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LARYNGOLOGY

Diagnosis of anterior commissure invasion in laryngeal cancer

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Abstract The objective of the study is the invasion of anterior commissure (AC) by a laryngeal carcinoma has an oncological importance for the outcome. Detection of invasion is difficult due to particular anatomical features of this region. Therefore, we aimed to investigate the value of different diagnostic modalities for the detection of AC involvement at the patients with laryngeal carcinoma. Retrospective analysis of medical charts in a tertiary referral center. Records of preoperative clinical examination, computerized tomography (CT), peroperative examination and postoperative histopathological examination of 47 patients with laryngeal carcinoma were analyzed. The results of postoperative histopathological examination were accepted as true. Sensitivity, specificity, negative-predictive value, positive-predictive value and accuracy ratios were calculated for each modality. AC involvement was found to be positive in 23 patients according to the postoperative histopathological examination. Peroperative clinical examination was found to be superior to preoperative clinical examination and CT. In conclusion, classical multi-slice CT only on axial planes is not a reliable method to detect the invasion of AC. Preoperative clinical examination by suspension laryngoscopy under general anesthesia has an approximately 30% failure rate. Peroperative examination must not be neglected if possible.

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Introduction

Anterior commissure (AC) is a part of endolarynx at the true vocal cord level representing the confluence of the mucosa within the airway reflected from the anterior aspect of both true vocal cords, covering the posterior aspect of the thyroid cartilage in the midline glottis [1]. It is a transition area between supraglottic and subglottic regions.

The anatomic features and neighboring of this region make it critical at staging and outcome. Tumors extending to AC can easily invade subglottis, thyroid cartilage and preepiglottic area. In one of the most largest series of the literature, Rucchi et al. [2] concluded that TNM does not correlate well with the outcome. They proposed a new staging system considering AC specifically. Nakayama and Brandenburg [3] reported the difficulty of noticing deep AC involvement as one of the most important factor for clinical understaging of laryngeal tumors. It is well known that radiotherapy and endoscopic laser resection has fairly good outcome at the treatment of early glottic carcinoma. However, the involvement of AC is likely to result in recurrence after radiotherapy [4–8] and surgery is recommended for these kinds of lesions [9, 10]. Success rates of endoscopic laser resection decrease when tumor invades AC [11]. Some authors recommend partial cartilage resection in addition to endoscopic laser resection for cases with the suspected cartilage invasion [12, 13]. Despite the optimum results in tumor recurrence, conservative surgical procedures have certain disadvantages. It has too much morbidity due to tracheostomy, swallowing difficulties, aspiration, deterioration in quality of voice and longer hospitalization

time when compared with laser resection and radiotherapy. Hence, accurate determination of AC involvement before decision-making on therapeutic choice is crucial to avoid insufficient treatment or overtreatment. Correct decision-making about tumor invasion at AC region is more difficult due to its anatomical location when compared with the other subregions of larynx. Therefore, our aim was to determine the value of different modalities at determining invasion of AC by a laryngeal carcinoma.

Materials and methods

Medical charts of 65 patients with laryngeal carcinoma who had undergone surgery between March 2006 and June 2008 were retrospectively studied. The patients who had records of preoperative clinical examination, peroperative examination, postoperative histopathological examination and computerized tomography (CT) images in their charts were included in the study. Forty-seven patients who suited those criteria were enrolled in the study. These patients had both early glottic carcinomas and advanced carcinomas. The location of the tumor of 10 (21.3%) patients was glottic, 27 (57.4%) patients were transglottic and 10 (21.3%) patients were supraglottic. According to postoperative histopathological examination, 4 (9%), 19 (42%),16 (34%) and 8 (15%) of the patients were T1, T2, T3 and T4, respectively. Any of the patients were not treated with radiotherapy prior to surgery. Cordectomy with laryngofissure was carried out at 4 (9%) patients. Frontolateral and frontoanterior laryngectomy were carried out at 15 (32%) patients. Horizontal supraglottic laryngectomy was carried out at 10 (21%) patients. Supracricoid partial laryngectomy was carried out at 10 (21%) patients and total laryngectomy was carried out at remaining 8 (17%) patients.

