



A review of the propriety of thyroid ultrasound referrals and their follow-up burden

Colin Davenport¹ · Jack Alderson¹ · Ivan G. Yu¹ · Aoiffe C Magner¹ · Diarmuid M. O'Brien¹ · Meabh Ni Ghiollagain¹ · Sinead Kileen¹ · Mark Heneghan¹ · Muna Sabah² · Eamon Leen² · John H. McDermott¹ · Seamus Sreenan¹ · Neil Hickey³ · Tommy Kyaw-Tun¹

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Abstract

Purpose The overdiagnosis of thyroid nodules and indolent thyroid cancers represents an increasing burden on health services, with thyroid ultrasound (US) imaging often representing the initial entry point into the thyroid nodule diagnostic pathway. The aim of this study was to retrospectively review thyroid US referrals to a single Irish hospital to determine if the stated indications for imaging had been appropriate, to review the results of the scans, and to assess the follow-up required in each case.

Methods Patient demographics, scan indications, results, and outcomes were retrospectively reviewed for all patients undergoing thyroid ultrasound from 2012 to 2016. Data were analyzed using GraphPad Prism and expressed in mean \pm standard deviation.

Results In total, 318 patients (mean age 53 ± 15 years, 85% female) had at least one ultrasound. Most US scans were performed for appropriate indications in order to follow up known thyroid nodular disease and/or malignancy (34.3%), to assess new thyroid goiters or discrete neck lumps (33.3%), and to follow up incidental findings from other imaging modalities (12.6%). However, scans were also requested (in the absence of any palpable goiter or mass) for choking/neck pain/swallowing complaints (12.3%), hypo/hyperthyroidism (6.6%), and miscellaneous reasons (0.6%) that were deemed either *potentially* or *likely* inappropriate. Of these scans, approximately half of the identified nodule(s) were deemed unlikely to be related to the stated symptoms, but which subsequently required follow-up imaging \pm biopsy. No cases of malignancy were identified.

Conclusions In our center, a significant percentage of thyroid US scans along with their subsequent follow-up were potentially avoidable.

Keywords Thyroid ultrasound · Thyroid nodule · Hyperthyroidism · Hypothyroidism · Fine-needle aspiration · Thyroid cancer · Goiter

Introduction

In recent years, the increasing use of thyroid ultrasound (US) in clinical practice along with advances in imaging technology has resulted in a higher rate of diagnosis of thyroid nodules and thyroid cancers from within the general population [1–3]. Despite more thyroid nodules and cancers being diagnosed, however, mortality rates associated with thyroid cancer have not changed over the same time period, indicating that the additional thyroid cancers diagnosed as part of this uptrend have been of low risk, and that the utility of identifying indolent thyroid malignancies is questionable [2–5]. In keeping with these observations, routine screening for thyroid malignancy via US is not

✉ Colin Davenport
drcdavenport@gmail.com

¹ Department of Endocrinology, Connolly Hospital, Blanchardstown, Co Dublin, Ireland

² Department of Pathology, Connolly Hospital, Blanchardstown, Co Dublin, Ireland

³ Department of Radiology, Connolly Hospital, Blanchardstown, Co Dublin, Ireland

currently recommended [5, 6], and a recent New England Journal of Medicine perspective article emphasized the importance of finding ways to reduce the overdiagnosis of thyroid nodules and malignancy [2]. In this context, it is notable that few studies to date have focused upon the role of the initial thyroid US referral—the “entry-point” into the entire thyroid nodule diagnostic pathway for the majority of patients. It is possible that by critically examining thyroid US referrals that performance of inappropriate/unnecessary scans could be reduced, which in turn could help to reduce the overdiagnosis of thyroid nodules and malignancies, and it is with this possibility in mind that this study was conducted.

