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CT Findings of Laryngeal Tuberculosis : Comparison with Laryngeal Carcinoma[1]

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Purpose : To determine the value of CT(Computerized Tomography) in the diagnosis of laryngeal tuberculosis and to assess to what extent its characteristic findings different from those of laryngeal carcinoma.

Materials and Methods : CT scans of twelve patients with laryngeal tuberculosis were reviewed and compared with those of fifteen patients with laryngeal cancer, retrospectively. Clinical symptoms, laryngoscopic examinations and the presence of pulmonary tuberculosis on chest radiographs were also reviewed.

Results : In laryngeal tuberculosis, bilateral symmetric or asymmetric involvement was noted in nine(75%) patients, while unilateral involvement was seen in three(25%). This was significantly different from laryngeal cancer in which unilateral involvement was noted in twelve patients(80%). Diffuse thickening of the free margin of the epiglottis was a characteristic and frequent finding in tuberculosis(n = 6, 50%). No deep submucosal infiltration of preepiglottic and paralaryngeal fat spaces is seen in tuberculosis in spite of large areas of involvement of laryngeal mucosa, while twelve patients(80%) with laryngeal cancer showed thickened deep infiltration which resulted in a submucosal mass.

Conclusion : CT was useful in the diagnosis of laryngeal tuberculosis and its CT findings were characterized by bilateral involvement, thickening of the free margin of the epiglottis and good preservation of preepiglottic and paralaryngeal fat spaces in spite of large areas of involvement.

Index Words : Larynx, CT
Larynx, neoplasms
Tuberculosis

INTRODUCTION

The real nature of laryngeal tuberculosis was first identified in the early nineteenth century, but it is today a rare disease. One of the dreaded complications of tuberculosis was its spread to the larynx, which sometimes heralded a rapid downhill course and fatal outcome(1). In the prechemotherapy era, tuberculosis of the larynx was invariably associated with advanced cavitary pulmonary tuberculosis, and patients with laryngeal tuberculosis were regarded as highly infectious. It is still the most common cause for granulomatous lesions of the larynx(2). On autopsy of patients who had succumbed to tuberculosis, Habersohn(3), in 1905, noted a 48% incidence of laryngeal involvement. In 1947, Auerbach(4) studied 811 postmortem cases of tuberculosis and found laryngeal involvement in 37.5% of the cases. These studies suggest that laryngeal tuberculosis was more common than clinically recognized. Recently, its incidence in developed societies has decreased due to appropriate chemotherapy, improved surveillance, immunization, housing and nutritional standards. But throughout Africa, India and Asia this infection still causes significant morbidity and mortality(5). In addition, a recent resurgence in the incidence of tuberculosis is reported in developed countries probably due to human immunodeficiency virus (HIV) infection, in which the most striking clinical feature is the extremely high frequency of extrapulmonary

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involvement, usually with concomitant pulmonary tuberculosis(6). Laryngeal tuberculosis is therefore also expected to be on the rise. With the advent of specific chemotherapy, improved immunity and altered resistance, the character of the disease has altered considerably(7). The most frequently encountered types of laryngeal lesions today are infiltrative mucosal hypertrophy and gross tumor-like surface appearance rather than ulcerative mucosal lesions which were the main findings in the past. Thus, laryngeal tuberculosis nowadays tends to mimic laryngeal cancer and the laryngoscopic appearances often simulate malignancy(8). Until now, no radiologic report including Computed Tomography(CT) related to laryngeal tuberculosis has been published. For this reason, we assessed CT findings of laryngeal tuberculosis in order to differentiate its characteristics from those of laryngeal carcinoma and to determine the value of CT in the diagnosis of laryngeal tuberculosis.

