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Case Report

A rare case of dermatofibrosarcoma protuberans of the forefoot

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ABSTRACT

Dermatofibrosarcoma protuberans is an extremely rare, potentially malignant tumor type that usually presents on the trunk or proximal extremities. The clinical presentation includes a gradually enlarging painless plaque-like or nodular lesion of the skin with surrounding red to blue discoloration. The diagnosis is based on clinical presentation, computed tomography or magnetic resonance imaging, and biopsy with histologic analysis. An early and timely diagnosis improves chances of complete surgical resection thus improving prognosis. Herein, we present a rare case of dermatofibrosarcoma protuberans with the hopes that its addition to the literature will aid in the earlier recognition of future patients and help prevent this potentially curable disease from becoming deadly.

Introduction

Dermatofibrosarcoma protuberans (DFSP) accounts for approximately 1%-6% of all soft-tissue tumors [1,2]. It has an annual incidence of 4.2 per million [3]. Although there have not been many extensive studies performed that identify the differences in the incidence of DFSP across race and sex, preliminary data points toward DFSP being approximately twice as common in blacks as compared with whites and equally distributed between males and females [3]. The tumor is found to be located on the trunk in 40%-50% of cases, the chest and shoulders in 30%-40% of cases, and the proximal portion of the limbs in 10%-15% of cases. Some studies report a greater frequency of distally located DFSP in children. One study of 27 cases, reports that 14.8% of childhood DFSP was located on the hands or feet [4]. It presents most frequently between the ages of 20 and 50 years [1]. Clinicians should be made aware that DFSP is known to occur among children. Because it occurs less commonly in this patient population, it is frequently misdiagnosed or underdiagnosed.

Case report

A 14-year-old boy with a history of a soft-tissue mass on the dorsum of his left foot since age 5 presented to the hospital

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because of a markedly increased growth rate of the mass over the last 3 months, see Figure 1. During the same period, the mass began eluting a serous fluid through separated skin margins over the 2nd and 3rd toes. He had developed areas of skin loss on the lateral aspect of the foot overlaying the 5th metatarsal and the anterolateral aspect of his ankle in an approximately vascular distribution. Physical examination confirmed a large ulcerating mass over the dorsum of the left foot with decreased sensation of the overlying skin. Magnetic resonance imaging (MRI) confirmed a 10 × 15 × 18-cm ovoid mass on the dorsum of the left foot, see Figure 2. Incisional biopsy results were consistent with DFSP, see Figure 3. After the biopsy results, surgical removal of the lesion was carried out to remove the locally invasive tumor.

Discussion

DFSP is a fibrohistiocytic tumor of intermediate malignancy characterized by a nodular cutaneous mass. It is most frequently located on the trunk and proximal extremities and has a propensity for recurrence. Because of its indolent growth, it is hypothesized that these tumors frequently arise during childhood but only become apparent during young adulthood [5]. Giant cell fibroblastoma (GCF) is considered to be the juvenile form of DFSP [1]. Initially, it manifest as a firm, plaque-like lesion of the skin with surrounding red to blue discoloration. Rarely, these tumors present as an area of atrophy or small subcutaneous nodules rather than a plaque [5].

