint Committee on Cancer) and IUAC (International Union Against Cancer) TNM classification (1992 and Supplement 1993). A total laryngectomy was performed in the following situations.

1. Advanced tumours with cartilage destruction;
2. Subglottic extension to preclude near-total laryngectomy;
3. Posterior commissure tumour invasion;
4. Extralaryngeal extension.

Results

Histopathological examinations of the biopsy materials revealed squamous cell carcinoma in all 35 patients. According to the clinical findings, vocal fold mobility was diminished or absent in 17 patients. In these patients, vocal fold fixation corresponded at histopathology to tumour invasion of the paraglottic space and in 3 patients to the arytenoid cartilage. According to the preoperative CT evaluation, the tumour invasion of the paraglottic space were found in 25 patients. Histopathological

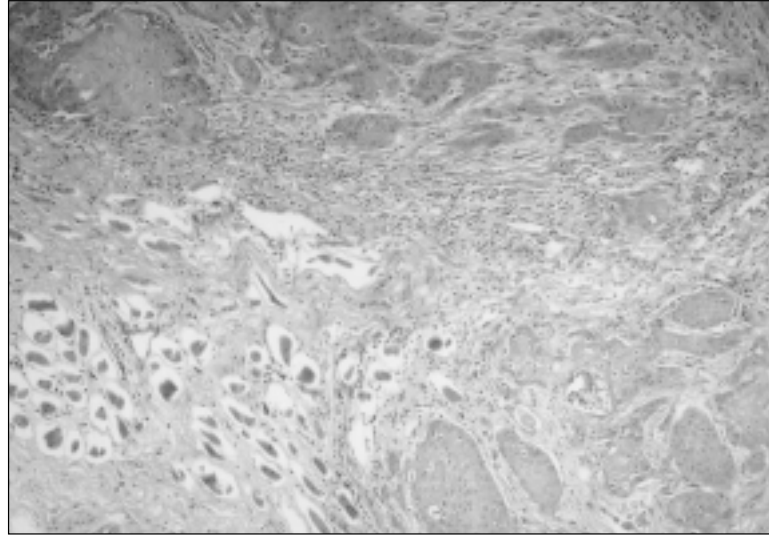


Figure 1. Paraglottic space involvement by tumour (HE x100).

examination confirmed these findings on 24 of the cases (Figure 1). One CT evaluation was false-positive (specificity 50%). Histopathological examination showed that 33 cases had paraglottic space invasion but CT could not reveal this finding in 9 cases resulting in a sensitivity of 73%.

The tumour invasion of the PES were preoperatively detected in 27 patients by CT scans (Figure 2A). Findings were confirmed on histopathological examination in 26 of the cases, while only one CT

evaluation was false-positive making specificity of 75%. In histopathological examination, 31 cases had PES invasion but CT could not show this finding in 5 cases (sensitivity 84%).

Preoperative CT evaluations for pyriform sinus invasion were evaluated in eleven (one patient had also oesophageal invasion) patients (Figure 2B). Histopathological examination confirmed this finding in five patients (totally six patients with histopathologically pyriform sinus invasion) while

