CASE REPORT

The use of SPECT-CT improves accuracy of post-radioiodine therapy imaging and changes the management strategy in a case of advanced follicular thyroid carcinoma

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SUMMARY

This is a case of follicular thyroid carcinoma with extensive lung, bone and brain metastases. Multi-modality treatments including total thyroidectomy, modified radical neck dissection, cranial radiotherapy and Iodine-131 (RAI) therapy were instituted. Post RAI therapy planar whole body scan showed RAI avid metastases in the skull, cervical spine, bilateral lungs and abdomen. With the use of SPECT-CT imaging, rare adrenal metastasis and additional rib metastasis were identified. Besides, management strategy was altered due to detection of non-RAI avid brain and lung metastatic lesions.

KEY WORDS:
Follicular thyroid cancer, differentiated thyroid carcinoma, adrenal metastasis, brain metastasis, SPECT-CT, planar whole body scan

INTRODUCTION

Differentiated thyroid cancer (DTC) that arises from the follicular cells consists of two subtypes, namely papillary and follicular carcinoma. The age-adjusted incidence of thyroid cancer is 4.9 per 100,000 Malaysian populations (Cancer Statistics 2006 for West Malaysia). There is a female preponderance with female to male ratio of 3:1.

Iodine-131 (RAI) is a radioisotope, which emits gamma rays and beta particles that can be utilized for scintigraphic imaging and therapeutic purpose respectively. RAI is selectively concentrated within tissues expressing sodium iodide symporters such as in normal thyroid tissue and DTC. This important characteristic of DTC makes RAI a useful therapeutic and diagnostic (theranostic) tool for its management.

Presence of distant metastasis is the most important prognostic factor, reducing 5-year survival from over 90% to 40%.[1] However, it is still possible to achieve remission or improve progression-free survival with the use of RAI therapy. The lungs and bones are common sites of metastasis but up to 10% can spread to other organs.

CASE REPORT

This is a case of a 60-year-old lady, who presented three years ago with a history of progressive left frontal skull swelling over 6 months. The histopathology of excision biopsy revealed metastatic follicular thyroid carcinoma. She underwent a total thyroidectomy and modified radical neck dissection with the histopathology confirming primary follicular thyroid carcinoma, which was widely invasive, and regional lymph nodes metastases.

Four months post-surgery, she received 200mCi (7.4GBq) RAI therapy. The post therapy planar whole body scan (WBS) showed tracer uptake at the thyroid bed, left frontal bone and bilateral lungs, consistent with presence of RAI avid residual thyroid tissue, lung and bone metastases. Stimulated serum thyroglobulin was > 300µg/L.

Unfortunately, she was lost to medical follow up and presented again two years later with recurrent swelling at the left frontal region. CT scan detected new multiple brain metastases in addition to the left frontal bone lesion. She was treated with whole brain radiotherapy, followed by 150mCi (5.55GBq) RAI therapy.

Post therapy planar WBS showed intense tracer uptake in the previously known left frontal bone and lungs metastases, with new findings of a small focus of mild uptake at the mid cervical spine and another focus of intense tracer uptake at left upper abdomen. SPECT-CT was performed to provide CT anatomical correlation of these lesions. The foci of uptake at cervical spine and abdomen were accurately localised to the spinous process of C3 vertebra and a left adrenal mass respectively. Additional unsuspected RAI avid metastasis was detected at the right eighth rib corresponding to a lytic bone lesion. This lesion was not detectable on planar WBS due to multiple overlapping lung lesions. Other important findings from SPECT-CT were multiple brain lesions demonstrated in previous CT (Figure 1) as well as a significant number of large lung nodules were non-RAI avid. Discovery of non-RAI avid brain and lungs metastases portends poor prognosis, therefore palliative management was opted for this patient.