MATERIALS and METHODS

Twelve patients with histopathologically confirmed laryngeal tuberculosis were reviewed retrospectively. The criteria for diagnosis were the characteristic histopathologic changes of caseating granuloma and/or the presence of acid fast bacilli in biopsy specimens. The clinical symptoms, laryngoscopic examinations, chest radiographs and CT scans were reviewed. Age ranged from 26 to 70 with an average of 55 ; nine were male and three were female. Fifteen patients with laryngeal cancer(squamous cell ca, n = 15) were randomly selected and their CT scans were evaluated and compared with those of tuberculosis patients. Patients with laryngeal cancer were aged between 54 and 83 with an average of 68 ; thirteen were male and two were female. Most cases were supraglottic cancers(n = 14) with the exception of one case of transglottic cancer. In TNM staging, T2 lesions were confirmed in five patients, T3 in six and T4 in four. Routine CT studies, with and without I.V. contrast injection, were performed with contiguous 5 mm sections from the upper ring of the trachea to the floor of the mouth with thin section at the glottic level. The scan planes were usually parallel to mid-cervical disc spaces when the patients were supine with mild extension of the neck. CT findings were analyzed by three neuroradiologists. Tabulated findings are : (1) symmetry of the lesion,(2) Sites of involve-

Table 1. CT Findings of Laryngeal Tuberculosis vs Laryngeal Cancer

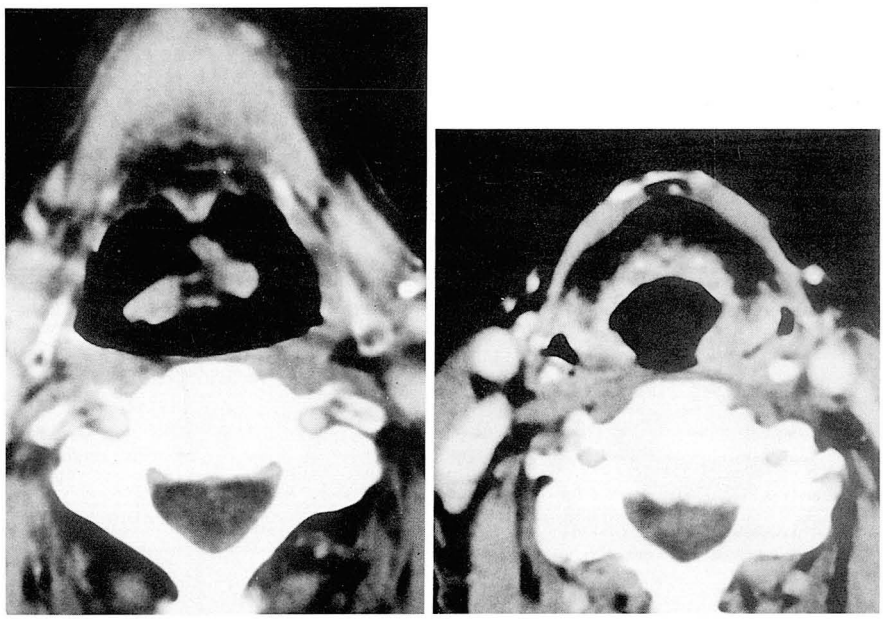
	Tbc(n = 12)	Cancer(n = 15)	p-value
1) Pattern			
Bilateral Symm	3	1	
Asymm	5	2	
Symm + Asymm	1	0	
Total	9	3	p = 0.004
Unilateral	3	12	
2) Involving Sites			
Supraglottis	10	14	p > 0.05
Glottis	6	4	
Subglottis	3	2	
supralarynx	1		
3) No. of involving Sites			
One	7	11	
Two	1	2	p > 0.05
Three	4	2	
4) Involvement of Free margin of Epiglottis	6	1	p = 0.011
5) Infiltration of Preepiglottic or Paralaryngeal fat space (Submucosal mass)	0	12	p < 0.001
6) Regional Lymphadenopathy : Central necrosis with rim enhancement	6 2	6 3	p > 0.05
7) Cartilage destruction or extralaryngeal soft tissue invasion	0	4	p = 0.053

Symm = Symmetric. Asymm = Asymmetric.

ment(supraglottis, glottis, subglottis, supralarynx),(3) number of involved sites,(4) involvement of the free margin of epiglottis,(5) preepiglottic or paralaryngeal fat space infiltration,(6) regional lymphadenopathy,(7) changes in laryngeal cartilage or extralaryngeal soft tissue invasion. All of the patients underwent microlaryngoscopy with biopsies. The Chi-square test was used for statistical analysis.

