

Ultrasound Features of Thyroid Nodules Predictive of Thyroid Malignancy as Determined by Fine Needle Aspiration Biopsy

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Abstract

Introduction: Current guidelines recommend that in patients presenting with clinically palpable nodules or with an ultrasound finding of a thyroid nodule, one has to evaluate its risk for malignancy by proceeding with a fine needle aspiration biopsy (FNAB). The decision to do FNAB would depend on ultrasonographic features of the nodule, which include its size, hypoechogenicity, presence of microcalcifications, increased central vascularity, infiltrative margins, and taller than wide measures on transverse plane. Elastography, a measure of tissue stiffness, is now also being utilized as another feature that has a positive correlation with malignancy. This study hopes to determine which among the abovementioned ultrasonographic features would best correlate with a higher risk for thyroid malignancy among adult patients who had undergone ultrasound guided FNAB.

Methodology: A prospective study was done in a cohort of all Filipino patients 19 years old and above who underwent ultrasound guided FNAB of the thyroid nodule/s from July to December 2013 at the Radiology Section of The Medical City, Pasig City, Philippines. Specimen obtained from FNAB were then reviewed by a pathologist to determine its cytopathology and categorized based on the Bethesda System of Classification. The cytopathology reports were correlated with the features seen on the patient's thyroid ultrasound to determine which characteristic would be predictive of malignancy.

Results: A total of 100 patients underwent ultrasound-guided FNAB, from which 157 nodules were biopsied.

27 nodules were excluded from the analysis due to non-diagnostic or unsatisfactory (Bethesda Category I) findings on cytopathology. Among the 100 patients, 86% of which were females with the mean age of 41 ± 11.31 in those found to have malignant cytopathologic diagnosis. Of the 130 nodules biopsied, 115 nodules were identified as benign (Bethesda Category II) while 15 were identified to be malignant or suspicious for malignancy (Bethesda Category III-VI). Each of the five sonographic features that were predictive of malignancy was compared between the two outcome groups (benign versus malignant). Among them, only the presence of microcalcifications on ultrasound showed to be significantly correlated with malignancy with an odds ratio of 11.3. Ultrasound evaluation with elastography was only performed on 24 nodules and hence results were inconclusive. A nodule possessing more than two of the ultrasound features that were predictive of malignancy was more likely to be malignant on cytopathology (p value of 0.00).

Conclusion: The presence of microcalcifications on thyroid nodules as seen on ultrasound is a significant predictor of malignancy and remains to be consistent locally as with foreign studies. Nodules that were proven to be malignant on cytopathology presented with more of the ultrasound features that are said to be predictive of malignancy.

Keywords: thyroid malignancy, thyroid nodules, thyroid ultrasound

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Introduction

Thyroid nodules are commonly encountered in clinical practice. Based on the recent data released by the PhilTiDeS Working Group, the prevalence of goiters in the Philippines was found to be at 8.9%, 44% of which were nodular goiters.¹ Once a thyroid nodule is discovered, the physician needs to determine whether this nodule is benign or malignant. Nodules that are 1.0 cm or larger can usually be palpated unless they lie deep within the neck.² Some palpable

lesions may not correspond to distinct radiologic abnormalities and non-palpable nodules have the same risk of malignancy as palpable nodules with the same size. Guidelines dictate that after determining the functionality of the nodule with serum thyroid stimulating hormone (TSH), a thyroid ultrasound should be done to confirm the presence of the nodule followed by a fine needle aspiration biopsy (FNAB).³ Nodules >1.0 cm should be evaluated, since they have a greater potential to be clinically significant cancers. For patients with multinodular goiters, sonographic characteristics are superior to nodule size for identifying nodules that are more likely to be malignant.