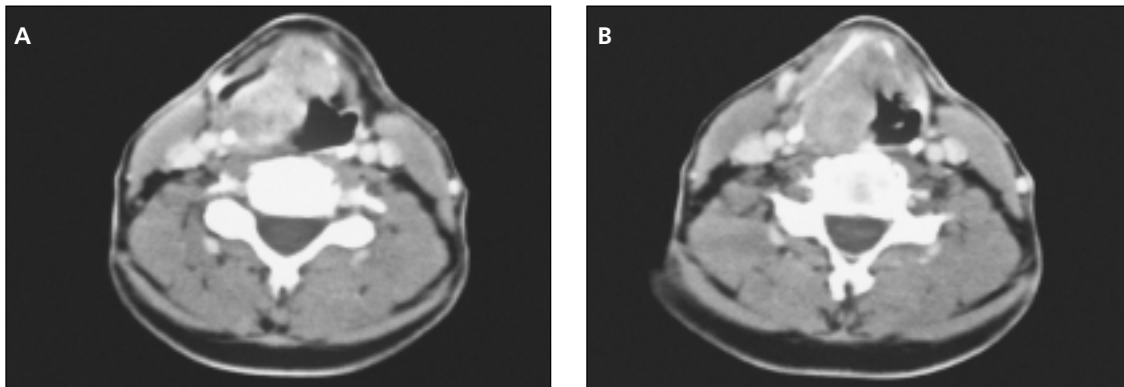


Figure 2. Glottic-supraglottic carcinoma with extension to the pre-epiglottic space, the right aryepiglottic fold and the right pyriform sinus. **A.** Contrast-enhanced CT scan at the level of the thyroid notch demonstrates extensive bilateral tumour in the preepiglottic space with displacement and narrowing of the laryngeal vestibule. **B.** One centimeter cephalad, the mass extends to the preepiglottic space, the right aryepiglottic fold and the right pyriform sinus.

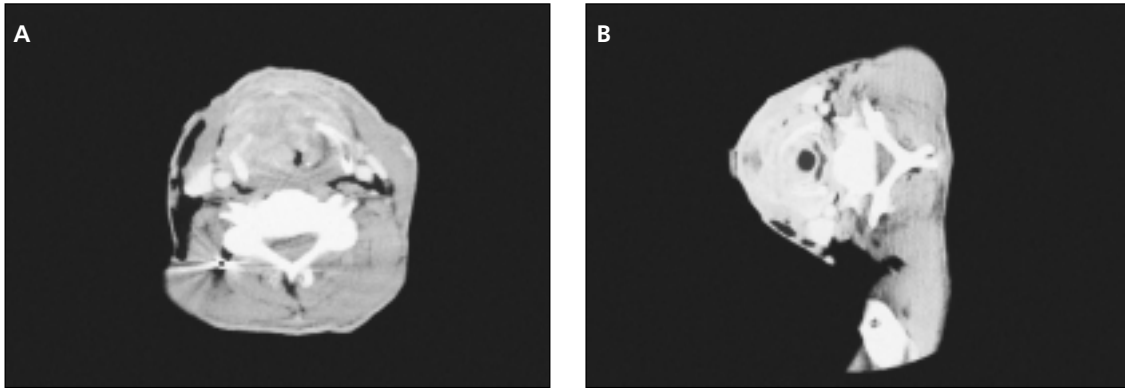


Figure 3. Glottic- supraglottic carcinoma of the larynx. **A.** Contrast-enhanced CT scan at the level of vocal cords showing a large tumour mass invading the thyroid cartilage and the soft tissues out of the larynx anteriorly. **B.** Contrast- enhanced CT scan at the same patient showing tumour extension to the subglottic region with invading into the neck.

six CT evaluations were false-positive (sensitivity 83%, specificity 79%). Clinical evaluation revealed pyriform sinus invasion in four patients (sensitivity 67%, specificity 100%).

CT showed cartilaginous involvement in 25 patients (Figure 3). Findings were confirmed on histopathological examination in 23 of the cases (Figure 4), while two CT evaluations were false-positive (specificity 77%). Histopathological examination showed that 26 cases had cartilage (24 thy-

roid, 2 cricoid) invasion but CT could not show this finding in three cases (sensitivity 88%).

Clinical evaluation indicated tumour invasion of the base tongue in two patients. Preoperative CT evaluations for these two patients revealed the same finding. Findings were confirmed on histopathological examination in both.

Tracheal invasion were found in two patients by CT. Findings were also confirmed on histopathological examination.

