Utility of CT-sestamibi Fusion in Parathyroid Exploration

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ABSTRACT

Objectives: Delineate the role of CT-technetium 99m sestamibi (CT-MIBI) fusion in directed parathyroidectomy. Determine the clinical situations where CT-MIBI fusion would be strongly recommended.

Methods: Charts from 190 patients with primary hyperparathyroidism who underwent CT-MIBI image fusion as a part of a scan directed, minimally invasive parathyroid exploration protocol were reviewed. The results of conventional sestamibi imaging and CT-MIBI image fusion were compared with operative findings.

Results: CT-MIBI image fusion accurately localized solitary hyperfunctional parathyroid glands in 70% of patients imaged. 55% of patients were localized with conventional-sestamibi imaging. CT-MIBI fusion imaging was most beneficial when conventional images suggested that the solitary gland was separated from the thyroid or when the adenoma was located in the retro-thyroidal retro-esophageal plane or mediastinum. CT-MIBI image fusion proved to be in guiding the directed approach to solitary glands that are separate from the thyroid or ectopically located, situations where conventional imaging has proven to be less accurate. This imaging technique will augment the minimally invasive surgical approach in selected patients with primary hyperparathyroidism in order to further refine the focused technique. Its utility as the standard preoperative localization modality is not yet established and requires further investigation.

Conclusions: CT-MIBI image fusion is not superior to conventional sestamibi imaging when utilized for routine localization of hyperfunctional parathyroid glands. CT-MIBI fusion is of greatest benefit in guiding the directed approach to solitary glands, which are separate from the thyroid or ectopically located, regions where conventional imaging has proven to be less accurate. This imaging technique will augment the minimally invasive surgical approach in selected patients with primary hyperparathyroidism in order to further refine the focused technique. Its utility as the standard preoperative localization modality is not yet established and requires further investigation. Evaluation of differences in facility utilization with CT-MIBI image fusion and conventional sestamibi imaging may be helpful in determining its role in preoperative localization for hyperparathyroidism.

INTRODUCTION

The development of new imaging technology including technicium-99m sestamibi has allowed for preoperative identification of a solitary adenoma and the option of directed exploration instead of the traditional four gland exploration in selected patients. A variety of directed exploration protocols have been described using sestamibi imaging in combination with other modalities including ultrasound, computer tomography (CT), gamma probe, and intraoperative PTH. Improved CT resolution and the development of software allowing nuclear and CT images to be combined has shown promise in further defining the anatomic location of hyperfunctional parathyroid tissue.

METHODS & MATERIALS

In order to characterize the clinical circumstances whereby CT-MIBI fusion provided a significant advantage over that of conventional imaging in planned directed parathyroid exploration, a retrospective chart review was conducted of 190 patients with primary hyperparathyroidism who underwent CT-MIBI image fusion as a part of a scan directed, minimally invasive parathyroid exploration protocol. Data was collected from the radiology reports, clinic notes and operative reports to determine how the images were interpreted prior to surgery, and to determine if the surgical findings were consistent with the expected location of the adenoma based on imaging. Then the CT-MIBI fusion and sestamibi scans were reviewed to confirm that the scans localized to the anatomic location described in the operative report.

RESULTS

CT-MIBI image fusion accurately localized solitary hyperfunctional parathyroid glands in 70% of patients imaged compared to 55% of the solitary glands localized with conventional sestamibi imaging. As illustrated in the following figures (1-4), CT-MIBI fusion provided the most benefit when the solitary gland was found to be separated from the thyroid or when the adenoma was located in the retro-thyroidal retro-esophageal plane or mediastinum and for recurrent hyperparathyroidism. CT-MIBI fusion imaging allowed for identification of the precise location of ectopic adenomas as well as determining if the ectopic gland was the superior or inferior gland based on the anatomic location. Figures 1 and 2 illustrate how CT-MIBI fusion provides precise localization accurately of single gland disease within the mediastinum. In Figure 3, the fusion scan localized a supernumerary hyperplastic gland within the thyroid lobe in a patient with recurrent hyperparathyroidism. CT-MIBI fusion also successfully identified an undescended right superior adenoma enhancing the capability of a minimally invasive approach as shown in Figure 4.

CONCLUSIONS

Although CT-MIBI image fusion does provide a more precise anatomic location of hyperfunctional parathyroid tissue, it has not proven to be superior to conventional imaging when utilized for routine localization. The greatest benefit of CT-MIBI fusion proved to be in guiding the directed approach to solitary glands that are separate from the thyroid or ectopically located, situations where conventional imaging has proven to be less accurate. The technology also showed promise with recurrent hyperparathyroidism. This imaging technique will augment the scan directed surgical approach in selected patients with single gland disease, especially when conventional sestamibi scan does not clearly show the hyperparathyroid tissue in close relationship to the thyroid. Current evidence does not support an argument for considering CT-MIBI image fusion as the standard preoperative localization modality for patients with primary hyperparathyroidism. Further investigation is required to determine a cost effective use for CT-MIBI fusion in the pre-operative evaluation in patients being considered for directed surgery. A multi-institutional investigation that evaluates the differences in utilization with CT-MIBI image fusion and conventional sestamibi imaging will be helpful in determining its role in the surgical management of hyperparathyroidism.

REFERENCES