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Clinical Paper

Point of Care Thyroid Ultrasound (POCUS) in Endocrine Outpatients: A Pilot Study

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ABSTRACT

Background: Thyroid ultrasound is used for the assessment and characterisation of thyroid nodules/goitres and to guide diagnostic biopsy, it is normally performed by radiologists. Point of care ultrasound (POCUS) by trained non-radiologists, has the potential to reduce cost, expedite diagnosis and enhance patient satisfaction if embedded in an outpatient clinic setting.

Aim: To perform a pilot of the use of point of care thyroid ultrasound in an endocrine outpatient setting for the assessment of thyroid nodules and goitres.

Methods: Thyroid ultrasound was undertaken with consultant radiologist supervision, over a period of 16 months between January 2017 to April 2018. Using a GE Logic e7 portable thyroid ultrasound machine with 12 MHz linear probe. All scans were performed on patients attending for assessment of thyroid disorders at the Regional Centre for Endocrinology and Diabetes, Royal Victoria Hospital, Belfast.

Results: Thyroid ultrasound was performed on 40 patients (M:10,F30), mean age 52 years, range 23-77 years, median follow up 14 months, range 6-18 months. Twenty scans were performed to assess thyroid nodules, 13 for investigation of a goitre and the remaining 7 were for patient preference. 39 patients had benign thyroid disease, 1 patient had a confirmed newly diagnosed papillary thyroid carcinoma (PTC). The ultrasound 'U' classification was U1 and U2 (n=37), U3 and above (n=3). Fine needle biopsy (FNA) was performed on 9 patients with one confirmed as a thyroid carcinoma (Thy1;n=2, Thy2;n=6 and Thy 5;n=1). Thyroid ultrasound reporting was broadly similar between radiologist and non-radiologist ($p< 0.01$). Time to scan was reduced during the pilot from the existing model (n=40) of a mean of 52 days (range 7-95 days) to 1 day ($p<0.01$).

Conclusion: With appropriate training and radiology supervision, point of care thyroid ultrasound can be performed accurately and safely in outpatients by an endocrinologist. There are potential benefits in terms of cost savings, time to scan, reduction in clinic visits, and in expediting diagnosis.

INTRODUCTION

Thyroid ultrasound for the assessment of thyroid disorders (nodules and goitres) is typically performed by a trained radiologist or sonographer. More recently in some centres, appropriately trained endocrinologists are performing thyroid ultrasound, often in the context of a 'one stop shop'.[1,2] The rate of incidental discovery of thyroid nodules continues to increase, adding further to the burden on Radiology Departments. Most of these nodules are benign, there appears to be a current need to rationalise this service. The British Thyroid Association (BTA) has recently produced clear guidelines for the investigation of thyroid nodules, in particular the use of an ultrasound (US) classification (U1-U5)-*Figure 1* which describes features indicative of being benign or malignant.[3] The use of such a classification for the prediction of a nodule being benign or malignant helps to determine whether a biopsy should be performed, (U3 to U5 typically requires biopsy). Thyroid cytology reporting of thyroid (FNA) biopsy is with the Thy classification which proceeds from 1 to 5, with Thy1: non-diagnostic, Thy2: non-neoplastic thyroid change such as a nodular goitre or thyroiditis, Thy3: all follicular lesions, Thy 4: abnormal, suspicious of malignancy and Thy 5:diagnostic of malignancy. POCUS (point of care ultrasound) is gaining momentum and an evidence base in other medical specialities as a means of an extension to the clinical examination. There are clear pathways in the UK to safe and effective certification provided there is direct supervision by a consultant radiologist.

Thyroid ultrasound and ultrasound guided biopsy in our centre currently represents a large service commitment to the radiology department, with an average of around 100 scans performed monthly. Against this background, we sought to establish the utility of a pilot of point of care thyroid ultrasound in endocrine outpatients.