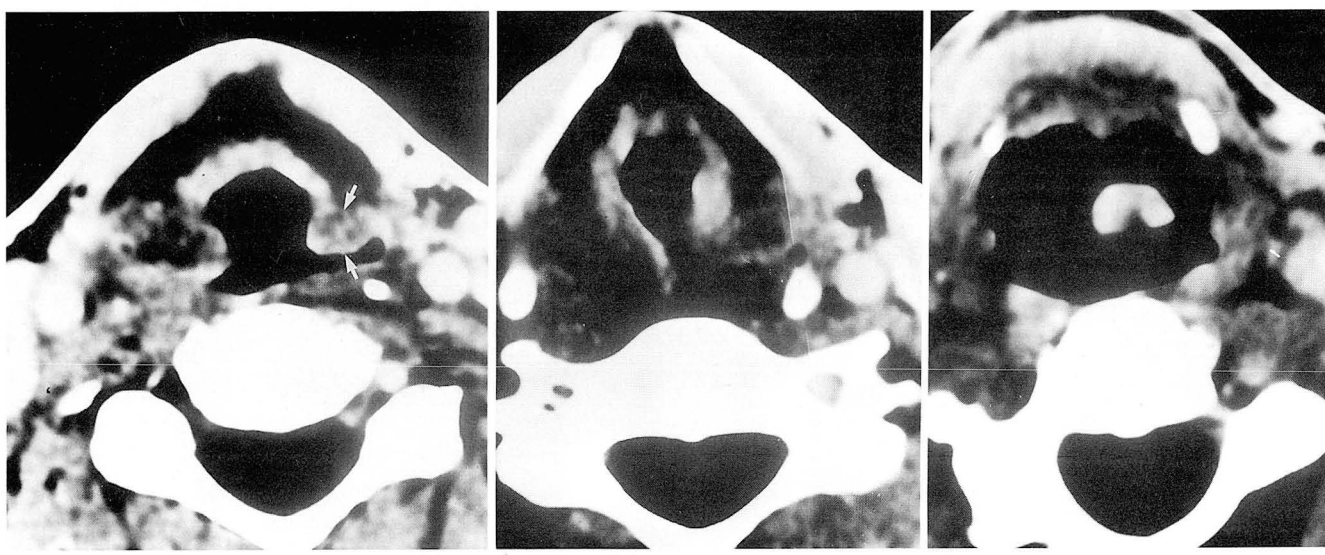
RESULTS

The predominant clinical symptoms of laryngeal tuberculosis were hoarseness, difficulty in swallowing, a sore throat, dysphagia and a sensation of foreign body. In laryngeal cancer, hoarseness, palpable neck mass and a sore thoroat were major symptoms. The duration of symptoms varied from one month to eight years in tuberculosis, while in the case of laryngeal cancer, it was from one to four months. On chest X-ray, nine patients (75%) were found to be suffering from active pulmonary tuberculosis, including one case of miliary tuberculosis and three(25%) were found to be normal. In indirect and direct laryngoscopic examinations, most(n =11) of the cases showed mucosal swelling, pinkish



a b

Fig. 1. Bilateral symmetric involvement of laryngeal tuberculosis(Tbc)
a. Diffuse thickening of free margin of epiglottis is noted.
b. Bilateral symmetric thickening of aryepiglottic folds are demonstrated. But preepiglottic and paralaryngeal spaces are well preserved.



