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CT of Muscle Necrosis Following Radiation Therapy in a Patient with Head and Neck Malignancy

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Summary: Radiation-induced changes within skeletal muscle may be seen on follow-up CT or MR scans in patients who have undergone postoperative radiation therapy for head and neck tumors. Because they may mimic recurrent disease, these changes should be borne in mind.

Index terms: Neck, computed tomography; Neck, therapeutic radiology; Therapeutic radiology, complications

Radiation therapy (RT) represents an important treatment option for the patient with head and neck malignancy. Although surgery remains the mainstay of treatment, adjunctive RT has taken on an increasingly prominent role. Complications of high-dose radiation regimens include tissue edema, fibrosis, osteoradionecrosis, and radiation-induced malignancies (1–3). We present a case of radiation-induced necrosis of the sternocleidomastoid muscle (SCMM), which mimicked recurrent nodal disease in a patient who had undergone surgical resection and adjunctive RT for an advanced head and neck malignancy.

Case Report

A 65-year-old man underwent a total laryngopharyngectomy, right radical neck dissection, and free jejunal graft reconstruction of the surgical defect for a T4N0M0 squamous cell carcinoma of the right pyriform sinus. Following an uncomplicated postoperative recovery, he underwent radiation therapy. Initial fields directed to bilateral necks and upper mediastinum consisted of 6 MV x rays with 3 to 1 weighting from the anterior with a posterior block. RT consisted of 3960 centigray (cGy) that were administered in 22 fractions at the 85% isodose line. The patient received a final 2000 cGy in 10 fractions with lateral fields to complete treatment. Because of the weighting of

the initial treatment the maximum tissue dose in the area of the SCMM was approximately 7590 cGy in 32 fractions. Seven months later he presented to the otolaryngologic surgeon with a large, hard, palpable mass in the left neck that extended along the course of the SCMM, contralateral to the side of the prior tumor and prior neck dissection. The preoperative computed tomographic (CT) (Philips; Shelton, CT) scan through the neck revealed a normal SCMM on the left (Fig. 1A). However, a CT scan obtained postoperatively to assess the palpable lesion revealed a large left neck mass with central low density and no significant peripheral enhancement (Fig 1B). The mass extended from the angle of the jaw to the thoracic inlet, along the course of the SCMM.

A biopsy was performed on the mass using a 23-g needle and standard fine needle aspiration (FNA) procedure. It was superficial and the needle was guided by palpation without imaging guidance. The mass was sampled in several areas. The aspirate revealed numerous fragments of skeletal muscle showing degenerative and atrophic changes. Small fragments of fibrous tissue were also present. No malignant cells were seen.

Although the CT diagnosis presumed radiation-induced necrosis of the SCMM, the possibility of malignant lymphadenopathy could not completely be excluded and the patient underwent resection of the neck mass. The soft-tissue specimen, which measured 6 × 5 × 2 cm, consisted of pale, gray-red skeletal muscle and yellow fat. Histologically, the specimen demonstrated myonecrosis, atrophy, and fibrosis of the SCMM with vascular sclerosis, consistent with radiation injury. No malignant cells were observed. These findings were compatible with results of the FNA. Additionally, several adjacent lymph nodes were negative for carcinoma.

Discussion

It is impossible to completely shield all normal tissue during RT, and because radiation affects

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both normal and abnormal tissue, its effects on normal tissue are commonly seen (2, 4). Some expected changes seen on CT scans after irradiation of the head and neck include skin induration or thickening, increased density in subcutaneous or deep fat, and thickening of the epiglottis (4, 5). These changes may be quite extensive, making it difficult or impossible to differentiate them from recurrent malignancy.

Patients with head and neck neoplasms treated with RT may develop more severe radiation-related complications including postradiation edema, necrosis, or fibrosis of the surrounding soft tissues in the neck. Osteoradionecrosis of the cartilaginous laryngeal skeleton and mandible is a well-known and not uncommon sequela of RT to the neck (1, 2). Although normal muscles are present within virtually every radiation portal, especially in the head and neck, little has been reported concerning muscular changes seen after RT, or the appearance of these changes on follow-up imaging studies.