PATIENTS AND METHODS

Patients attending the Regional Centre for Endocrinology and Diabetes, Royal Victoria Hospital, Belfast for investigation and management of thyroid disorders were invited to have a point of care ultrasound at their outpatient clinic visit as

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part of the pilot study. Clinical information and laboratory data were obtained from the online medical record NIECR (Northern Ireland Electronic Healthcare Record). A total of forty scans were performed over a 16-month period between January 2017 and April 2018. Indications for scanning were the presence of thyroid nodule/s, goitre and also for patient preference. Thyroid ultrasound was performed using a 12 MHz linear probe GE Logic e7 portable thyroid ultrasound machine (MDI Medical Ltd, Kells Co Meath, Ireland), purchased after a successful in-house business case application. The duration of each scan was around 5-7 minutes. A provisional report of each scan in accordance with BTA guidelines and template for reporting was documented in the patient's notes, each scan and subsequent report was reviewed by a consultant radiologist (*PKE*). In addition, to ensure the accuracy and integrity of the study and for validity of medico-legal documentation all patients had a formal departmental scan which was uploaded/stored onto i-Site (online radiology imaging system), performed by another in house radiologist. Point of care thyroid ultrasound was performed by an endocrinologist (*PCJ*), in accordance with the UK accredited BTA and RCR (Royal College of Radiologists) national training scheme for certification in the use of ultrasound in the management of thyroid disease by non-radiologists. Briefly, this includes a knowledge of neck anatomy, ultrasound technique, interpretation and reporting of images in accordance with BTA US 'U' classification system (Figure 1). Attendance is also required at a national training course in thyroid ultrasound. All patients were examined in the supine position with the neck hyperextended. Using a high frequency linear-array transducer, scanning was done in both transverse and longitudinal planes. Real time images of the thyroid were performed using gray scale and colour doppler techniques. FNA (fine needle aspiration) was performed if indicated.

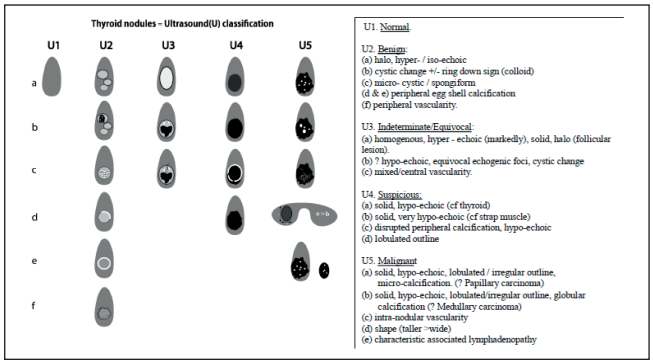


Figure 1 British thyroid association "U" classification

RESULTS

Baseline characteristics

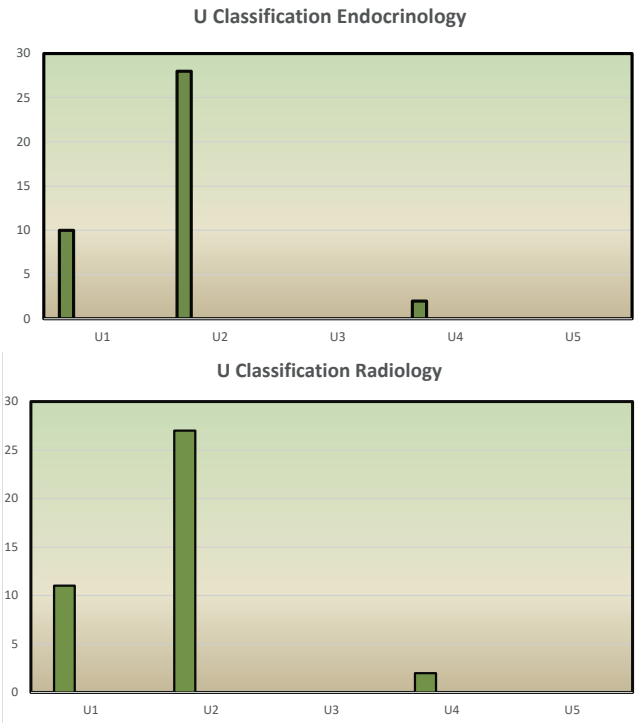
Thyroid ultrasound was performed on 40 patients (M:10,F30), mean age 52 years, range 23-77 years, median follow up was 14 months, (range 6-18 months). Twenty scans were performed for the assessment of thyroid nodules, 13 were for investigation of a goitre and the remaining 7 were for patient preference, *Table 1*.