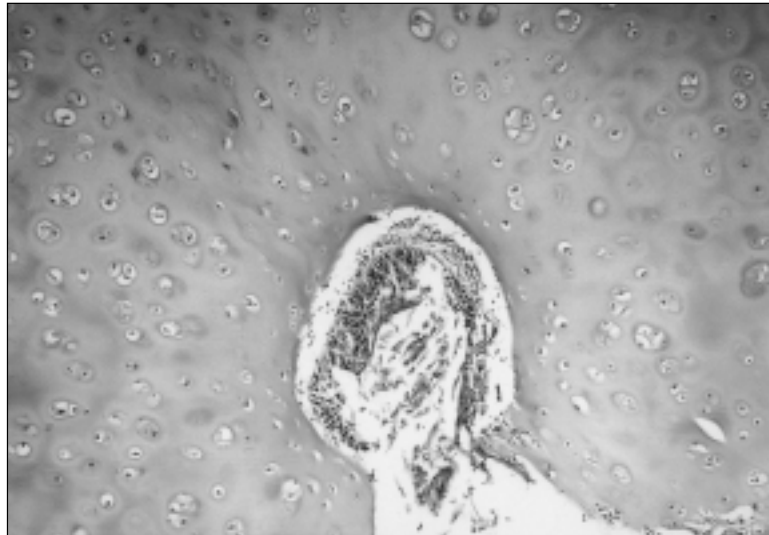


Figure 4. Tumour invasion in the thyroid cartilage (HE x100).

According to the clinical evaluation (CE) 19 laryngeal tumours were classified as T4, 6 tumours as T3 and 10 tumours as other T's. Thus clinical evaluation understaged the tumour in 13 of 35 (37%) patients.

According to the CT findings 24 laryngeal tumours were classified as T4 and 11 tumours as T3. CT evaluation alone understaged eight cases by failing to detect extensions (23%).

According to combined clinical and CT findings, 27 laryngeal tumours were classified as T4 and 8 tumours as T3. Decrease of understaging (14%) in the diagnosis of laryngeal carcinoma extension was observed by combining both of CE and CT (Table 1 and 2).

Table 1. The comparison of the stages according to the diagnostic procedures and histopathological findings.

	CE	CE	CE + CT	Histopathology
T3	6	11	8	3
T4	19	24	27	32
Other T's	10	-	-	-
Total	35	35	35	35

CE: Clinical evaluation; CT: Computed tomography

Table 2. Accuracy of clinical evaluation and computed tomography at staging in comparison with histopathological findings.

	A.st (%)	U.st (%)	O.st (%)	Total
CE	22 (63%)	13 (37%)	-	35
CT	27 (77%)	8 (23%)	-	35
CE + CT	30 (86%)	5 (14%)	-	35

CE: Clinical evaluation; CT: Computed tomography; A.st: Accurate staging; U.st: Understaging; O.st: Overstaging

Discussion

An accurate pretherapeutic staging is required for optimal treatment planning and moreover; for evaluation and comparison of the results of different treatment modalities. However the systematic comparison of CT scan and endoscopic data for all laryngeal cancers seen in a medical center presents a number of methodological problems. But pathological examination of laryngeal specimens should provide a definitive answer in cases of CT and

endoscopy diagnostic discrepancies. In case of small or medium-size tumours, however, such specimens are either unavailable (radiotherapy) or only partial (conservation surgery).

The endoscopic examination allows accurate evaluation of superficial tumour extension. Specific sites, such as laryngeal ventricle, and the subglottic region are often difficult to examine in the presence of an adjacent exophytic tumour. In addition, there are areas, such as the paraglottic space, the preepiglottic space, and the laryngeal framework that cannot be evaluated endoscopically.² Large vegetative supraglottic lesions can even make glottic and subglottic areas impossible to be seen. It has been suggested that CT has a more important role in evaluating deep laryngeal and paralaryngeal soft tissues while it provides little information to demonstrate the anatomy of small, superficial lesions.²⁻⁵