a b c

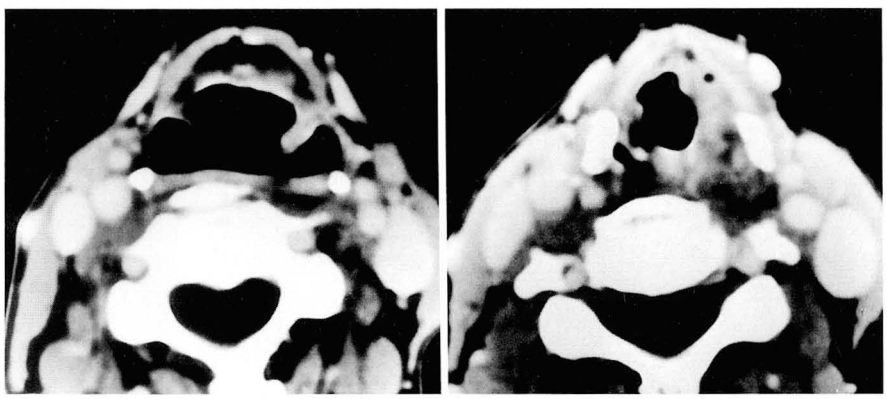
Fig. 2. Bilateral asymmetric involvement of laryngeal Tbc.
a, b. Bilateral thickening of aryepiglottic folds and laryngeal vestibules are identified with some contrast enhancement, infiltration is more severe on left side(arrows). Preepiglottic and paralaryngeal fat spaces are well preserved.
c. Diffuse thickening of the epiglottis is also noted.

hypertrophic and polypoid lesions, a dirty exudate and a fungating tumor-like appearance resulting in a provisional diagnosis of laryngeal carcinoma. Only one case was considered to be a granulomatous lesion, in which symmetric, irregular and nodular mucosal infiltrations on the true vocal cords, without vocal cord palsy, were seen.

Findings of Computerized Tomography

CT findings of laryngeal tuberculosis compared with laryngeal carcinoma were tabulated(Table 1). Diffuse bilateral involvement(Fig. 1, 2) was seen in nine patients(75%) of laryngeal tuberculosis, while unilateral involvement(Fig. 3) was noted in three(25%). Involvement was symmetric in three patients and asymmetric in five. One case showed symmetric involvement in the upper laryngeal vestibule and asymmetry on the lower level. In patients with laryngeal cancer, only three(20%) had bilateral involvement while twelve(80%) had unilateral involvement ; this was significantly different statistically($p = 0.004$) from laryngeal tuberculosis. The supraglottic larynx was the most prevalent site of involvement in both laryngeal tuberculosis and carcinoma, which statistically showed no significant difference($p > 0.05$). The most common site was the aryepiglottic fold, while the epiglottis, the false and true vocal cords were the next commonly affected sites. Isolated vocal cord involvement was seen in one case. There were also three cases of tuberculosis in which the lesions extended into the subglottic region.

Although there was no significant statistical difference($p > 0.05$) from laryngeal cancer($n = 4$, 26.7%) in the total number of involved sites, in case of tuberculosis, lesions of the larynx tended to involve two or



a b

Fig. 3. a, b. Unilateral Involvement of Laryngeal Tbc.
Diffuse thickening of left aryepiglottic fold(a) and left laryngeal vestibule(b) is visualized. This case is difficult to differentiate from early stage of laryngeal cancer.

Fig. 4. Thickened and dense deep infiltration of Lt. paralaryngeal fat space results in submucosal mass(fullness). This case was confirmed squamous cell carcinoma.