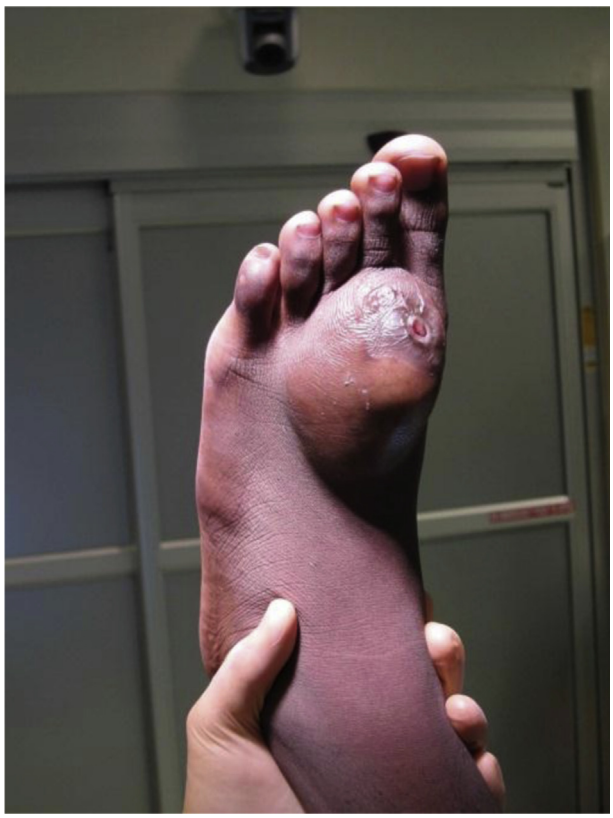

Fig. 1 – A large fungating mass present preoperatively on the left foot of a 14-year-old boy.

Prior trauma is reported in up to 20% of cases and larger lesions can ulcerate, bleed, and become painful.

The tumor is characterized histologically by surface bound CD34 and the absence of factor XIIIa, which are used to differentiate it from other soft-tissue tumors [6]. Molecular characterization of DFSP has identified an association with the chromosomal translocation t(17;22)(q22;q13) and with supernumerary ring chromosomes containing material from chromosomal regions 17q22 and 22q13 accompanied by simple chromosome trisomies. These genetic aberrations fuse the COL1A1 and PDGF beta genes, resulting in PDGF beta being under the transcriptional control of the COL1A1 promoter. This gives rise to an overexpression of PDGF beta, which leads to the constitutive activation of the platelet-derived growth factor subunit B (PDGFB) receptor, a type III tyrosine kinase receptor leading to autocrine stimulation and tumorigenesis [1,7,8].

Multiple histologic variants of DFSP exist. These variants include myxoid DFSP, the Bednar tumor, the atrophic variant of DFSP, and GCF. The myxoid variant is characterized by the presence of moderately cellular areas made up of stellate or fusiform cells with abundant accumulation of hyaluronidase-sensitive mucin in the intercellular space. The Bednar tumor has a pigmented storiform appearance. The atrophic variant of DFSP is characterized by reduced thickness of the dermis and replacement of much of the dermis and subcutis by spindle cells. Finally, the GCF is often myxoid and punctuated by pseudovascular tissue spaces being lined by multinucleated giant cells [1].

Presumptive diagnosis of DFSP can usually be made based on clinical appearance alone do to its superficial location and characteristic findings. However, the ease of diagnosis of less superficial tumors can be enhanced through the use of imaging techniques. The radiologic appearance of DFSP is characterized by a nodular soft-tissue mass involving the skin and subcutaneous adipose tissue with a lack of mineralization [9]. The case we present here provides unique radiologic images that can be used as comparisons for physicians that are treating patients with potential DFSP.

Both computed tomography (CT) and MRI can be used to define the underlying structure of a given lesion. In 1 study of 14 cases, CT generated minimally enhanced images in 3 of the cases, heterogeneously enhanced images in another 3 cases, and homogenously enhanced images in 8 cases. In the same study, all 14 lesions imaged with MRI were T1-isointense to muscle. Ten lesions were T2-hyperintense and 4 were T2-isointense to T2-hypointense to muscle. T1 postcontrast enhancement patterns ranged from mild to markedly heterogeneous or markedly homogeneous [10].

MRI has stood out as the modality of choice for margin definition in planned operative procedures for DFSP because of the increased resolution available with higher Tesla (3-4T) magnets as compared with CT. MRI also surpasses CT in its utility for imaging DFSP because of the ability to produce images with unique imaging protocols: T1, T2, frequency-selective fat suppression, and short tau inversion recovery (STIR). DFSPs are usually hypointense to fat on T1-weighted images and hyperintense to isointense to fat on T2-weighted images. Specialized techniques such as frequency-selective fat suppression and STIR are frequently used to accentuate the pathology on MRI [11].

