

Hibernoma in the Thigh Mimicking Soft Tissue Sarcoma on FDG-PET

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Hibernoma, a tumor of benign brown adipose tissue can present as a large mass that can mimic a sarcoma. Imaging characterization of large extremity tumors can be very helpful in assessment of these masses for treatment planning and follow-up. We report on a case where FDG-PET imaging was performed on a patient with a large thigh mass, suspected to be a sarcoma. The FDG-PET uptake was highly avid, suggesting a preliminary diagnosis of an intermediate to high grade tumor. However, brown fat is highly metabolically active, and therefore high levels of FDG uptake can be misleading for tumor characterization in treatment planning, as it was in this case.

Introduction

Hibernomas are relatively rare, partially encapsulated lipomatous neoplasms that resemble brown adipose tissue. They are usually benign and often occur in the thigh, trunk, upper extremities, and head and neck region; however, hibernomas are usually diagnosed as

malignant liposarcoma prior to surgery because their images appear similar to malignant liposarcoma [1].

The histologic features and MRI appearance of hibernomas have previously been described [2]. In this case study, however, FDG Positron Emission Tomography (FDG-PET) image findings are presented and described from a recent patient to further characterize hibernomas. With improved descriptions of hibernoma from FDG-PET images, hibernomas may be more easily identified.

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Abbreviations: CT, computed tomography; MRI, magnetic resonance imaging; SUV, standard uptake value

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Case Report

The patient was a 54-year-old man with a month long history of a left posterior thigh mass. The patient noticed that his left leg seemed larger than his right leg. One month later, he sought medical attention. An MRI of the left thigh was performed and revealed a 20 cm lipomatous tumor in the posterior thigh (Fig. 1). The tumor was superficial in location in the distal aspect but proximally deep to the gluteus maximus muscle. Size

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and MRI features of this tumor suggested a soft tissue sarcoma.

For further preoperative tumor characterization, the patient underwent 18F-FDG PET scanning. Forty-five minutes after injection of 370 MBq 2-[18F]fluoro-2-deoxy-D-glucose (FDG), three axial field of view emission scans were performed over the patient's left thigh. These

were followed by three axial field of view transmission scans of the same region. Three attenuation corrected images were reconstructed in three orthogonal planes.

PET imaging revealed a large area of FDG uptake within the soft tissue of the left buttock and thigh with a standard uptake value (SUV) of 7.3 (Fig. 2). There was a central zone of decreased uptake that was suspicious for necrosis. These images suggested that the patient could possibly be diagnosed with intermediate grade behavior sarcoma; the patient was therefore referred for a surgery that excised a 20 cm soft tissue mass.

At surgery, a 20 cm soft tissue mass was excised from the posterior thigh and buttock. The mass was processed for a routine light microscopic examination. Chromosome analysis was performed on the tumor tissue preparations that were G-banded by trypsin treatment. The tissue was also examined by standard electron microscopy for ultrastructural evaluation. Tissue samples were also obtained for cytogenetic analysis, a sample was fixed in glutaraldehyde, and remainder was fixed in formalin.

The excised mass was partially encapsulated by thin fibromembrane, yellow-brown in color, and had a soft fatty consistency. Serial sections revealed relatively homogenous yellow-brown parenchyma interlaced with thin white fibrous septae that became focally conflu-