FNAB of thyroid nodules has eclipsed all other techniques for diagnosis of thyroid cancer prior to surgery, with reported overall rates of sensitivity and specificity exceeding 90% in iodine-sufficient countries,⁴ and is the best single test for differentiating malignant from benign thyroid lesions. In a local retrospective case control study done by Young et al., wherein 2,239 nodules were evaluated through ultrasound-guided FNAB and correlated with histopathologic findings the sensitivity, specificity, positive predictive value, negative predictive value and accuracy rate of ultrasound-guided FNAB (USG-FNAB) were 70.3%, 92.8%, 76.5%, 90.4% and 87.2%, respectively.⁵

However the dilemma continues to hold on which nodules should be biopsied. Hypoechogenicity, presence of microcalcifications, increased central vascularity, infiltrative margins, and taller than wide measures on transverse plane are sonographic features that are said to be suspicious for malignancy.⁶

In the assessment of thyroid nodules, clinical evaluation is also very important. A firm or hard consistency is associated with an increased risk of malignancy. However, this clinical parameter is highly subjective and dependent on the experience of the examiner. Elastography is a newly developed dynamic technique that uses ultrasound to provide an estimation of tissue stiffness by measuring the degree of distortion under the application of an external force. Ultrasound elastography has been applied to study the hardness/elasticity of nodules to differentiate malignant from benign lesions. The utility of this technique was likewise evaluated in this study.

When encountering a patient with a thyroid nodule, there is often the predicament on which nodule would be best biopsied to determine the risk for malignancy. Performing FNAB in all nodules is not cost effective and would only introduce unnecessary discomfort to patients. Previous studies have proven that each ultrasound characteristic alone is not sufficient in predicting a nodule's risk for malignancy. Instead a combination of these features may yield a higher predictive value.³ This study hopes to correlate not only the known ultrasound characteristics but

incorporate elastography findings in the evaluation as well.

In patients presenting with a clinically palpable thyroid nodule or who have undergone thyroid ultrasound and found to have a nodule with suspicious features, which nodule would best be evaluated or biopsied that would correlate to cytopathologic findings of malignancy?

Objectives

General:

To determine which feature of a thyroid nodule as seen on ultrasound would best predict thyroid malignancy.

Specific:

1. To correlate ultrasonographic characteristics and elastography findings of a thyroid nodule suspicious for malignancy with cytopathologic findings based on FNAB results.
 - a. To determine which among the thyroid ultrasound characteristics would best correlate with thyroid malignancy in the local setting.
 - b. To determine the number of ultrasound features present in a thyroid nodule that would correlate with a higher chance of malignancy.

Methodology

1. Study subjects
 - a. Inclusion criteria

All Filipino adults, 19 years old and above who underwent USG-FNAB of a thyroid nodule or nodules at the Department of Radiology of The Medical City from July 2013 to December 2013, who were found to have a suspicious nodule on a previous ultrasound or on physical examination or as recommended by their physician.
 - b. Exclusion criteria
 - i. Patients who have been scheduled to undergo ultrasound-guided FNAB of a thyroid nodule but later found to be technically difficult (e.g. nodule encroaching a blood vessel, inaccessible by needle).
 - ii. Patients who refused to be included in the study or refused to sign informed consent.
 - iii. Patients who underwent fine needle aspiration biopsy and later found to have cytopathologic findings that were non diagnostic or unsatisfactory (Bethesda Category I).

2. Study Population

An average of about 15 patients per month undergo ultrasound-guided fine needle aspiration biopsy for a thyroid nodule at The Medical City. With a study period of approximately six months, the computed population size (N) using the Sloven's formula is 90, where a sample size (n) of 73 will have a 5.0% margin of error while a sample size (n) of 43 will have a 10% margin of error. A total of 100 patients underwent ultrasound guided FNAB during the six-month investigation period, from which 157 nodules were biopsied.

3. Description of Study Procedure

All adult patients who underwent USG-FNAB who presented with a clinically suspicious nodule on palpation and/or with previous thyroid ultrasound findings who were seen at The Medical City, either admitted or on outpatient basis, were included in the study. Signed informed consent for the study as well as for the procedure ("Informed Consent To Perform a Procedure" from The Medical City) were obtained from the patient.

