

## Multi-site abdominal tuberculosis mimics malignancy on $^{18}\text{F}$ -FDG PET/CT: Report of three cases

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reports on accumulation of  $^{18}\text{F}$ -FDG in abdominal TB are available in the literature. A high index of suspicion is necessary to achieve an early diagnosis and a better outcome of the disease.

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### Abstract

$^{18}\text{F}$ -fluorodeoxyglucose positron emission/computed tomography ( $^{18}\text{F}$ -FDG PET/CT) imaging, an established procedure for evaluation of malignancy, shows an increased  $^{18}\text{F}$ -FDG uptake in inflammatory conditions. We present three patients with abdominal pain and weight loss. Conventional imaging studies indicated that abdominal neoplasm and  $^{18}\text{F}$ -FDG PET/CT for assessment of malignancy showed multiple lesions with intense  $^{18}\text{F}$ -FDG uptake in abdomen of the three cases. However, the three patients were finally diagnosed with multi-site abdominal tuberculosis (TB). Of them, two were diagnosed with TB by pathology, one was diagnosed with TB clinically. They recovered after anti-TB therapy. Few

### INTRODUCTION

Patients with abdominal mass caused by benign lesions such as infection and benign tumor are often encountered in daily clinical practice. Sometimes, it is difficult to differentiate them from malignancy with the conventional imaging techniques, such as ultrasonography, computed tomography (CT) and magnetic resonance imaging (MRI)<sup>[1-3]</sup>. In spite of the great success achieved by  $^{18}\text{F}$ -fluorodeoxyglucose positron emission tomography/CT ( $^{18}\text{F}$ -FDG PET/CT) imaging in the evaluation of malignant disorders<sup>[4-6]</sup>,  $^{18}\text{F}$ -FDG is not specific for malignant lesions, and can accumulate in inflammatory lesions with an increased glucose metabolism<sup>[7,8]</sup>.

Abdominal tuberculosis (TB) may involve the gastrointestinal tract, peritoneum, mesenteric lymph nodes, liver, spleen, or genitourinary tract. Its presentations are non-

specific and its diagnosis is frequently elusive<sup>[9,10]</sup>. Since the presentations of multi-site abdominal TB are even more atypical and insidious, its definitive diagnosis requires a high index of suspicion, various laboratory findings, imaging modalities, and histologic exclusion of malignancy<sup>[9,10]</sup>.

We present three patients with abdominal mass diagnosed as malignancy by ultrasonography and/or CT. <sup>18</sup>F-FDG PET/CT also showed an increased activity. However, these three patients were finally diagnosed with multi-site abdominal TB.

## CASE REPORT

### Case 1

A 50-year-old male presented with a 4-mo history of left abdominal pain and body weight loss of about 6 kg in the past 2 mo. He had not any past clinical or radiological evidence of TB. Ultrasound examination imaging showed a mass behind the pancreatic body, multiple enlarged and confluent lymph nodes in retroperitoneal space and on the left side of abdominal aorta. Physical examination of the abdomen showed a slight tenderness in upper left abdominal area. Liver function tests, electrolytes, and complete blood count were normal. Whole-body <sup>18</sup>F-FDG PET/CT scan demonstrated a mass-like area with an intense <sup>18</sup>F-FDG uptake extending up behind the pancreatic body and tail, a focal area with an intense <sup>18</sup>F-FDG uptake in spleen, multiple focal areas with an intense <sup>18</sup>F-FDG uptake along the arcus minor ventriculi, around the abdominal aorta, and post crura diaphragm (Figure 1). Delayed <sup>18</sup>F-FDG PET/CT scan was performed 120 min after <sup>18</sup>F-FDG was injected into the patient. The maximal standardized uptake value (SUVmax) measurements of each tuberculous lesion were obtained both on early-(SUV1) and on delayed-scans (SUV2). Furthermore, we calculated the retention index (RI) of SUVmax (RI-SUVmax) from SUVmax according to the following formula: RI-SUVmax (%) = [SUV2 (delayed-phase) - SUV1 (early-phase)] × 100/SUV1 (early-phase). The images of delayed-scan demonstrated almost the same multiple areas with an intense <sup>18</sup>F-FDG uptake. The SUVmax was increased in some lesions and decreased in others (Table 1), indicating that the patient has lymphoma or retroperitoneal tumor with multiple metastases. The subsequent laparoscopic biopsy of the mass extending up behind the pancreas and histopathological examination revealed TB in the patient (Figure 2).