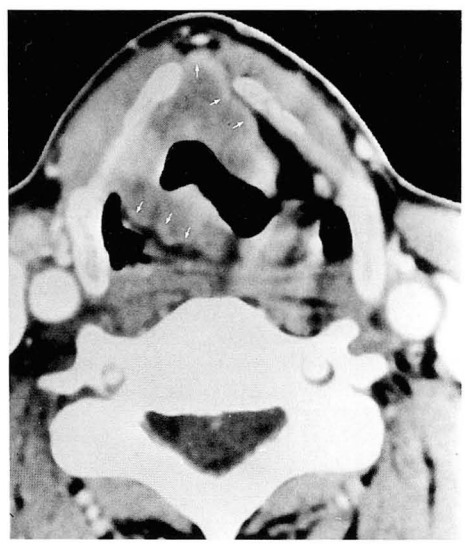


Fig. 5. Thickned aryepiglottic fold is seen on right side. Dense and deep infiltration is seen on right paralaryngeal and preepiglottic fat spaces, resulting in submucosal mass. Strong and linear contrast enhancement(arrow) is demonstrated along the margins of deeper portion of submucosal mass. Squamous cell carcinoma was proven.

more sites(n = 5, 41.7%), including the supraglottis and the glottis. In laryngeal tuberculosis, smooth or sometimes lobulated and diffuse thickening of the free margin of the epiglottis(Fig. 1a) was a characteristic and frequent finding(n = 6, 50%), which was significantly different statistically(p = 0.011) in comparison to laryngeal cancer in which only one case(n = 1, 7%) with this finding was noted. The case was an epiglottic cancer, and an intense contrast enhancement in the free margin of the epiglottis was noted to a degree which was different from the laryngeal tuberculosis in which none of the cases showed a similar degree of strong contrast enhancement on the free margin of the epiglottis. No infiltration of preepiglottic or paralaryngeal fat spaces was seen in laryngeal tuberculosis, while a large number of patients with laryngeal cancer(n = 12, 80%), showed thickened and dense infiltration of disease process in these spaces, forming a submucosal mass or fullness(Fig. 4). Two cases of laryngeal cancer showed strong and linear contrast enhancement along the advanced margins of deeper infiltrating portions of the submucosal mass(Fig 5). Regional lymphadenopathy was noted in six patients(50%) with laryngeal tuberculosis, and the lymph nodes of two patients revealed a central necrosis with peripheral rim enhancement pattern. Among laryngeal cancer patients, regional lymphadenopathy was noted in six patients(40%) and a central necrosis with peripheral rim enhancement was noted in three. Destruction and/or sclerotic changes of laryngeal cartilage or extralaryngeal soft tissue invasion were noted in laryngeal cancer(n = 4).

No patient in the tuberculosis group showed such findings ; the findings were, however, were statistically significant(p = 0.053). In one case of tuberculosis, an ulceroinfiltrative mass-like lesion with contrast enhancement was identified on the tonsil, oropharyngeal mucosa, the supraglottis and anterior commissure of the vocal cords without infiltration of the preepiglottic or the paralaryngeal fat spaces(Fig 6). The free margin of the epiglottis was also thickened. Numerous acid-fast bacilli were found within the biopsy specimens of the tonsil and the epiglottis.