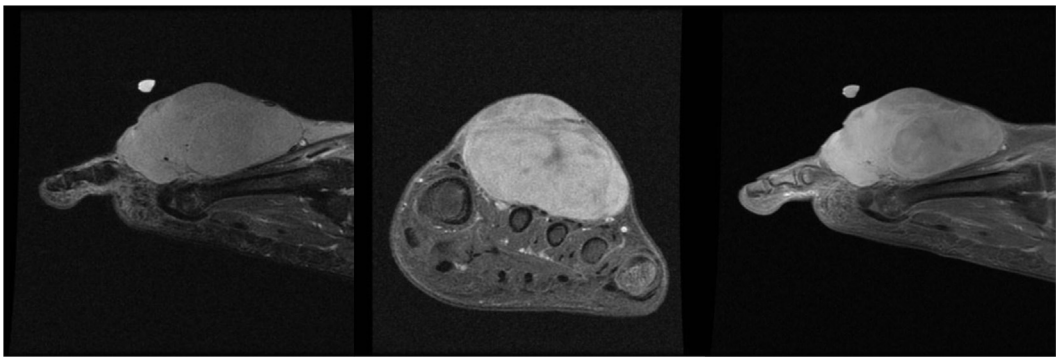

Fig. 2 – Magnetic resonance imaging findings of the DFSP of the foot in a 14-year-old boy. (Left) Sagittal fast spin echo (FSE) T2-weighted fat suppressed (FS) image shows a large, lobulated mass in the dorsum of the foot with mildly heterogeneous, hyperintense signal intensity. The mass involves the dermis and subcutaneous soft tissues, without osseous invasion or scalloping. (Middle and right) Axial (middle) and sagittal (right) enhanced T1-weighted FS images show marked enhancement of the lobulated mass, without involvement of the metatarsals.

Frequency-selected fat suppression images are generated using a pulse of radio waves at the resonant frequency of protons contained in fat. This dephases the protons, resulting in a decreased signal intensity of fat, thus accentuating the DFSP. STIR is an inversion recovery pulse sequence timed to decrease the signal intensity of fat. It works by first generating a radio frequency pulse that inverts the spin of protons from all tissue types, then, when fat has reached its null point and there is no fat magnetization to flip into the x-y plane, the image is taken. Using these techniques, MRI has been found to be useful in identifying atypical cases, the extent of tumor spread, and determining depth and involvement of critical structures. The use of MRI is now suggested in DFSP for the following situations: large tumor size, tumors with a suspected deeper component, recurrent tumors, critical anatomic locations, and reexcision of DFSPs with positive surgical margins [11].

The final 2 imaging modalities that are used for patients with DFSP are arteriography and bone scintigraphy. Arteriography will demonstrate minor to moderate hypervascularity of the tumor. Bone scintigraphy will demonstrate increased accumulation of radiopharmaceutical [9].

