Ensuring patient safety when implementing a new diagnostic pathway for thyroid nodules

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ABSTRACT

INTRODUCTION The aim of this study was to determine whether ultrasound alone is sufficient to safely exclude malignancy in thyroid nodules in a district general hospital setting, to comply with the latest British Thyroid Association guidelines.

METHODS This retrospective study investigated the quality of ultrasound reporting and the correlation between ultrasound report and histology for individual thyroid nodules. Cases were selected from the thyroid multidisciplinary meeting and included all patients having undergone surgery for a thyroid malignancy in a one-year period.

RESULTS Forty-seven patients were included in the study. Ultrasound reports were reviewed and assessed, in which 21 clinicians were involved; 36% of scans included a summary of whether the nodule(s) overall appeared benign, equivocal, suspicious or malignant; 4% of reports included a U classification; 81% of reports commented on cervical lymph nodes. Ultrasound was compared with histology. The sensitivity of ultrasound in correctly identifying nodules requiring further investigation was of 56% and specificity was 81%. Positive predictive value was 81% and negative predictive value was 56%.

DISCUSSION These findings suggest that, in a district general hospital setting without a dedicated head and neck radiologist, using only ultrasound and limiting fine-needle aspiration cytology to identify suspicious nodules may not be safe, as a high number of nodules appearing benign on ultrasound may ultimately prove to be malignant.

KEYWORDS

Otolaryngology – Thyroid gland – Thyroid nodule – Ultrasonography – Fine-needle biopsy

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Introduction

The British Thyroid Association (BTA) published a third edition of their guidelines on the management of thyroid cancer in 2014.¹ The second edition, published in 2007, recommended fine-needle aspiration cytology (FNAC) as a core investigation for all thyroid nodules.² Since then, a number of studies comparing ultrasound findings with FNAC findings have concluded that ultrasound features can be reliably used to predict malignancy.^{3–8} Based on these studies, the 2014 guideline recommends relying on ultrasound findings to determine which nodules need further investigation with FNAC, thereby reducing the number of unnecessary FNAC being performed.

No single ultrasound feature can indicate whether a nodule is malignant or benign. However, in expert hands, ultrasound features have been used in combination to design a classification system (The U classification), which indicates the likelihood of malignancy (Table 1).^{1,3,4,9–12}

The new guideline recommends that U1 and U2 nodules do not require FNAC unless the patient has a statistically high risk of malignancy. Features suggesting a higher risk of malignancy include:

- > age less than 20 years or over 60 years
- > firm nodule on palpation
- > rapid nodule growth
- > fixation to adjacent structures
- > vocal cord paralysis
- > regional lymphadenopathy
- > history of neck irradiation
- > family history of thyroid cancer
- > U3 to U5 nodules require further investigation with FNAC.¹

When implementing these recommendations, it is therefore crucially important that no malignant nodule is missed on the basis of an erroneously reassuring ultrasound report.

Table 1 U classification of thyroid nodules (adapted from 2014 BTA guidelines).¹

U Classification	Description	Features
1	Normal	
2	Benign	<ul style="list-style-type: none"> • halo, iso-echoic/mildly hyper-echoic • cystic change ring down sign (colloid) • microcystic/spongiform • peripheral egg shell calcification • peripheral vascularity • halo, isoechoic/mildly hyper-echoic
3	Equivocal	<ul style="list-style-type: none"> • homogenous, hyperechoic (markedly), solid, halo (follicular lesion). • ? hypoechoic, equivocal echogenic foci, cystic change • mixed/central vascularity
4	Suspicious	<ul style="list-style-type: none"> • solid, hypoechoic (cf. thyroid) • solid, very hypoechoic (cf. strap muscle) • disrupted peripheral calcification, hypoechoic • lobulated outline
5	Malignant	<ul style="list-style-type: none"> • solid, hypoechoic, lobulated/irregular outline, microcalcification. (? papillary carcinoma) • solid, hypoechoic, lobulated/irregular outline, globular calcification (? medullary carcinoma) • intranodular vascularity • shape (taller than wide; anterior–posterior > transverse) • characteristic associated lymphadenopathy

We wished to investigate whether this guideline could be safely implemented in a district general hospital setting, where 90 thyroidectomies are performed per year. In addition, whereas several studies have compared radiological findings and FNAC results, there is little information available on direct comparison of radiological findings with final histology.^{3–8}

Methods

A retrospective study involving a nodule-specific analysis was conducted as part of a multisite regional audit to assess a) the consistency of US reporting and b) the quality of

ultrasound reports in predicting potential malignancy in histologically proven malignant thyroid nodules.

Case selection

Thyroid multidisciplinary meeting records were reviewed for the year leading up to the publication of the new BTA guideline. All patients having undergone thyroid surgery for malignant disease were selected.

