

# Follicular thyroid carcinoma metastasizing to rare sites and exhibiting variable inter-lesional heterogeneity on <sup>18</sup>F-fluorodeoxyglucose positron emission tomography/computed tomography and <sup>131</sup>I

## ABSTRACT

A patient of differentiated follicular thyroid carcinoma with unusual sites of metastases is illustrated with <sup>131</sup>I and <sup>18</sup>F-fluorodeoxyglucose positron emission tomography/computed tomography (<sup>18</sup>F-FDG PET/CT) imaging findings. The described case harbored extremely rare metastasis to the urinary bladder with multi-organ metastatic disease (including unusual sites of right bronchus and hepatic metastases). There was inter-lesional heterogeneity among the metastatic lesions with regard to the <sup>131</sup>I and FDG uptake in the aforementioned lesions. The detection of such heterogeneity has important implications for patient management in metastatic differentiated thyroid carcinoma.

**Keywords:** <sup>131</sup>I theranostics, <sup>18</sup>F-fluorodeoxyglucose positron emission tomography/computed tomography, differentiated thyroid carcinoma, follicular thyroid carcinoma, urinary bladder metastasis

## INTRODUCTION

The cervical lymph node is the most common organ for metastasis in differentiated thyroid carcinoma (DTC). At the same time, lungs, bones, and at times, the brain are the usual organs for distant metastases in DTC. Metastasis to the urinary bladder in DTC is extremely rare for distant organ involvement. To the best of our knowledge, only four such cases have been reported in the literature.<sup>[1-4]</sup> <sup>18</sup>F-fluorodeoxyglucose positron emission tomography/computed tomography (<sup>18</sup>F-FDG PET/CT) scan has a valuable complementary role in the evaluation of thyroid carcinoma,<sup>[5,6]</sup> while <sup>131</sup>I as theranostic agent (used for both purposes of imaging and therapy) remains the cornerstone in the management of DTC.<sup>[7]</sup> The interesting feature of our case was extremely rare metastasis to the urinary bladder with multi-organ metastatic disease (including unusual sites of the right bronchus and hepatic metastases) and the observation of inter-lesional heterogeneity on molecular imaging which may guide therapeutic management and follow-up in this case with rare site metastatic disease.

## CASE REPORT

A 54-year-old male patient presented with cough and occasional hemoptysis for 1 year and hematuria for 6 months. The contrast-enhanced computed tomography (CECT) was used for the evaluation of these complaints. CECT of the thoracic region [Figure 1a] demonstrated soft-tissue mass

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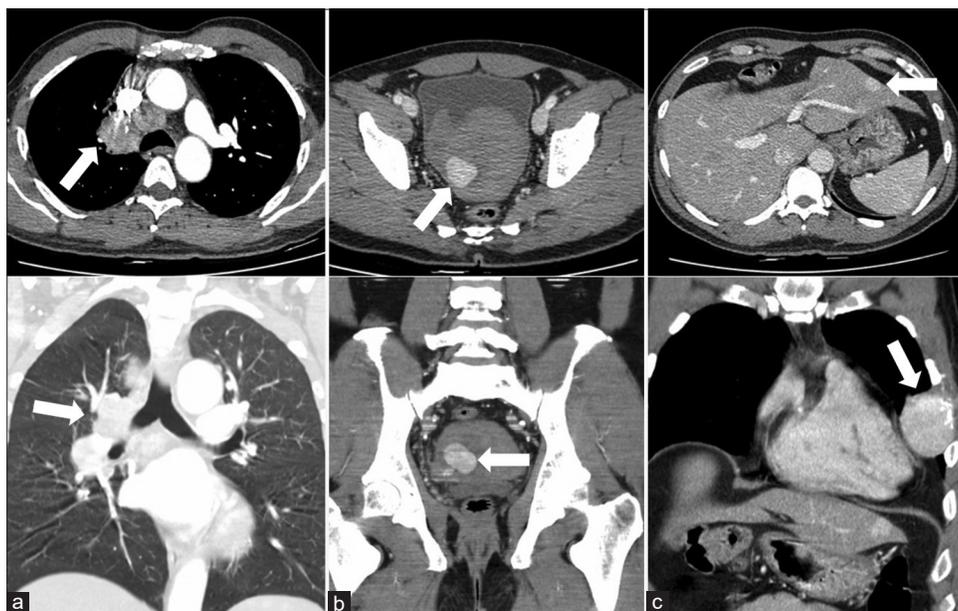
lesions in the hilar region of the right lung. CECT scan of the pelvic region [Figure 1b] showed soft-tissue lesion in the urinary bladder and CECT scan of the thoracoabdominal region [Figure 1c] showed a well-defined enhancing lesion in the segment III of the liver and enhancing soft-tissue lesion involving left-sided 5<sup>th</sup> rib. The patient underwent bronchoscopy guided biopsy for the right hilar lung lesion and transurethral resection of the urinary bladder lesion. The bronchoscopic biopsy specimen and as well as transurethral resected specimen showed metastasis tumor cells of a follicular pattern from the thyroid carcinoma origin and immunohistochemistry showed tumor cells express of PAX8 and TTF-1. These features were suggestive of metastases from carcinoma of the thyroid follicular origin. The patient underwent near-total thyroidectomy with right supraclavicular lymph nodal dissection. The follicular thyroid carcinoma was demonstrated on the thyroid surgical specimen. Postthyroidectomy stimulated serum thyroglobulin level was >300 ng/mL.