DISCUSSION

SPECT-CT is a relatively new hybrid imaging technique and currently the availability of this facility is limited in Malaysia. The fusion images of SPECT-CT enables accurate localization of the pathological lesions and correlation with findings of anatomical imaging. The use of this technology

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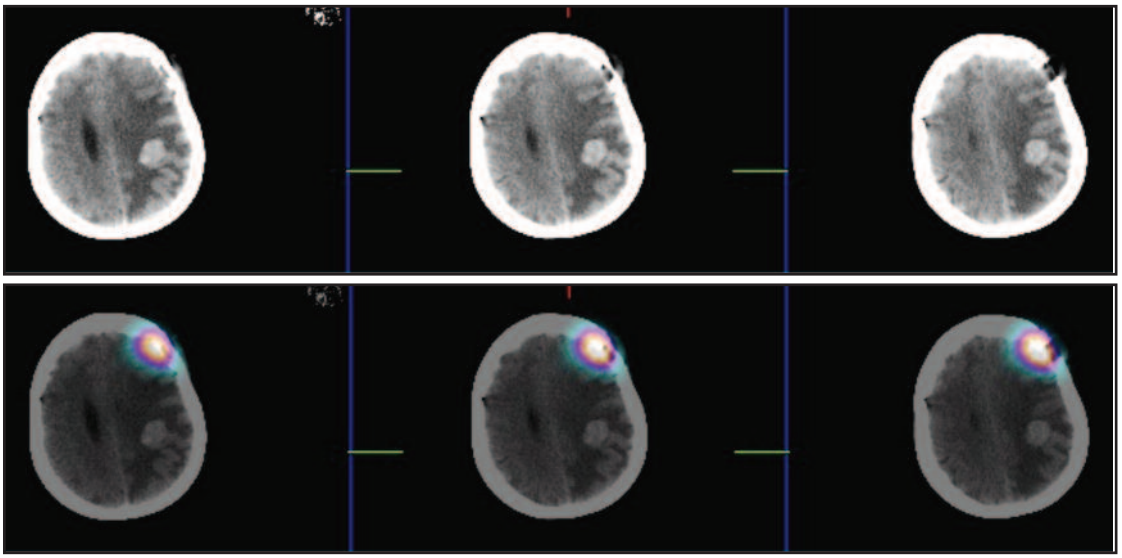

Fig. 1: Axial CT and fused SPECT-CT images showing RAI avid metastatic lesion at the site of previous craniectomy at left frontal bone and a non-RAI avid intracranial metastatic lesion at left parietal region with intense surrounding white matter oedema.

enhances diagnostic capability of RAI imaging and directs personalized management strategies.

The use of SPECT-CT has many advantages over conventional planar WBS in the management of DTC. For residual or recurrent locoregional DTC, it enables identification of macroscopic lesions larger than 1cm, in which a combined surgical or radiotherapy approach is desired to achieve optimal therapeutic outcome. The advantage of SPECT-CT is also observed in advanced DTC. For example, uptake in the thoracic region on planar WBS may indicate metastasis in lung, rib or mediastinal lymph nodes and each requires a different management strategy. Bone metastasis necessitates higher RAI dose for effective treatment whereas special precaution is needed in treating lung metastasis to prevent radiation pneumonitis and lung fibrosis.

Besides lymph node, lung and bone, uncommon DTC metastases in other organs, such as brain, eye, breast, liver, pancreas, adrenal, renal, gastrointestinal tract, ovary, skin and skeletal muscle have been reported. Adrenal metastasis mostly occurs in advanced disease, such as illustrated in our case report. However, there are rare cases of solitary adrenal metastasis or adrenal metastasis preceding bone and lung metastases. [2]

As the metastatic DTC progresses or following subsequent therapy, heterogenous cancer comprising both well differentiated and de-differentiated cells can be encountered. De-differentiation is usually suspected due to elevated serum thyroglobulin but negative RAI scan. In addition, de-differentiated DTC demonstrates glucose hypermetabolism on the 18F-Fluorodeoxyglucose PET scan and shows poor response to RAI therapy. Reduced expression of sodium iodide symporters and other enzymes of iodide metabolism in de-differentiated DTC has been linked to mutations of various oncogenes. [3]

We suggest SPECT-CT to be a routine standard of care for advanced DTC as early identification of non-RAI avid metastasis enables physicians to seek alternative treatment options. When brain and skull metastases coexist, SPECT-CT is essential to assess RAI avidity of each lesion. Brain metastasis from DTC are mostly non-RAI avid, in which surgical resection has been found to be superior to RAI, radiotherapy or chemotherapy in terms of survival benefit. [4] The role of molecular targeted therapy such as sorafenib in treating advanced thyroid carcinoma is emerging but requires further clinical study. [5]

CONCLUSION

Personalized treatment strategy for advanced DTC requires detail evaluation of the disease including location, size and RAI avidity of the metastasis. Hybrid imaging with SPECT-CT is able to fulfil such requirement and it should be available in all nuclear medicine centres.

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