



"The 18-FDG PET-CT Skeletal muscle uptake; to be or not to be?"

A pictorial case series

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ABSTRACT

Hybrid imaging with 18FDG-PET in oncology, neurology and cardiology has been well established. 18-FDG acts as a glucose analogue and hence uptake of tracer is through the GLUT 1 to 4 receptors. Glut 4 receptors are the primary receptor for the muscle uptake in FDG and hence muscle uptake may be either physiological or pathological. This study looks at the various uptakes in muscles and strives to identify, and classify, the various causes under the broad headings of a benign and malignant etiology.

INTRODUCTION

Skeletal muscle metastases (SMM) are a rare occurrence de-spite the fact that skeletal muscle comprises more than 50% of total body mass. When present, most are asymptomatic and are often found incidentally on imaging.

Muscle resistance to both primary and metastatic malignancies is well-known, but its causes are still unclear. The factors preventing tumours from growing are believed to be connected with the ability of muscles to metabolize lactic acid, which selectively inhibits the proliferation of tumour cells in vitro and in vivo, inhibition by adenosine, or mechanical destruction of cancer cells within the micro-vasculature.

Although considered rare, SMM are suggested to occur more frequently than it is usually recognized. This may be a result of the improvement in quality and availability of imaging modalities, particularly the increase in utilization of 18F-fluorodeoxyglucose (18F-FDG) PET/computed tomography (PET/CT) in routine staging and follow-up of patients with different tumours.

OBJECTIVE

Prime Objective

To demonstrate uptake of 18FDG in the muscles on the oncological scanning

Secondary Objectives:

To understand and classify the causes for these uptakes and help educate the various pathologies and present pictorial presentation for the same

METHODS AND MATERIALS

The PET CT database from our institution was reviewed retro as well as prospectively from March 2020 to September 2023 for muscle metastasis from patients referred for oncological scanning with pathologically proven malignancies. The patients with SMM were reviewed and included in this pictorial case series study.

RESULTS

(as a pictorial presentation)