The patient was diagnosed with multi-site abdominal TB. Six months after anti-TB therapy, a second <sup>18</sup>F-FDG PET/CT scan showed remission of all his prior lesions. Three weeks after anti-TB therapy, his abdominal pain disappeared and 10 mo after anti-TB therapy, his general condition including body weight loss was much improved.

### Case 2

A 61-year-old female was admitted to our hospital due to right abdominal pain for 1 wk and a body weight loss of about 5 kg in the past 2 mo. The patient had a 3-year

**Table 1** Maximum standardized uptake values and retention index of maximal standardized uptake value

Lesion location	SUV1	SUV2	RI-SUVmax (%)
Patient 1			
Behind pancreas	17.7	16.5	-6.78
In retroperitoneal space	14.4	12.1	-15.97
In spleen	6.7	9.2	37.31
Patient 3			
In liver hilum	13.2	15.3	15.91
Near the pancreatic head	13.7	12.8	-8.03
Peritoneum lesion	13.9	14.3	2.88
In retroperitoneal space	12.4	11.8	-4.84

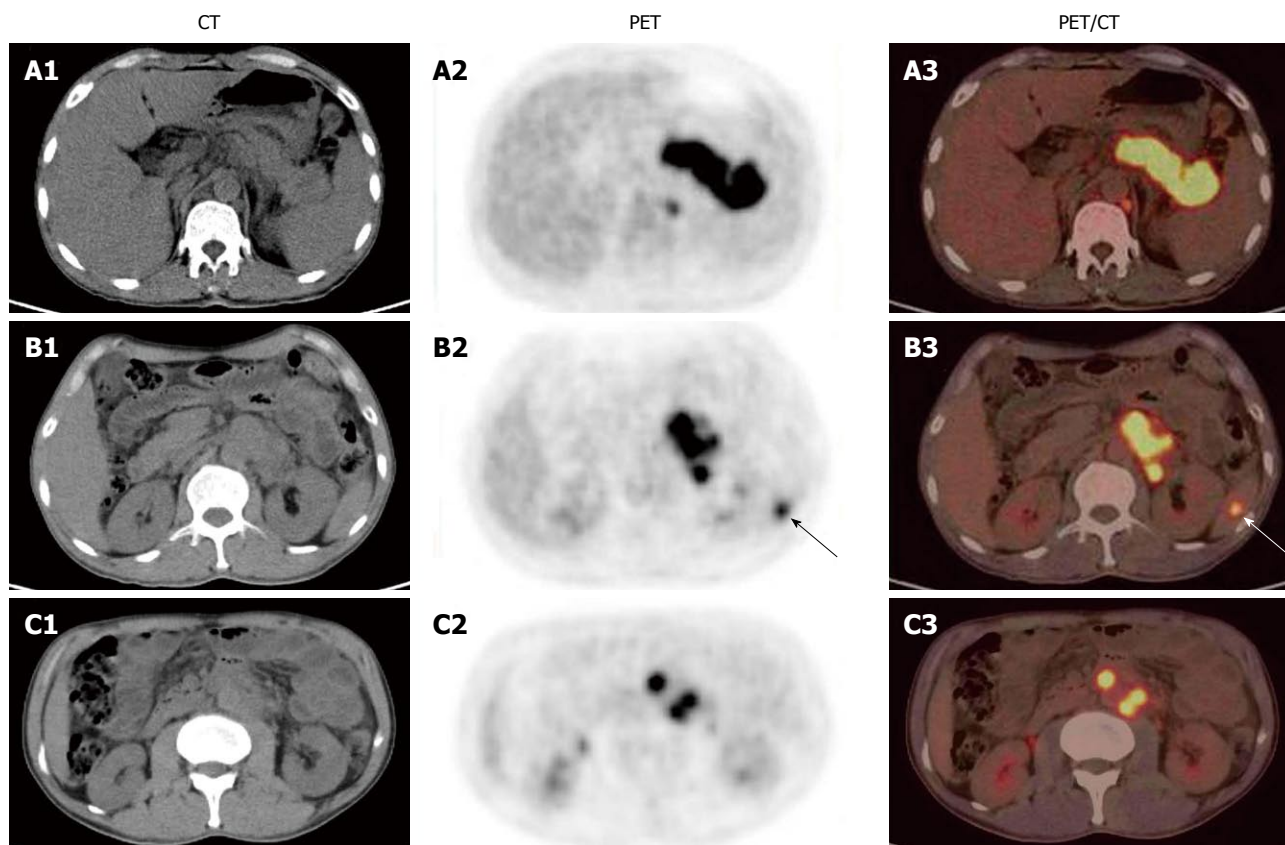
SUV1: Maximal standardized uptake value obtained on early-scan; SUV2: Maximal standardized uptake value obtained on delayed-scan; RI-SUVmax: Retention index of maximal standardized uptake value [RI-SUVmax (%) = (SUV2 - SUV1) × 100/SUV1].

