Juvenile Laryngeal Carcinoma: Correlation of Computed Tomography and Magnetic Resonance Imaging with Pathology*

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ABSTRACT

The clinical, radiologic and pathologic features of invasive squamous cell carcinoma of the larynx are reported in a 16-year-old girl. In particular, computerized tomography (CT) and magnetic resonance imaging (MRI) are correlated with histopathological findings. It was found that the combined use of CT and MRI enabled an accurate identification of laryngeal tissue components and a precise delineation of extent of cancer spread. This diagnostic approach is emphasized as well as the need to suspect carcinoma of the larynx in any child with unrelenting or recurring hoarseness.

Introduction

Squamous cell carcinoma of the larynx accounts for one percent of all malignant tumors in the adult population. The occurrence of this laryngeal cancer in the pediatric population is very unusual, with 54 cases having been reported in the literature. However, it may not be as uncommon as previously believed. Juvenile laryngeal carcinoma has been associated with juvenile papillomatosis,
the most common laryngeal illness in childhood, as well as other risk factors. The average patient with laryngeal cancer involving the true vocal cords visits three physicians and waits eight months before a diagnosis is made. Delay in diagnosis is even greater in young laryngeal cancer patients who may undergo prolonged unsuccessful antibiotic treatments for presumed tonsillitis, laryngitis, and upper respiratory infection.

In this report is described a 16-year-old female with invasive squamous cell carcinoma of the larynx arising in the right true vocal cord. This case is interesting in that the patient was examined preoperatively by both computerized tomography and magnetic resonance imaging, and the results were correlated with the histopathology to evaluate the potential benefits of these studies in the workup of young patients with laryngeal cancer.

Case Report

A 16-year-old Hispanic girl was referred for persistent hoarseness of at least six months duration. Four months prior to admission, she had been treated by her family physician for presumed tonsillitis with a course of antibiotics despite two sterile throat cultures. Two months later, the hoarseness worsened and was accompanied by dysphagia and otalgia radiating down the right side of her neck. There were no chills, fever, cough, fullness in her throat, hemoptysis, dyspnea or weight loss.

Past medical history was positive only for frequent upper respiratory tract infections and episodes of otitis media. She smoked one-half a pack of cigarettes per day for approximately two years but denied taking alcohol or other recreational drugs. There was no report of vocal abuse or papillomatosis.

Physical examination revealed a 16-year-old female whose voice was hoarse and breathy in quality. She had palpable neck nodes along a right jugular chain which were hard and mildly tender. The nodes were palpated at levels 2 and 3 and measured 0.5 to 2 cm. Flexible laryngoscopy showed an exophytic mass of the right side of the larynx with vocal cord fixation at the midline. The patient was scheduled for computerized tomography (CT), magnetic resonance imaging (MRI), and panendoscopy. Thyroid, tuberculosis, and immunodeficiency studies were normal.

Direct laryngoscopy revealed a large exophytic granular mass, mostly submucosal, extending from the right arytenoid into the right ventricle and true vocal cord. Biopsies revealed an invasive, well-differentiated keratinizing squamous cell carcinoma. A total laryngectomy with right radical neck dissection was followed by radiation therapy (6500 Rads to the angle of the mandible) in 36 fractions over 55 days.

Pathology

The laryngectomy specimen was sliced horizontally at two mm intervals following fixation in 10 percent neutral buffered formalin for three days, and decalcification in a 1N hydrochloric acid per 10 percent neutral buffered formalin solution for one day. Whole slices were embedded in paraffin, sectioned at 10 microns, and stained with hematoxylin-eosin, Masson’s trichrome and Vernhoff-Van Gieson’s method for elastic fibers. A well-differentiated keratinizing squamous cell carcinoma (figure 1) was seen to arise from the mid portion of the right vocal cord with invasion in several directions. The main pathway of tumor spread was laterally into the paralaryngeal space up to the inner surface of the thyroid cartilage which remained intact (figure 2A). The tumor was contained along the medial surface of the cartilage to the pyriform recess (figure 2A). Squamous cell carcinoma crossed the midline anteriorly as well as at the interarytenoid space, and there was extension of tumor into the pre-epiglottic space to the superior border of the thyroid cartilage. There was no infraglottic spread, and all resection margins were free of tumor. The radical neck dissection revealed lymph nodes showing reactive hyperplasia with no evidence of malignancy.