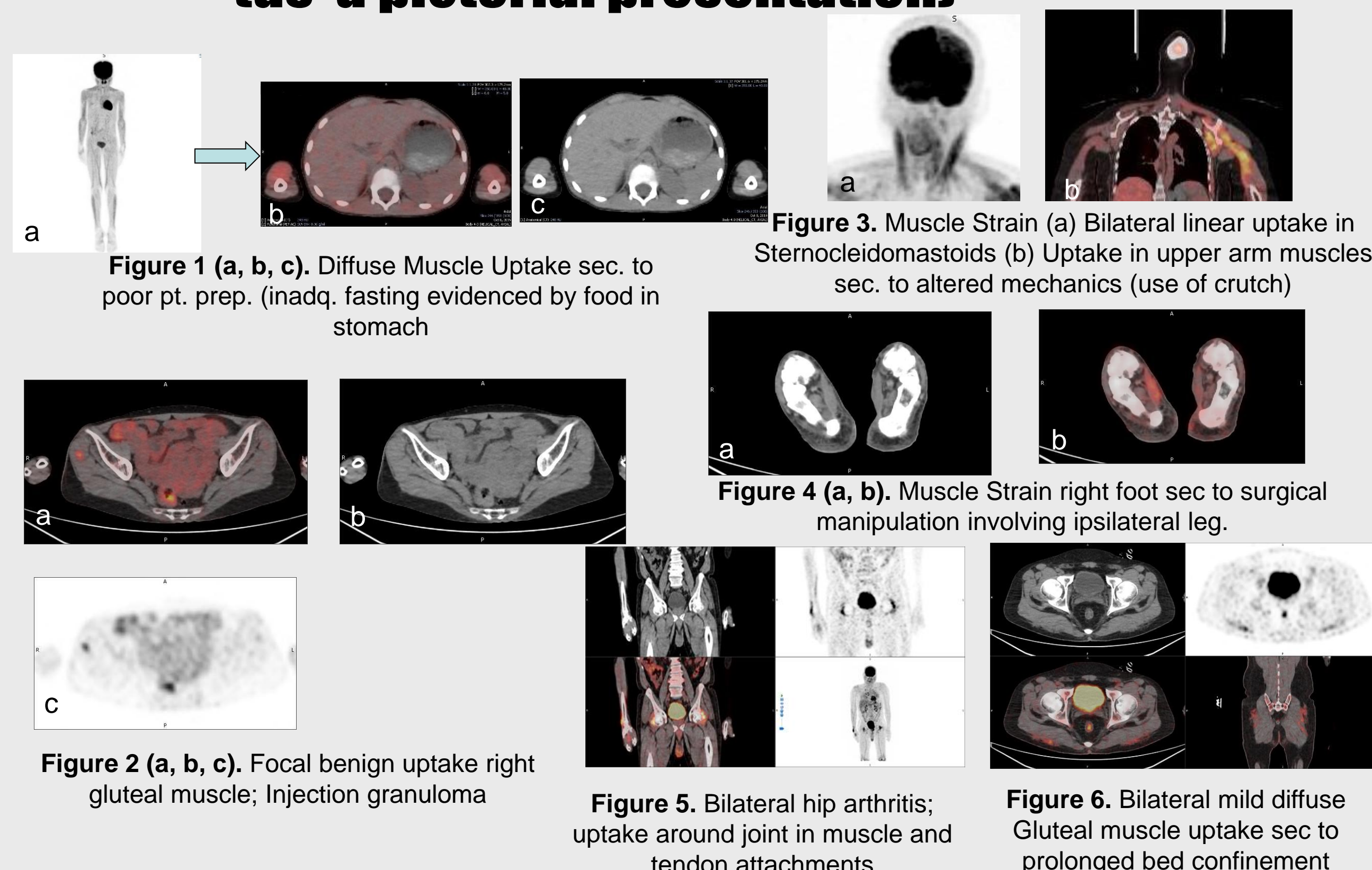


Figure 1 (a, b, c). Diffuse Muscle Uptake sec. to poor pt. prep. (inadq. fasting evidenced by food in stomach)

Figure 2 (a, b, c). Focal benign uptake right gluteal muscle; Injection granuloma

Figure 3. Muscle Strain (a) Bilateral linear uptake in Sternocleidomastoids (b) Uptake in upper arm muscles sec. to altered mechanics (use of crutch)

Figure 4 (a, b). Muscle Strain right foot sec to surgical manipulation involving ipsilateral leg.

Figure 5. Bilateral hip arthritis; uptake around joint in muscle and tendon attachments

Figure 6. Bilateral mild diffuse Gluteal muscle uptake sec to prolonged bed confinement

