Malignant Triton Tumor of the Brachial Plexus Invading the Left Thoracic Inlet

A Rare Differential Diagnosis of Pancoast Tumor

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Malignant triton tumor is a divergent malignant peripheral nerve sheath tumor with rhabdomyoblastic differentiation. We report a case of malignant triton tumor arising in the brachial plexus of a 28-year-old women with neurofibromatosis type 1. Fluorodeoxyglucose-positron emission tomography-computed tomography before excision demonstrated a tumor with a maximum standard uptake value of 21 at 4 hours postinjection. The patient underwent complete excision of the tumor through median sternotomy and left supraclavicular approach. Adjuvant radiotherapy and chemotherapy were planned but the patient died of metastatic disease within 3 months of surgical resection.

Key Words: Malignant peripheral nerve sheath tumor, Triton tumor, Neurofibromatosis 1, Pancoast tumor.

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Malignant Triton tumor (MTT) is a rare type of malignant peripheral nerve sheath tumor (MPNST) with divergent differentiation and is identified histologically by the finding of rhabdomyoblasts among malignant Schwann cells in a tumor arising from a peripheral nerve.1 In 1932 Masson described the first case of a MTT in a patient with Von Recklinghausen disease (now known as Neurofibromatosis 1 [NF1]).2 However, it is now believed that only two thirds of MTT arise in patients with NF1.3,4 The prognosis of this rare and highly malignant tumor is poor and optimal treatment remains unclear. In this article we present a patient with NF1 who was found to have a MTT arising in the brachial plexus causing Pancoast tumor.

Clinical Summary

A 28-year-old women presented with a 15-year history of progressive left shoulder pain and 5-month history of an enlarging supraclavicular mass and reduced sensation with ‘claw’ deformity of her left hand. A clinical diagnosis of NF1 was made due to the presence of multiple café-au-lait spots and axillary and inguinal freckling. She had no significant family history, but two of her three children were also diagnosed with NF1 at that time. A tender left supraclavicular mass was palpable and complete radiculopathy of C8/T1 was demonstrable. Her left radial and ulnar pulses were absent.

Chest radiograph revealed a large mass in the left thoracic inlet. Chest computed tomography (CT) and magnetic resonance imaging were suggestive of a large tumor involving the brachial plexus and left subclavian artery (Figure 1). Fluorodeoxyglucose-positron emission tomography-CT (18FDG PET-CT) demonstrated increased uptake of FDG within the tumor with a maximum standardized uptake value (SUVmax) of 21 at 4 hours postinjection (Figure 2). It was clear that the tumor involved the brachial plexus and surrounding mediastinal structures but its origin was not certain. CT-guided biopsy of the mass was performed and histopathology raised the suspicion of a MPNST.

The patient underwent resection of the tumor en bloc with the lower cord of the brachial plexus via a median sternotomy with supraclavicular extension and excision of the first rib (Figure 3). The left subclavian artery and phrenic nerve were dissected from the tumor and preserved. The patient had an uneventful postoperative recovery and was discharged after 5 days. There was no postoperative Horner syndrome, the left radial pulse was palpable and no C5–7 neurologic deficit could be demonstrated, although she had persistent severe weakness and sensory loss in C8/T1.

Histopathological examination of the specimen revealed a 135 × 90 × 60 mm tumor that contained spindle cells and scattered large round cells with eosinophilic cytoplasm (Figure 4). On immunohistochemical staining, the spindle cells showed patchy focal staining for S100 and the larger eosinophilic cells showed positivity for desmin and myogenin (muscle-specific antibodies). The resection margins, local lymph nodes and rib showed no evidence of malignancy. The final diagnosis was of a Triton tumor.