Table 1 Clinical characteristics, imaging and diagnoses

Variable	N
Age	52 years (mean) range 23-77 years
Gender	F:30, M:10
Indication for scan	Nodule (n=20), Goitre (n=13), patient preference (n=7)
U Score (endocrine-PJ)	U1+U2 (n=37), U3-U5 (n=3)
FNA result	Thy1;n=2, Thy2 n=6 and Thy 5;n=1
Diagnosis	Benign (n=39), Malignant (n=1)

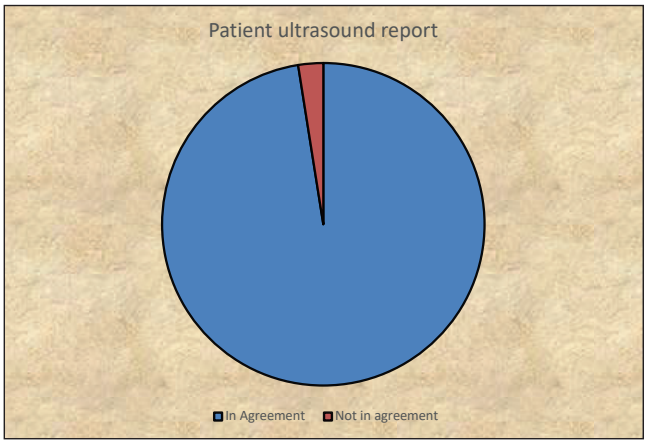
On the initial point of care scanning at outpatient clinic by PCJ, the ultrasound 'U' classification was as follows; U1-normal (n=10) and U2 (n=27), U3 (n=1), U4 (n=2), U5 (n=0) total. Agreement between PCJ and PKE on

Figure 2a Imaging features and agreement between endocrine and radiology reporting



the U classification (*Figure 2a*) demonstrated very good agreement which was statistically significant ($p< 0.01$). The one difference between (PCJ and PKE) interpretation was a U2 nodule (PCJ) interpreted as U1 (PKE) by radiology, this

Figure 2b Comparison of U scoring between the radiologist and endocrinologist



was confirmed as U2 on follow up and formal departmental scan. Formal departmental scanning performed by the in house radiology department (*Figure 2b*) demonstrated good agreement between PCJ and in house radiologists (not PKE) ($p< 0.01$). The one difference (between PCJ and in house radiologists) was between a U2 lesion-in house radiology U4-PCJ. This had been reported as possible U4 previously by radiology but subsequently reclassified to U2, with a subsequent FNA Thy 2;-benign.

OUTCOME OF BIOPSY (FNA)

FNA was performed on 9 patients (Thy1;n=2, Thy2 n=6 and Thy 5;n=1)-*Table 1*. Indications for the 9 FNA's were; five performed due to U scoring, one due to a positive PET result, one for symptomatic relief of a cyst, one on patient request given concerns and the last FNA due to the appearance on CT scanning. At follow up one patient was diagnosed with a papillary thyroid carcinoma (initial POCUS U classification U4 (agreed among PJ, PKE and in house radiologist), and subsequent FNA-Thy 5), this was performed on a patient who did not have an overt goitre or palpable nodule and requested the scan at clinic.