Radiologic-Pathologic Correlation

Computed tomography (CT) revealed an enhancing mass in the right larynx containing areas of lower density (approximately the same as muscle) which correlated precisely with islands of squamous cell carcinoma in the pathologic specimen (figure 2B). The lower density was attributed to keratin associated with the malignant epithelium and not tumor necrosis, the latter not being significant in this case. In this young patient, the laryngeal cartilages were not ossified. The thyroid and arytenoid cartilages could not be confidently identified, and therefore cartilaginous invasion could not be accurately assessed. Magnetic resonance imaging (figure 3) was superior to CT in identifying the laryngeal cartilages. On T1 weighted images the thyroid cartilage did not appear to be involved, an observation which corresponds to the histopathologic findings.

Discussion

The principle predisposing factor for developing juvenile laryngeal cancer is previous radiation therapy for juvenile
Juvenile laryngeal carcinoma (JLC). Juv

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laryngeal papillomatosis (JLP). Juvenile laryngeal papillomatosis is the most common neoplasm in the pediatric larynx, and is associated with infection by the human papilloma virus types 6 and 11. It has long been known that radiation treatment for JLP can result in malignant transformation. Owing to the latency period between radiation therapy and the development of malignancy, the patients are usually not afflicted until they become adults. Other risk factors for pediatric laryngeal cancer include cancer malformation syndrome, intrauterine exposure to ionizing radiation, chemical carcinogens, and smoking or tobacco exposure. While cancer risk with tobacco use rises with duration of exposure, intervals as short as that seen in this patient with one pack-year history have been described. In light of continuing active use of tobacco in the adolescent population, there remains a need to be vigilant for the occurrence of head and neck cancer.

Several differences in adult and juvenile laryngeal carcinomas have been noted. In general, young persons have an increased percentage of glottic tumors and a lower percentage of subglottic tumors than adults. Young people initially present with more advanced tumors than adults. This may be secondary to delay in diagnosis because the tumors are fast growing. The tumors are mostly well-differentiated keratinizing carcinomas, as was our case, and most authors agree that survival is relatively good since the patients are generally healthy and can tolerate therapy well. It is the conclusion of the current authors that for many patients with juvenile laryngeal carcinoma, aggressive treatment should be given. However, one caution is that X-ray treatment to the head and neck exacts a higher price when given to patients in their primitive years. It can increase the incidence of thyroid, parathyroid, salivary gland and squamous cell tumors later in life. It also has been shown to interfere with cartilage growth centers and cause delayed atrophy of soft tissues. Overall survival statistics are extremely variable; however, they are slightly better for young persons than for adults.

FIGURE 1. Well-differentiated keratinizing squamous carcinoma in right vocal cord. Hematoxylin & eosin × 100.
Figure 2. A. Whole mount of larynx sectioned horizontally at level of arytenoid cartilages (ac). Squamous carcinoma involves right vocal cord (sq) and extends laterally into paralaryngeal space (+). Tumor continues posteriorly (arrowheads) along inner surface of thyroid cartilage (tc) to the mucosa of the pyriform fossa (pf). Figure 2B. Corresponding CT horizontal cross-section demonstrates the bulk of tumor in right paralaryngeal space (+) and its extension posteriorly (arrowheads) to the pyriform mucosa.
The value of CT in the diagnosis of laryngeal cancer lies in its ability to image the soft tissue of the larynx, the information of which is additive to observed surface changes recorded by laryngoscopy.\textsuperscript{10,12} However, CT evaluation of laryngeal carcinoma is limited by its inability to detect early cartilaginous invasion and failure to provide a three-dimensional image. In contrast, MRI has been documented to demonstrate excellent resolution of the intralaryngeal musculature and compartments in the axial, sagittal and coronal planes.\textsuperscript{3}

To the best of our knowledge, our case is unique in that it is the first reported tumor in this age group examined preoperatively by both CT and MRI. Histopathologic features, including extent of tumor spread and reaction in adjacent tissues, were able to be correlated with the two diagnostic procedures. In our patient, CT was capable of resolving the location and shape of discrete foci of invasive keratinizing squamous cell carcinoma as low density, nonenhancing areas. It was incapable, however, of properly visualizing the non-ossified laryngeal cartilages, and it was unclear whether or not the tumor had spread beyond the larynx. Magnetic resonance imaging was capable of discriminating laryngeal cartilages, but a uniformly high signal was received from the infiltrated soft tissue, making determination of extent of tumor spread imprecise by this method alone. It can be seen that both methods, used in conjunction, were complimentary in providing an accurate preoperative evaluation of the topographic extent of tumor invasion, which was important in planning the surgical management of this young patient. These data were shown postoperatively...
to correlate with the histopathologic findings of tumor spread in the laryngectomy specimen.

References