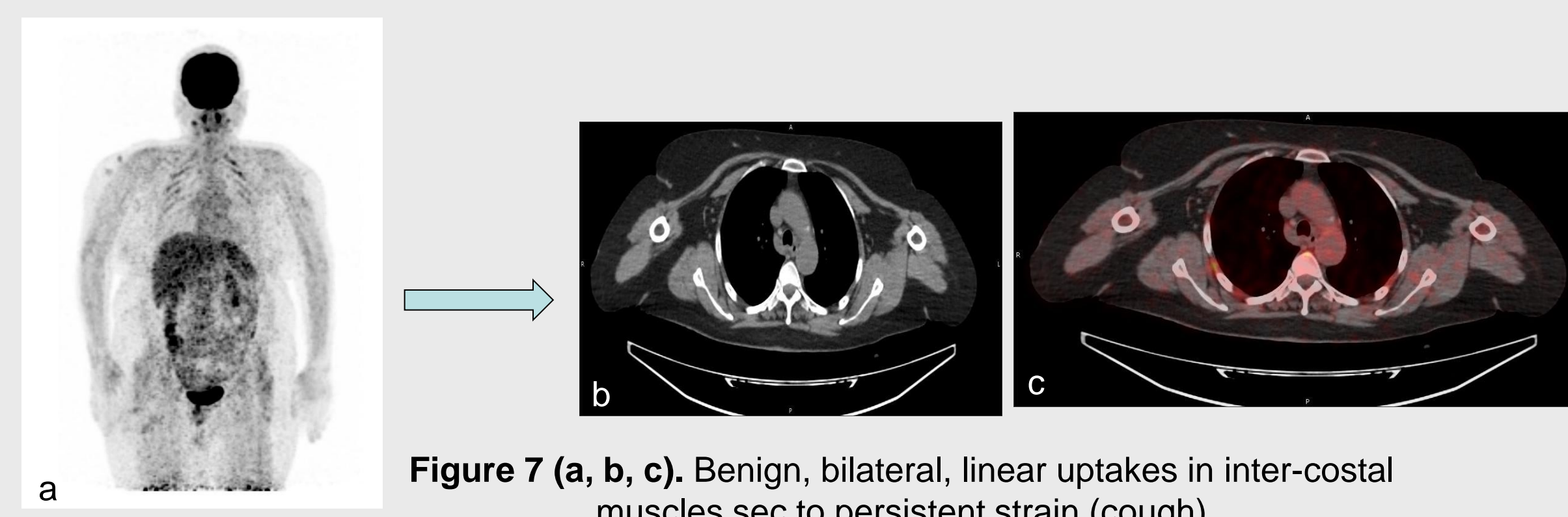


Figure 7 (a, b, c). Benign, bilateral, linear uptakes in inter-costal muscles sec to persistent strain (cough)

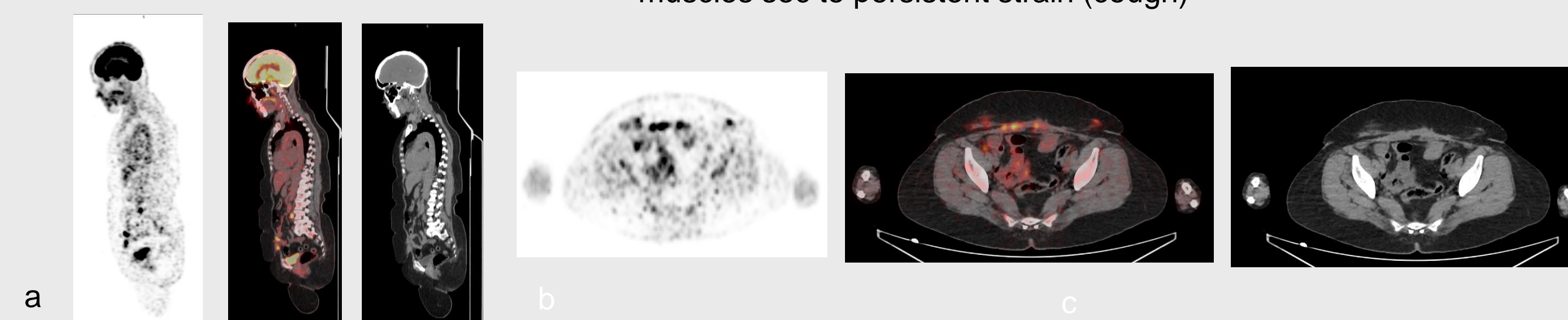


Figure 8 (a, b, c). Metastatic muscle deposit from endometrial ca; focal uptake in muscle of ant abdominal wall (satellite deposit)

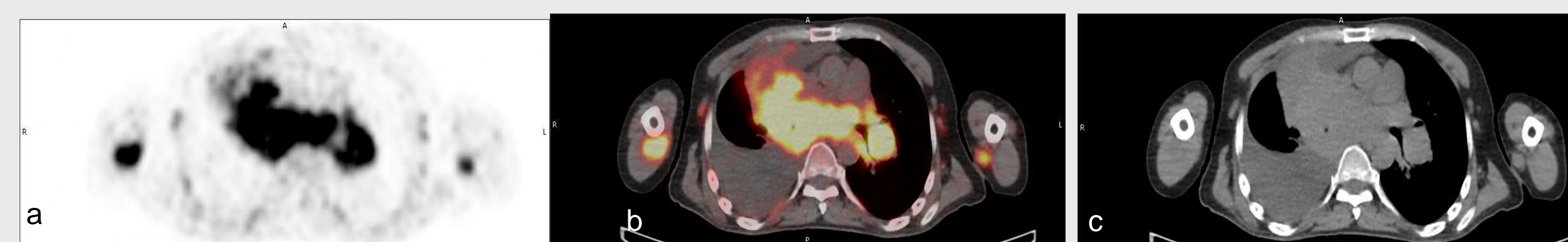


Figure 9 (a, b, c). Metastatic muscle deposit from Mantle Cell Lymphoma; focal uptakes in bilateral arm muscles