The basic and common pathophysiologic mechanism of all radiation reactions is presumed to be effects on the local blood supply, with small arterioles showing obliterative intimal proliferation (3). The main radiation parameters that determine complications are total dose, overall treatment time, fractionation size, volume of tissue irradiated, and associated therapies (surgery or chemotherapy) (2). Radiation-induced changes are exaggerated following combined RT and extensive surgery due to excessive impairment of the local blood supply. Additionally, the extent of disease and its location, as well as the patient's

age and nutritional status (especially the presence of cachexia) may modify the reaction (1, 2).

Radiation-induced myopathic changes are uncommon complications of RT, and little has been written about such changes. Zeman and Solomon, in their review of radiation myopathy (6), noted in their work with axial muscles in rats that radiation-related changes were histologically similar regardless of the total dose. The latent period, however, was shorter with increasing doses. Acute radiation necrosis of skeletal muscle, which may occur within hours of exposure, requires a very high single dose on the order of 50,000–100,000 cGy (3). Delayed changes, which may occur 2 to 3 months following therapeutic doses, have been reported (6) but are not routinely clinically apparent. Pathologically, a variety of appearances may be seen including necrosis and fragmentation of individual myocytes, focal necrosis, and areas of atrophic fibers. Vascular changes that may be seen range from thrombosis and necrosis to obliterative intimal proliferation or hyalinization.

Detection of recurrent disease by physical examination may be difficult in the posttreatment patient due to edema and fibrosis of the remaining soft tissues of the neck. Because of the limitations of the physical examination, CT and magnetic resonance (MR) imaging have assumed important roles in detecting recurrent disease in this patient population. Although the postradiation appearance of the neck on CT has been described (4, 5), little has been written about the appearance of complications, specifically in normal muscle. To our knowledge, there has been no report of the appearance of frank muscle necrosis on either CT or MR imaging. We would anticipate that muscle necrosis on MR imaging would show central low signal intensity on T1-weighted images and high signal intensity on T2-weighted images, with the periphery of the muscle isointense or high signal intensity with respect to normal muscle on T2-weighted images.

The necrotic muscle seen on CT in our patient was difficult to differentiate from metastatic adenopathy. However, in retrospect, there were definite and important differences. The location of the necrotic mass was more typical of SCMM, and actually remote from the important jugular chain nodal group. Furthermore, the pattern of enhancement was not typical for necrotic adenopathy; although there was a low density center, there was no apparent peripheral enhancement.

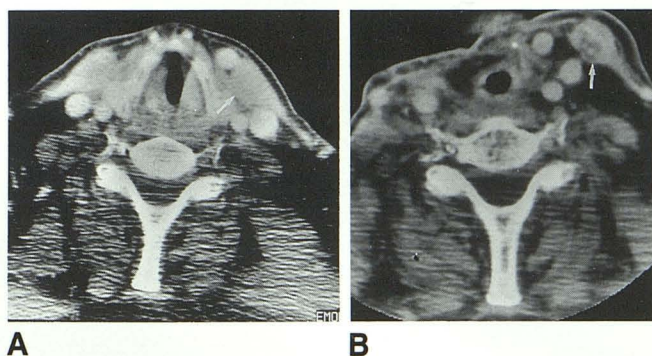


Fig. 1. A, Preoperative CT scan reveals a normal left SCMM (white arrow).

B, CT scan, at the same level as A, performed following total laryngopharyngectomy, right radical neck dissection, and radiotherapy demonstrates a large irregular left neck mass with central low density in the expected location of the SCMM (white arrow). The mass enhances inhomogeneously without significant peripheral enhancement typical of a necrotic node.

This patient, because of the radiotherapy technique used, received higher than normal doses to the anterior neck. The overall total dose appears to be the only predisposing factor that led to radiation-induced myonecrosis.

Therefore, it appears that radiation-induced changes within skeletal muscle may be seen on follow-up CT or MR scans in patients who have undergone surgery and RT for head and neck malignancies. The paucity of references about these changes in skeletal muscle suggests they occur rarely, but these effects should be borne in mind as they may mimic recurrent disease. Reoperation is technically more difficult, and the risk of local wound complications is higher if reoperation is required in any area that has been operated and received radiation therapy. The combination of a mass along the course of the

SCMM remote from the carotid sheath, and a negative FNA for tumor, should suggest a benign postradiation complication and obviate an extensive surgical procedure.

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