Evaluation of preoperative parathyroid imaging modalities within a provincial hospital setting

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Background

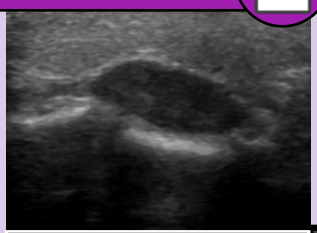
Primary hyperparathyroidism affects approximately 30 in 100,000 people in NZ annually; predominantly in their 3rd to 6th decade of life.(1) Accurate pre-operative localisation and characterisation of parathyroid adenoma assists in surgical planning. As new imaging techniques become available; evaluating their sensitivity and localisation accuracy ensures a continued high standard of patient care.

Aims

- To evaluate the sensitivity and localisation accuracy of preoperative parathyroid imaging modalities currently implemented within Whanganui District Hospital.
  Ultrasound (US), **Nuclear medicine (NM)** and **4D-CT**.
- Guide clinical decision making pre-operatively
- Avenue for potential standardisation of imaging protocols preoperatively within a provincial hospital settings.

Methodology

- Quantitative, single-institution, retrospective study
- Data collection from 2018, continuing prospectively
- Patient selection within WDHB catchment who met inclusion criteria
- Imaging localisation accuracy & sensitivity determined relative to intraoperative findings and histology reports



Parathyroid adenoma seen on ultrasound.(3)

Inclusion Criteria

- Hypercalcemia (Ca^{2+} >2.55), Hyperparathyroidism (PTH >7.0)
- Parathyroidectomy within WDHB since 2018

(excluded if opted for no surgical intervention)

Results

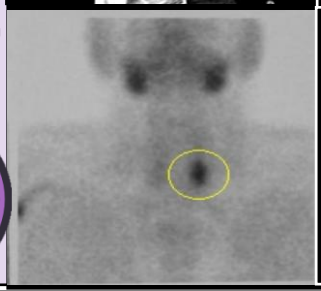
61 — Average age

1:4 — Male : Female

Sample Size (n=32)

	Sensitivity	Accuracy
Ultrasound	35%	60%
NM	90%	95%
4D-CT	85%	100%

Left parathyroid adenoma using 4D computed Tomography (3)



Left parathyroid adenoma using Tc-99m nuclear medicine imaging.(3)

Conclusion

- 4D-CT had the greatest localisation accuracy (100%) which is due to its high image resolution, multi-planar ability; allowing for superior anatomical localisation for both eutopic and ectopic parathyroid localisations. Nuclear medicine (Tc-99m) was the most sensitive imaging modality (90.0%) which is reflective of its functional uptake capability for tissue-type delineation.
- US was the least sensitive (35.3%) and least accurate (60.0%) imaging modality significantly affected by anatomical variability.
- Combined US protocols with NM (93.5%) and 4DCT (90.0%) were as sensitive as single-study imaging techniques alone.

Discussion

- Sensitivity and localisation accuracy of NM and 4D-CT within this study are reflective of current literature (at 95% confidence range).(1,2)
- Small sample size limits statistical power and sub-data set analysis. Prospective nature allows ongoing analysis and revisitation in 12-24months.
- Areas for further research include; side-effect profile, imaging-duration and preparation, cost-effectiveness.

References: (1) Cheung K, Wang T, Farrokhyar F, et al. Meta-analysis of preoperative localisation techniques for patients with primary hyperparathyroidism. Ann Surg Oncol. 2012;19(2):577-83. (2). Treglia G, Sadeghi R, Caldarella C. Detection rate of Tc-MIBI in preoperative planning with patients with primary hyperparathyroidism; a meta analysis. Head Neck. 2016;38. (3) Kuok YJ, Weerakkody Y. Parathyroid adenoma. Radiopaedia. [Internet] 2021 [accessed Jan 2021]. (4) Yeh R, Tay Y, Dercle L, et al. Diagnostic performance of 4DCT and SPECT/CT in localisation of parathyroid adenomas. Radiology. 2019;291(2):469-476.

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