To the best of our knowledge, there has only been one recent set of international guidelines that made specific reference to what constitutes an appropriate indication for imaging the thyroid gland with US. These guidelines (for the assessment and management of thyroid nodules) were released by the American Association of Clinical Endocrinologists/American College of Endocrinology/Associazione Medici Endocrinologi (AAACE/ACE/AME) in 2016. In essence, they recommend thyroid US in all patients with palpable thyroid nodules or goiter, particularly if the risk factors for malignancy are present (e.g., if nodule growth is noted, if persistent dysphonia or dysphagia accompany the palpable abnormalities, in the aftermath of thyroid cancer or childhood neck irradiation, or as part of focused screening in people with familial conditions predisposing to malignancy, such as multiple endocrine neoplasia type 2) [7]. In patients without palpable abnormalities, they recommend performing an US if a thyroid nodule is suspected on “clinical grounds”, but they also note that symptoms such as choking, vague neck pain, and swallowing difficulties are rarely related to thyroid disease, and make the point that US evaluation is not recommended as a screening test for the general population or in patients with a normal thyroid on palpation and a low risk of thyroid disease.

It is noteworthy that these guidelines do not definitively clarify the propriety of using thyroid US for the investigation of functional thyroid disease (hyper/hypothyroidism). While general consensus would agree that hypothyroidism in the absence of palpable abnormalities should not require an US, there is a debate regarding the role of US in the investigation of hyperthyroidism. Certainly when requested by specialists and for specific reasons (e.g., thyroid blood flow), this imaging modality can aid the management of hyperthyroidism and is of great importance to the practice of endocrinology. However, outside of the specialist setting and in the absence of palpable disease, a number of authors and guidelines have suggested that US may not be the optimal first-line investigation for hyperthyroid disease [8–10]. This approach was reinforced by the American

Endocrine Society in a 2013 Choosing Wisely® recommendation stating that US should not be ordered routinely in patients with abnormal thyroid function tests if there is no palpable abnormality of the gland [11].

The primary aim of this paper was to retrospectively examine the patterns of referral for thyroid US in our own tertiary referral center, with a focus on identifying which referral requests were appropriate vs. inappropriate. The secondary aim was to assess the consequences for those patients whose initial thyroid US referral was deemed to be inappropriate, but which had shown incidental nodular disease.

Materials and methods

This study was conducted in Connolly Hospital, a large teaching hospital in the Dublin area of Ireland. The hospital includes an endocrine department which accepts referrals for all aspects of thyroid disease, including hormonal hyper/hypofunction, nodular, and malignant thyroid disease and which reviews nodular/malignant cases via a thyroid multidisciplinary meeting (MDM) which follows the British Thyroid Association Guidelines for Management of Thyroid Cancer [12]. In this hospital, patients with a clinical query of thyroid disease can be referred directly to the radiology department for a thyroid US by general practitioners (GP) and non-endocrine specialties, and then referred onward to endocrinology, as indicated by the scan results. Alternatively, patients can be referred to endocrine services first, who in that case will make the decision to perform an US scan or not. This study was retrospective in nature and involved an analysis of the records of all patients referred to our center for a thyroid US between 2012 and 2016, which was inclusive. For patients who underwent more than one scan during these years, the analysis of indications for referral focused on the first US scan within this time period.

Patients who had undergone thyroid US were identified via a database search of the hospital’s picture archiving and communication system (PACS). A structured proforma was then used to gather data on each patient. The PACS system was further interrogated to ascertain the source of referral of the US, the stated indication for the scan, what the results of the scan were, and whether the patient had subsequent thyroid imaging, been discussed at the thyroid MDM, or had undergone FNA of a thyroid nodule or mass. A separate database, the patient administration system (PAS), was used to gather additional demographic data. Cytology results for those patients who underwent FNA and/or partial or total thyroidectomy were accessed via the hospital laboratory system.