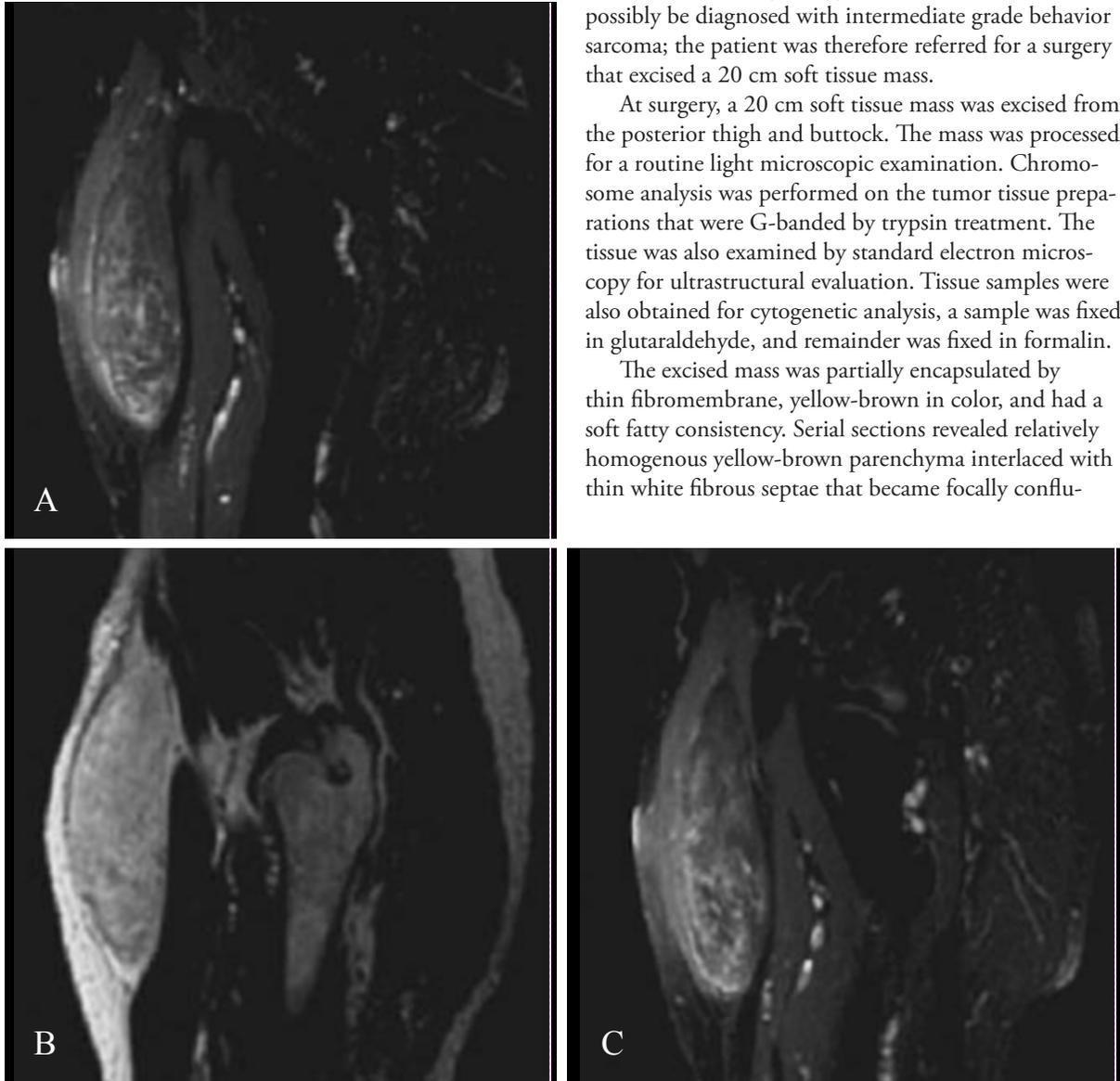


Figure 1A-C. 54-year-old man with thigh mass subsequently proven to be hibernoma. Sagittal T1 (A), sagittal T2 with fat saturation (B), and sagittal T1 with fat saturation following intravenous gadolinium-based contrast infusion (C) show a heterogeneous fat-containing large mass in the posterior thigh, superficial to the hamstring muscles.

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ent. Histologically, the neoplasm was characterized by univacuolated adipocytes that were intermingled with infrequently pale multiloculated adipocytes. Polygonal cells with eosinophilic granular cytoplasm were present in low numbers. Areas of bland fibrous tissue were encountered, and mitotic figures were not observed. The relative paucity of granular cells and the large size of the mass both suggested the differential diagnosis of hibernoma versus lipoblast-rich well-differentiated liposarcoma. Electron micrographs revealed cells that contained lipid droplets of varying sizes with numerous mitochondria filling the intervening cytoplasm. The granular cells were filled with mitochondria. Cytogenetic analysis demonstrated diploid cells with a 46, XY, t(11;19)(q11;p13.3) karyotype. According to these findings, the final diagnosis for this tumor was hibernoma.

Discussion

Hibernomas predominately occur in young adults with a mean age of 38 years [3]. The thigh, trunk, upper extremity, and head and neck are the most common regions of hibernoma, although hibernoma may also arise within the thoracic and abdominal cavities. These slow growing neoplasms range in size from 1 to 24 cm; their mean size is 10 cm. Most hibernomas are easy to recognize histologically because they mimic ordinary brown adipose tissue. Some, however, are unusually large or have a paucity of multivacuolated cells that are typical of hibernoma. These “lipoma-like” variants can mimic well-differentiated liposarcomas (also known as atypical lipomatous tumors when they occur in the extremities). Cytogenetic analyses may be useful in the differential diagnosis of hibernomas because they typically reveal aberrations involving chromosome 11q13-21. Meanwhile, well-differentiated liposarcomas possess ring and giant marker chromosomes composed of the long arm of chromosome 12. Notably, the current case had a translocation involving 11q13.3 that, when considered with the ultrastructural features, removed any doubt about the diagnosis of hibernoma.