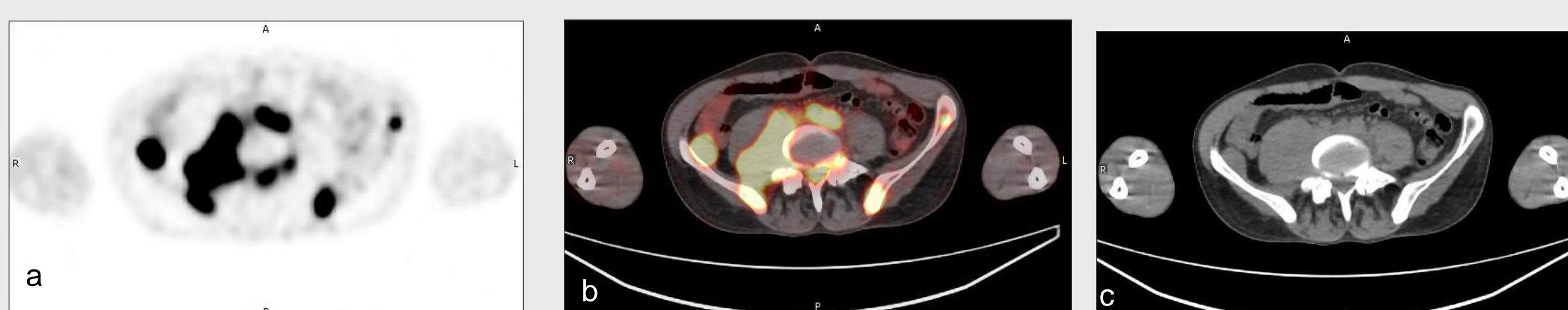


Figure 10 & 11 (a, b, c) [both above and below]. Metastatic muscle deposit from Burkitt's cell Lymphoma; uptakes in right sided iliacus and iliopsoas muscle