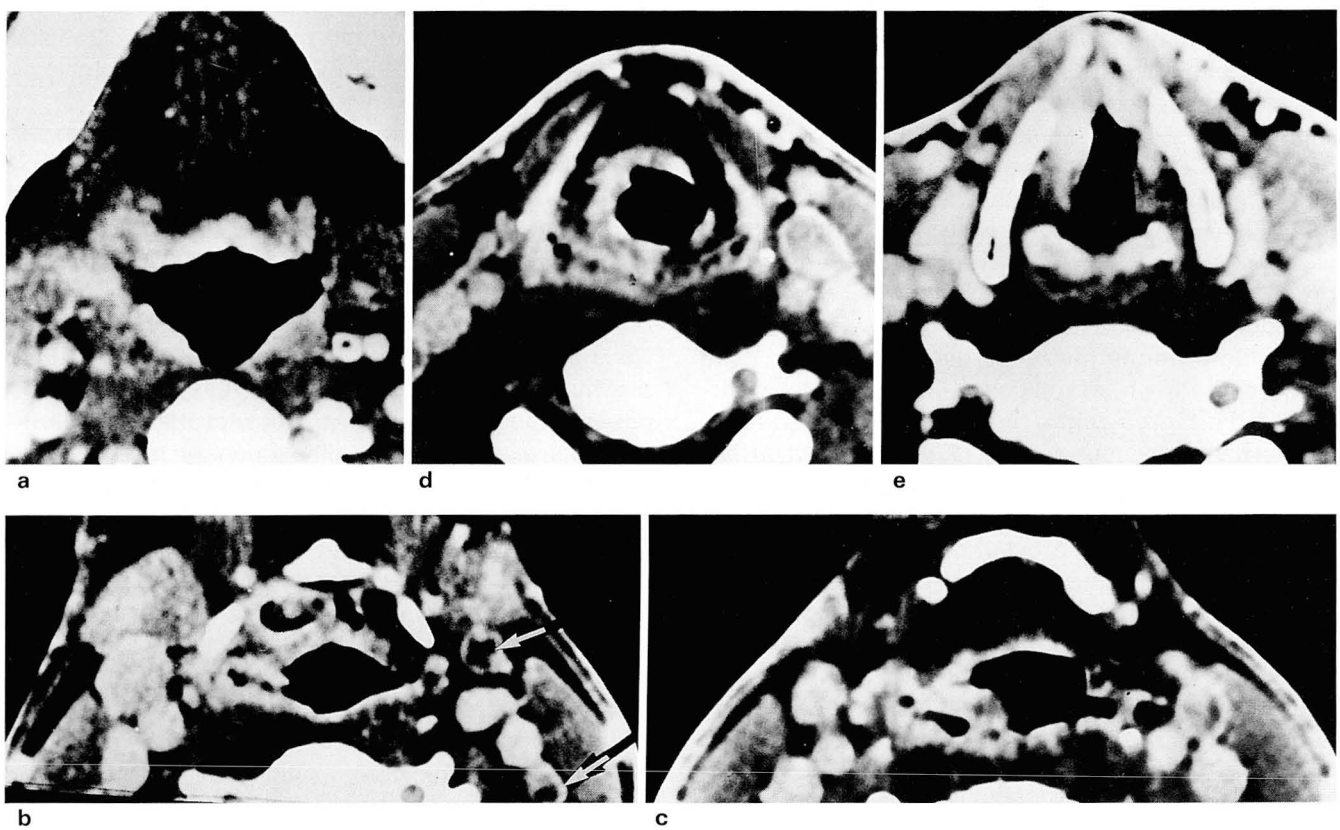


Fig. 6. Tuberculosis from tonsil to anterior commissure of vocal cords.

a, b. Right palatine tonsil and posterior wall of oropharyngeal mucosa show swollen appearance and contrast enhancement, extending to epiglottis and right vallecula. Multiple lymphadenopathies on both internal jugular chains, some with central necrosis and peripheral rim enhancement(arrows) are also seen.

c. Right aryepiglottic fold also shows diffuse thickening with contrast enhancement. Rt. pyrifirm sinus is also involved.

d, e. Laryngeal vestibule and anterior commissure are also involved.

Despite large areas of involvement, Preepiglottic and paralaryngeal fat spaces are well preserved. Numerous acid-fast bacilli were found within the biopsy specimens of tonsil and epiglottis.

