Ultrasonography: its role in nodular thyroid disease

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Abstract

Objective The objective was to correlate the number, size and extent of the nodules as determined during the pre-operative clinical examination of the thyroid gland, USG, intra-operative examination and histopathology. Also, FNAC (with or without USG guidance) and USG findings suggestive of malignancy were correlated with the final histopathology.

Setting Tertiary referral centre

Patients A retrospective chart review was done for 106 patients who underwent surgery for benign or malignant nodular thyroid disease in our center, between Jan 2004 - Dec 2006.

Results USG has 7 times higher predictive value than clinical examination in detecting number of nodules and determining size of nodules. USG guided FNAC has a sensitivity of 85.71% and specificity of 90.0% in detecting malignancy in nodular thyroid disease. However for

predicting malignancy in thyroid nodules, this study shows that USG has a sensitivity of 20.0% and specificity of 97.67%.

Conclusion In patients with nodular thyroid disease, USG can accurately determine the number and the size of the nodules. It is extremely useful in guiding FNAC; However its role in predicting malignancy is doubtful. We therefore recommend that USG guided FNAC be carried out as a routine in the evaluation of thyroid nodules.

Keywords Nodular thyroid disease · Ultrasonography · Guided FNAC

Introduction

Discrete thyroid swellings (thyroid nodules) are very common clinical entities. The prevalence varies according to the method of screening used. Prevalence of thyroid nodules on clinical palpation has been reported to range from 1% to 7% [1]. Ultrasonography (USG) studies have revealed that the prevalence of thyroid nodules in the general population was between 19% and 46% [2]. This increase in prevalence is due to the discovery of smaller nodules that are undetected by palpation (mostly smaller than 1.5 cm). In addition, USG studies revealed that a significant number of clinically solitary nodules occur in the context of multiple nodules. Only 38% of clinically solitary nodules were demonstrated to be solitary on high resolution ultrasound [3]. An even higher nodule prevalence of 49.5% was reported during an autopsy study of 821 thyroid glands [4].

USG is indeed the most widely used imaging technique for the evaluation of thyroid nodules. It is safe, noninvasive and non radioactive. Modern USG is performed with high frequency transducers (7–13 MHz) and can detect solid nodules of 3 mm to 4 mm and cystic nodules of 2 mm in diameter. When routinely used for solitary nodules, it can discover coexisting nodules in approximately 50% of

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patients. USG has been formerly widely used as a supplement to clinical examination in determining the physical characteristics of thyroid swellings. Although USG can demonstrate sub-clinical nodularity and cyst formation, the former is clinically irrelevant and the latter apparent at aspiration, which should be routine in all discrete swellings. There was a decline in the use of USG in many parts of the world because it had minimal impact on management, but it is becoming popular again as an adjunct to aspiration cytology. In India it still continues to be widely used in the initial evaluation of nodular thyroid disease. The reasons for its widespread popularity are the relatively low cost, easy availability and non-invasive nature.

In our centre we have been using USG routinely in the pre-operative evaluation in patients with nodular thyroid disease. We undertook this study to determine whether this practice had any impact on the management of our cases.

The objective was to correlate the number of nodules, size (largest dimension) and the extent of the nodules as determined during the pre-operative clinical examination of the thyroid gland, USG, intra-operative examination and histopathology. Besides we also correlated FNAC (with or without USG guidance) and USG findings suggestive of malignancy with the final histopathological diagnosis.

Patients and Methods

A retrospective chart review was performed of all patients who underwent surgery for benign or malignant nodular thyroid disease in our centre, between Jan 2004 - Dec 2006. All our patients were subjected to USG examination of the neck by a radiologist who assessed the thyroid gland and cervical nodal disease if any. The USG examination was performed with a scanner (Siemens, Sonoline ADARA, Germany) equipped with a 2.6 to 8.5 MHz High frequency probe. The spatial resolution for this system is about 2 mm. The features which were considered suggestive of malignancy were absent “halo” sign, solid or hypoechogenicity, heterogeneous echo structure, irregular margin, fine calcifications and extra glandular extensions. The evaluation of the cervical nodal disease has not been included in this study.