It was reported that all clinical / endoscopic evaluation errors consisted of an underestimation that resulted from a failure to clinically identify invasion of the paraglottic and preepiglottic space and destruction of laryngeal cartilage with extralaryngeal tumour invasion.^{2,6} Therefore many T3 or T4 laryngeal tumours were clinically unrecognized. Harrison⁷ reported clinical evaluation underestimation of the lesion extent in 40% of his patients. Pillsbury and Kirchner⁸ reported 40% and Sulfaro et al.,⁹ indicated 41% clinical staging errors in their series. Zbaren et al.² observed inaccurate clinical/endoscopic staging in 45% of laryngeal cancers. In the present study, we observed inaccurate clinical/endoscopic staging in 43% (15/35) of laryngeal cancers. It can be easily stated that endoscopy is quite limited with respect to deep or distal extension.

Detection of cartilage invasion is not only an important factor for accurate staging but also for optimal treatment planning in laryngeal carcinoma.^{2,6} According to the literature, CT accurately demonstrates gross cartilage invasion, especially in the presence of extralaryngeal tumour spread, but fails to detect minor cartilage invasion in many cases.^{3-5,10} The ability of the CT to detect neoplastic

invasion varies with sensitivities of 46-83% and specificities of 84-94%.^{5,10,11} In the present study we found a sensitivity of 88% and specificity of 77% in the evaluation of cartilage invasion by CT.

Paraglottic space is composed primarily of muscle and fatty tissue. Since tumour and muscle have the same densities on CT scans, it can be more difficult to discriminate one from the other. At the level of the vocal folds, the normal paraglottic space is visualized as a fairly thin, low-density zone lying between the cords and medial surface of the thyroid cartilage. For this reason, unless tumour is large enough to produce distortion of normal anatomy, tumour invasion into the paraglottic space may not be evident on CT.¹² In 14 (42%) of 33 cases who have, pathologically, paraglottic space involvement, vocal cord mobility was diminished, which corresponds at histopathology to tumour invasion of paraglottic space. Zbaren et al.,² reported CT accuracy of paraglottic space involvement in 86% of cases. In our study, the sensitivity of 73% and specificity of 50% were found in the assessment of the paraglottic space by CT.

PES is primarily composed of fatty content of this space. The obvious differences between the densities of tumour and fatty tissue make it easier to evaluate tumour invasion into the PES by CT.¹³ Zbaren et al.,² also reported the CT correct assessment of the preepiglottic space was 95%. The CT assessment of preepiglottic space involvement was correct, in our study, in the 26 of 31 cases with preepiglottic space involvement. This study showed a sensitivity of 84% and specificity of 75% in the assessment of the preepiglottic space by CT.

In our study, clinical and also CT evaluations indicated tumour invasion of the tongue base in two patients. Tracheal invasion was found in two patients by CT. Findings were confirmed on histopathological examination in both.

Clinical evaluation revealed pyriform sinus invasion in four of five patients making the sensitivity 67% and specificity 100%. Preoperative CT evaluations for pyriform sinus invasion were evaluated in eleven (one patient had also oesophageal invasion) patients. Histopathological examination confirmed

this finding in five patients while six CT evaluations were false-positive.

In CT assessment of juxtalaryngeal regions, such as the base of tongue and the pyriform sinuses, motion or mucus secretion artifacts, asymmetrical bulging of lingual tonsils, anatomical variations and collapses in case of compression from a nearby tumour may lead to misdiagnosis. On the whole, it appears that precise juxtalaryngeal extension assessment depends more on endoscopic workup than on CT evaluation.

For the evaluation of laryngeal tumours, CE was not sufficient but CT should be used to detect the involvement of PES, PGS and cartilage invasion. In the present study, the accuracy of combined clinical and CT staging was 86%.

Clinical evaluation fails to identify invasion of the laryngeal framework and of extralaryngeal tissues in a high percentage of cases; therefore many T4 laryngeal tumours are clinically unrecognized. An interdisciplinary evaluation of all clinical endoscopic, and radiological findings by the radiologist and laryngologist is mandatory in order to avoid inappropriate treatment.

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