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PET/CT and Thyroid Cancer

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As a rapidly evolving imaging modality, positron emission tomography/computed tomography (PET/CT) has gained widespread acceptance in the management of thyroid cancer. However, controversial attitudes towards its application still exist. How can we use it more effectively in this setting?

Firstly, ^{18}F-Fluorodeoxyglucose (FDG)-PET/CT has been used most commonly in searching for metastasis in differentiated thyroid cancer (DTC) patients with increasing serum thyroglobulin (Tg) and negative radioiodine whole body scan. Several studies have reported high sensitivity and specificity of up to 85% and 95%, respectively. Furthermore, the integrated PET/CT fusion imaging systems seem able to provide some additional advantages over PET alone, mainly because of a better anatomical localization of the hypermetabolic metastatic lesions. However, its definitive role is not completely clear, in particular regarding the influence of thyrotropin and Tg cutoff value on the accuracy of the examination. A literature analysis suggested that levothyroxine withdrawal was preferable in patients with relatively low Tg levels and good clinical compliance to hypothyroidism, indicating that a Tg cutoff level over 10 ng/ml may be a reasonable value maintaining high accuracy in terms of a good compromise between sensitivity and specificity. Recombinant human thyrotropin could be an alternative in patients clinically unable to tolerate therapy withdrawal. However, we must keep in mind that studies still conflict as to whether high thyrotropin levels can lead to a lower sensitivity, increased FDG uptake, or have no effect. In addition, PET/CT evaluation can be compromised by other elements, including tumor size, location, cell differentiation, and the presence of brown fat.

Secondly, emerging data suggest that PET/CT fusion studies provide increased accuracy and modify the treatment plan in a significant number of DTC cases when compared to PET images alone. A change in the management has been reported in 20% to 30% of DTC patients affected by non-functioning metastasis not visualized by other imaging techniques. In these patients an early diagnosis of non-radioiodine-avid metastasis may lead them to surgical resection, an optimal therapeutic approach if possible. However, studies documenting improvements in survival and tumor recurrence attributable to FDG-PET/CT imaging in thyroid cancer patients are lacking. Also of value is the identification of patients unlikely to benefit from additional ^{131}I therapy and identification of patients at highest risk of disease-specific mortality, which may prompt more aggressive therapy or enrollment in clinical trials.

Thirdly, the positron emitting radioiodine, ^{124}I, in combination with PET/CT has made it possible to measure the spatial distribution of radioiodine in tumors and normal organs at high resolution and sensitivity. The CT component of PET/CT has made it simpler to match the activity distribution to the corresponding anatomy. These developments have facilitated patient-specific dosimetry, utilizing software packages such as three-dimensional radiobiological dosimetry, which can account for individual patient differences in pharmacokinetics and anatomy. At present, although ^{124}I PET/CT is not likely to be routinely performed for thyroid cancer treatment planning, analysis of a number of specific studies with this approach will help address the still unresolved question regarding the role of dosimetry in radioiodine treatment of thyroid cancer. Once resolved, ^{124}I-PET/CT studies will become valuable in establishing an optimal treatment planning methodology.

Lastly, the role of PET/CT seems to be also promising in patients affected by medullary thyroid carcinoma and an aplastic thyroid carcinoma, especially for detection of neck and mediastinal lesions, with sensitivity superior to other currently available imaging methods. However, the data reported are little and further studies are needed to elucidate the preliminary promising results.

In conclusion, despite the fact that PET/CT has been shown to be an indispensible tool in the management of thyroid carcinoma, both utility and limitations need to be completely explored. During practice, we should select appropriate candidates and optimize the condition, so that PET/CT imaging can be used more effectively in both diagnosis and treatment of thyroid cancer.

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