Postthyroidectomy and post excision of urinary bladder lesion, <sup>18</sup>F-FDG-PET/CT scan [Figure 2a] was ordered for prognostication and to look for other metastatic sites. Maximum intensity projection image shows FDG avid mediastinal lymph nodal lesions, liver lesions, large-sized soft lesions on the left thoracic region and multiple skeletal lesions. Fused images of <sup>18</sup>F-FDG PET/CT [Figure 2a] showed FDG avid enlarged right paratracheal lymph nodes, FDG avid lytic lesion in the right

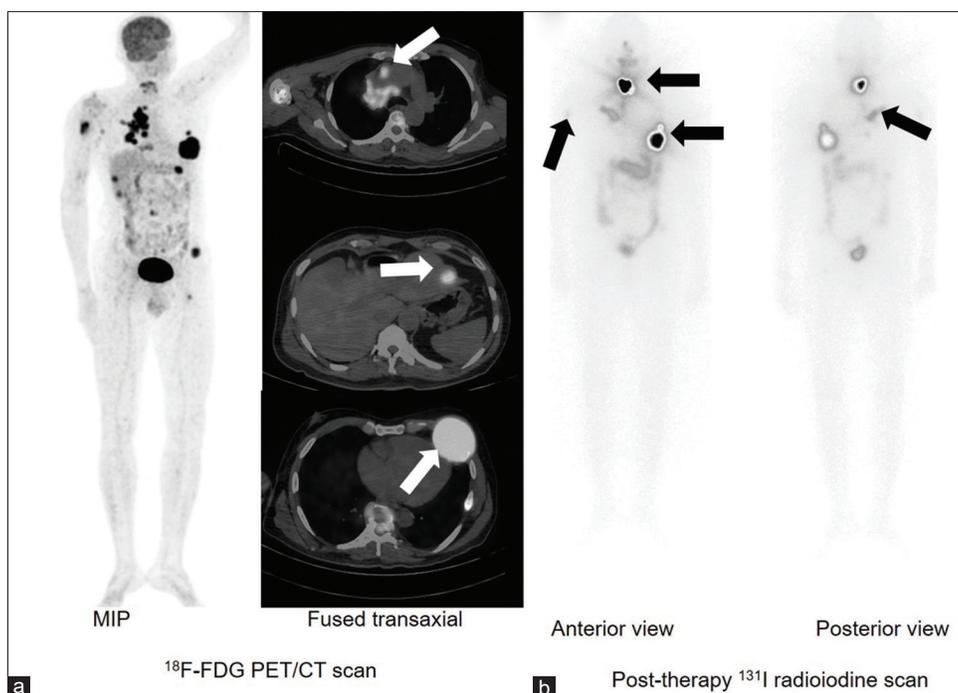
humerus, FDG uptake in segment III liver lesion and FDG avid soft tissue lesion involving left-sided 5<sup>th</sup> rib and FDG-avid lytic lesion in D6 vertebra. Subsequently, the patient was treated with <sup>131</sup>I radioiodine therapy. Posttherapy <sup>131</sup>I radioiodine scan [Figure 2b] showed good tracer concentration in thyroid bed and soft-tissue lesion involving left-sided 5<sup>th</sup> rib and faint tracer uptake in the right humerus and right-sided lung lesions. In contrast, the other skeletal, pulmonary and hilar nodal lesions were <sup>131</sup>I negative (the metastatic urinary bladder lesion was not present during the scan, as the patient had undergone complete excision during biopsy of the same prethyroidectomy).

