

Pre-operative localization of parathyroid adenomas in patients with primary hyperparathyroidism (PHPT): Can a single modality of imaging be adequate

H Imran¹, P Wilson², R Sinha³, GI Varughese¹, UA Nayak¹, L Varadhan¹

¹Dept of Diabetes & Endocrinology, ²Dept of ENT surgery, ³Keele University, University Hospitals of North Midlands NHS Trust, Stoke on Trent, UK

Introduction

- Parathyroidectomy is a curative treatment for primary hyperparathyroidism (PHPT)
- 85-90% of PHPT are due to parathyroid adenomas (PA)
- Pre-operative localization of adenomas in PHPT done with ultrasound (US) and MIBI scan, to facilitate mini-parathyroidectomy
- US of the neck needs a trained radiographer with knowledge of parathyroid embryology and anatomy to locate a parathyroid adenoma
- US locates concomitant (and more common) thyroid nodules – this can cause false + localization of parathyroid adenoma; ectopic PTH adenoma cannot be located with US. US identification of thyroid nodules helps in subtraction imaging with MIBI (Reeder et al, J Ultrasound Med 2002, Prager et al, J Am Coll Surg 2003)
- The sensitivity of MIBI scans have improved with time with use of Tc and concomitant use of SPECT CT
- Improved imaging and localization could help to triage more patients to mini-parathyroidectomy
- Previous published data have shown sensitivity of 75% -80% for either of the imaging, with MIBI being marginally better (Nasiri et al, Endo abstracts 2008, Lewis et al, Endo abstracts 2014)

Aim

The aim of our retrospective analysis was to assess the utility of US and MIBI in localizing a parathyroid adenoma in facilitating parathyroid surgery, by comparing their accuracy to the intra-operative localization and histology post-operatively

Methods

- Patients who had been operated for a diagnosis of PHPT analysed (2009-2014)
- All patients had biochemical confirmation of PHPT pre-operatively – high PTH, high Ca and renal function not contributing to secondary PTH raise.
- Surgical notes and histology results collated to finalize the location of parathyroid adenoma
- Comparison made between pre-operative anatomical and pathological localization to post operative histology, mainly for solitary parathyroid adenoma (PA)
- Results of US and Tc MIBI (MIBI) scan reports taken from radiology

Results

- N=220
- Mean age: 58 years (18-84)
- Females 77%
- Imaging done:
 - US : 164 (75%)
 - MIBI: 178 (81%)
 - Both : 149 (68%)
- Post op Histology confirmed:
 - Parathyroid adenomas : 155 (70.5%)
 - Diffuse hyperplasia : 20 (9.1%)
 - One gland hyperplasia : 10 (4.5%)
 - Parathyroid carcinoma : 3 (1.4%)
 - Normal : 17 (7.7%)
 - Others :12 (6.8%)

Results

- All histology confirmed parathyroid adenomas (n=155)
 - Accuracy of MIBI : 83% (identified 110 of the 132 who had MIBI)
 - Accuracy of US: 80% (identified 98 of the 122 who had the US)
- US and/or MIBI showed PA in 168/220 (on pre-op imaging)
 - 77.4% accuracy (and confirmed by post-op findings also)
 - A further 11.9% had hyperplasia
 - 5.4% were normal

	US	MIBI
Sensitivity	80%	83%
Specificity	36%	40%
PPV	78%	80%

- US and MIBI performed in 149/220
 - 112/149 were PA (confirmed by histology) in at least one of them
 - 78/112 (70%) imaging were concordant in localizing the adenoma
 - A further 12.5% by US and 11% by MIBI identified PA
 - 16/149 (11%) were false localization; 5/16 were entirely normal
- Both US and MIBI negative 14/149
 - 50% of these were PA
 - 29% were normal

Discussion

- Pre-operative accuracy of MIBI and US to identify the pathology is 77%
- Sensitivity of US or MIBI in identifying a Parathyroid adenoma is comparable – 80% and 83% respectively. Combining MIBI and US improves the sensitivity to 94%
- Concordance rates of MIBI and US identifying the PA is only 70%
- Pre-operative localization may not be possible in 5% of patients with PHPT despite the pathology being a parathyroid adenoma
- Even combining MIBI and US, false localization in 4% of the patients (even if hyperplasia is included as a confounder)
- Combined use of SPECT/CT with MIBI increases the sensitivity of the MIBI; this could however increase the risk of radiation to thyroid gland– on our data we could not do a sub-analysis due to the retrospective nature of the analysis
- Additional imaging modality such as MRI or 4D CT have been used to locate the adenoma in some of these patients as per the surgeon's decision (Starker et al, Ann Surg Oncol 2011)
- We did not do any sub-analysis on recent cohorts – with improvement in imaging modalities and use of newer techniques such as SPECT and 4D CT, the accuracy of pre-operative localization is likely to have improved

Conclusion

- MIBI and US continue to be the combined initial imaging modality for pre-operative localization of parathyroid adenomas in PHPT
- MIBI and US offer comparable sensitivity in location a parathyroid adenoma; combining them improves sensitivity
- Concordance between the two forms of imaging is quite good; however due to the risk of false positivity it would still be prudent to use both imaging to avoid misdiagnosing PHPT