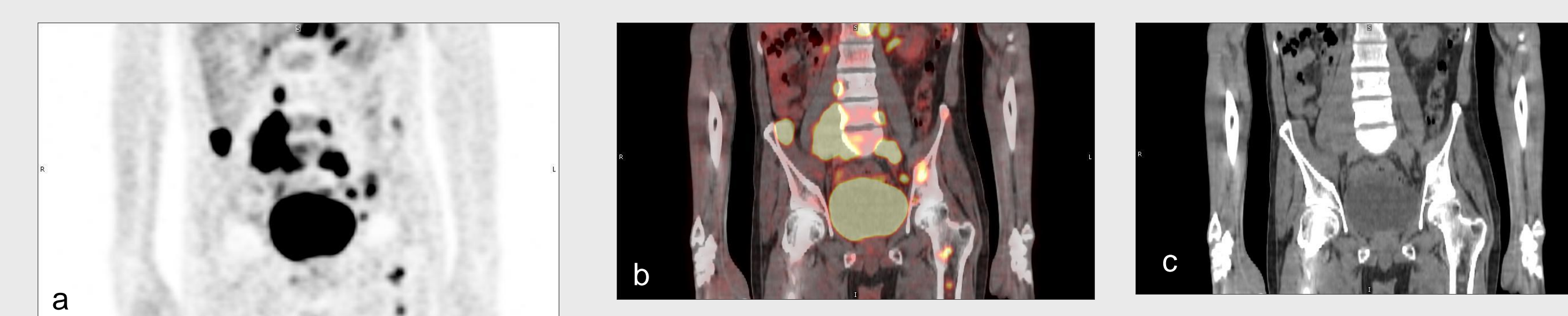


Figure 12. Primary Muscle Tumor Rhabdomyosarcoma left arm