Table 1 Categories of propriety of thyroid US referrals utilized in this study

Categorization of propriety of referrals for thyroid US			
Category	Appropriate	Potentially inappropriate	Likely inappropriate
Indication for US as per the referral	Palpable nodule Palpable goiter Follow-up of thyroid cancer Follow-up of known nodules Screening of high-risk populations Post-childhood irradiation MEN 2	Neck symptoms (pain, choking, and hoarseness) without palpable mass without risk factors for thyroid cancer	Hypothyroidism or hyperthyroidism without palpable mass without specialist indications for imaging noted
US ultrasound			

Table 1 demonstrates the criteria by which thyroid US referrals were categorized as appropriate, *potentially* inappropriate, or *likely* inappropriate. Referrals for thyroid US scans were considered appropriate when they were requested for the indications, as specified by the 2016 AACE/ACE/AME guidelines [7]. Referrals for thyroid US were considered *likely* inappropriate when they were requested for functional disease without specifying the presence of a palpable mass/nodule or without any specialist indication having been mentioned in the referral. Referrals were considered *potentially* inappropriate (a necessary category given the lack of guidelines in this area of thyroid care) when they were requested for nonspecific symptoms (neck pain, choking, and hoarse voice) without any mention of a palpable mass/nodule or specific risk factors for thyroid malignancy (e.g., prior neck irradiation, family history of thyroid cancer) in the referral [12]. If a nodule or nodules were reported on a thyroid US requested for symptoms without any palpable mass/nodule, then the result was assessed to determine whether the nodule was likely to have caused the symptoms in question, based on the presence of the features of malignancy and subsequent cytology, the size of the nodule/nodules, and their relationship to other structures in the neck. Nodular disease with no evidence of malignancy, showing no evidence of adherence to or compression of adjacent structures within the neck, showing no signs of bleeding within the nodule (in the context of neck pain), and which was stable on serial imaging (when available), was deemed unlikely to be related to symptoms of choking, change in voice/hoarseness, or neck pain.

In the case of US referrals that mentioned both appropriate (e.g., new goiter) and *likely/potentially* inappropriate indications (e.g., hypothyroidism), the request was deemed appropriate and the appropriate indication was recorded as the primary reason for referral. This was a retrospective analysis of already-available data. Data were anonymized during the collection process. Data were analyzed via Graphpad Prism version 4.03 (California, USA) and, unless otherwise stated, are expressed as mean \pm standard deviation.

Results

Number of thyroid US referrals, source of referrals, and breakdown of indications for the scan

In total, 318 patients had at least one thyroid US in our center during the time period assessed. The mean age of the referral was 53 ± 15 years and 270/318 (85%) were female. GPs submitted the majority of the referral requests (40.9%), followed by endocrinology (36.2%), other hospital-based medical specialists (17.9%), and surgical specialists (5%).

Table 2 contains a full breakdown of the indications for referral for thyroid US. The commonest stated indication was to follow up a known nodular/malignant disease (34.3%), followed by referral for assessment of a new palpable nodule/mass (33.3%) and for characterization of nodules that had been identified incidentally via other imaging modalities (12.6%). All of these indications were deemed appropriate reasons for imaging.

Thyroid US scans were requested for neck symptoms without any mention made of a palpable mass or specific risk factors for thyroid malignancy in 12.3% of cases and were deemed *potentially* inappropriate.

US scans were requested to investigate functional disease with no mention of a palpable mass or specialist indication in 6.6% of cases and were deemed *likely* inappropriate. Finally, two (0.6%) US referrals were made for reasons that did not fit in the preceding categories. These consisted of a referral for “thyroid disease” with no additional details provided and a referral to “screen for thyroid disease” in a patient with a neuroendocrine tumor of the bladder and no other details provided. Given the information provided in the US referral, we deemed both of these requests as *likely* inappropriate.

Sources of referral for potentially inappropriate requests

Of the 39/318 (12.3%) thyroid US referrals which were deemed *potentially* inappropriate, 69.2% were requested by

Table 2 Indications for thyroid ultrasound imaging as stated on referring request and broken down into categories of referral

Indications for thyroid US	
Indication provided in the referral	n (%)
Follow-up of nodular/malignant disease	109 (34.3)
Follow-up of thyroid nodule	70 (22)
Follow-up of thyroid goiter	28 (8.8)
Follow-up of thyroid malignancy	12 (3.8)
Assessment of new palpable mass	106 (33.3)
Assessment of new goiter	62 (19.5)
Assessment of a new discrete nodule/neck lump	44 (13.8)
Incidental thyroid finding on other imaging	40 (12.6)
CT	26 (8.2)
MRI	5 (1.6)
CXR	4 (1.3)
Carotid Doppler	3 (1)
PET	1 (0.3)
Isotope scan	1 (0.3)
Neck symptoms—no mention of palpable mass (<i>potentially</i> inappropriate)	39 (12.3)
Choking/swallowing difficulties	24 (7.6)
Neck pain	9 (2.8)
Change in voice/hoarseness	6 (1.9)
Functional disease—no mention of palpable mass (<i>likely</i> <i>inappropriate</i>)	21 (6.6)
Hypothyroidism	12 (3.8)
Hyperthyroidism	9 (2.8)
Miscellaneous indications (<i>likely</i> inappropriate)	2 (0.6)