## DISCUSSION

Multiple sites with metastatic involvement of more than one organ were seen in about 10% of patients with metastatic DTC.<sup>[8]</sup> The epidemiological data in DTC with rare metastatic sites are not available and unknown. Therefore, documentation of these rare sites is important as they would demonstrate a significant impact on patient management. The American Thyroid Association recommends an FDG-PET scan in high-risk patients with elevated serum Tg (generally > 10 ng/mL) and negative radioactive iodine scan.<sup>[9]</sup> It is usually believed that radio-iodine-avid lesions are not FDG avid and FDG-avid lesions are not iodine avid. Noniodine avid lesions are believed to be due to dedifferentiation. However, in this case, some lesions are both FDG and I-131 avid and some are only FDG avid. Studies in intermediate-to-high risk patients have also reported



**Figure 1:** (a) Contrast enhanced computed tomography of thoracic region showing a heterogeneously enhancing soft tissue lesion with irregular margin (size 3.8 cm × 3.7 cm) in the hilar region of right lung with partial encasement and indentation of the right main bronchus and bronchus intermedius (white colour arrow). (b) Contrast enhanced computed tomography of pelvic region showing 3.0 cm × 2.2 cm sized soft tissue lesion along the right lateral wall of urinary bladder (white colour arrow). (c) Contrast enhanced computed tomography of thoracoabdominal region showing a well-defined enhancing lesion of size 2.5 cm × 2.2 cm in the segment III of liver (white colour arrow in transaxial image) and enhancing soft tissue lesion of size 5.0 cm × 5.0 cm involving and destroying left sided 5<sup>th</sup> rib (white colour arrow in the coronal view in the lower row)



**Figure 2:** (a) Maximum intensity projection and fused images of  $^{18}\text{F}$ -fluorodeoxyglucose positron emission tomography/computed tomography showing intensely fluorodeoxyglucose-avid multiple mediastinal lymph nodal lesions, three liver lesions, large-sized soft-tissue lesion on the left thoracic region and multiple skeletal lesions. Fused transaxial slices of  $^{18}\text{F}$ -fluorodeoxyglucose positron emission tomography/computed tomography demonstrating intensely fluorodeoxyglucose avid enlarged right paratracheal lymph nodes (white arrow), fluorodeoxyglucose avid lytic lesion in the right humerus, intense fluorodeoxyglucose uptake in well-defined segment III liver lesion (white arrow) and intensely fluorodeoxyglucose-avid soft-tissue lesion involving and destroying left-sided 5<sup>th</sup> rib (white arrow) and fluorodeoxyglucose-avid lytic lesion in D6 vertebra. (b) Posttherapy  $^{131}\text{I}$  radioiodine scan showing good tracer concentration in thyroid bed and soft-tissue lesion involving left-sided 5<sup>th</sup> rib (black arrow) and faint tracer uptake in right humerus and right-sided lung lesions (black arrows), while the other skeletal, pulmonary and hilar nodal lesions were negative on  $^{131}\text{I}$  (the metastatic urinary bladder lesion was not present during the  $^{131}\text{I}$  radioiodine scan, as the patient had undergone complete excision during biopsy of the same prethyroidectomy)

similar findings.<sup>110,111</sup> Overall, in this case, FDG-PET detected more lesions than posttreatment I-131 scan.

Inter-lesional heterogeneity may be present in DTC.  $^{18}\text{F}$ -FDG PET/CT and  $^{131}\text{I}$  scans are helpful in detecting metastatic sites with inter-lesional heterogeneity. The detection of metastatic lesions with inter-lesional heterogeneity in these patients is very useful for both therapeutic and prognostic purposes. The interesting feature of the present case was extremely rare metastasis to the urinary bladder with multi-organs metastatic disease to unusual locations in DTC. These multi-organ lesions were deciphered on the combined study of  $^{18}\text{F}$ -FDG-PET/CT scan and  $^{131}\text{I}$  posttreatment scintigraphy.

## CONCLUSION

The documentation of rare site metastatic disease and the combined use of  $^{18}\text{F}$ -FDG PET/CT and  $^{131}\text{I}$  scans by detection metastatic sites with inter-lesional heterogeneity in this patient of DTC were helpful for both therapeutic and prognostic purpose.

## Declaration of patient consent

The authors certify that they have obtained all appropriate

patient consent forms. In the form, the legal guardian has given his consent for images and other clinical information to be reported in the journal. The guardian understands that names and initials will not be published and due efforts will be made to conceal identity, but anonymity cannot be guaranteed.

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## Conflicts of interest

There are no conflicts of interest.

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