Prior to the biopsy, a repeat scan of the thyroid was done noting the five specific ultrasound characteristics suspicious for malignancy. (presence or absence of hypoechogenicity, microcalcifications, increased central vascularity, infiltrative margins, and taller than wide measures on transverse plane). Elastography was also done depending on the availability of the ultrasound machine/probe capable of measuring a nodule's tumor area ratio (Siemens ACUSON S2000 SN:200557 with a 7.5 MHz linear probe of the same model).

Fine needle aspiration biopsy of the thyroid nodules was then performed by a trained and certified interventional radiologist from the Department of Radiology of The Medical City or by the patient's attending endocrinologist. Specimen were studied and reviewed by consultants and/or residents from the Department of Clinical Pathology of The Medical City. Cytopathologic diagnosis was reported using the Bethesda System⁷ of classification as seen in Table I.

Table I: The Bethesda System for reporting Thyroid Cytopathology: recommended diagnostic categories

I. Nondiagnostic or Unsatisfactory

- Cyst fluid only
- Virtually acellular specimen
- Other (obscuring blood, clotting artifact, etc)

II. Benign

- Consistent with a benign follicular nodule (includes adenomatous nodule, colloid nodule, etc)
- Consistent with lymphocytic (Hashimoto) thyroiditis in the proper clinical context
- Consistent with granulomatous (subacute) thyroiditis

III. Atypia of Undetermined Significance or Follicular Lesion of Undetermined Significance

IV. Follicular Neoplasm or Suspicious for a Follicular Neoplasm

Specify if Hurthle cell (oncocytic) type

V. Suspicious for Malignancy

- Suspicious for papillary carcinoma
- Suspicious for medullary carcinoma
- Suspicious for metastatic carcinoma
- Suspicious for lymphoma
- Other

VI. Malignant

- Papillary thyroid carcinoma
- Poorly differentiated carcinoma
- Medullary thyroid carcinoma
- Undifferentiated (anaplastic) carcinoma
- Squamous cell carcinoma
- Carcinoma with mixed features (specify)
- Metastatic carcinoma
- Non-Hodgkin lymphoma
- Other

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Nodules that were found to be malignant were correlated with thyroid ultrasound findings of the patient indicating which of the ultrasonographic features were present.

As a protocol for post-FNAB patients, a repeat thyroid ultrasound/scan was done 30 minutes after the procedure to re-evaluate for the presence of any bleeding or hematoma at the site of biopsy.

a. Data Collection:

The investigator provided the ultrasonographer with a data sheet (see appendix) for every patient who underwent thyroid ultrasound noting the nodules having the characteristics suspicious for malignancy.

b. Definition of terms:

- i. A solid thyroid nodule is defined as a purely solid or predominantly solid with a cystic component comprising less than 10% of the total volume
- ii. Marked hypoechogenicity was defined as having the same or decreased echogenicity compared with the strap muscle.
- iii. A margin related to thyroid malignancy included microlobulation, a speculated margin, and perithyroidal infiltration.
 1. Microlobulation was defined as having the presence of many small lobules on the surface of a nodule;
 2. a spiculated margin was defined as having the presence of irregular spiculation on the surface of a nodule;
 3. perithyroidal infiltration was defined as having the extension of the

- lesion into an extracapsular area.
- iv. Microcalcifications were defined as tiny, hyperechoic foci (< 1.0 mm in size) with no comet-tail artifacts or posterior shadow.
 - v. A taller-than-wide shape was defined as a nodule having a greater anteroposterior diameter than its transverse diameter (A/T >1.0).
 - vi. Central vascularity was defined as vascular predominance in the center of the nodule in a color Doppler US
 - vii. Tumor area ratio (elastography) is the measure obtained before and after compression of the ultrasound probe to generate an elastogram depicting the relative stiffness of tissue. A tumor area ratio of >1.0 was found to have a higher correlation with malignancy based on previous studies.

