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Case Report

FDG PET-MRI evaluation of synchronous gallbladder adenocarcinoma and POEMS syndrome ☆

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ABSTRACT

POEMS syndrome is a rare paraneoplastic syndrome associated with a plasma cell proliferative disorder. Gallbladder adenocarcinoma is a rare malignancy, with no association with POEMS syndrome. The plasma cell dyscrasia is routinely evaluated with advanced hybrid imaging to assess both anatomic and functional components. We present a case of a 59-year-old female with a known diagnosis of POEMS syndrome who underwent a whole-body restaging evaluation with hybrid positron emission tomography (PET) and magnetic resonance imaging (MR) to restage her plasma cell dyscrasia. She also had a prior diagnosis of gallbladder adenocarcinoma. Our case focuses on the value of PET/MR in this scenario as well as a rare case of osseous metastasis from gallbladder carcinoma.

Introduction

POEMS syndrome or osteosclerotic myeloma is a rare paraneoplastic syndrome associated with a plasma cell proliferative disorder, mainly monoclonal lambda [1]. The acronym refers to multiple paraneoplastic features seen in the disorder, specifically polyneuropathy, organomegaly, endocrinopathy, monoclonal gammopathy, and skin changes. Additional potential findings may include papilledema, extravascular volume overload, and sclerotic bone lesions [2]. The monoclonal gammopathy may progress to multiple myeloma, which when diagnosed is amenable to therapy.

2-deoxy-2-[^{18}F] fluoro-D-glucose (FDG) positron emission tomography (PET) computed tomography (CT) is currently one of the preferred imaging methods for diagnosis, evaluation, and therapy response assessment in multiple myeloma and other plasma cell dyscrasias [3,4]. The bone lesions may radiographically appear densely sclerotic, lytic with a sclerotic rim, or with a mixed soap-bubble appearance. In a study of bone lesions evaluation with FDG PET/CT imaging in 91 patients with POEMS syndrome, the FDG uptake was variable, but overall

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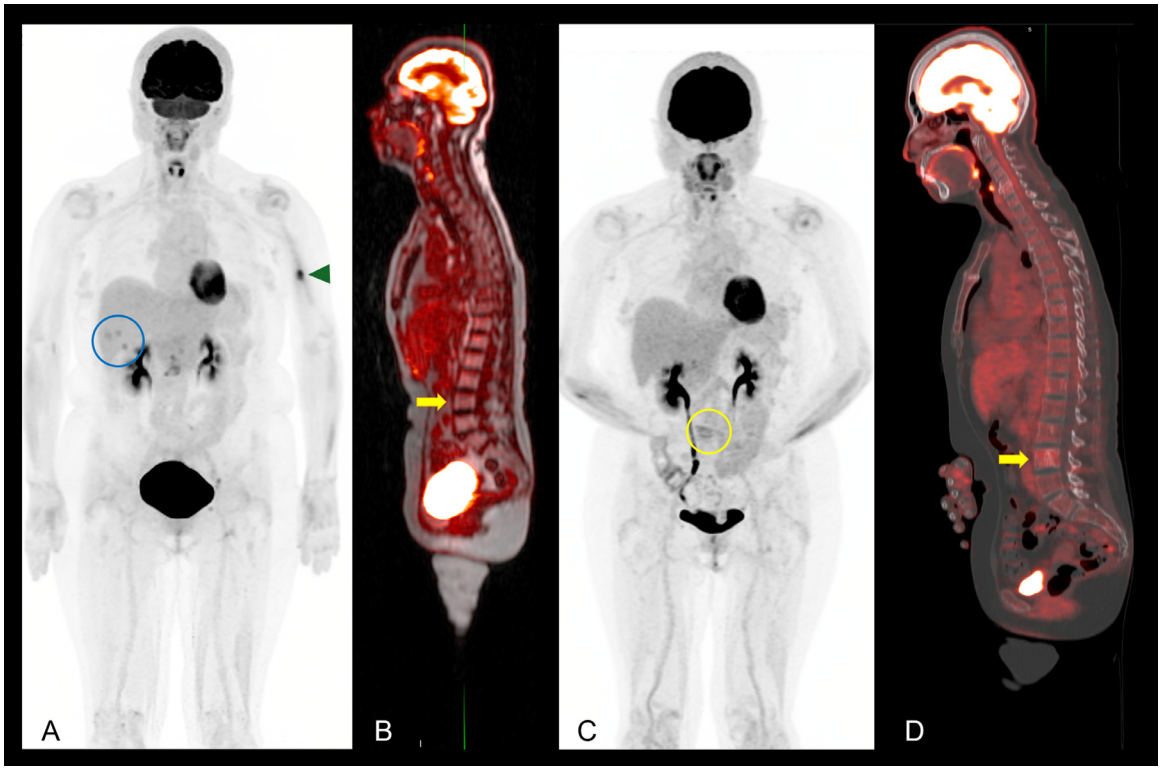