history of hypertension but no past clinical or radiological evidence of TB. Liver function tests, electrolytes, and complete blood count were normal. The serum levels of  $\alpha$ -fetoprotein, carcinoembryonic antigen, carbohydrate antigen 50, carbohydrate antigen 125, carbohydrate antigen 153, and carbohydrate antigen 199 were normal. Ultrasound and abdominal CT showed a mass in the hepatic hilar region, and multiple enlarged lymph nodes around the abdominal aorta. Whole-body <sup>18</sup>F-FDG PET/CT scan demonstrated multiple lesions with an intense <sup>18</sup>F-FDG uptake in the hepatic hilar region, para-abdominal aorta, right iliac arterial region, thoracic and lumbar vertebrae (Figure 3), suggesting malignancy with multiple metastases. A biopsy of the 1st lumbar vertebra showed osteomyelitis (Figure 4A). Subsequently laparoscopic biopsy of the mass in hepatic hilar region and histopathological examination revealed TB (Figure 4B).

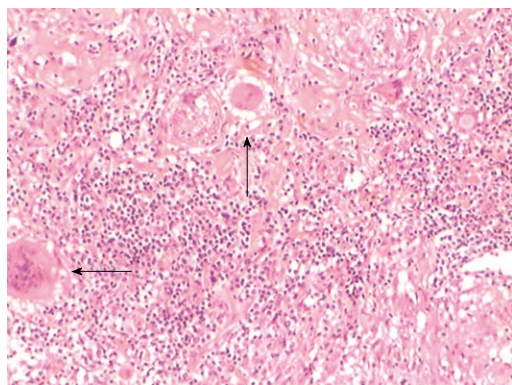
The patient was diagnosed with multi-site abdominal and bone TB. Ten months after anti-TB therapy, a second <sup>18</sup>F-FDG PET/CT scan showed remission of all her prior lesions. Two weeks after anti-TB therapy, her abdominal pain disappeared. Twelve months after anti-TB therapy, her general condition including body weight loss was much improved.

### Case 3

A 37-year-old male presented with malaise and abdominal pain in the past 6 mo, as well a body weight loss of about 3 kg in the past 3 mo. He had not any past clinical or radiological evidence of TB. Ultrasound and abdominal CT showed multiple enlarged nodes in hepatic hilar region, pancreatic head, retroperitoneal space, and disorganization of the pancreatic head. Laboratory test showed an elevated white-cell count (15 250 per cubic millimeter) with an increased neutrophil differential count (12 060 per cubic millimeter). His serum biochemistry values, including liver-function test, were normal. Whole-body <sup>18</sup>F-FDG PET/CT scan demonstrated multiple focal or lamellar lesions with an intense <sup>18</sup>F-FDG uptake in hepatic hilar region, curvatura ventriculi minor, radix mesenterii region,



**Figure 1**  $^{18}\text{F}$ -fluorodeoxyglucose positron emission/computed tomography images of patient 1 showing a mass-like area with an intense  $^{18}\text{F}$ -fluorodeoxyglucose uptake extending up behind the pancreatic body and tail (A1-A3), a focal area with an intense  $^{18}\text{F}$ -fluorodeoxyglucose uptake in spleen (arrows) (B1-B3), and multiple focal areas with an intense  $^{18}\text{F}$ -fluorodeoxyglucose uptake around the abdominal aorta (C1-C3). CT: Computed tomography; PET: Positron emission tomography.



**Figure 2** Hematoxylin and eosin staining of laparoscopic biopsy specimen ( $\times 200$ ) from mass extending to behind the pancreas showing amorphous, eosinophilic and granular debris, as well as Langhans giant cells (arrows) in granulomas.