Percentages expressed are out of the total *n* of 318 scans

general practitioners, 10.3% were requested by other hospital-based medical specialists, 15.4% were requested by endocrinologists, and 5.1% were requested by surgical specialists.

Results and follow-up of potentially inappropriate thyroid US scans

Of the 39/318 (12.3%) US referrals deemed to be *potentially* inappropriate, nodular disease was identified in 21 cases. Repeat US scans were required in 11/21 of these cases, 4/21 cases led to an endocrine clinic referral for assessment of the nodular disease, and MDM discussion was required in 5/21 cases. FNAs were performed in 2/21 cases and cytology was benign in both. No complications relating to the FNAs were reported. In no case was the nodular disease deemed likely to be the cause of the patient's symptoms on the initial referral.

Sources of referral for likely inappropriate requests

Of the 23/318 (7.2%) of thyroid US referrals which were deemed *likely* inappropriate, 47.8% were requested by general practitioners, 30.4% were requested by other hospital-based medical specialists, and 21.8% were requested by endocrinologists.

Results and follow-up of likely inappropriate thyroid US scans

Of the 23/318 (7.2%) US referrals deemed *likely* inappropriate, nodular disease was identified in 12 cases. Repeat US scans were required in 5/12 of these cases, 3/12 cases led to an endocrine clinic referral for assessment of the nodular disease, and MDM discussion was required in 2/12 cases. No FNAs were performed.

Discussion

By focusing on the initial thyroid US as the entry point into the thyroid nodule diagnostic pathway, our study highlights a potentially important area of improvement in the context of ongoing efforts to reduce the overdiagnosis of thyroid nodules and indolent thyroid cancer. The results of this study show that the indications for 7.2% of the referrals for thyroid US received by our hospital over a 4-year period were *likely* inappropriate, with a further 12.3% of scans performed for *potentially* inappropriate indications (categories as specified in Table 1). Furthermore, we found that a significant burden of additional imaging, MDM discussions, endocrinology clinic visits, and biopsies were ultimately required as a result of these referrals, with no malignancies identified. It is important to note at the onset that our results are from a single center only and that larger datasets will need to be reviewed in a similar fashion to assess the broader applicability of these data. Nonetheless, in the context of a recently reported clear link between the increased use of thyroid US imaging and increasing rates of low-risk thyroid cancer being diagnosed in the US over the last two decades [3], our observation that critically examining the indications for US imaging may help to address this issue is timely.

To the best of our knowledge, there are a few studies to date that have looked at this aspect of thyroid imaging and its importance to the overdiagnosis of thyroid nodules and cancer. Within the limited evidence base, the study with the greatest similarities to our own was published by Fraenkel et al. in 2005 [9]. In this study, the authors examined first attenders to their endocrine clinic who had undergone a