Fig. 1 – Selected images from a FDG PET-MR and a FDG PET/CT acquired one year prior. FDG PET coronal maximum intensity projection (A) shows a new hypermetabolic focus in the midshaft of the left humerus (green arrowhead) as well as subtle hypermetabolic foci projecting over the inferior aspect of right lobe of the liver (blue circle). Sagittal fused FDG PET-MR image (B) shows post-treatment hypometabolism in the L3 vertebral body. For comparison, FDG PET coronal maximum intensity projection (C) from 1 year prior shows only a subtle focus of uptake in mid abdomen, which on sagittal fused FDG PET/MR (D) localized to the L3 vertebral body as focal hypermetabolism (thick yellow arrows). This was confirmed as active myeloma and started on lenalidomide/dexamethasone with resulting expected hypometabolism (B).

higher in lesions with a lytic component [5]. At the same time, the use of whole-body magnetic resonance imaging (MR) is becoming prevalent in evaluation of myeloma [6]. Recently, FDG PET combined with simultaneous magnetic resonance (PET-MR) has also become available [7,8]. While FDG PET is useful for functional assessment of active lesions, the MR sequences, including Dixon and diffusion-weighted imaging (DWI), help to delineate normal marrow from suspected myelomatous lesions with apparent diffusion coefficient (ADC) sequences accurately differentiating variable marrow patterns from active disease [9,10]. We present a case of a patient with known POEMS syndrome and previously treated gallbladder carcinoma, undergoing routine FDG PET-MRI to evaluate her POEMS disease with discovery of an atypical osseous lesion in the left arm that was subsequently biopsy proven to be a rare osseous metastatic deposit from the patient's gallbladder carcinoma.

Case report

A 59-year-old woman was diagnosed with POEMS syndrome and treated with lenalidomide and dexamethasone therapy for 4 months. Nine months after the diagnosis of POEMS syndrome, while on maintenance therapy with lenalidomide and dexamethasone, she presented to the emergency department with new-onset abdominal pain. Multi-modality imaging revealed acute gangrenous cholecystitis with an incidental 3-cm polypoid mass in the gallbladder body and 2 new enlarged periportal lymph nodes. A diagnosis of gallbladder adenocarcinoma was confirmed, and the patient underwent 6 months of gemcitabine-based neoadjuvant chemotherapy for the newly diagnosed gallbladder cancer, which was also deemed beneficial to the underlying plasma cell dyscrasia. This was followed by partial hepatectomy and cholecystectomy, deemed as definitive treatment. Approximately 4 months after the cholecystectomy, she presented with new onset left arm pain and swelling. Given her diagnosis of POEMS syndrome and ongoing treatment she underwent a FDG PET-MR evaluation for restaging (Fig. 1).

Close evaluation of the gallbladder fossa demonstrated hypermetabolic soft tissue that was not appreciated on the previous FDG PET-CT (not shown). Combine FDG PET-MRI characterization of this tissue in the gallbladder fossa allowed for definitive characterization of recurrent disease (Fig. 2).