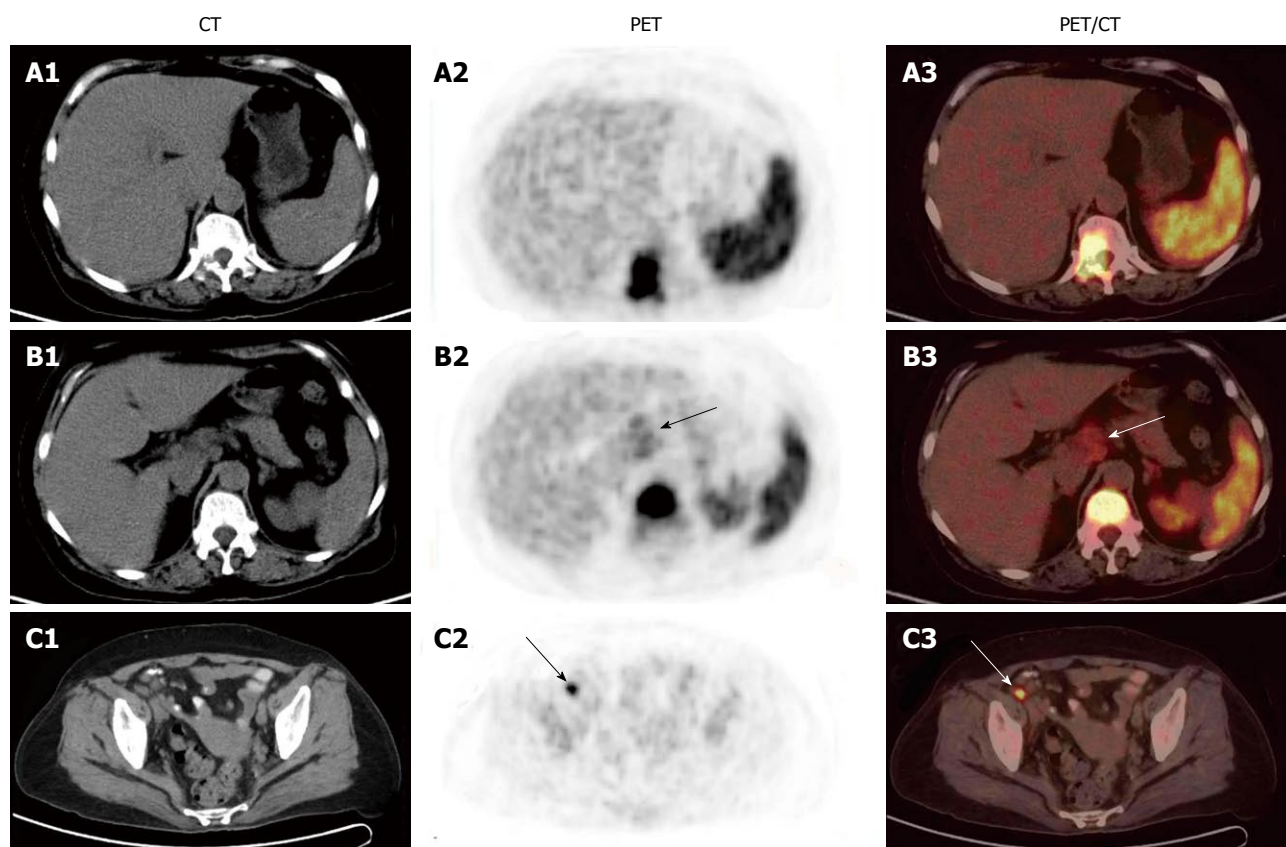
retroperitoneal space, pancreatic body and tail, peritoneum, and around the pancreatic head (Figure 5), suggesting TB or cancer. Delayed  $^{18}\text{F}$ -FDG PET/CT scan, 112 min after  $^{18}\text{F}$ -FDG injection, demonstrated almost the same multiple areas with an intense  $^{18}\text{F}$ -FDG uptake. The SUV-max was increased in some lesions and decreased in others (Table 1). Blood tests showed an accelerated erythrocyte sedimentation rate of 96 mm/h. Based on the experience

with the reported two patients, this patient was suspected to have TB, a Mantoux test was thus done. The size of induration on Mantoux test was 35 mm (strongly positive). The patient was diagnosed with multi-site abdominal TB.