Potential cost and clinic visit savings and time to scan

A comparison of time to scan was made between the current pilot and a selection of 40 consecutive scans who had thyroid US requested at their outpatient clinic visit prior to the start of the pilot. The mean time to scan prior to the pilot was 52 days, range 7 to 95 days, in comparison to the pilot which was done on the day of the scan (52 days v 1 day, $p<0.01$). Potential cost savings are accrued as patients are not required to attend the radiology department for an ultrasound scan. On average in the NHS this costs £60 per ultrasound. Over forty patients this is a potential significant saving of £2400 and can be extrapolated for a larger POCUS service.

DISCUSSION

Real time imaging of the thyroid gland performed as part of a routine evaluation during outpatient clinic can aid in the diagnosis and therapeutic intervention in thyroid disease.[4] Across the UK there has been a recent trend towards the establishment of 'one stop shops' whereby a trained radiologist in tandem with either an endocrinologist and/or an endocrine surgeon performs the scan, typically for the assessment of thyroid nodules and for thyroid cancer screening[5]. The current pilot is a slight departure from previously established models, in that the scan was performed by an endocrinologist under the guidance/mentorship of a trained radiologist as part of the routine clinic visit. The perceived advantage to the patient is the convenience of real time scanning with the potential to improve patient satisfaction (although this was not formally assessed during the pilot) and allow for immediate diagnosis or the need for biopsy if required. In addition to assessing thyroid nodules, thyroid US can also be utilized for the assessment of goiters. For patients, same day imaging at their clinic visit can offer reassurance to patients as it can differentiate what the aetiology of the goitre is. One of the indications for scanning in the current pilot was imaging at clinic if the patient requested it, this has the potential to add to unnecessary workload if the scan was not indicated, however a new thyroid cancer in a patient who was relatively asymptomatic with no clear indication for the use of thyroid ultrasound in this particular case was identified. This raises questions regarding the suitability of screening for thyroid cancer in patients who present with thyroid disorders.

In order for the current pilot to commence certain pre-requisites had to be met by the endocrinologist including; a knowledge of neck anatomy, an understanding of the U classification system, ultrasound technique and reporting of the imaging according to the BTA guidelines. With the advent of portable ultrasound machines, this has meant an increase in the use of ultrasound by non-radiologists in a variety of settings. Recent evidence suggests that clinicians when trained by radiologists can gain similar diagnostic accuracy.[6] With the introduction of the new UK internal medicine curriculum there are potential opportunities to incorporate ultrasound into training. Point of care ultrasound is rapidly gaining an evidence base in other specialities mainly within respiratory and rheumatology specialities, where it is now embedded within the trainee curriculum and there is a clear pathway for obtaining certification to allow for independent use.[7] It has been shown to improve safety during medical procedures and aid in diagnostic accuracy. Advantages of POCUS can include improved patient satisfaction, expediting diagnoses, reducing the need for multiple clinic/imaging visits, cost and time savings, and the potential to ease the work burden for radiologists.[8] Perceived disadvantages can include the expense of obtaining the machine, time constraints for scanning within clinic time, ensuring diagnostic accuracy, obtaining certification, and the perceived taking of business from radiology colleagues, *Table 2*.

CONCLUSION

With appropriate training and supervision by a radiologist, point of care thyroid ultrasound can be performed accurately and safely in outpatients by an endocrinologist. There are potential benefits in terms of cost savings, reduction in clinic visits, and in expediting diagnosis.

Table 2 Point of care thyroid ultrasound-pros and cons

For	Against
• Same day scanning	• Expense of obtaining machine
• Patient centred	• Time constraints
• Non-invasive	• Diagnostic accuracy
• Reduce need for multiple visits	• Obtaining certification
• Cost and time savings	• Taking of business from radiologists
• Expedite diagnosis	• Radiology supervision
• Ease burden for radiologists	• Documentation of scans

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