^{18}F-fluorodeoxyglucose Positron Emission Tomography/Computed Tomography and ^{68}Ga-prostate-specific Membrane Antigen Positron Emission Tomography/Computed Tomography Imaging in the Evaluation of Rare Entity Adult Embryonal Rhabdomyosarcoma of Prostate

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Abstract

A 21-year-old male with embryonal rhabdomyosarcoma of the prostate was referred for ^{18}F-fluorodeoxyglucose positron emission tomography/computed tomography (^{18}F-FDG PET/CT) and ^{68}Ga-prostate-specific membrane antigen (PSMA) PET/CT for initial disease staging. The PET scans revealed hypermetabolic and PSMA expressing lobulated mass involving both lobes of the prostate and weakly metabolic and PSMA expressing few bilateral pararectal and external iliac nodes, multiple bilateral lung nodules scattered over the lung parenchyma and multiple bone marrow lesions in both axial and appendicular skeleton. Magnetic resonance imaging prostate showed gross prostatomegaly with large lobulated T2 hyperintense heterogeneously enhancing mass lesion showing restricted diffusion, involving both lobes of the prostate with extraprostatic spread along anterior, posterior, and left lateral margins with evidence of lymph nodal and osseous metastases. The demonstration of increased uptake of ^{18}F-FDG and ^{68}Ga-PSMA in the primary as well as bilateral pararectal and external iliac nodes, multiple bilateral lung nodules, and multiple bone marrow lesions in both axial and appendicular skeleton indicates a potential role of ^{18}F-FDG PET/CT and ^{68}Ga-PSMA PET/CT in disease staging in this rare aggressive tumor of the prostate.

Keywords: *^{18}F-fluorodeoxyglucose positron emission tomography/computed tomography, ^{68}Ga-prostate-specific membrane antigen positron emission tomography/computed tomography, embryonal rhabdomyosarcoma prostate, rhabdomyosarcoma*

A 21-year-old male presented with a sudden onset of retention of urine and painful passage of stool. A computed tomography (CT) scan of the pelvis dated revealed a markedly enlarged prostate measuring with moderate size ill-defined irregular collection along the inferior aspect of the prostate suggestive of prostate abscess. The serum prostate-specific antigen was 5.48 ng/mL. Incision and drainage were done for the same. Follow-up magnetic resonance imaging prostate [Figure 1a-c] revealed gross prostatomegaly with large lobulated T2 hyperintense heterogeneously enhancing mass lesion showing restricted diffusion, involving both lobes of the prostate with extraprostatic spread along anterior, posterior, and left lateral margins. There is evidence of lymph nodal and osseous metastasis. Histopathological evaluation of prostate core biopsy turned out to be embryonal rhabdomyosarcoma (ERMS) with immunohistochemistry as desmin positive, negative for CD15/CD99/CD45/CK. The patient was referred for ^{18}F-fluorodeoxyglucose positron emission tomography/CT (^{18}F-FDG PET/CT) [Figure 2] and ^{68}Ga-prostate-specific membrane antigen (PSMA) PET/CT [Figure 3] for disease staging which revealed hypermetabolic (SUVmax 10.76) and PSMA expressing (SUVmax 5.44) lobulated mass involving both lobes of prostate measuring approximately 5.9 cm × 6.7 cm × 7.2 cm (APxTxCC) with extension anteriorly to the pubic symphysis and infiltrating the bulb of penis, posteriorly infiltrating the anterior wall of the distal rectum, weakly metabolic and PSMA expressing bilateral pararectal and external iliac nodes, largest seen in the right pararectalnode measuring 2.2 cm × 1.5 cm,

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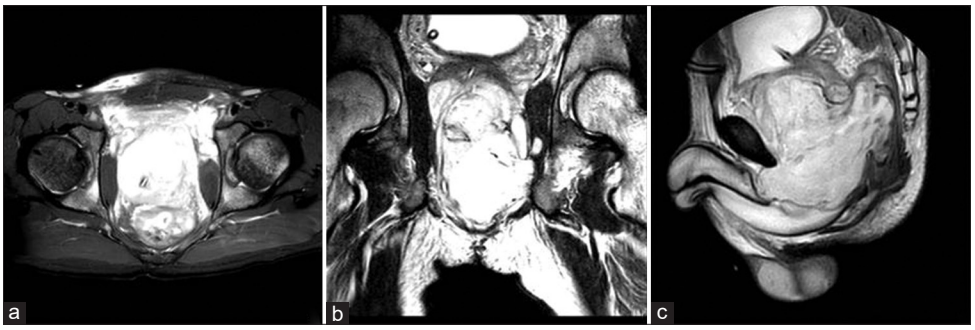

Figure 1: Magnetic resonance imaging (a, b, c) shows gross prostatomegaly with large lobulated T2 hyperintense heterogeneously enhancing mass lesion showing restricted diffusion, involving both lobes of the prostate with extraprostatic spread along anterior, posterior, and left lateral margins