All patients were treated by transcervical approach. Preoperative clinical examination had been done by means of suspension direct laryngoscopy with the aid of an operating microscope under general anesthesia. Angled endoscopes were used for the assessment of the subglottic region and the AC. Peroperative examination had been done by direct vision inside larynx, while the larynx had been entered into before the resection of the specimen. At that moment, tumor extension to all parts of larynx including AC had been noted. The invasion of AC by tumor was defined as yes or no at pre and perioperative clinical and postoperative histopathological examination. Radiological study consisted of helicoaxial CT scan of 1-mm thickness. The detection of AC thickening greater than 1 mm detected in two following images was accepted as positive for tumor invasion. The results of histopathological examination were accepted as the definite final diagnosis. During those examinations, AC was accepted to be involved even if the tumor invades the mucosa and submucosa of that region.

NCSS 2007&PASS 2008 Statistical Software (UT, USA) program is used for all statistical analysis. Mc Nemar and Kappa tests were used for statistical purposes. Sensitivity ratio, specificity ratio, negative-predictive value, predictive value and accuracy ratio were calculated according to the histopathological examination for each modality. Significance was determined to be at the confidence level of $P < 0.05$.

Results

The average age of the patients was 57.9 ± 9.8 years. There were 41 males and 6 females.

The rate of invasion of AC by tumor was 48.9% according to histopathological examination (23 patients out of 47), while clinical examination had diagnosed 38.3% of AC of patients as tumor positive both as false and true. According to preoperative clinical examination, 14 of these 23 patients were diagnosed as true positive, while the diagnosis of remaining 9 patients were false negative. Four patients were diagnosed false positive, while these patients were finally evaluated as negative by histopathological examination. Preoperative clinical examination sensitivity, specificity, positive-predictive value, negative-predictive value and accuracy ratios were 60.87, 83.33, 77.78, 68.9 and 72.34%, respectively (Table 1). The non-coincident kappa ratio was 44.4% between histopathological and preoperative clinical examination.

There was a statistically significant difference in the detection of AC invasion between CT and histopathological examination ($P < 0.05$). CT had diagnosed 29.8% of AC of patients as tumor positive both as false and true. By preoperative CT examination, 10 patients were diagnosed as

Table 1 Comparison of results of AC tumor invasion between preoperative clinical examination and postoperative histopathological examination

Anterior commissure	Histopathological examination						*P*
	Yes		No		Total		
	n	%	*n*	%	*n*	%	
Preoperative clinical examination							
Yes	14	29.8	4	8.5	18	38.3	0.267
No	9	19.1	20	42.6	29	61.7	
Total	23	48.9	24	51.1	47	100	
Sensitivity							60.87
Specificity							83.33
Positive-predictive value							77.78
Negative-predictive value							68.97
Accuracy							72.34

Mc Nemar test applied

Table 2 Comparison of results of AC tumor invasion between preoperative CT and postoperative histopathological examination

Anterior commissure	Histopathological examination						*P*
	Yes		No		Total		
	n	%	*n*	%	*n*	%	
Preoperative CT							
Yes	10	21.3	4	8.5	14	29.8	0.049*
No	13	27.7	20	42.6	33	70.2	
Total	23	48.9	24	51.1	47	100	
Sensitivity							43.48
Specificity							83.33
Positive-predictive value							71.43
Negative-predictive value							60.61
Accuracy							63.83

Mc Nemar test applied *$P < 0.05$

Table 3 Comparison of results of AC tumor invasion between peroperative examination and postoperative histopathological examination

Anterior commissure	Histopathological examination						*P*
	Yes		No		Total		
	n	%	*n*	%	*n*	%	
Peroperative examination							
Yes	19	40.4	5	10.6	24	51.1	1,000*
No	4	8.5	19	40.4	23	48.9	
Total	23	48.9	24	51.1	47	100	
Sensitivity							82.61
Specificity							79.17
Positive-predictive value							79.17
Negative-predictive value							82.61
Accuracy							80.85