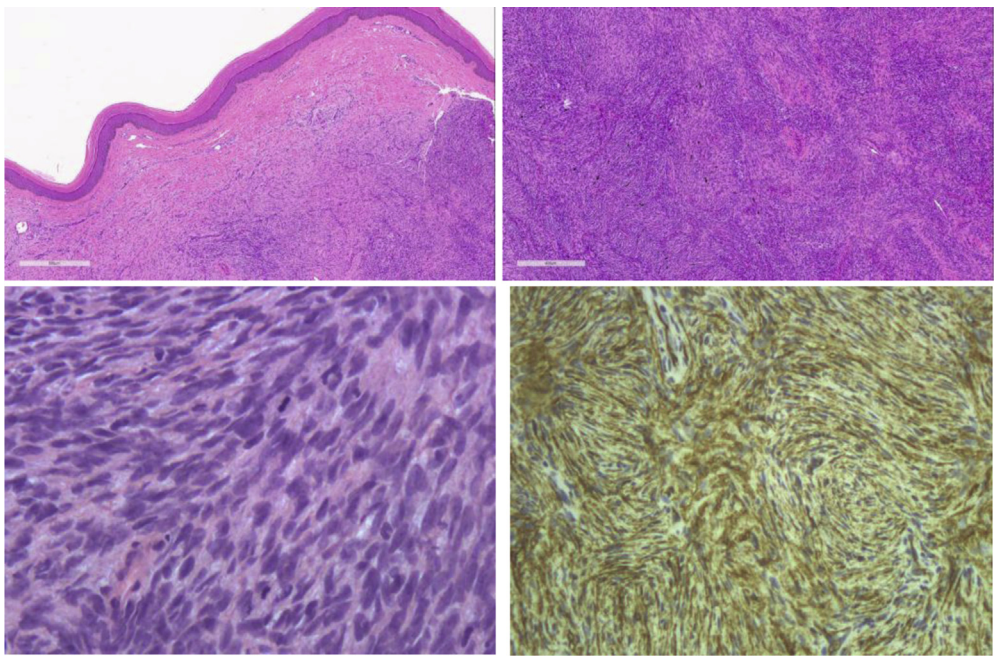

Fig. 3 – Upper left: hematoxylin-eosin stain of the epidermis, dermis, and subcuticular region of the lesion (4×). Upper right: hematoxylin-eosin stain of classic storiform pattern of fibrohistiocytic tumors found within this patient's DFSP (4×). Lower left: hematoxylin-eosin stain of mitotic bodies present within this patients lesion (40×). Lower right: CD34+ staining of the lesion (10×).

Both medical and surgical treatment options exist for DFSP. The fusion of COL1A1 and PDGF beta results in the overexpression of PDGF beta which leads to the constitutive activation of the PDGFB receptor, a type III tyrosine kinase receptor. PDGFB receptor has intracellular tyrosine kinase activity that functions through the PI3 kinase and Ras-mitogen-activated protein kinase pathways. Activation of these pathways controls cellular proliferation, adhesion, and apoptosis [1,12]. The discovery of this mechanism of action led to the suggestion that tyrosine kinase inhibitors such as imatinib may have a role to play in therapy for DFSP. Resulting studies demonstrated that doses between 400 and 800 mg daily for a period ranging from 2 to 24 months produced an average tumor reduction of 50% after a median follow-up time of 24 months [1].

For locally invasive DFSP, a surgical approach of wide excision with margins of 2-3 cm is standard practice [13]. However, frequent local recurrence of approximately 20% with these margins and unacceptable cosmetic defects with wider margins has led to the search for a technique that more confidently produces negative surgical margins [1]. This increased frequency of local recurrence is thought to be a result of increased production of hyaluronic acid leading to increased invasion of surrounding tissue by tumor microtendrils [14]. As a result, Mohs micrographic surgery (MMS) is becoming a more and more common means of tumor resection, both for its more accurate production of clear margins, <1%, and its preservation of nondiseased tissue. The technique used differs slightly from normal MMS in that the tissue is fixed in formalin and then embedded in paraffin. This method facilitates the diagnosis of fat invasion by the tumor that could otherwise go unnoticed in frozen sections [1,14].

Surgical resection using the modified MMS technique is carried out by first debulking the main portion of the tumor mass. Then 0.5 to 1.0-cm margins of tissue are removed from what remains. This excised tissue is then formalin fixed and paraffin embedded. Finally, it is hematoxylin and eosin stained and confirmed with CD34 immunostaining [14].

Radiotherapy has been used in the treatment of DFSP primarily as an adjuvant to surgery and chemotherapy in instances where there is a high probability that the lesion was not completely removed through surgery [1]. In one study, a radiation dose of between 50 and 80 gray, depending on whether radiation therapy alone was used or radiation in combination with surgical resection was used, generated a 10-year local control rate of 88% for the 18 patients studied [15]. Radiation therapy remains a viable option as the sole treatment of nonresectable tumors and in the presence of resected tumors with positive or negative margins to ensure complete removal of all potentially cancerous tissue.

Conclusions

As we have established, DFSP is a very rare but potentially malignant soft-tissue tumor. A timely diagnosis can significantly decrease patient morbidity and mortality and is therefore critical. Clinicians should be aware that DFSP can occur in the pediatric population and should understand the differences in presentation that accompany the childhood form of the disease. We hope that this case will serve as a reference for physicians presented with similar cases of soft-tissue masses in both the adult and pediatric population.

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