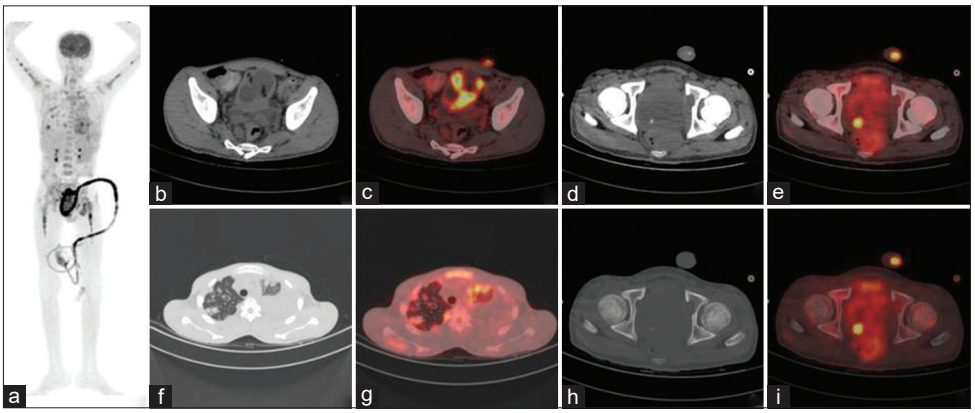

Figure 2: ^{18}F-fluorodeoxyglucose positron emission tomography/computed tomography (PET/CT) for disease staging of embryonal rhabdomyosarcoma of the prostate (a: whole-body maximum intensity projection (MIP) and b-i axial PET/CT images) revealed hypermetabolic lobulated mass involving both lobes of prostate (SUVmax 5.44) and weakly metabolic few bilateral pararectal and external iliac nodes, multiple bilateral lung nodules scattered over the lung parenchyma and multiple bone marrow lesions in both axial and appendicular skeleton

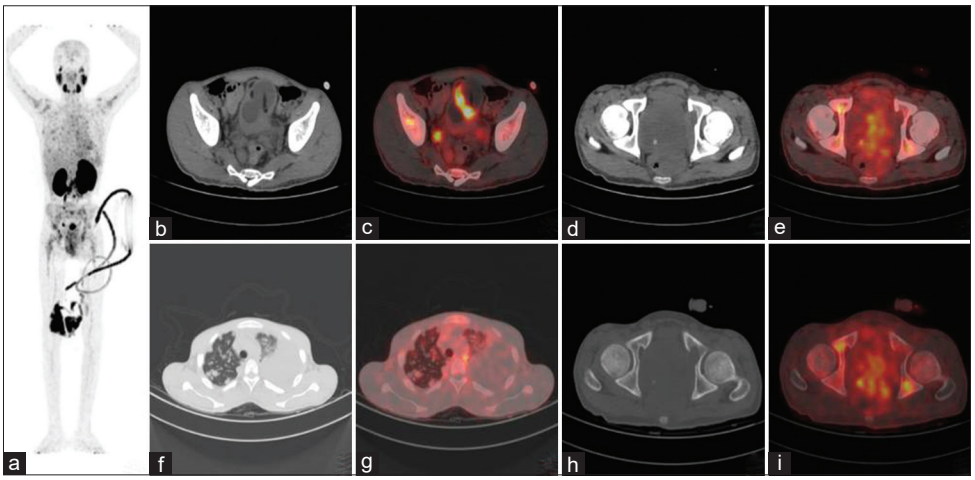

Figure 3: ^{68}Ga-prostate-specific membrane antigen (PSMA) positron emission tomography/computed tomography (PET/CT) for disease staging of embryonal rhabdomyosarcoma of the prostate (a: whole-body maximum intensity projection (MIP) and b-i axial PET/CT images) revealed PSMA expressing lobulated mass involving both lobes of prostate, bilateral pararectal, and external iliac nodes, multiple bilateral lung nodules scattered over the lung parenchyma and multiple bone marrow lesions in both axial and appendicular skeleton

weakly metabolic and PSMA expressing multiple bilateral lung nodules scattered over the lung parenchyma with left-sided pleural effusion with atelectasis, largest lung nodules on the right lung measuring 2.0 cm × 2.4 cm, hypermetabolic and PSMA expressing multiple bone marrow lesions in both axial and appendicular skeleton.

ERMS is a primitive malignant soft-tissue tumor arising from premature mesenchymal cells. It accounts for <1% of all prostate malignancies. ERMS of the prostate often presents with symptoms such as difficulty urinating, blood in the urine, and pelvic pain. Due to its rarity and aggressive nature, ERMS carries a poor prognosis and

possesses significant diagnostic and therapeutic challenges. The factors associated with a worse prognosis include advanced stage, metastasis at diagnosis, incomplete surgical resection, and high tumor grade.[1] ERMS of the prostate carries a poor prognosis with high rates of recurrence and metastasis with 25% of patients presenting with distant metastasis at the time of diagnosis.[2] Due to the rarity of the disease, there are few cases reported.[3,4] The treatment depends on the stage and extent of the disease and overall health of the patient. The management of ERMS of the prostate is multimodal, including surgery, radiation, and chemotherapy. For localized disease, radical prostatectomy with pelvic lymph node dissection is the preferred surgical approach.[5] For patients with high-risk features, such as positive surgical margins or extraprostatic extension radiation therapy is often used as adjuvant therapy. For patients with advanced or metastatic disease, chemotherapy is also an essential component of treatment, the standard chemotherapy regimen for ERMS consists of vincristine, actinomycin, and cyclophosphamide.[6,7] The outcome of adolescents and adults with RMS appears to be worse than that of children.[8] A study by Sultan *et al*.[9] demonstrated a 5-year overall survival rate of 27% in adults versus 61% in children. Few studies are done by Ferrari *et al*.,[10] Burke *et al*.,[11] and Burke *et al*.[12] evaluating various clinical parameters such as tumor size and tumor volume at diagnosis, response to initial chemotherapy, and weight loss during treatment did not show significant prognostic value.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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