Mc Nemar test applied *$P < 0.05$

positive correctly among these 23 patients while 13 patients were diagnosed as false negative. Four patients were diagnosed false positive by CT while these patients were finally evaluated as negative by histopathological examination. Preoperative clinical examination sensitivity, specificity, positive-predictive value, negative-predictive value and accuracy ratios were 43.48, 83.33, 71.43, 60.61 and 63.83%, respectively (Table 2). The non-coincident kappa ratio was 53.9% between histopathological and preoperative CT examination.

There was no statistically significant difference between peroperative examination and histopathological examination in detecting the patients having AC (p:1.00). Peroperative examination had diagnosed 51.1% of AC of patients as tumor positive both in a right or wrong way. By peroperative examination, 19 patients were diagnosed as positive correctly among these 23 patients, while 4 patients were diagnosed as false negative. Five patients were diagnosed false positively by peroperative examination, while these patients were actually evaluated as negative by histopathological examination. Preoperative clinical examination sensitivity, specificity, positive-predictive value, negative-predictive value and accuracy ratios were 82.61, 79.17, 79.17, 82.61 and 80.85%, respectively (Table 3) The non-coincident kappa ratio was 61.7% between histopathological and peroperative examination.

Discussion

The invasion of AC is one of the most challenging issues for otolaryngologists for diagnosis and staging. Oncologic importance of AC invasion is still a subject of debate. According to some authors, AC is a dangerous area for tumor invasion to thyroid cartilage due to Broyle ligament. The lacking of perichondrium at the point where ligament adheres to cartilage is responsible for this weakness against tumor spread [14–17]. Because only there is 2–3-mm distance between an AC mucosa and the thyroid cartilage, a relatively small tumor may actually penetrate the cartilage [18]. In contrast, Kirchner et al. [19] and Sessions et al. [20] proposed AC as to be a line of resistance against the cranial spread of tumors arising in the cordocommissural region. According to his study over 412 whole organ section of the larynx, Kirchner concluded that Tla and Tlb glottic tumors rarely invade the cartilage and the tumors invading the cartilage are actually T2 and T3 tumors of glottic region extending to epiglottis and root of the tongue. Session also reported that AC involvement solely represents extended tumor bulk and upper stages indeed. Based on the results of these histopathological studies, we can assume that failures of minimal invasive treatment modalities such as endoscopic laser resection or radiotherapy result from understaging of tumor. Insufficient treatment is inevitable after understaging.

Barbosa et al. [21] reported 40% rate of correct staging of laryngeal tumors with anterior glottic involvement by endoscopic examination in a series of 52 patients. They concluded that AC lesions except from actual T1 tumors were frequently understaged when evaluated by clinical endoscopic examination alone. But success rate increased to 75% using multi-slice helicoidal axial CT scan with sagittal and coronal reconstruction. We found an accuracy of clinical examination in detecting AC invasion as 72%. High-failure rates in determination of AC invasion by clinical examination in our study and very low rate of correct

staging of laryngeal tumors with anterior glottic involvement in Barbosa's study is a matter of grief. Because false-negative evaluation is likely to result in insufficient treatment and recurrence, while false-positive evaluation results in overtreatment and unnecessary morbidity. Difficulty in detecting the invasion of AC by endoscopy arises from its particular anatomic features. AC is not under direct vision when the larynx is viewed by the aid of suspension laryngoscope. Some kind of manipulation must be done even when a specifically designed laryngoscope for AC is used. In addition, large tumor bulk may hide real status of AC regarding tumor invasion.