thyroid US scan in the community at the request of their GP and reviewed the indications for the initial scan. In their approach, they deemed all US scans for neck symptoms in the absence of palpable disease, as well as US scans for functional disease, as entirely inappropriate. Ultimately, their study reported that of the 69 thyroid US scans that had been performed on the patients prior to presentation at the endocrine clinic, only five (7%) had been requested for appropriate indications, and that 55 out of the 69 scans ultimately reported incidental thyroid nodular disease. It is important to note that our study differs from that of Fraenkel et al. in that they adopted a lower threshold for declaring US referrals inappropriate, and also only analyzed US referrals from GPs. In our own approach, we were more cautious about declaring scans to be inappropriate, especially in the context of symptoms such as neck pain and hoarseness in the absence of palpable disease and a debate regarding the utility of US in the investigation of hyperthyroidism. While the literature suggests that thyroid US is unlikely to be of use in these scenarios outside of the specialist setting, it falls short of indicating that such scans are definitively unwarranted [9, 13, 14]. As a percentage of US scans requested for the investigation of functional disease in this study originated from endocrinologists, we believe it likely that a number of scans were for specialist indications, as opposed to routine imaging, but in the absence of reasons such as this being mentioned in the referral, the cases were classified as *likely* inappropriate, regardless of origin, in our results. Finally, it is to be hoped that increasing awareness of the overdiagnosis of thyroid nodules and cancers in the years since the publication by Fraenkel et al. has helped to decrease the frequency of inappropriate US requests. Ultimately, while our own study reported a lower percentage of requests that were *likely* or *potentially* inappropriate compared with their results, both papers observed that targeting the propriety of US scans in this fashion may be an important and under-recognized method of reducing the diagnosis of incidental nodular and malignant disease which carries a low likelihood of morbidity and/or mortality.

The strengths of this study include its real-life applicability, our integrated information technology (IT) systems facilitating the follow-up of cases subsequent to their initial US scan, and the timely nature of these data given the ever-increasing burden of over-diagnosed thyroid pathology. There are a number of important limitations to this study that should be borne in mind. We note that our study population is relatively small, particularly when compared with the catchment population served by our hospital and the duration of the study. This may be explained in part by the fact that patients in Ireland can choose to attend private hospitals for assessments of conditions like thyroid disease, or source thyroid US imaging privately before presenting to our public hospital with the imaging already performed.

These patients would not be captured by the assessment of thyroid imaging within the public system that was performed in this study. It is also relevant that our endocrine department's approach to the assessment of hyperthyroid disease largely reflects the recommendations of the ATA 2016 guidelines which prioritize TRAB and isotope testing over US imaging, and as such, our imaging numbers may be lower than centers which adopt a different approach in this regard. Ultimately, with our sample size in mind, we submit that our findings are exploratory and require (and indeed should prompt) confirmatory studies in larger databases and in other healthcare systems to further investigate this area of concern. This would also help to assess the applicability of our results to healthcare systems other than our own with different imaging and referral practices, although it should be noted that in the only other healthcare system studied to date, even higher rates of inappropriate thyroid US referrals were reported [9]. We also acknowledge that some of the cases characterized as *likely* or *potentially* inappropriate may have been reclassified as appropriate if additional information had been provided in the US request, which in turn may reduce the total number of potentially avoidable scans in clinical practice. However, we feel that it is unlikely that referring physicians would omit palpable abnormalities of the gland from an imaging request, and this was the main factor determining whether a scan was deemed appropriate or inappropriate. Equally, we note that in this study, we did not attempt to determine if those US scans ordered to follow up a known nodule, goiter, or cancer that had already been imaged (prior to the beginning of the study period) were genuinely indicated in all cases, or whether unnecessary follow-up imaging had been requested. Therefore, there may have been some additional avoidable scans that were not identified by our approach. Finally, we acknowledge, again with private healthcare in mind, that it is possible that some of the patients in this study may have left the public system and sourced private follow-up of their thyroid nodules with outcomes that were not captured by our database searches, but we found no definite cases of this occurring and we also note that said cases would not detract from the primary findings of the study with regard to the critical review of the indications given for thyroid US.

In conclusion, therefore, our study indicates that a significant number of thyroid US scans and their follow-up burden were potentially avoidable in our center. It is possible that a more critical examination of thyroid US referrals may in turn facilitate a reduction in the diagnosis and imaging of benign thyroid nodules and indolent thyroid malignancies, in keeping with recent reviews favoring a more conservative approach to this clinical entity in general [2, 3, 15]. Interventions to improve this situation could include a prospective endocrinology review of thyroid US

referrals to hospital radiology departments, along with the establishment and dissemination of formal, updated guidelines on the indications for thyroid imaging.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interests.

Ethical approval This article does not contain any studies with human participants or animals performed by any of the authors.

Informed consent For this type of study format, consent was not required.

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