Cardiac Gated 4D CT for localization of ectopic parathyroids in the mediastinum

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ABSTRACT

Objective: Describe a localization study for four patients after a non-localizing Sestamibi scan using a novel application of cardiac gated 4D CT imaging to identify small hypervascular foci consistent with ectopic parathyroid adenomas.

Methods: Four patients with primary hyperparathyroidism underwent cardiac gated 4D CT imaging after a non-localizing Sestamibi scan. Cardiac gating was employed to remove motion in the mediastinum during scan acquisition as a factor in identifying small hypervascular foci. An initial non-contrast prospectively gated low dose CT was given two contrast passes of 7.9 mSv each. Images were retrospectively reviewed for foci consistent with parathyroid adenoma. The size was 7-8 mm on 4D CT. The surgical specimens weighed 1.6 – 1.9 g. Intraoperative turbo PTH (t-PTH) met both normalization criteria: a 50% reduction from pre-resection t-PTH levels and a post-resection t-PTH level that fell into normal range.

Results: Three patients elected to proceed with surgery where imaging guided the localization and surgical resection. Of the four cases, the imaging guided the resection in three surgical cases. The imaging characteristics were similar to the surgically confirmed cases.

Conclusions: Cardiac gated 4D CT is an excellent adjunct study for patients with non-localizing Sestamibi scan with occult or ectopic parathyroid adenomas in the mediastinum. This method allows for confident in-sulce localization that is invaluable for surgical planning.

DISCUSSION

REFERENCES


RESULTS

Image Acquisition

Parathyroid imaging has undergone significant advancement, partially due to surgical advancements and patient expectations. Traditionally, surgical patients are preoperatively evaluated with a non-contrast multiphase CT of the neck. Current multi-detector CT scanners have excellent spatial and temporal resolution. The images are obtained with 0.5 mm slice thickness and 0.5 mm interval. The effective radiation dose of 4D CT is 20 mSv. The radiation dose is much lower than the dose of 15.6 mSv in the preoperative neck or the dose of 20 mSv in the preoperative neck.

Figure 1: A 59 year old male with primary hyperparathyroidism: A: scout axial cut; B: axial cuts; C: control cut; D: 3-D reconstruction showing the location of the parathyroid adenoma and the adenoma size was 7-8 mm on 4D CT. The surgical specimens weighed 1.6 – 1.9 g. Intraoperative turbo PTH (t-PTH) met both normalization criteria: a 50% reduction from pre-resection t-PTH levels and a post-resection t-PTH level that fell into normal range.

Figure 2: A 26 year old male with primary hyperparathyroidism: A: scout axial cut; B: axial cuts; C: control cut; D: 3-D reconstruction showing the location of the parathyroid adenoma and the adenoma size was 7-8 mm on 4D CT. The surgical specimens weighed 1.6 – 1.9 g. Intraoperative turbo PTH (t-PTH) met both normalization criteria: a 50% reduction from pre-resection t-PTH levels and a post-resection t-PTH level that fell into normal range.

DISCUSSION

Within the last year, the radiology department has developed a new protocol for imaging suspected ectopic parathyroid adenomas. This protocol was developed for imaging suspected parathyroid adenomas in the mediastinum. The first 4D CT was given two contrast passes of 7.9 mSv each.

The largest case series in the literature using the concept of four-dimensional imaging was by Rodgers et al with 75 patients. CT image acquisition over time was used to localize non-ectopic and ectopic parathyroids. Cardiac-gating was not used in Rodgers’ case series because of limitation of the case series. Limitations of the case series are that there were no double adenomas and all ectopic adenomas were in the anterior mediastinum, making it difficult to assess the usefulness of this modality in other ectopic parathyroid adenomas. In addition, the small numbers make it difficult to make a definitive statement on where the 4D CT should fall in the imaging algorithm. 4D CT is more expensive than Sestamibi and at the current time, Sestamibi remains the primary modality for imaging suspected parathyroid adenomas in the context of primary hyperparathyroidism. As more data are collected, a wider role for 4D CT may emerge especially given its lower radiation dose in the current climate of increased attention to radiation exposure.

CONCLUSIONS

This is the first published report of a case series using 4D CT with cardiac gating for localization of ectopic parathyroid adenomas. Cardiac-gated 4D CT offers excellent anatomic detail and localization for parathyroid adenomas. We currently use this modality only after a non-localizing Sestamibi. Given that the radiation dosing is minimal, the use of 4D CT may broaden over time although financial considerations will also come into play.