Classical multi-slice axial CT examination was found to have a limited role in detecting AC status in this study. False-positive cases may be due to difficulty at discrimination of reactive inflammation and edema from tumor. There is not any study in the literature giving knowledge about the efficacy of CT solely at detecting AC invasion. But, CT has reported to be efficient at detecting cartilage invasion at the tumors with extralaryngeal spread, but ineffective in detecting minor invasion [22–24]. We found a very low sensitivity rate (43.5%) of CT in detecting AC invasion. Classical evaluation of AC involvement consists of detecting AC thickening greater than 1 mm detected in at least two contagious tomographic slices. Barbosa et al. [21]. presented a new radiological term that they named as GRACI (gross radiologic AC involvement). In addition to axial images, they reconstructed images on sagittal and coronal planes. They reported that GRACI signs aided in staging T1 and T2 lesions correctly and had a great influence on therapeutic choice. It is obvious that assessment depending solely on axial CT images is not enough for a correct decision about AC involvement. Reconstructed multi-plane images must be preferred.

Peroperative evaluation was found to be the most efficient way for detecting AC invasion. It has the highest rates of sensitivity, negative-predictive value, positive-predictive value and accuracy. Unfortunately, this method may not be applicable to all surgical procedures. Also, it is not possible when radiotherapy, endoscopic laser resection or total laryngectomy had become the decided choice of treatment method. But when conservative surgery is the therapeutic choice, if possible; it seems wise to prefer following a surgical procedure which allows evaluation of AC invasion peroperatively before irreversible resection both to avoid overtreatment and insufficient treatment. Sánchez et al. [25] reported a 14% rate of local recurrence that required total salvage laryngectomy in 35 patients with Tlb glottic tumors who underwent reconstructive anterior glottectomy including partial resection of thyroid cartilage. Laccourreye et al. [26] reported a 5-year local control rate of 98.2% when performing supracricoid partial laryngectomy with cricohyoidoepiglottopexy in a series of 62 patients with early glottic cancer that had invaded the AC. The detection of deep invasion peroperatively may change the procedure from frontolateral, frontoanterior or Tucker operation to supracricoid subtotal partial laryngectomy.

Alternative modality for detecting AC involvement is magnetic resonance imaging (MRI). Berkiten et al. [27] reported an 84% accuracy of MRI in detecting AC invasion. Optical coherence tomography and high-frequency ultrasound are promising new methods in the early diagnosis of laryngeal cancer. However, there has been no reliable value given in the literature for the efficacy in detecting AC invasion.

Conclusion

Evaluation of AC by multi-slice axial CT is not a useful method. Preoperative clinical examination by suspension laryngoscopy has a failure rate of 28%. Peroperative examination by direct vision is the most reliable method to detect the invasion of AC.

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Conflict of interest statement None.

References

1. Kallmes DF, Phillips CD (1997) The normal anterior commissure of the glottis. Am J Roentgenol 168:1317–1319
2. Rucci L, Gammarota L, Gallo O (1996) Carcinoma of the anterior commissure of the larynx: II. Proposal of a new staging system. Ann Otol Rhinol Laryngol 105:303–308
3. Nakayama M, Brandenburg JH (1993) Clinical underestimation of laryngeal cancer: predictive indicators. Arch Otolaryngol Head Neck Surg 119:950–957
4. Kanonier G, Fritsch E, Rainer T, Thumfart WF (1996) Radiotherapy in early glottic carcinoma. Ann Otol Rhinol Laryngol 105:759–763
5. Burke LS, Greven KM, McGuirt WT, Case D, Hoen HM, Raben M (1997) Definitive radiotherapy for early glottic carcinoma: prognostic factors and implications for treatment. Int J Radiat Oncol Biol Phys 38:1001–1006
6. Marshak G, Brenner B, Shvero J, Shapira J, Ophir D, Hochman I, Marshak G, Sulkes A, Rakowsky E (1999) Prognostic factors for local control of early glottic cancer: the Rabin Medical Center retrospective study on 207 patients. Int J Radiat Onco Biol Phys 43(5):1009–1013
7. Hirota S, Soejima T, Obayashi K, Hishikawa Y, Honda K, Okamoto Y, Maeda H, Takada Y, Inoue K, Kinishi M, Amatsu M, Kimura S (1996) Radiotherapy of T1 and T2 glottic cancer: analysis of anterior commissure involvement. Radiat Med 14:297–302
8. Maheshwar AA, Gaffney CC (2001) Radiotherapy for T1 glottic carcinoma: impact of anterior commissure involvement. J Laryngol Otol 115:298–301