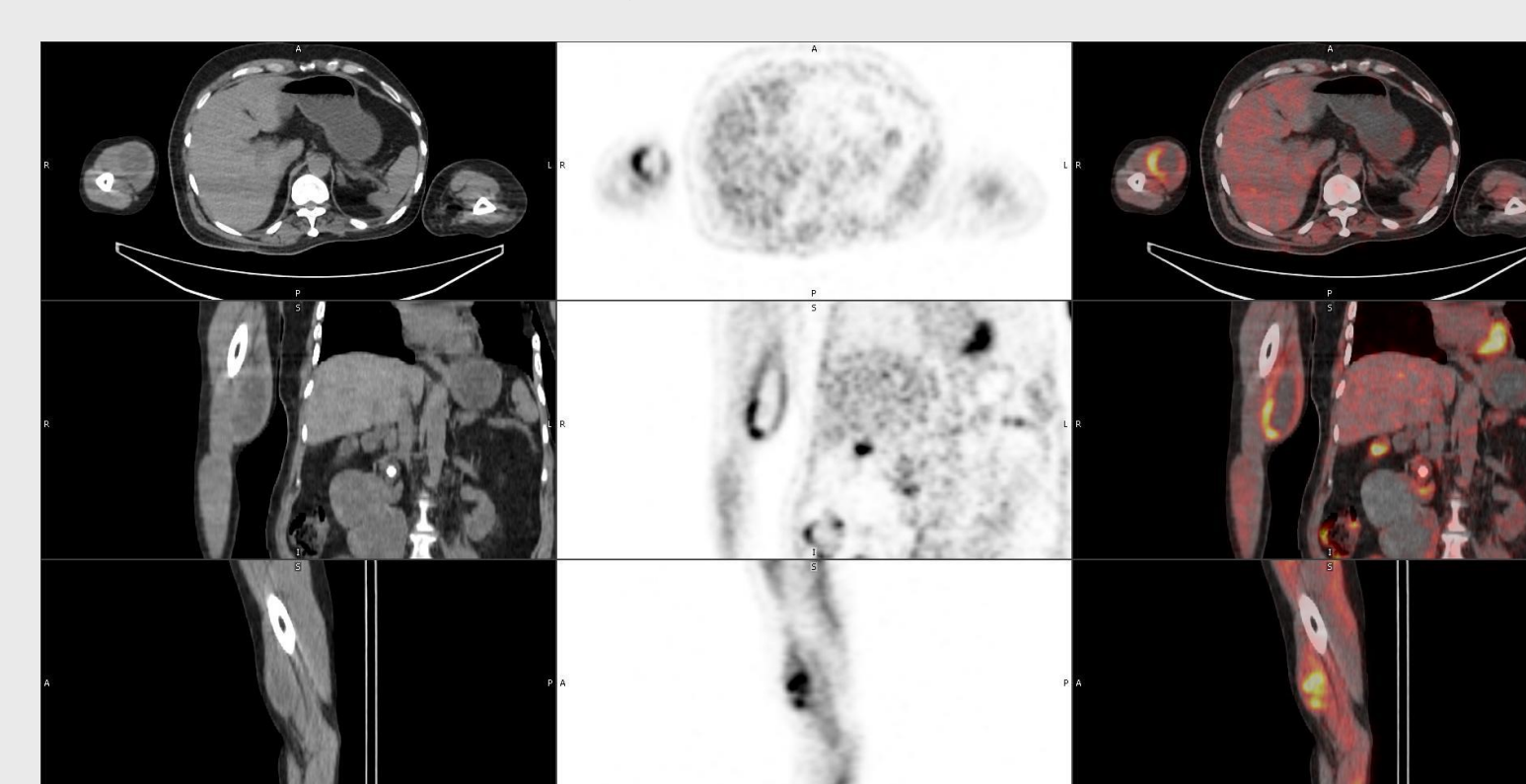
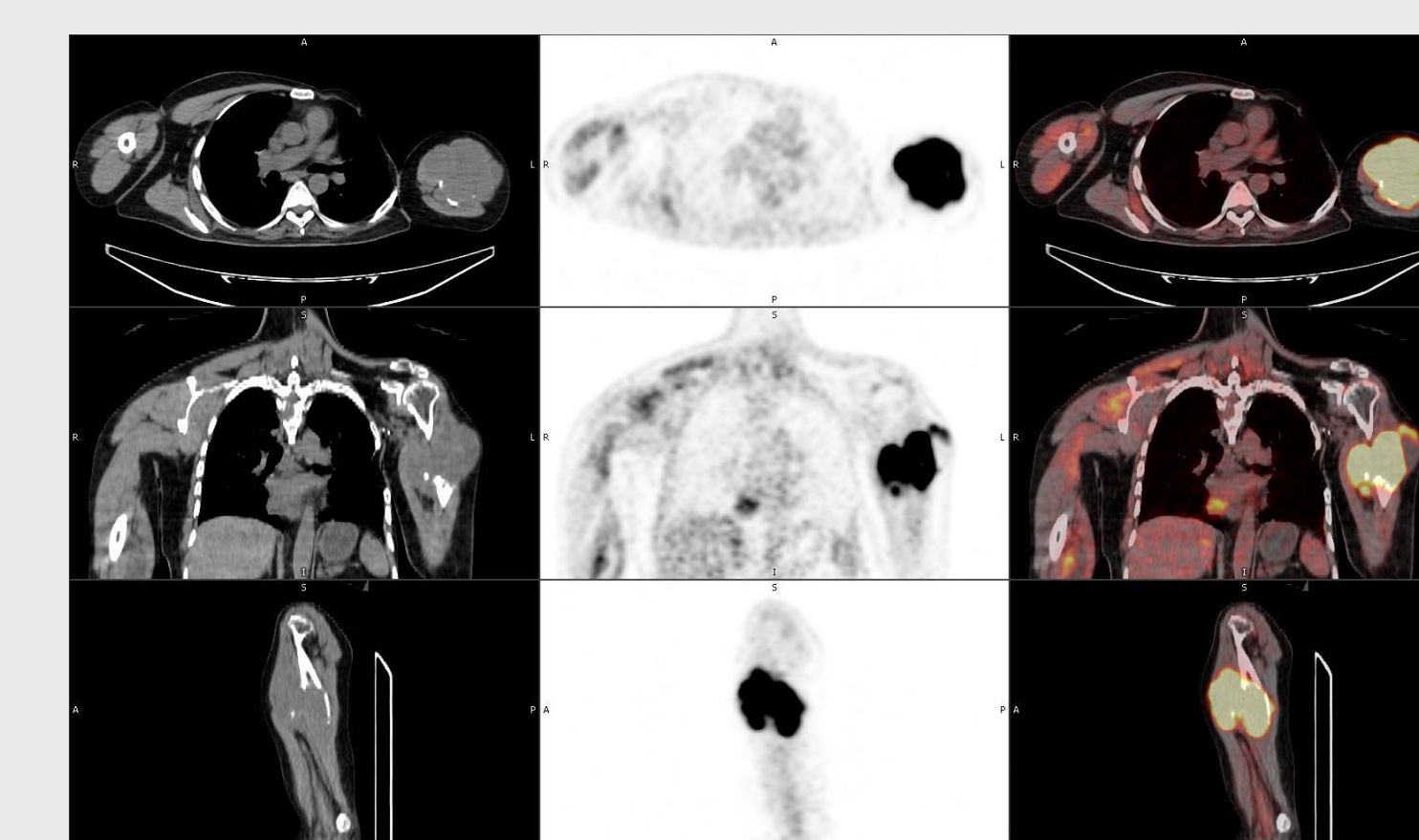