In the light of the aggressive nature of MTT, plans were made for the patient to receive adjuvant radiotherapy. A planning CT at 6 weeks showed multiple pleural and pulmonary metastases. The patient was referred for palliative care and died 3 months postoperatively.
DISCUSSION

MTT is a rare tumor with less than 100 cases documented in the English literature and less than 10 cases arising in the chest. MTT is an interesting neurogenic tumor in which the neural component is thought to induce skeletal muscle production. This process was known to occur following Locatelli’s experiment with the Triton salamander, where he showed that by implanting a sciatic nerve in the salamander’s back, growth of accessory limbs containing both neural and muscular tissue could be stimulated. Mason, in 1932, first described the malignant potential of this in the form of a MTT, naming it after Locatelli’s Salamander.

The diagnosis of MTT is usually made following surgical resection as the areas containing rhabdomyoblasts may be a small proportion of the total tumor and may not be represented in preoperative biopsies. On light microscopy, spindle Schwann cells and larger rounder rhabdomyoblasts are seen. Immunohistochemical staining for S-100 protein is used to identify the Schwann cell component. A variety of muscle-specific antibodies can be used to show rhabdomyoblastic differentiation, in this case myogenin and desmin were both positive.

Patients with NF1 have a 10% lifetime risk of developing malignant change in plexiform neurofibromas, particularly deep-seated lesions and those involving the brachial and lumbo-sacral plexus. These individuals require lifelong monitoring by clinicians conversant with NF1. Our patient had been complaining of left shoulder pain for 15 years before she was referred to us for diagnosis or investigations. It is likely that the Triton tumor arose from a pre-existing neurofibroma in her brachial plexus.

The value of $^{18}$FDG PET CT as a diagnostic tool for NF1 associated MPNST has been recognized recently. FDG PET CT has a sensitivity of 0.89 and specificity of 0.95 in NF1 patients undergoing investigation for symptomatic plexiform neurofibromas. The SUVmax may help distinguish between benign and malignant tumors, but cannot accurately predict the grade of malignancy. In a recent study from our institution, at 200 minutes post injection the mean SUVmax of malignant tumors was 5.4 whereas the mean SUVmax for benign tumors was 1.54 with an overlap between malignant and benign tumors in the range of 2.7 to 3.3. In our patient a SUVmax of 21 at 4 hours, was highly suggestive of malignant transformation. In a study of 16 NF1 patients with known MPNST Brenner et al. found that patients with a MPNST and an SUV greater than 3 had a significantly shorter median survival than those with a SUV less than 3.

Two thirds of patients with MTT have NF1. They are predominantly male and under 35 with lesions arising from the head and neck. The remainder of the patients are generally older and female with tumors arising on their trunk. For both groups the prognosis is poor and overall survival is 33% at 2 years and 12% at 5 years. As MTT is a very aggressive tumor, behaving like a high grade sarcoma, it is believed that to obtain the best outcome a full surgical resection with as wide a margin as possible is vital. Complete resection of
tumors arising from the brachial plexus is difficult but technically feasible in 79% of cases with acceptable morbidity and mortality. It usually provides good symptom control. An anterior supraclavicular approach to the brachial plexus is the most common technique and, in this case, was combined with excision of the first rib, to enable control of the subclavian vessels. A median sternotomy was also performed to allow access to the mediastinum, aortic arch, and left upper lobe. After surgery, it is generally accepted that, if fit enough, patients should receive adjuvant radiotherapy as MTTs have a high rate of local recurrence. Systemic chemotherapy is instituted if there is evidence of metastatic disease.

One of us has reported a patient with MTT of the posterior mediastinum who survived without relapse for more than 8 years following complete resection and adjuvant radiotherapy. However, a recent case report showed local relapse 3 months following excision and adjuvant radiotherapy in a young patient with NF1. We have recently treated a 42-year-old man with neurofibromatosis who had a large MTT completely excised from his chest wall, relapsed and died within a year following adjuvant radiotherapy.

Based on our experience and in view of the literature, we suggest that MTTs arising in the chest are treated as high grade soft tissue sarcomas. The diagnostic and prognostic value of 18FDG-PET-CT may help select patients for multimodality therapy or palliative treatment.

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REFERENCES