Magnetic Resonance Imaging of Head and Neck Tumors

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Abstract. Magnetic resonance imaging (MRI) provides several advantages over computed tomography (CT) in the evaluation of head and neck region tumors. The improved soft-tissue contrast among normal and abnormal tissues provided by MRI now permits the exact delineation of tumor margins in the nasopharynx, oropharynx, and skull base regions. In addition, the ability to depict cross-sectional anatomy and pathology in three planes without intravenous contrast, patient manipulation, or ionizing irradiation is a distinct advantage of MRI over CT scanning. Drawbacks of MRI include the detection of subtle osseous abnormalities, patient motion, and artifacts introduced by ferromagnetic dental appliances. These drawbacks appear minimal when compared to the benefits of improved soft-tissue contrast and the ability to image exact tumor volumes.

Key words: Head and neck tumors—Nasopharynx—Magnetic resonance imaging

Magnetic resonance imaging (MRI) has several advantages over CT in the evaluation of head and neck anatomy and pathology [1, 2]. Magnetic resonance imaging allows greater contrast detail among soft tissues because of its dependence on several tissue parameters (T1 and T2 relaxation times, mobile hydrogen density), unlike CT, which depends primarily on differences in electron attenuation. The ability to depict cross-sectional anatomy and pathology in multiple planes (axial, sagittal, coronal) without intravenous contrast, patient manipulation, or ionizing irradiation is a distinct advantage of MRI, but the potential ability to better characterize abnormal tissue has promoted the rapid emergence of MRI as a diagnostic tool. Specifically in the extracranial head and neck region, soft-tissue neoplasms involving the nasooropharynx, paranasal sinuses, orbit, and cervical neck are better delineated from surrounding normal soft-tissue structures by MRI than by CT [1–5]. Dental fillings, which often obscure important regions of interest in the oropharynx on CT, usually do not present problems for MRI, because most dental amalgam has no ferromagnetic properties.

Technique

Magnetic resonance imaging's sensitivity and specificity for disease not only vary from instrument to instrument but are particularly dependent on the region of the body studied and the technique utilized for each examination. From our experience with extracranial head and neck MRI, it appears that the spin-echo (SE) technique (using both a 0.35- and a 1.5-Tesla superconducting magnet) is the optimal radiologic examination for imaging the soft tissues of the nasopharynx and oropharynx. Imaging is performed with either a specially designed neck coil which encircles the patient's lower head and neck or with surface coils applied directly to the area of concern. This optimizes the signal-to-noise ratio and eliminates artifacts produced by the edge of the smaller head coils used in brain imaging. At present, instruments are capable of slice thicknesses of 2, 5, 7, and 10 mm. Pixel dimensions available are either 1.7 mm2 or 0.8 mm2, depending on the selected matrix size (256 × 128 or 256 × 256 pixels, respectively). For most evaluations of the nasopharynx, oropharynx, paranasal sinuses, and neck, 5-mm contiguous sections through the region of interest are acquired on a 256 × 256 matrix using 2–4 averages per acquisition. Scan time is dependent on the matrix size, the number of averages, and the selected TR interval.

An exam using a minimum of two SE sequences with TR intervals of approximately 0.5 and 2.0 sec has proved most useful in delineating the normal anatomy of the upper aerodigestive tract [1] (Figs. 1, 2). This technique optimizes the signal from mobile hydrogen proton as well as the T2 relaxation time contrast between lower-intensity muscle and higher-intensity mucosa and edema. T2-weighted images (TR = 0.5 sec), obtained at the expense of lower signal-to-noise ratio, emphasize T2 relaxation value differences, which seem most important in differentiating soft-tissue–fat interfaces. T2-weighted images best delineate mucosal and neoplastic structures from surrounding muscle. Thus at our institution patients are examined with both axial T1- and T2-weighted image sequences using the SE technique. A TR = 2.0 sec sequence will acquire 20 images in approximately 17 min.
Normal and Pathologic Anatomy of the Upper Aerodigestive Tract

The nasopharynx is ideally suited to MRI because it is composed of relatively immobile symmetric soft-tissue structures having inherent differences in those tissue parameters sensitive to MR scanning.