Study Design

Prospective Cohort study

Data Analysis

A 2x2 contingency table which included the five sonographic characteristics predictive of malignancy as well as the sub population where in elastography results were obtained, were presented using count/frequency and percentage. Comparison of categorical factors (across outcomes groups, i.e. malignant vs benign) was done using chi-square (Fishers Exact Test). Quantitative continuous variables were presented in mean and standard deviations and were compared using independent t tests. Significance was set at a 0.05 level of confidence. Odds ratio was employed for the characteristic that yielded a significant result.

Ethical Considerations

The study protocol was approved by the Ethical Review Board (Institutional Review Board) of The Medical City. All patients' information will be anonymous and kept confidential. Patients were required to sign an informed consent form prior to inclusion to the study.

Indemnification Policy

The subject inclusion in this study was voluntary and did not include any monetary nor material compensation. Denial of inclusion did not result to denial of any medical service to the patient. The study is considered safe and possible complications include pain, bruising and possible

hematoma formation at the site of fine needle aspiration biopsy. Subcutaneous hematoma at the biopsy site, accidental puncture of the trachea and local infection are rare complications.⁸ No such complications occurred during the period of investigation.

Results

A total of 100 patients underwent USG-FNAB of the thyroid nodule during the investigation period, 86% of which were females and only 14% were males. The mean age of those found to have unfavorable cytopathologic diagnosis had a mean age of 41 ± 11.31 (Table II).

Table II: Patient data

	Patients with Benign findings (n=86)	Patients with Malignant findings (n=14)	Total number of patients (n=100)	P-value
Gender				
Male	11 (12.8%)	3 (21.4%)	14 (14%)	0.409
Female	75 (87.2%)	11 (78.6%)	86 (86%)	
Age				
	50.35 ± 11.76	41 ± 11.31	49.04 ± 12.09	0.011

Categorical Data presented in Count (Percentage%) and compared using Chi-Square Test (Fishers Exact Test)

Continuous Data presented in Mean $\pm$ Standard Deviation and Compared using Independent T-test

Significant if p-value < 0.05

One hundred fifty seven (157) nodules were biopsied, among which 27 were excluded from the analysis due to non-diagnostic or unsatisfactory (Bethesda Category I) findings on cytopathology. Bethesda Category I specimen include cyst fluid only, virtually acellular specimen or other artifacts such as obscuring blood or clotting artifact.¹¹⁵ nodules were identified as benign (109 colloid, 6 lymphocytic thyroiditis, Bethesda Category II) while 15 were identified to be malignant or suspicious for malignancy (Bethesda Category III–VI), later confirmed to be indeed malignant based on surgical pathology results.

Each of the five sonographic features that were predictive of malignancy was compared between the two outcome groups, benign or malignant cytopathologic results (Table III). Among them, only the presence of microcalcifications on ultrasound showed a significant result ($p = 0.000$).

Table III: Sonographic/Ultrasound characteristics

	Benign (n=115)	Malignant (n=15)	Total (n=130)	P-value
Hypoechoic				
Presence	81 (70.4%)	14 (93.3%)	95 (73.1%)	0.069
Absence	34 (29.6%)	1 (6.7%)	35 (26.9%)	
Infiltrative Margins				
Presence	3 (2.6%)	1 (6.7%)	4 (3.1%)	0.391
Absence	112 (97.4%)	14 (93.3%)	126 (96.9%)	
Microcalcification				
Presence	42 (36.5%)	13 (86.7%)	55 (42.3%)	0.000
Absence	73 (63.5%)	2 (13.3%)	75 (57.7%)	
Taller Than Wide				
Presence	6 (5.2%)	1 (6.7%)	7 (5.4%)	0.585
Absence	109 (94.8%)	14 (93.3%)	123 (94.6%)	
Increased Central Vascularity				
Presence	76 (66.1%)	13 (86.7%)	89 (68.5%)	0.143
Absence	39 (33.9%)	2 (13.3%)	41 (31.5%)	