US reporting

The ultrasound reports were reviewed and assessed for the following:

- > clinician performing the scan
- > whether U classification was reported
- > whether the report comments on the nodules appearing benign, equivocal, suspicious or malignant
- > whether the report comments on lymph node status.

Ultrasound report classification

Ultrasound reports were classified into benign, equivocal, suspicious and malignant. For the reports that included an overall summary, these specific descriptive words were used. For the other reports, descriptive features recommended in the BTA guidance were used to allow classification (Table 1). All equivocal, suspicious and malignant nodules on ultrasound (i.e. equivalent to U3–U5) were categorised as ‘positive’ and all benign nodules on ultrasound were classified as ‘negative’.

Preoperative ultrasound scans compared with histology reports

Nodule-specific comparison of ultrasound reports and final histology was then used to determine sensitivity, specificity, positive predictive value and negative predictive value of ultrasound reports in identifying malignant nodules.

Results

Case selection

Forty-seven cases of patients with histologically confirmed thyroid cancer were identified at multidisciplinary meetings. These included 39 patients with malignant nodules and 8 patients with incidental microcarcinomas (defined as malignant nodules of less than 1 cm) who had thyroid surgery for the management of multinodular goitres. The eight cases of incidental microcarcinomas are included in the first part of the study (reviewing of ultrasound reports) but are not included in the second part of the study (nodule-specific analysis of ultrasound reports compared with histology) as they are incidental histological findings.

Ultrasound reporting

Eighty-five ultrasound scans performed for the 47 patients were reviewed. For the patients with multiple preoperative ultrasound scans, all reports were amalgamated and were considered as one report for the purpose of this study.

Twenty-one clinicians were involved in reporting the scans, including 13 consultant radiologists, 4 locum consultant radiologists, 2 sonographers, 1 radiology registrar, 1 consultant in nuclear medicine. Two of the 47 reports (4%) used the U classification and both were U5; 17 of the 47 reports (36%) included a summary of whether the nodule(s) overall appeared benign, equivocal, suspicious or malignant; 38 of the 47 reports (81%) commented on cervical lymph nodes. No notable difference was identified between reports by different clinicians in terms of U classification, comment on overall appearance of nodule or lymph node assessment.

Histology results

As several histological specimens contained multiple nodules, a total of 66 nodules were identified for the 39 patients with confirmed malignancy (excluding microcarcinomas). Of these nodules, 39 were malignant and 27 were benign. The histology of the 39 malignant nodules was 25 papillary carcinomas, 9 follicular carcinomas, 2 Hurthle cell tumours, 1 anaplastic carcinoma, 1 poorly differentiated carcinoma, 'likely thyroid' and 1 pleomorphic sarcoma.

Preoperative ultrasound scans vs histology reports

Correlation was made between the histological specimen and the preoperative ultrasound scan, based on the nodule size and location within the thyroid. Of the 39 malignant nodules, 22 were 'positive' and 17 were 'negative'. Of the 27 histologically benign nodules, 5 were 'positive' and 22 were 'negative' (see further subdivisions in Table 2). The sensitivity of ultrasound in correctly identifying nodules requiring further investigation was therefore of 56%. Specificity was 81%. Positive predictive value was 81% and negative predictive value was 56%.

Discussion

The decision to fully adopt the diagnostic pathway recommended in the new BTA guidelines in individual hospitals must be considered carefully: malignant nodules not identified as intermediate (U3), equivocal (U4) or malignant (U5) will not be further investigated by FNAC unless, as stated in the guideline, the patient has a statistically high risk of malignancy and a diagnosis of cancer may therefore be missed or delayed. In centres with dedicated head and neck radiologists, the consistency and quality of ultrasound reporting allows for such an approach. Studies that were reviewed to create the BTA guidelines, which investigated the accuracy of ultrasound in predicting the risk of malignancy, include a minimal number of specialist radiologists

or sonographers performing or reviewing the ultrasound scans, and scans were sometimes reviewed by two independent radiologists.⁵⁻⁸ The situation is likely to be different in practice in a district general hospital setting. Indeed, in a single year of practice within our hospital, a total of 21 different clinicians performed and interpreted 85 ultrasound scans. With no dedicated head and neck radiologist or sonographer, the consistency of ultrasound scan reports is decreased.

Only two of the reports included a U classification (4%). This is likely to be due to the fact that there was no consensus within the hospital regarding a classification system at the time. It is indeed highly probable that if guidance were implemented in the hospital requiring all thyroid ultrasound scans to be reported using the U classification system, this number would increase significantly. The number of ultrasound scan reports including an overall opinion on whether the nodule(s) appeared benign, intermediate or malignant was also low and similarly this may be due to the lack of consensus on reporting criteria. A similar study on the consistency of ultrasound reporting was done in a neighbouring district general hospital over the same time period, with similarly striking results: of 35 ultrasound scans, none included a U classification and 18 (51%) included a comment on whether the nodule appeared benign or suspicious (unpublished data).