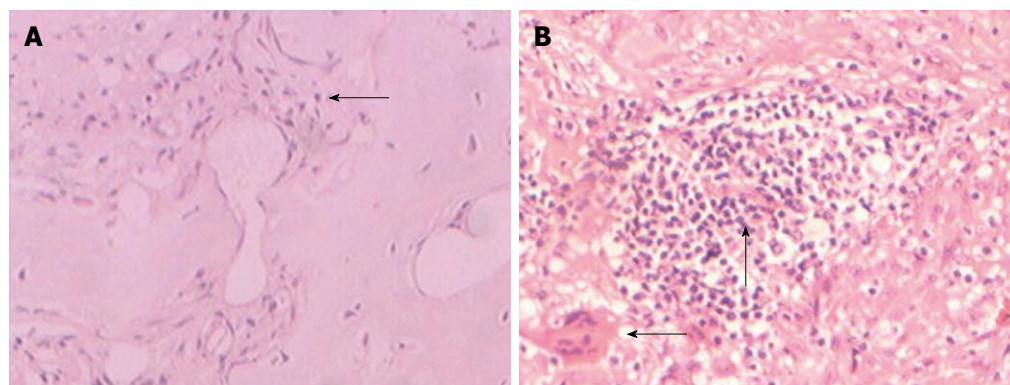
Ten days after anti-TB therapy, his abdominal pain disappeared and his white-cell count returned to normal. A second  $^{18}\text{F}$ -FDG PET/CT scan 5 mo after anti-TB therapy showed remission of all his prior lesions. His treatment was terminated 4 mo after the second PET/CT. Nine months after anti-TB therapy, his general condition including body weight loss and malaise was much improved. Five months after anti-TB therapy, the patient was in good health.

## DISCUSSION

Differentiation of TB from malignancy is very important, because the treatment modalities for them are different. Abdominal TB and malignancy often have common clinical features, such as weight loss, abdominal mass, and malaise. Overlap of symptoms of multi-site abdominal TB and metastatic carcinoma makes their differential diagnosis rather difficult and sometimes confusing. Histology is the only way of making its diagnosis as all available imaging methods are not sufficiently specific<sup>[1-3]</sup>. It has been shown that laparoscopic biopsy is a good diagnostic tool



**Figure 3**  $^{18}\text{F}$ -fluorodeoxyglucose positron emission/computed tomography images of patient 2 showing diffuse intense uptake of  $^{18}\text{F}$ -fluorodeoxyglucose in spleen and intense  $^{18}\text{F}$ -fluorodeoxyglucose uptake in thoracic vertebrae (A1-A3), a mass-like area with an intense  $^{18}\text{F}$ -fluorodeoxyglucose uptake in hepatic hilar region (arrows) and thoracic vertebrae (B1-B3), and a focal intense uptake of  $^{18}\text{F}$ -fluorodeoxyglucose in right iliac arterial region (arrows) (C1-C3). CT: Computed tomography; PET: Positron emission tomography.