The FDG PET-MR study also revealed a new, solitary, hypermetabolic lesion in the left humeral mid-shaft, not seen on a previous PET-CT scan from a year ago (Fig. 3). The lesion demonstrated decreased intensity on the T1 in-phase sequence and demonstrated no drop-out on the out of phase

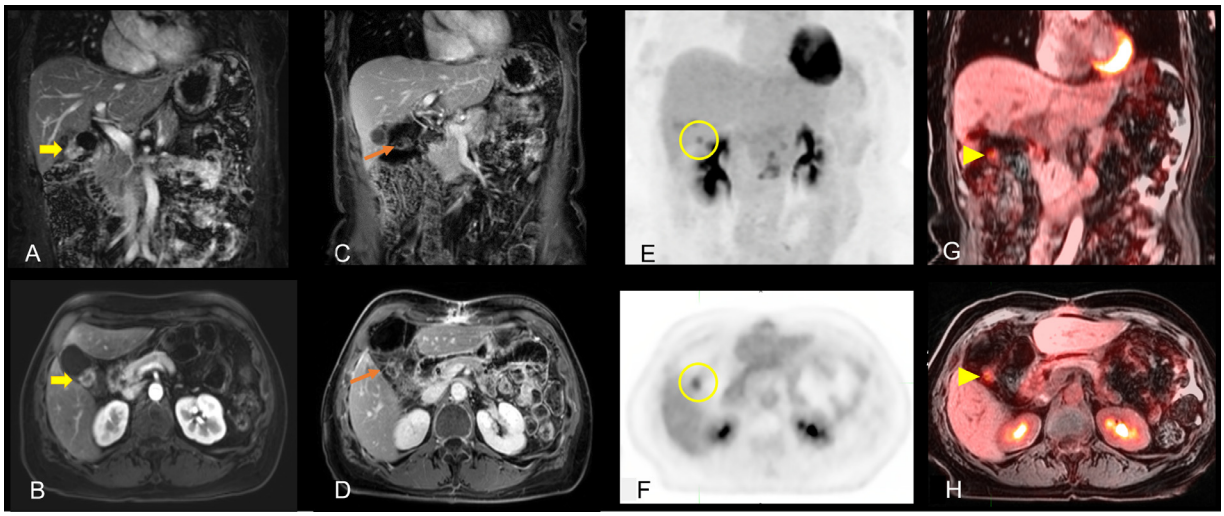

Fig. 2 – Selected matched images from a contrast-enhanced MR abdomen study performed 5 months prior to the ^{18}FDG PET-MR including coronal (A) and transaxial (B) revealed a 3 cm gallbladder mass (thick yellow arrows). Matching abdominal MRI coronal (C) and transaxial (D) images show postsurgical changes within the gallbladder fossa (thin orange arrows). Coronal (E) and transaxial (F) FDG PET show 3 foci of uptake, one of which localized to the gallbladder fossa (yellow circles). Corresponding fused FDG PET/MR coronal (G) and transaxial (H) images show the uptake localizing to a subtle soft tissue nodule in the gallbladder fossa (yellow arrowheads).