DISCUSSION

Laryngeal and meningeal invasion represent the most serious complications of pulmonary tuberculosis. According to previous reports, 15—37% of patients with pulmonary tuberculosis were associated with laryngeal tuberculosis(4, 9). These reports indicated that the condition was not frequently recognized clinically. The presence of laryngeal symptoms in a patient with known active pulmonary tuberculosis suggests an important association that should not be overlooked(10). In our series, 75%(n = 9) of the patients had active pulmonary tuberculosis including one miliary tuberculosis. Pulmonary tuberculosis still seems to be the major etiological factor in the development of laryngeal tuberculosis. A predominance of males among patients has long been recognized. The male to female ratio in most reports is 2 : 1 to 3 : 1(11). A ratio of 3 : 1 was observed in our series. The well recognized modes of infection in laryngeal tuberculosis are through bronchogenic spread by direct infestation via highly infectious sputum from active pulmonary tuberculosis, and hematogenous or lymphatic spread(12). Bronchogenic spread, directly from open cavities, is the most accepted etiologic theory. In this scenario, tuberculosis tends to be localized on the vocal cord and posterior larynx(13). The hematogenous theory can account for the 20 % incidence of negative chest radiographic findings. Our series showed no predilection for posterior laryngeal involvement ; instead, diffuse and large areas of involvement were seen. Nowadays, the spread appears to be mainly via the lymphatic and hematogenous route. In the study by Travis et al., the mode of infection in purely cordal lesions is bronchogenic spread, while additional involvements of the false cords, the epiglottis and the aryepiglottic folds suggest hematogenous spread(12). One case of purely cordal involvement in our series had normal chest radiographs, and it seems that purely cordal involvements do not always represent bronchogenic spread. The most frequent impression of laryngeal tuberculosis when first examined by the otolaryngologists was carcinoma of the larynx. Hypertrophic changes of the mucosa may occur and result in a mass formation simulating a malignancy. Before the era of antibiotics, this was considered to represent a greater resistance to infection or a less virulent infection(14, 15).

Today, the pattern of the disease has altered. there is diffuse involvement with hematogenous spread and mass formation. In our series, chest X-rays of three patients(25%) were normal, and other primary lesion could not be identified on admission. Primary laryngeal tuberculosis or hematogenous spread from an unknown focus was therefore thought to be the case. Diffuse or lobulated thickening of the free margin of the epiglottis was a unique and frequent finding in tuberculous laryngitis ; this phenomenon is better explained by hematogenous spread of tuberculosis. In laryngeal cancer, thickened and dense submucosal infiltration of preepiglottic or paralaryngeal fat spaces, forming a submucosal mass, was frequently found. Especially, linear and strong contrast enhancement along the advancing margins of deeper infiltrating submucosal mass was highly characteristic. This finding had never been observed in laryngeal tuberculosis. Increased vascularity of the peripheral portion of the malignant tumor, probably at the active proliferative zone, could be suggested as the possible cause of this phenomenon. Bilateral symmetric or asymmetric involvements were also more common in laryngeal tuberculosis. Sometimes it was difficult to differentiate tuberculous laryngitis from a T2 lesion of laryngeal cancer without paralaryngeal fat space obliteration, but bilaterality or involvement of the free margin of the epiglottis was helpful in differentiation. Park has reported a case of concurrent tuberculosis of the larynx and the tonsil(16). Our series included a similar case involving the tonsil, the oropharynx, the supraglottis and the true vocal cord. This was a representative case of diffuse, wide and continuous involvement in laryngeal tuberculosis from the oropharynx to the true vocal cords. Despite such an extensive area of involvement, preepiglottic or paralaryngeal fat space obliteration was absent.

It has been suggested that during attempts to expel the heavily infected pulmonary exudate and secretions, mucosal ulceration may occur, with subsequent infection of the trachea, larynx, and even oral mucosa (17). In one study, a high proportion(26.9%) of patients with laryngeal tuberculosis were associated with diabetes(18), and these were more prone to tuberculosis. None of our patients had diabetes. It is well known that airway obstruction rarely occurs even in fulminant cases, although the patient might succumb to respiratory failure as a results of pulmonary tuberculosis. There was no evidence of sclerosis or destruction of laryngeal cartilage or extralaryngeal soft tissue invasion, often present in laryngeal carcinoma(T4), in our cases of laryngeal tuberculosis. Clinically, if the possibility of tuberculous laryngitis is suspected in a patient with known pulmonary tuberculosis, direct laryngoscope and biopsy can be postponed and often avoided, even though the possibility of coexistent carcinoma of the larynx cannot be ruled out without biopsy(19). In the case of an irradiated larynx, due to carcinoma of the larynx or hypopharynx, similar findings, such as diffuse thickening of the suprahyoid & infrahyoid epiglottis, the aryepiglottic fold and the false cord, are also identified. However, other findings relating to skin and platysmal thickening, retropharyngeal space edema, obliteration of preepiglottic & paraglottic fat space and atrophy of submandibular gland & enhancements as well as a clinical history of irradiation were helpful in differentiating between an irradiated

