Role of Advanced Laryngeal Imaging in Glottic Cancer

Early Detection and Evaluation of Glottic Neoplasms

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KEYWORDS

• Glottic cancer • Laryngeal imaging • Videostroboscopy • High-speed imaging
• Videokymography • Optical coherence tomography • Autofluorescence
• Biologic endoscopy

KEY POINTS

- Direct laryngoscopy and biopsy are the gold standard for diagnosis of laryngeal cancer, but multiple imaging modalities exist and are in development that aid in the identification of early glottic neoplasms.
- Videostroboscopy, high-speed imaging, and videokymography characterize the vibratory properties of the vocal folds and can identify lesions that disrupt the normal mucosal wave.
- Optical coherence tomography, autofluorescence, and biologic endoscopy techniques noninvasively provide information about superficial and deep tissue structure.
- Computed tomographic scan, MRI, PET, and ultrasound can provide information relevant to staging of the primary tumor as well as about nodal metastases.

INTRODUCTION

Laryngeal carcinomas account for approximately 2.4% of new malignancies worldwide each year.[1] According to the American Cancer Society, 10,000 new cases of laryngeal cancer are diagnosed in the United States annually and result in 3900 yearly deaths.[2] More than 95% of laryngeal cancers are the squamous cell carcinoma (SCC) type.[3] The glottic larynx is the most common site of occurrence of laryngeal SCC.[4] Laryngeal cancers that are considered "early" typically include carcinoma in situ (CIS), T1, and T2 lesions without metastasis. In CIS, malignant cells are present but

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Abbreviations

AF	Autofluorescence
AFE	Autofluorescence endoscopy
AH	Acriflavine hydrochloride
ALA	Aminolevulinic acid
CE	Contact endoscopy
CEM	Confocal endomicroscopy
CIS	Carcinoma in situ
CT	Computed tomography
FDG	18F-fluorodeoxyglucose
HSI	High-speed imaging
NBI	Narrow band imaging
NPV	Negative predictive value
OCT	Optical coherence tomography
PPV	Positive predictive value
PS-OCT	Polarization sensitive optical coherence tomography
PTP	Fluorophore protoporphyrin IX
RS	Raman spectroscopy
SCC	Squamous cell carcinoma
SLP	Superficial lamina propria
US	Ultrasound
USPIO	Ultrasmall supramagnetic iron oxide

have not penetrated the basement membrane.[5] T1 lesions are limited to one (T1a) or both (T1b) vocal folds, with normal vocal fold mobility. T2 lesions extend to the supraglottis or subglottis and may impair vocal fold mobility without vocal fold fixation.

Early detection of pathologic tissue change is of utmost importance for effective treatment and the preservation of function in glottic malignancy. It can be difficult to find a balance between ensuring adequate resection and favorable oncologic outcome with preserving laryngeal structure and function. Imaging has traditionally been an important adjunct in the diagnosis, staging, and monitoring of glottic neoplasms. Although direct laryngoscopy and biopsy are the gold standard for definitive diagnosis of glottic cancers, radiologic imaging modalities have traditionally provided essential information regarding overall staging and prognosis, resectability, and the feasibility of subtotal surgical options.[6] Accurate identification of tumor margins within the larynx is also paramount to maximize oncologic outcome, because leaving positive margins increases the risk of local recurrence by 32% to 80%.[7] The goal of this article is to provide an overview of advanced techniques in laryngeal imaging and their application to the diagnosis, treatment, and long-term follow-up of glottic neoplasms.

INDIRECT LARYNGOSCOPY

Perhaps the most useful examination tool in the general otolaryngologic practice is indirect laryngoscopy, which can be performed by either laryngeal mirror examination or flexible fiber-optic endoscope. Irregularities of laryngeal mucosa may be concerning for malignancy. Because differentiating malignancy from benign processes is not predictable based on gross appearance, direct laryngoscopy and biopsy are warranted. However, the burning question in every patient's mind when they are diagnosed with a concerning laryngeal mass is what is the likelihood of malignancy. The largest study currently available evaluating clinical leukoplakia was performed by Isenberg and colleagues[8] in 2008 and combined their 15-year institutional experience with a review of the literature from the prior 50 years. They noted that there was no dysplasia in 54% of