Fine-needle aspiration cytology (FNAC) was performed by a pathologist in all cases. USG guided FNAC of nodules was requested whenever the clinician felt the need for it. The common scenario when a USG guided FNAC was performed included small nodules, suspected cystic degeneration in a nodule (in order to target the viable tissue), repeat FNAC when there was strong clinical suspicion of malignancy and when additional nodules with adverse features were detected on USG.

At least a total lobectomy and isthmusectomy was performed in all cases. In such situations, the contralateral lobe was always examined per-operatively. In malignant lesions a total / near-total thyroidectomy was performed. In benign

multinodular disease involving both lobes, we performed a total lobectomy on one side and total / sub-total lobectomy on the other side. Frozen section examination was not done per-operatively. Post operatively all specimens were subjected to histopathological examination, and a detailed report including gross and microscopic features was obtained.

The number of nodules, size (largest dimension) and extent of the nodules as determined during the pre-operative clinical examination of the thyroid gland, USG, intra-operative examination and histopathology examination (gold standard) were correlated. Any change in the number of nodules or size ($> 25\%$) as compared to the HPE findings were taken into account for analysis. In the extent of the lesion, extrathyroidal spread, retrosternal extension and involvement of adjacent structures were considered for analysis.

In addition the correlation between FNAC and final histopathological diagnosis when performed with or without USG guidance was compared. Also, the correlation between adverse findings noted on USG and final histopathological diagnosis was analyzed.

Results

A total of 106 patients (20 males and 86 females), with a mean age of 36.6 years (range 14 – 68 years) were evaluated in this center between Jan 2004 and Dec 2006. The initial presentation of these patients was as depicted in Table 1. The number of nodules, size (largest dimension) and extent of the nodules as determined during the pre-operative clinical examination of the thyroid gland, USG and intra-operative examination as compared to histopathology is depicted in Table 2. It shows that USG has seven times more predictive value than clinical examination in detecting number of nodules as well as in determining size of nodules.

Ultrasonography-guided FNAC was performed in 07 patients only, as it was done when the clinician specifically asked for it.. The correlation between FNAC and final histopathological diagnosis when undertaken with or without USG guidance is as depicted in Table 3. It shows that conventional FNAC has a sensitivity of 70% and specificity of 93.02 %, whereas USG guided FNAC has a sensitivity of 85.71% and a specificity of 90% in detecting malignancy in nodular thyroid disease. Pathologically we found 17 papillary carcinomas, 02 follicular carcinomas, 01 medullary carcinoma, 10 follicular adenomas and 84 colloid goiters. The adverse findings noted on USG examination was cor-

Table 1 Initial presentation (n=106).

Presentation	Number of Patients (%)
Solitary Nodule	68 (64)
Multiple Nodules	34 (32)
Post-operative Recurrence	04 (4)

Table 2 Changes in findings as compared to histopathological examination (n=106)

	Differences in the number of nodules (% of patient)	Differences in the size (largest dimension) (% of patient)	Differences in the extent (% of patient)
Pre-operative	14 (13.2)	25 (23.6)	0 (0)
USG	2 (1.8)	3 (2.8)	0 (0)
Intra-operative	1 (0.9)	3 (2.8)	0 (0)

Table 3 Correlation between FNAC done with or without USG guidance and histopathological diagnosis

Type of FNAC	FNAC matches the final histopathological diagnosis. (No of Patients)	FNAC does not match the final histopathological diagnosis (No of Patients)
Conventional FNAC (n = 106)	94	12
USG Guided FNAC (n = 07)	6	1

Table 4 Correlation between adverse findings noted during USG examination and final histopathological diagnosis.

Adverse findings on USG	Malignancy on HPE. (No of Patients)	Benign on HPE. (No of Patients)
Present	4	2
Absent	16	84

related with the final histopathological diagnosis and is shown in Table 4. It shows that USG has a sensitivity of 20.0% and specificity of 97.67% in predicting malignancy in thyroid nodules.