Figure 13. Primary Muscle Tumor Rhabdomyosarcoma of medial compartment right arm

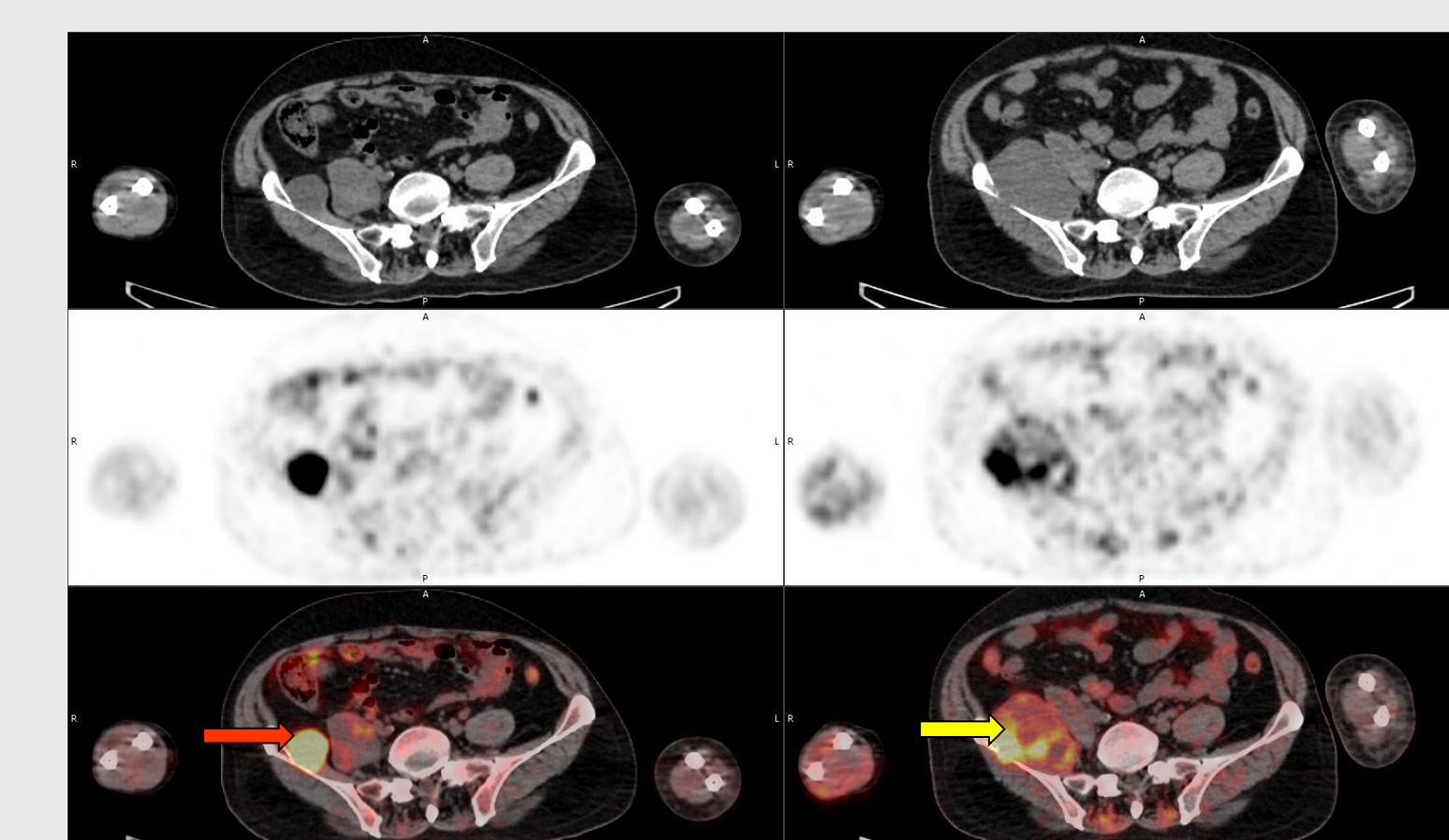


Figure 14. Comparison Scan (2TP): Metastatic muscle deposit to right iliacus muscle (red arrow) showing progression on follow-up scanning (yellow arrow)