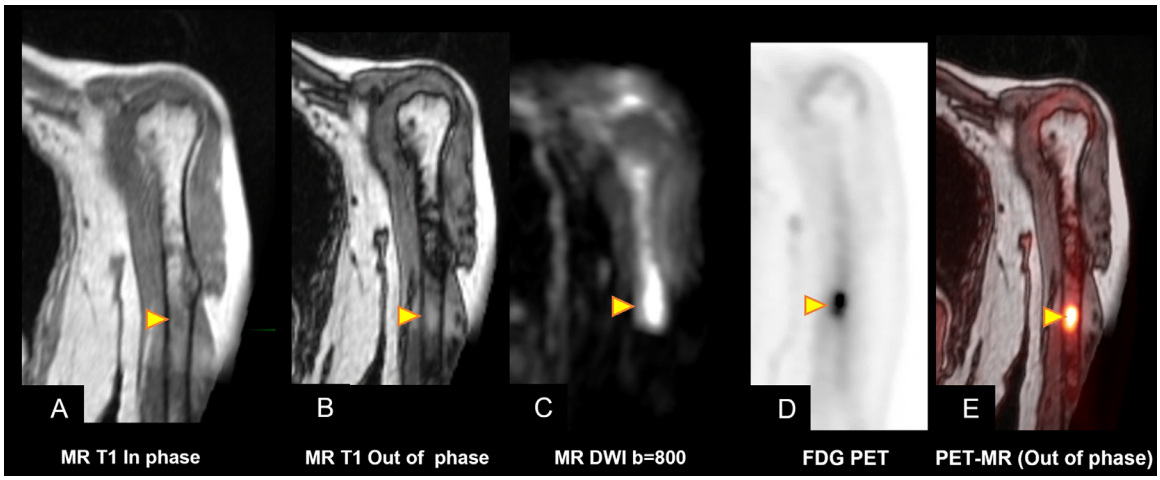

Fig. 3 – Multiple sequence assessment of an osseous lesion in the left humerus seen on FDG PET-MR. On multiple coronal oriented images of the left humerus, the mid shaft lesion has the signal characteristics of a malignant process. T1-weighted in phase (A) coronal image show a T1 hypointense lesion that does not drop-out on opposed out-of-phase imaging (B). b800 DWI coronal image (C) shows a hyperintense lesion in the mid shaft corresponding with the T1 opposed phase imaging. Coronal MIP projection FDG PET (D) shows the lesion has hypermetabolic activity with a maximum SUV of 5.5. Coronal-fused PET and MRI out of phase imaging (E) showing the area of hypermetabolic activity corresponds with the MRI abnormality.

sequence. It was also hyperintense on the DWI (b800) images. On PET imaging, increased FDG uptake was noted within the lesion with no other appreciable abnormal metabolic activity throughout the skeleton. Together these findings were concerning for oligometastatic relapsed myeloma; a CT-guided biopsy of the lesion was performed, which revealed the lesion to be metastatic adenocarcinoma with gallbladder origin. The patient subsequently underwent targeted radiation therapy.

Discussion

MRI aims to distinguish normal red marrow from abnormal marrow [11] and inactive osteosclerotic from active osteolytic lesions. Red marrow is expected to be slightly hyperintense on T1-weighted sequences and hyperintense/isointense on the T2-weighted sequences. Red marrow decreases intensity on

out-of-phase imaging relative to in-phase imaging (or "drops out") [12]. A few studies have evaluated the appearance of bone lesions in POEMS syndrome with MRI. The sclerotic lesions reveal low signal intensity in both T1 and T2 sequences. The osteolytic or mixed lesions may appear with high T2 signal [13,14]. Given hematopoietic marrow often has variable but near blood pool uptake on FDG PET, the combination of MRI and FDG PET may help prevent misclassification of hematopoietic marrow activity as an active lesion. However, in our case, there was an abnormally increased DWI signal corresponding to the focal increased uptake, reliably identified as a suspicious lesion.

GB adenocarcinoma is rare [15] with no association with POEMS syndrome. Liver and regional lymph nodes are the common primary sites for metastasis [16,17]. Skeletal metastasis from GB carcinoma is rare, with only a few instances reported in the literature [18–22]. Furthermore, the role of PET imaging in gallbladder cancer is limited, with MRI evaluation preferred due to the highest risk of locoregional and nodal recurrence [23]. No studies regarding the role of PET-MR in the staging of hepatobiliary cancers have focused specifically on gallbladder carcinoma, with the predominant focus being on the value of contrast enhanced MR in the evaluation of the liver in conjunction with PET [24].

While PET-CT is ubiquitous in oncologic imaging, the role and use of PET-MR is still developing as a relatively new technology. After the installation of a PET-MR at our institution in 2018, we began exploring the combining of the FDG PET as well as whole body MR in assessment of plasma cell disorders. Once technical feasibility was confirmed we increased utilization of FDG PET-MR for myeloma over the next 2 years and by 2020 started to triage the myeloma patients preferentially to PET-MR when feasible.

Conclusions

PET/MR imaging integrates the functional PET and the anatomical MR studies in a simultaneous evaluation with less radiation exposure than FDG PET/CT [25]. While we are preferentially utilizing FDG PET-MR for evaluation of multiple myeloma/plasma cell dyscrasias to co-opt the value of FDG PET as well as MR in a single exam, this case is a cautionary tale defying the statistics of osseous metastasis in gallbladder carcinoma as well as highlighting the fact that the high sensitivity for detecting metastatic disease with this modality is not specific to a given malignancy.

Patient consent

Written informed consent was taken from the patient for publication of this case. The patient was informed that no personal details will be revealed in the publishing of this case.

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