Discussion

USG is a safe, non-invasive and non-radioactive test which is very popular in evaluation of nodular thyroid disease. It has been used to detect non palpable or difficult to palpate nodules, and in predicting malignancy in the nodules based on definite imaging characteristics. USG guided FNAC is also useful in smaller nodules difficult to target without guidance and in situations where initial FNAC was nondiagnostic (Fig. 1).

Our study confirms the superiority of USG over clinical examination as it is seen to have seven times more predictive value in detecting number of nodules and determining size of nodules. It is almost as accurate as intra-operative palpation in detecting the number and size of nodules.

The main goal of FNAC in evaluating nodular thyroid disease is to accurately predict which nodule is malignant. In many centers USG guided FNAC of thyroid nodules is performed as an initial diagnostic procedure, given its excellent ability to identify discrete nodules and direct needle localization. Although the nondiagnostic rates of USG guided FNAC is reported to be lower than the non diagnostic rates for palpation-guided FNAC, approximately

4 - 16% will continue to be inadequate for cellular diagnosis [5]. When the initial palpation guided FNAC was nondiagnostic a repeat USG guided FNAC has been shown to be diagnostic up to 50% of the times [7, 10, 11].

Cystic thyroid nodules represent a major challenge for an adequate cytological diagnosis, yielding a high rate of non-diagnostic fine-needle aspiration biopsies attributable to scarcity or absence of follicular cells. In complex (solid-cystic) nodules, USG guided FNAC was seen to be diagnostic in 63 % of cases [6].

It was seen in our study that USG guided FNAC has a higher sensitivity than conventional FNAC. However there is not much difference in the specificity between the two procedures. Since the number of cases investigated by the former procedure is small, definitive conclusions cannot be drawn and further studies with much larger numbers need to be done.

The role of USG in pre-operative evaluation of thyroid nodule for predicting malignancy was evaluated by Koike et al (2001) who found a sensitivity of 86.5% for non-follicular neoplasms and 18.2% for follicular neoplasms, with a specificity of 92.0% and 89.0% respectively [8]. The characteristics he used were margin, shape, echo structure, echogenicity and calcification. For predicting malignancy in a thyroid nodule, our study showed that USG has a specificity of 97.67 %, but a sensitivity of only 20%. This raises doubts about the utility of USG for this purpose. In any case no universally accepted formula for predicting malignancy from USG findings are available [8].

The routine use of ultrasound for nodular thyroid disease was investigated by Marqsee et al (2000) at the Thyroid Nodule clinic of Brigham and Women's Hospital [9]. USG guided FNAC was performed on all nodules more than 1 cm in maximum diameter. On this account, he found that USG changed the clinical management of 44% of patients who were referred for solitary nodules. The findings that altered management included the discovery of multiple nodules, no actual nodules identified and very small solitary nodules

Fig. 1 USG Guided FNAC being done in a case where initial FNAC was nondiagnostic

Fig. 2 USG Guided FNAC (needle has been guided by USG so as to sample the solid areas of the nodule)

(< 1 cm). However, when asymmetric and multinodular goiters were considered, clinical management was seen to be affected in 63%. But the study does not address the issue whether the FNAC performed on the additional nodules (1cm or larger) actually affected the treatment decision (surgery performed). We therefore feel that the conclusions drawn by the author are open to question.

The role of Color-flow Doppler USG in improving the diagnostic accuracy in nodular thyroid disease has been studied by with encouraging results reported by some workers [12]. We have not utilised this modality in our study.

Conclusion

We conclude that USG has utility in accurately determining the number and size of the nodules in the thyroid gland. But whether this information will have any effect on decision-making for treatment is not clear. However, it appears that USG may be useful if combined with FNAC as a routine.

Our study raises doubts about the usefulness of USG in predicting malignancy, and a formula for predicting malignancy from USG findings needs to be worked out, probably by multicentric trials. Use of color flow Doppler USG may be tried out to increase the diagnostic accuracy.

Our results therefore suggest that the only utility of USG in nodular thyroid disease is for guiding FNAC. We recommend that USG guided FNAC should be carried out as a routine in evaluation of thyroid nodules.

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