larynx and laryngeal tuberculosis(20). In patients of chronic non-granulomatous laryngitis, characteristic laryngoscopic findings and clinical symptoms make it easy to diagnose, and most of the cases do not require laryngeal CT scan. In chronic laryngitis due to gastroesophageal reflux disease, posterior laryngitis demonstrating red mucosa with piled up interarytenoid mucosa on laryngoscopic examination is characteristic and quite different from the findings in cases of tuberculosis or carcinoma. Laryngeal amyloidosis, which is also a very rare disease, occurs as diffuse mucosal thickening or as subepithelial nodules localized mainly on the anterior subglottis. On CT scan, the lesion appears as a well-defined homogenous submucosal mass with soft tissue density without evidence of cartilage destruction or lymphadenopathy. CT would be helpful for clinicians in making a decision whether to perform a direct laryngoscope or laryngomicroscopic biopsy or treat first with antituberculosis drugs in equivocal cases. We conclude that in laryngeal tuberculosis :

Bilateral symmetric or asymmetric involvements were common, while unilateral involvements were common in laryngeal carcinoma. Diffuse smooth or lobulated thickening of the free margin of the epiglottis was a characteristic and frequent finding. Despite extensive areas of mucosal involvement, including the extralaryngeal region, preepiglottic and paralaryngeal fat spaces were well preserved. In contrast, thickened and dense infiltration with submucosal mass was frequently found in laryngeal carcinoma. And pulmonary tuberculosis still seems to be the most important etiological factor, despite changing patterns of the spread of tuberculosis. CT with characteristic and often unique features was useful in diagnosis of this disease.

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후두 결핵의 컴퓨터 단층 촬영 소견:후두암 소견과의 비교[1]

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목 적:후두 결핵을 진단하는데 있어서 CT 의 유용성을 알아보고, 후두암과는 다른 특징적인 소견이 있는지에 대하여 알아보고자 하였다.

대상 및 방법:12명의 조직병리학적으로 확인된 후두 결핵 환자와 15명의 후두암 환자의 CT 소견을 후향적으로 분석하였다. 또한 임상적 증상, 후두 내시경 소견 및 단순 흉부 사진상 폐결핵의 유무를 조사하였다.

결 과:후두 결핵의 경우, 양측 대칭성 또는 비대칭성 병변을 보인경우가 9예(75%), 단측성 병변은 3예(25%)를 나타낸 반면, 후두암의 경우 단측성 병변이 12예(80%)를 나타내었으며, 이는 통계학적으로 유의한 차이를 나타내었다($p = 0.004$). 후두개염(epiglottis)의 자유연이 두꺼워지는 특징적인 소견이 6예(50%)에서 관찰되었으며, 또한 광범위한 후두점막의 병변을 나타내고 있음에도 불구하고 preepiglottis와 paralaryngeal space의 지방층에 침윤 소견 은 보이지 않았다. 반면에 후두암의 경우 12예(80%)에서 점막하 심침윤이 관찰되었다.

결 론:CT는 후두 결핵을 진단하는데 있어서 매우 유용하였으며, 그 소견으로는 양측성 병변이라는 것, 후두개염(epiglottis)의 자유연이 두꺼워지는 것, 그리고 넓은 후두 점막의 병변에도 불구하고, preepiglottis와 paralaryngeal fat spaces는 침윤을 나타내지 않는 것으로 특징 지워질 수 있었다.