We have shown that the sensitivity of ultrasound in identifying positive nodules in our centre is 56%, meaning that of all patients with malignant nodules, only just over half would have been referred for FNAC based upon ultrasound features alone. It is reasonable therefore to assume that several more patients would have been identified as high risk by the clinician and would have been referred for biopsy on clinical grounds. Nevertheless, there still remains a high percentage of patients with malignant nodules that would not have undergone FNAC. Similarly, in this surgical cohort, the negative predictive value is 56%, meaning that of all nodules reported as benign on ultrasound, only 56% are indeed benign whereas the rest were in fact malignant. For the diagnostic procedure suggested in the guidelines to be safe, the negative predictive value of the ultrasound scan should be higher, as falsely reassuring ultrasound scans risk leading to missed cancer diagnoses.

Several factors can explain this low sensitivity and negative predictive value. Firstly, it must be reiterated that the study period was during the period of publication of the 2014 BTA guideline. Prior to this edition, the recommendation was for patients to undergo FNAC routinely. In this case, considering that additional cytological data was also

Table 2 Ultrasound report compared with histology of thyroid nodules.				
Histology	Ultrasound report			
	Benign	Equivocal	Suspicious	Malignant
Benign	22	3	1	1
Malignant	17	13	5	4

available for all patients, an ultrasound report of a benign nodule did not carry as much weight as it would under the new guideline. If, however, the diagnostic protocol of the new guidelines was followed, clinicians would be aware of the consequence of reporting a nodule as overall normal (U1) or benign (U2). It is plausible that they may be more cautious in reporting and that the number of equivocal/indefinite nodules may increase. In addition, the high number of clinicians performing ultrasound scans and reporting them reflects the lack of dedicated specialist radiologist. If the new guidelines were adopted, the U classification would be used, not only allowing for more uniformity of ultrasound reporting but also permitting a higher diagnostic accuracy as the features used in the U classification system have been demonstrated to have a high predictive value. One study reviewed and summarised the ultrasound features for benign and malignant nodules, to further guide clinicians performing and reporting ultrasound; this should indeed provide a helpful adjunct to the guideline.¹³

There were limitations to our study. The number of histologically confirmed thyroid malignant cases is low. The study was retrospective and selection bias is therefore inevitable: the cases included in this study were a highly select group of patients with confirmed histological diagnosis and may therefore not reflect the general population of patients that undergo thyroid nodule investigation in our unit. Many patients will have been assessed using ultrasound, considered benign and therefore not proceeded to surgery. Assuming these were truly benign, inclusion would have increased the accuracy of ultrasound. As we lacked histological results

for these patients, they were excluded. Finally, we did not analyse if the patients had additional risk factors that would have placed them in an ‘at risk’ category, warranting an FNAC, and therefore the percentage of potentially missed cancer diagnoses may be overestimated.

Despite these considerations, our findings strongly suggest that, in the district general hospital setting, limiting FNAC to patients with U3–U5 nodules may not be safe, as a high number of negative nodules on ultrasound may ultimately prove malignant. It is of course important to create a setting in which the guidelines can be followed. For this reason, we deemed it crucial to implement ways of improving our service. A template for reporting ultrasound scans was made to help consistent ultrasound reporting in the hospital (Fig 1) to minimise the operator reporting variation. A feedback mechanism to the reporting radiologists/radiographers and working as part of a multidisciplinary team to improve the service where all parties involved are engaged would help improve the sensitivity and specificity of the ultrasound scans.

Conclusion

The recent BTA guidelines offer a streamlined diagnostic pathway in terms of avoiding unnecessary investigations compared with previous recommendations. In centres where there is a lack of a dedicated head and neck radiologist, such changes in clinical pathways need to be approached with caution. We aspire to follow the national guidelines on the investigation of thyroid nodules and we suggest that

Clinical history:

Procedure: grey scale ultrasound and colour doppler were utilised to evaluate the neck.

Findings:

	Normal	Abnormal
Right thyroid lobe		
Left thyroid lobe		
Isthmus		
Cervical lymph nodes		
Parotid and submandibular glands		

If abnormal, please comment on:

- Size
- Cystic/solid, echogenicity, margins, matrix, halo, vascularity
- Retrosternal extension/tracheal deviation
- U classification

Figure 1 Proposed template for thyroid ultrasound reporting

some changes could help in safely applying the guidelines, allowing both diagnostic efficiency and patient safety.

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