Radiographic Evaluation of Non-localizing Parathyroid Adenomas
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Introduction

Primary hyperparathyroidism is an overproduction of parathyroid hormone from a single adenomatous gland (85%) or less commonly by multiple adenomatus or hyperplastic glands (15%).1 Localization with pre-operative imaging allows for the possibility of performing a guided parathyrodiectomy procedure rather than the traditional bilateral neck exploration.2 Prior to surgery, patients who present with primary hyperparathyroidism routinely undergo preoperative imaging including sestamibi (MIBI) scans, single photon emission computed tomography (SPECT), combined SPECT/CT, or 4D CT scans to localize the abnormal parathyroid gland. 3 We aimed to determine whether non-localization is the result of radiologic interpretive error or is a true representation of pathologically non-localizing parathyroid adenomas.

Methods and Materials

- Retrospective chart review of 364 patients who underwent a parathyrodiectomy by two head and neck surgeons over five years.
- Thirty patients met all the inclusion criteria.
- All available patient images were retrospectively re-reviewed by two senior radiologists at the same tertiary care center proficient in both nuclear radiology and ultrasound.
- A simple, semi-quantitative scoring system was created for this study. Each radiographic study was scored separately by both radiologist who were blinded.
- The results were compared for inter-reader reliability using the Cohen’s kappa test.

Results

- Three hundred and sixty four patients underwent parathyroidectomy between January 2007 and March 2013.
- The study cohort equaled 30 patients (8.2%) who failed to localize preoperatively on nuclear scan or ultrasound.
- Radiologist scored 1 out of 30 nuclear studies POSITIVE in retrospect with very good inter-reader agreement.
- Radiologist scored 1 out of 18 ultrasounds as POSITIVE on retrospective review. They disagreed on the positivity of two additional studies with fair inter-reader agreement.

<table>
<thead>
<tr>
<th>Imaging Modality</th>
<th>% of patient who underwent imaging study</th>
<th>Positive studies in re-review</th>
<th>Inter-reader agreement</th>
<th>Kappa Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ultrasound</td>
<td>60%</td>
<td>1/18</td>
<td>86.67%</td>
<td>0.706 (SE=\pm0.131, 95% CI for x=0.449-0.962)</td>
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<tr>
<td>MIBI</td>
<td>100%</td>
<td>1/30</td>
<td>55.6%</td>
<td>0.351 (SE=\pm0.139, 95% CI for x=0.080-0.623)</td>
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Table 1. Results of re-review of 30 patients with either ultrasound or nuclear scan

Discussion

At our institution, ultrasound and sestamibi scars are the imaging modalities most often used to localize hyperfunctioning parathyroid glands. Our institutional rate of non-localization on preoperative imaging equals 8.2% (30 of 364). Previous studies show rate of 14 to 32%.4 7

Review of the literature revealed several explanations for radiographic non-localization which include:

- Accuracy of imaging modality. Some studies suggest localization is higher in nuclear imaging than ultrasound. Others suggest US is more sensitive.8 11
- Imaging technique. Thyroid washout and reevaluating early phase nuclear imaging improves localization.12 13
- Discipline of interpreter. Sensitivity of surgeon interpretation greater than radiologist (93% vs 72%).14
- Experience of interpreter. High volume centers achieve higher scan sensitivities.15

Upon investigation of the role of radiographic error in preoperative non-localization, we found no statistically significant difference in preoperative and retrospective interpretation. Most studies were found to be truly negative on re-review with good inter-reader agreement between the two senior radiologist re-reviewers. This supports the conclusion that for a sub-population of patients with a proven parathyroid adenoma, preoperative imaging with nuclear or ultrasound imaging are negative/non-localizing and not due to radiographic interpretive error. This finding is consistent with prior reports in which nonlocalization of adenomas by ultrasound and sestamibi have been reported in association with a number of physical and biological factors rather than radiographic errors.

Conclusions

Several studies to determine potential physical and biological factors of non-localizing parathyroid adenomas have been described. In this study, we aimed to determine the role of radiology in non-localization. Upon analysis of the experience at our institution, we have shown that radiographic interpretive error is not a cause of non-localization. Additional studies to further investigate the physical and biological properties of non-localized parathyroid adenomas are needed. Preoperative knowledge of this would allow greater utilization of guided parathyrodiectomy procedures in lieu of traditional neck explorations.

References