Imaging of Patients with Head and Neck Cancer

From Staging to Surveillance

Daniel P. Seeburg, MD, PhD[a,*], Aaron H. Baer, MD[a], Nafi Aygun, MD[b]

KEYWORDS

• Imaging • Head and neck cancer • Staging • Surveillance • Squamous cell carcinoma • FDG-PET/CT • MRI • CT

KEY POINTS

- Imaging is an integral part of staging, treatment planning, and surveillance of patients with head and neck cancer.
- New and improving imaging technologies increase accuracy of imaging studies but leave ordering providers with increased complexity in choosing the best study for a given indication.
- This review hopes to provide a summary of the latest imaging methods and recommendations for each of the various steps in managing patients with head and neck cancer.

INTRODUCTION

Few patients with head and neck cancer go through diagnosis, staging, treatment, and surveillance without at least one imaging study to aid in each one of these steps. With the availability of new and improving imaging technologies, including dual-energy computed tomography (CT), diffusion-weighted MRI, CT/MRI perfusion, and PET/MRI, it is becoming increasingly complex for the head and neck surgeon, radiation oncologist, or medical oncologist to request the most appropriate study for the specific indication at hand. This review hopes to provide a summary of the latest imaging methods and imaging recommendations for each of the various steps along the clinical path of patients with head and neck cancer, from initial staging to posttreatment surveillance. Because staging of head and neck cancer is different for various subsites of the head and neck, imaging is also discussed separately for each. A separate discussion of imaging of perineural spread, imaging in the setting of an occult primary tumor, and imaging of lymph nodes is followed by a discussion of paradigms for surveillance imaging in the posttreatment neck.

ORAL CAVITY

The oral cavity extends from the lips anteriorly to the anterior tonsillar pillars and circumvallate papillae posteriorly. Squamous cell carcinoma (SCC) is by far the most common cancer of the oral region and makes up greater than 90% of all cancers there.[1] Common subsites include the floor of the mouth, oral tongue, gingiva, and buccal mucosa. SCC in the oral cavity and elsewhere in the head and neck is staged based on the tumor, node, metastasis (TNM) system developed by the American Joint Committee on Cancer (AJCC).[2]

CT and MRI are both commonly used for assessing the primary tumor site.[3,4] CT should

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[a] Section of Neuroradiology, Charlotte Radiology, 1705 East Boulevard, Charlotte, NC 28203, USA; [b] Division of Neuroradiology, Johns Hopkins University, School of Medicine, 600 North Wolfe Street Phipps B100, Baltimore, MD 21287, USA

* Corresponding author.

E-mail address: daniel.seeburg@charlotteradiology.com

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be performed with intravenous contrast material (contrast-enhanced CT [CECT]) to increase tumor conspicuity. MRI has superior soft tissue contrast compared with CT and may provide a better assessment of smaller tumors and adjacent soft tissue invasion.[5] A common limitation in the oral region is streak artifact from dental restoration amalgam and beam hardening from adjacent mandible and maxilla. In this setting, MRI shows increased sensitivity for primary tumor detection over conventional CT.[3] However, newer CT technologies have contributed to significant improvements in metal artifact reduction. Dual-energy CT allows reduction of metal artifacts with virtual mono-energetic reconstructions at high kiloelectron volt levels.[6,7] In addition, new iterative software algorithms including iterative metal artifact reduction (IMAR) have further contributed to improved metal artifact reduction on CT, with the combination of IMAR and dual energy appearing to provide the greatest metal artifact reduction (**Fig. 1**).[8]

The decision of which modality to use ultimately needs to be tailored to the individual patient, taking into account such factors as dental artifacts, availability of the newer CT technologies for metal artifact reduction, the patient's ability to hold still (degradation of magnetic resonance [MR] images with tongue and swallowing movements), and the size of the primary tumor. In general, given the common artifacts in this region, the opinion of these authors is that MRI is preferred over CECT. However, when the primary tumor is small and superficial, allowing a thorough clinical assessment of extent, CT may be a more cost-effective choice for the evaluation of nodal basins. Per the National Comprehensive Cancer Network's (NCCN) guidelines, ^{18}F-fluorodeoxyglucose (FDG)- PET/CT may be additionally considered for stage III to IV (eg, T3 or N1) disease, as it may result in upstaging of disease.[9]

The primary tumor should be assessed for tumor size, deep (submucosal) extension, bone invasion, and precise characterization of adjacent structures involved, with special attention to structures delineated in the AJCC's guidelines for TNM staging. Second primary cancers are also important to identify during initial staging and on follow up surveillance imaging.[10] These can be either synchronous (discovered within 6 months of the first lesion) or more commonly metachronous. Most common locations for second primary malignancies are in the upper aerodigestive tract and lung. Nodal spread occurs primarily in neck levels I, II, and III.

Oral cavity malignancies have a high incidence of bone invasion, ranging from 12% to 56%[11]; but there is continued controversy in the literature over which modality is best for its detection. CT is generally considered superior for detection of subtle cortical erosion (using thin-section bone kernel images), but MRI is more sensitive for the

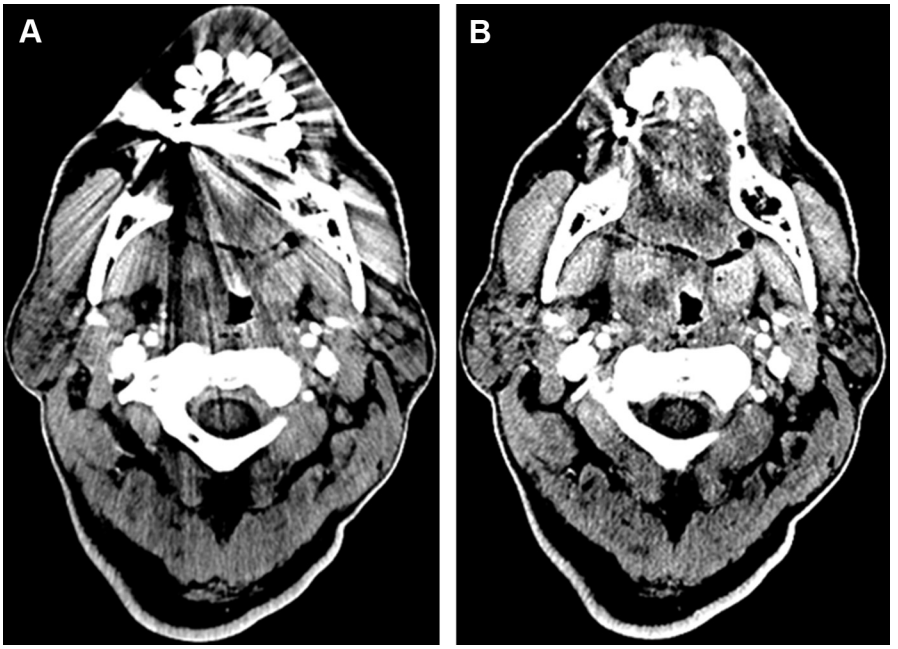

Fig. 1. IMAR. Axial noncontrast CT without (*A*) and with (*B*) IMAR in a patient with a necrotic right tonsillar mass.