Data presented in Count (Percentage%), Compared using Chi-Square Test (Fishers Exact Test)
Significant if p-value < 0.05

An odds ratio was computed for the ultrasound feature that yielded a significant results. The presence of microcalcifications in a thyroid nodule based on ultrasound gave an odds ratio of 11.3 that it would yield a malignant cytopathologic result (Table IV). The presence of hypoechogenicity shows a trend for a positive correlation with malignancy with a p value of 0.069. The presence of infiltrative margins, a taller than wide dimension and central vascularity did not show to have a significant difference with malignancy.

Table IV: Odds ratio

	Benign (n=115)	Malignant (n=15)	Odds Ratio (95% CI for OR)	P-value
Microcalcification				
Presence	42 (76.4%)	13 (23.6%)	11.3 (2.4, 52.5)	0.000
Absence	73 (97.3%)	2 (2.7%)		

Of the 130 nodules biopsied, elastography was only performed on 24 nodules. This is due to the limitation of ultrasound machines that had the special function and capability of determining the tumor area ratio of the nodule. Statistical analysis was still performed on this subgroup to evaluate the utility of this feature. Based on the small number of data gathered for this sonographic characteristic, nodules having a tumor area ratio of greater than one did not have a significant correlation with malignancy having a p value of 0.576 (Table V).

Table V: Tumor area (Distance) ratio > 1 (Elastography correlation)

	Benign (n=21)	Malignant (n=3)	Total (n=24)	P-value
Tumor Area (Distance) Ratio >1				
Presence	9 (42.9%)	2 (66.7%)	11 (45.8%)	0.576
Absence	12 (57.1%)	1 (33.3%)	13 (54.2%)	

Data presented in Count (Percentage%), Compared using Chi-Square Test (Fishers Exact Test)
Significant if p-value < 0.05

A comparison was made between the two outcomes based on the number of sonographic characteristics present in each nodule. A mean of 2.8 ± 0.68 characteristics was seen in those with malignant cytopathology, which was significant with a p value of 0.00. Hence, the presence of more than two of the five characteristics had a significant correlation with malignancy (Table VI). Among the patients found to have malignant cytopathology, only six patients had undergone thyroidectomy within the period of this study. Nevertheless, the histopathology results of these patients were consistent in that five were diagnosed to have papillary carcinoma and one patient was identified to have a follicular carcinoma.

Table VI: Correlation of the number of characteristics present with cytopathology results

	Benign (n=115)	Malignant (n=15)	Total (n=130)	P-value
# of Present Characteristics in UTZ				
0	12 (10.4%)	0 (0%)	12 (9.2%)	0.000
1	32 (27.8%)	0 (0%)	32 (24.6%)	
2	40 (34.8%)	5 (33.3%)	45 (34.6%)	
3	28 (24.3%)	8 (53.3%)	36 (27.7%)	
4	3 (2.6%)	2 (13.3%)	5 (3.8%)	
All Characteristics				
Mean ± Std Dev	1.81 ± 1.01	2.8 ± 0.68		0.000

Data presented in Count (Percentage%) and Mean $\pm$ Standard Deviation
Compared using Independent T-test
Significant if p-value < 0.05

Based on the accuracy analysis of the data obtained from this study, the presence of hypoechogenicity of a thyroid nodule on ultrasound has the highest sensitivity at 93%, while the presence of infiltrative margins of a thyroid nodule on ultrasound has the highest specificity at 97%. Positive Predictive Values range from 14 to 25% for each of the ultrasound features, while negative predictive values are between 89% and 97%. False positive rates are highest with the ultrasound feature of hypoechogenicity and false negative rates are highest with infiltrative margins and taller than wide dimensions as seen on thyroid nodules on ultrasound.