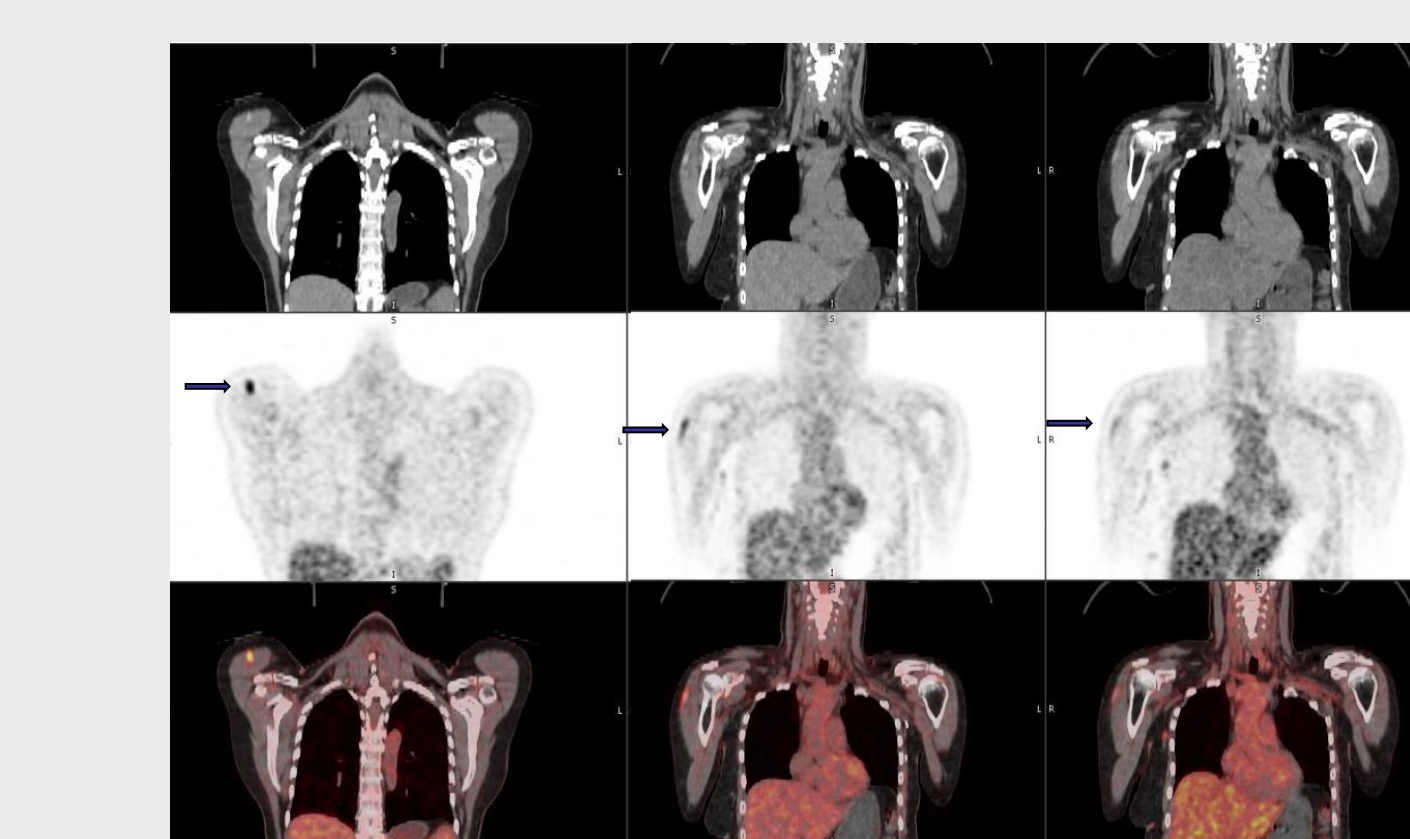


Figure 15. Comparison Scan (3TP): Metastasis of the right deltoid muscle showing healing over time evidenced by decreasing intensity of uptake over the lesion (black arrow)

DISCUSSION

The normal 18FDG uptake by the muscle is relatively mild and homogenous. The reason for this being the use of fatty acid oxidation by the muscles during period of rest. With the release of insulin into the circulation, as a result of food intake or exercise, there is a translocation of the GLUT-4 receptor from the cytosol to the plasma membrane. This results in uptake of 18FDG (an analogue of glucose) into the cell. Hence a normal physiological uptake on scan is seen post prandial, with endo or exogenous insulin release or use/activity of muscle or muscle groups. This may also include, stress-induced muscle tension spastic paresis, hyperventilation, and activities such as talking, chewing, and so forth. These uptakes are usually mild to moderate and symmetrical. Adequate patient education and preparation can help in reducing these uptakes

Pathological uptakes by the muscle may be benign (infective / inflammatory) or malignant. The benign uptakes may be due to a primary infective involvement or secondary as a sequel to surgery/radiation therapy.

The skeletal musculature is a very well perfused organ; fortunately, however, as a result of increased lactic acid production during exertion, there is limited response of the blood vessels to the angiogenic stimuli of tumor deposit, rendering it relatively safe for secondaries. Despite this, muscle metastasis is still observed which may be asymptomatic (discovered on surveillance scanning), or cause local pain. Neoplasms involving the muscles can be either primary (benign/malignant) or secondary. Among the primaries that may involve the muscles, the more common seen in our set-up have been the sarcomas.

CONCLUSIONS

Skeletal muscle uptake on an 18FDG scan can be either physiological or pathological. Proper patient preparation and knowledge of the normal physiologic variants of FDG uptake in the skeletal muscles are essential for differentiating physiologic from pathologic conditions and in giving a final decision on the uptake for further management

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