9. Rucci L, Gallo O, Fini-Storchi O (1991) Glottic cancer involving anterior commissure: surgery vs radiotherapy. Head Neck 13(5):403–410
10. Zohar Y, Rahima M, Shvili Y et al (1992) The controversial treatment of anterior commissure carcinoma of the larynx. Laryngoscope 102(1):69–72
11. Strong MS (1975) Laser excision of carcinoma of the larynx. Laryngoscope 85(8):1286–1289
12. Zeitels SM (1998) Infrapetiole exploration of the supraglottis for exposure of the anterior glottal commissure. J Voice 12(1):117–122
13. Steiner W, Ambrosch P (2000) Laser microsurgery for laryngeal carcinoma. In: Steiner W, Ambrosch P (eds) Endoscopic laser surgery of the upper aerodigestive tract. Thieme, New York, pp 47–82
14. Broyles E (1942) The anterior commissure tendon of the larynx: its significance in the laryngofissure operation: preliminary note. Bull Johns Hopkins Hospital 70:90–345
15. Bagatella F, Bignardi L (1981) Morphological study of the laryngeal anterior commissure with regard to the spread of cancer. Acta Otolaryngol 92:167–171
16. Shvero J, Hadar T, Segal K et al (1994) T1 glottic carcinoma involving the anterior commissure. Eur J Surg Oncol 20:557–560
17. Tillmann B, Paulsen F, Werner JA (1994) Structures of the anterior commissure of the larynx: biomechanical and clinical aspects. Laryngorhinootologie 73:423–427
18. Krespi YP, Meltzer CJ (1989) Laser surgery for vocal cord carcinoma involving the anterior commissure. Ann Otol Rhinol Laryngol 98:105–109
19. Kirchner JA, Carter D (1987) Intralaryngeal barriers to the spread of cancer. Acta Otolaryngol 103:503–513
20. Sessions DG, Ogura JH, Fried MP (1975) The anterior commissure in glottic carcinoma. Laryngoscope 85(10):1624–1632
21. Barbosa MM, Araújo VJ Jr, Boasquevisque E, Carvalho R, Romano S, Lima RA, Dias FL, Salviano SK (2005) Anterior vocal commissure invasion in laryngeal carcinoma diagnosis. Laryngoscope 115:724–730
22. Castelijns JA, Gerritsen GJ, Kaiser MC et al (1988) Invasion of laryngeal cartilage by cancer: comprasion of CT and MR imaging. Radiology 167:199–206
23. Becker M, Zbaren P, Laeng H, Porcellini B, Vock P (1995) Neoplastic invasion of laryngeal cartilage: comprasion of MR imaging and CT with histopathological correlations. Radiology 194:661–669
24. Archer CR, Yeager, Herbold DR (1983) Computed tomography vs histology of laryngeal cancer: their value in predicting laryngeal cartilage invasion. Laryngoscope 93:140–147
25. Talavera Sánchez J, Paredes JR, Gómez Finana M et al (1992) Glottectomía anterior reconstructiva. An Otorrinolaringol Ibero Am 19:349–361
26. Laccourreye O, Muscatello L, Laccourreye L et al (1997) Supracricoid partial laryngectomy with cricohyoidoepiglottopexy for "early" glottic carcinoma classified as T1-T2N0 invading the anterior commissure. Am J Otolaryngol 18:385–390
27. Berkiten G, Topaloğlu I, Babuna C, Türköz K (2002) Comparison of magnetic resonance imaging findings with postoperative histopathologic results in laryngeal cancers. Kulak Burun Bogaz Ihtis Derg 9:203–207 (in Turkish)