Table VII: Sensitivity, specificity, PPV and NPV of ultrasound features in predicting Thyroid malignancy

	Hypoechoic	Infiltrative Margins	Microcalcification	Taller than wide	Increased Central Vascularity
True Positive	14	1	13	1	13
False Positive	81	3	42	6	76
False Negative	1	14	2	14	2
True Negative	34	112	73	109	39
Sensitivity	93%	7%	87%	7%	87%
Specificity	30%	97%	63%	95%	34%
Positive Predictive Value (PPV)	15%	25%	24%	14%	15%
Negative Predictive Value (NPV)	97%	89%	97%	89%	95%
False Positive %	70%	3%	37%	5%	66%
False Negative %	7%	93%	13%	93%	13%

Discussion

Ultrasonography has been an integral part in the evaluation of thyroid nodules and is the initial imaging of choice to further evaluate a thyroid nodule that is found to be non-functioning. Since hyperfunctioning nodules rarely harbor malignancy, if one is found that corresponds to the nodule in question, no cytologic evaluation is necessary. Based on recommendations and guidelines, nodules that are greater than one centimeter should be evaluated since they have a greater potential to be clinically significant cancers. There are conditions as well wherein a nodule is non-palpable but had been incidentally discovered during imaging procedures that have been requested for other disease entities. Such "incidentalomas" may pose the same risk as palpable nodules with the same size. Occasionally, there may be nodules less than one centimeter that require evaluation because of suspicious United States findings such as those evaluated in this study, associated lymphadenopathy, a history of head and neck irradiation, or a history of thyroid cancer in one or more first-degree relatives. In this study, one patient was noted to have a subcentimeter nodule (0.9 x 0.66 x 0.73 cm) but possessing three out of the five suspicious features, later found out to have malignant histopathologic findings. Hence, a larger nodule size alone may no longer be a good predictor of thyroid malignancy in this instance. The decision on which nodule or nodules to biopsy still continues to pose as a dilemma to every clinician. The presence of the previously evaluated sonographic features of hypoechogenicity, microcalcifications, increased central vascularity, infiltrative margins, and taller than wide measures on transverse plane somehow narrows down what one may need to seek out when determining which nodule would best be biopsied. Consistent with already published data, the presence of microcalcifications has likewise shown in this study to be a significant predictor of

malignancy with 23.6% present among those with malignant cytopathology results and only 2.7% without microcalcifications. This was found to be significant with a p value of 0.00.

There is no single sonographic feature or combinations of features that is adequately sensitive or specific to identify all malignant nodules. However, certain features and combination of features have high predictive value for malignancy.

Papini et al., evaluated the relative risk of malignancy of the main ultrasound features and showed that the presence of microcalcifications presented a higher specificity for malignancy (95%) than the findings of irregular margins (85%) or intranodular vascular images (80.8%), but the predictive value of microcalcifications was blunted by their low sensitivity (29.0% vs. 77.5% and 74.2%, respectively).⁹ Capelli et al., on the other hand, evaluated a thyroid nodule's shape (taller than wide or anteroposterior/transverse diameter ratio, A/T > 1.0) as a predictor of malignancy. The investigators found that in incidentally discovered thyroid lesions, no single ultrasound and color-flow doppler pattern taken by itself is highly predictive for malignancy.¹⁰ The study was able to determine the odds ratio of the different characteristics at 9.9, 8.6, 7.7, 3.2, and 1.7 for microcalcifications, A/T ≥ 1, blurred margins, solid hypoechoic appearance, and intranodular vascular pattern, respectively. Locally, an unpublished retrospective review done by Canete et al. at the Philippine General Hospital showed that sonographic findings of microcalcifications and irregular margins were significantly predictive of thyroid malignancy.