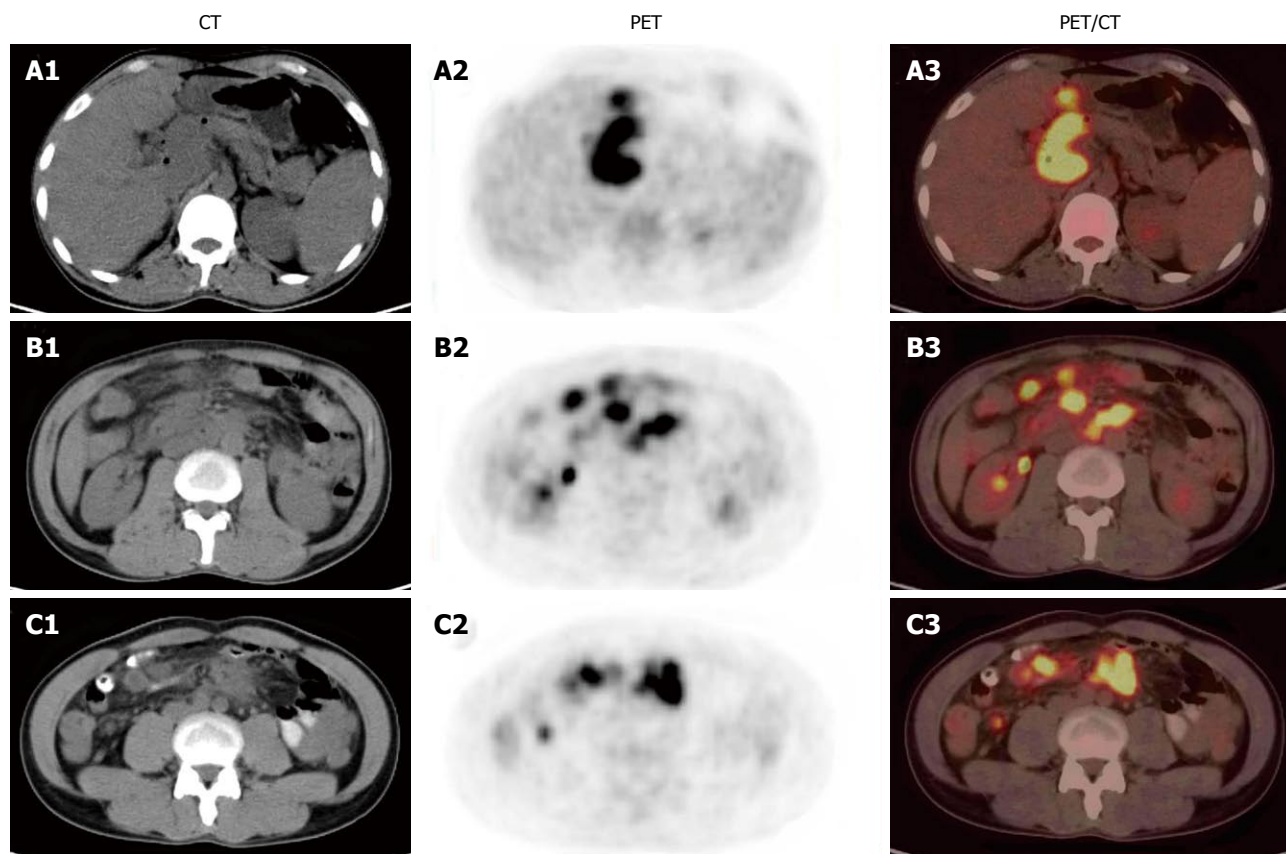


**Figure 4** Hematoxylin and eosin staining of the biopsy specimen from the 1st lumbar vertebra and the mass in hepatic hilar region showing thickened irregular bone trabeculae with a slight infiltration of lymphocytes and plasmacytes (arrow) (A), granulomatous lymphadenitis and amorphous, eosinophilic and granular debris, and Langhans giant cells in granulomas (arrows) (B).

for doubtful abdominal TB<sup>[11]</sup>. Laparoscopic biopsy confirmed the diagnosis of abdominal TB in our two patients.

Few reports are available on  $^{18}\text{F}$ -FDG accumulation in abdominal TB lesions<sup>[12,13]</sup>. The abdominal appearance on TB  $^{18}\text{F}$ -FDG PET/CT image is nonspecific and various<sup>[12,13]</sup>. These  $^{18}\text{F}$ -FDG positive lesions are often proliferative lesions composed of epithelioid cells, Langhans giant cells, and lymphocytes. These cells highly metabolize glucose and show a high uptake of  $^{18}\text{F}$ -FDG. In this study,

a focal accumulation pattern (Figure 1) and a diffuse accumulation pattern (Figure 3) of  $^{18}\text{F}$ -FDG were observed in spleen TB. Although a SUVmax, greater than 2.5, is attributed to malignant lesions<sup>[14]</sup>, in this study, the peak SUVmax value was 17.7 for abdominal TB (include TB of the spleen, lymph nodes, and peritoneum) (Figures 1, 3 and 5). It has been shown that inflammatory lesions show an increased  $^{18}\text{F}$ -FDG washout on delayed images obtained 90-120 min after  $^{18}\text{F}$ -FDG injection, whereas cancerous



**Figure 5**  $^{18}\text{F}$ -fluorodeoxyglucose positron emission/computed tomography images of patient 3 A showing a mass-like area with an intense  $^{18}\text{F}$ -fluorodeoxyglucose uptake in hepatic hilar region (A1-A3), multiple focal lesions (B1-B3) or multiple lamellar lesions (C1-C3) with an intense  $^{18}\text{F}$ -fluorodeoxyglucose uptake in peritoneal cavity, retroperitoneal space, and peritoneum. CT: Computed tomography; PET: Positron emission tomography.

lesions usually exhibit a further accumulation of tracer<sup>[15,16]</sup>. However, it was reported that TB exhibits a further accumulation of tracer, mimicking malignant lesions<sup>[17,18]</sup>. In our study, the SUVmax was reduced in some TB lesions and increased in others.

In conclusion, it is difficult to distinguish multi-site abdominal TB from malignancy even with  $^{18}\text{F}$ -FDG PET/CT. A high index of suspicion is necessary to achieve an early diagnosis and a better outcome of the disease.

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