Brown adipose tissue is a highly vascular tissue found in great quantities in hibernating animals [4]. It is also abundant in newborn humans and gradually decreases in quantity during life with residual brown adipose located near the kidneys, aorta, neck, and mediastinum. Unlike white adipose, the function of brown adipose

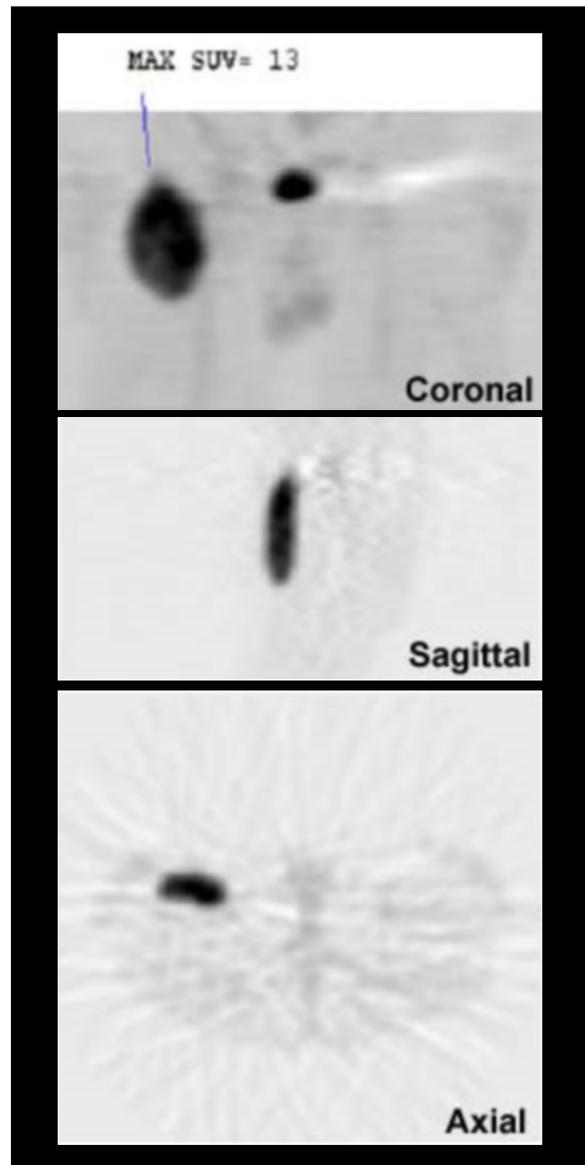


Figure 2. FDG PET images show avid uptake within the mass (SUV = 7.3).

is thermogenesis. The multivacuolated adipocytes of brown adipose are rich in mitochondria that lack many of the enzymes necessary for ATP production. Instead, energy production is dissipated as heat after stimulation by the sympathetic nervous system.

The differential utilization of glucose by tissue is the

basis of the imaging characteristics of FDG PET. Studies in mice have demonstrated that brown fat has a high level of FDG uptake (SUV) when compared with other metabolically active tissues like myocardium and liver. Recently, common intense supraclavicular FDG uptake has been shown to be related to brown fat tissue in the neck [3]. In humans, masses with SUV greater than 2 are generally considered worrisome for malignancy. The elevated tumor SUV in this case is due to the high mitochondrial content of the neoplastic cells and the increased metabolic activity of the neoplasm. The inhomogeneous pattern seen on the PET scan was caused by the presence of areas with fibrous tissue within the tumor and not necrosis. This case demonstrates FDG uptake mechanisms that inherently proceed with a lack of specificity for FDG PET scanning: FDG uptake occurs in areas of high glucose metabolism irrespective of the underlying such as benign or malignant tumors, inflammatory processes, or normal tissue with high metabolic rates such as brown fat.

Hibernomas are rare benign lipomatous neoplasms related to brown adipose tissue. In the presented case, a preoperative PET scan revealed an elevated SUV that was highly suggestive of a soft tissue malignancy. It is important to consider hibernoma in the differential diagnosis of soft tissue lipomatous neoplasms with high SUV because hibernomas are clinically benign; they do not recur or metastasize. Thus, conservative and marginal excision is adequate therapy to remove the symptoms from mass effect [4].

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