Elastography has been used to differentiate malignant from benign lesions in prostate, breast, pancreas, and lymph nodes. In a study done by Rago et al., 92 patients who presented with a single thyroid nodule who underwent surgery for compressive symptoms or suspicion of malignancy on fine needle aspiration cytology was likewise evaluated for tissue stiffness on ultrasound elastography. An

elasticity score was applied to these nodules from one (greatest elastic strain) to five (no strain). The elasticity scores four to five were highly predictive of malignancy ($P < 0.0001$), with a sensitivity of 97%, a specificity of 100%, a positive predictive value of 100%, and a negative predictive value of 98%.¹¹ A local unpublished study done by Natividad used elastography in determining thyroid malignancy among patients who underwent ultrasound guided fine needle aspiration biopsy of thyroid nodules at The Medical City. Elastography was performed in 34 thyroid gland tumors in 30 patients and tumor area ratio was obtained. All of the malignant thyroid gland nodules exhibited tumor area ratio of >1.0 , with a high sensitivity and negative predictive value (both 100%). The specificity (68.75%) and positive predictive value of 16.6 % are both relatively low. Although there is significant agreement between elastography and malignancy confirmed by fine needle aspiration biopsy using the Kappa test (an overall accuracy of 70.58% was obtained, $Kappa=0.206 \pm 0.104$ and $p=0.048$), the small sample size obtained should be taken into consideration. Lyshchik et al.¹² prospectively evaluated the elastographic appearance of thyroid gland tumors. Fifty-two thyroid gland lesions (22 malignant, 30 benign) in 31 consecutive patients (six men, 25 women) were examined with real-time elastography in the elasticity imaging mode. Results revealed that a strain index value greater than four on off-line processed elastograms was the strongest independent predictor of thyroid gland malignancy ($P < .001$); this criterion had 96% specificity and 82% sensitivity. Two other elastographic criteria, which were evaluated on real-time elastograms—a margin regularity score higher than three (88% specificity, 36% sensitivity) and a tumor area ratio higher than one (92% specificity, 46% sensitivity), as with Natividad's study, —also were associated with malignancy ($P < .05$).

FNAB is the best tool in helping to decide between nodules that require surgery and those that can be followed. By developing a more methodical approach in describing nodules on ultrasound, sonographers and endocrinologists may be able to identify which nodules would be best sampled and perhaps yield a sample that would best correlate with histopathologic findings. The need to establish some basic criteria to select nodules for FNAB to minimize costs and maximize benefits was recognized by Horvath et al.¹³ and what this study intends to propose as well.

Conclusion

This study had shown that the presence of microcalcifications on thyroid nodules as seen on ultrasound is a significant predictor of malignancy based on cytopathology results as determined by fine

needle aspiration biopsy specimen. This observation also remains to be consistent locally as with foreign studies.

Nodules that were proven to be malignant on cytopathology presented with more of the ultrasound features that are said to be predictive of malignancy.

Limitations of the Study and Recommendations

The investigators have identified several limitations to this study. The population of subjects, although satisfying the computed sample size, did not represent the outcomes equally with a majority of the subjects having benign cytopathology results. This is due to the fact the patients were included in the study consecutively or as they came for their FNAB and in a prospective manner with no knowledge of what the outcome of their biopsies would be. A larger sample size and matched samples would also be ideal to give a true representation of the population.

Another limitation identified is an inter-operator bias. Although a pool of only a few radiologists and endocrinologists were utilized for the study to minimize errors of variations in the interpretation of ultrasound readings and methods in performing biopsies, it would be ideal to maintain just one operator/physician to minimize inconsistencies and differences in the interpretation of results. A more standardized way in reporting thyroid ultrasound findings is recommended; giving special attention and taking note of the characteristics that have a significant correlation for malignancy.

There was an intention to formulate a Thyroid Ultrasound Scoring System based on the results of this study to have a more standardized approach in evaluation thyroid nodules. However this was not accomplished in since only one feature among the five showed to be significant. It would be most ideal that the weight of each of the five sonographic features be evaluated by determining each of its predictive values, and perhaps formulate a weighted score for each nodule rather than just an arbitrary number.

In determining the value of elastography and its correlation with malignancy, a larger sample size is also recommended to further investigate and evaluate its utility since there have been foreign, and one local unpublished, studies showing its positive correlation with malignancy.

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