Int J Clin Exp Med 2013;6(6):413-422
www.ijcem.com /ISSN:1940-5901/IJCEM1304016

Review Article

Appropriate and accurate diagnosis of thyroid nodules: a review of thyroid fine-needle aspiration

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Received April 23, 2013; Accepted May 21, 2013; Epub June 26, 2013; Published July 1, 2013

Abstract: Thyroid nodules are clinically palpable in 4-7% of adults in the United States. With ultrasound examination, thyroid nodules are identified in up to 70% of adults. In asymptomatic individuals, the potential for malignancy underlies the clinical importance of investigating thyroid nodules. Increased diagnostic accuracy has improved non-operative management of benign thyroid lesions. Appropriate management of thyroid microcarcinoma and large nodules remains a topic of debate. False-negative FNA cytology remains a concern for clinicians treating patients with thyroid nodules. Due to the challenge of interpreting FNA cytology and recent changes to the cytopathologic classification system, we reviewed the current literature on diagnosis of thyroid nodules using the recent Bethesda criteria.

Keywords: Thyroid nodule, thyroid cancer, fine-needle aspiration, Bethesda criteria

Background

Thyroid nodules are clinically palpable in 4-7% of adults in the United States [1-7]. With ultrasound examination, thyroid nodules are identified in up to 70% of adults [8]. In asymptomatic individuals, the potential for malignancy underlies the clinical importance of investigating thyroid nodules.

Thyroid nodules most commonly represent benign colloid nodules [3]; traditionally less than 5% are malignant [1, 5, 6]. Despite the fact that a small proportion of thyroid nodules are malignant, the incidence of both thyroid nodules and thyroid cancer are increasing and has grown 2.4 folds over the last 3 decades [9, 10]. Increased incidence of thyroid nodules is likely, in part, due to improved surveillance as well as higher resolution ultrasound (US) [11, 12]. However, risk of cancer in addition to patient anxiety begets the need to accurately identify and diagnose thyroid nodules.

Thyroid surgeries are complicated by post-operative thyroid hormone imbalance, hypoparathyroidism, recurrent laryngeal nerve injury, bleeding, or infection; thus, there has been an effort to limit unnecessary surgery in asymptomatic patients with benign lesions [5, 6, 10, 13-16]. Surgery for benign lesions should ideally be limited to patients with compressive symptoms, Graves's disease presenting with a nodule, hyperthyroidism, hyperparathyroidism, enlarging nodule, or the patient's personal desire for surgical management [2, 3, 17].

Due to the challenge of interpreting fine-needle aspiration (FNA) cytology and recent changes to the cytopathologic classification system, we would like to review diagnosis of thyroid nodules with FNA biopsy as well as explore the utility of the Bethesda criteria.

Fine-needle aspiration (FNA) biopsy of thyroid nodules

FNA biopsy was introduced to the United States from Sweden in the early 1980's [2], and it is now the gold standard diagnostic test (American Thyroid Association (ATA) Grade A recommendation) for initial evaluation of a thyroid nodule, along with a serum TSH level [9, 18]. Numerous studies have found FNA to be an accurate, safe, rapid, cost-effective, and minimally invasive diagnostic tool for management of thyroid nod-

ules [2-4, 6, 16, 19]. Complications due to FNA are extremely rare but may include persistent pain, hematoma, infection, and recurrent laryngeal nerve palsy [18].

FNA has played a significant role in selecting appropriate surgical candidates. In recent years, the number of thyroidectomies has decreased by 50%, and malignancy has risen from 14% to 30-50% of surgical cases [4, 6, 13-15]. FNA has diagnostically useful results in 80% of cases [4]. Reported sensitivity and specificity range from 65-98% and 72-100%, respectively [3, 20-23]. FNA is limited by skill of the aspirator and expertise of the cytologist [6]. FNA is a valuable diagnostic tool; however, FNA may not be necessary if the result will not change clinical management of the patient [3]. If FNA indicates benign cytology, no further immediate diagnostic steps are required (ATA Grade A recommendation), and the patient should be followed with serial US exams [1, 9, 14, 15]. It is important, however, that surgeons exercise clinical judgment in patients with negative FNAs who still have higher likelihood of malignancy, such as patients with rapid tumor growth, very firm nodules, fixation of nodule to adjacent structures, paralysis of vocal cords, regional lymphadenopathy, metastases, age less than 20 or greater than 70, history of head or neck irradiation, nodule greater than 4 cm or that is partially cystic, or family history of thyroid cancer or MEN II syndromes (**Table 1**) [4, 18].

US-guided FNA

US-guided FNA has been found to be superior to palpation-guided FNA due to reduced inadequate sampling and need for repeat biopsy with inadequate sample rates of 14-21% versus 32-50%, respectively [16, 24]. US-guided FNAs also had higher sensitivity, specificity, positive and negative predictive values, accuracy, and lower false positives and false negatives than palpation-guided FNA. These data were statistically significant and especially pronounced in smaller nodules [16]. Deep nodules and nodules in patients with larger necks are also difficult to locate and adequately biopsy via palpation [25]. US guidance for FNA is recommended (ATA Grade B recommendation) for nonpalpable, predominantly cystic, or posteriorly located thyroid nodules. US-guided FNA is also recommended for repeat FNA after initial non diagnostic result (ATA Grade A recommendation) and for nodules demonstrating growth on serial US exams [9].

US guidance also provides valuable information about the sonographic characteristics of thyroid nodules [5, 8, 18, 24, 26]. Sonographic characteristics consistent with malignancy include a lesion that is solid or mixed solid and cystic, ill-defined, hypoechoic or with mixed echogenicity, with larger vertical than horizontal dimensions, nodule “halo” on Doppler US, central vascularity, microcalcifications and lymphadenopathy. Benign lesions are typically cystic, well-defined with regular borders, isoechoic, and without microcalcifications [5, 8, 18, 26]. Patients presenting with multiple thyroid nodules have the same risk of malignancy as those with solitary nodules [18]. Thyroid US alone is 98.5% specific for detection of benign pathology, and patients with benign-appearing US may potentially follow up with serial US exams rather than invasive diagnostic tests or management. Unfortunately, though the vast majority of thyroid nodules are benign, only 10% of nodules are classically benign-appearing on US [8]. This fact demonstrates the necessity of FNA sampling.

Comprehensive neck US

US is also valuable for the detection of metastatic disease that requires additional comprehensive neck dissection during the first surgery. Suspicious cervical LN are detected in up to 30% of cases and change surgical plans in 14-24% of patients with papillary thyroid cancer [27-30]. For this reason, patients with malignant thyroid nodules should undergo preoperative cervical neck US examination for detection of lymphadenopathy. Sonographic characteristics of malignant LN include greater vertical than horizontal size, lack of fatty hilum, peripheral vascularity, and microcalcifications (**Table 1**) [11]. Though central neck US is standard of care for patients with known malignant thyroid nodules, there are no like recommendations for patients with suspicious or indeterminate nodules. Roy et al [11] performed a retrospective study on 134 patients treated by a single surgeon to examine the utility of cervical neck US in patients with suspicious or indeterminate thyroid nodule FNA. Suspicious LN were found in 17 (12.6%) preoperative central neck US exams. US findings resulted in 7 (5.2%) cen-

Table 1. Signs of malignancy

Patient history	Sonographic features of thyroid nodule	Sonographic features of cervical lymph nodes
Rapid tumor growth	Solid lesion	Larger vertical than horizontal dimensions
Very firm nodule	Mixed solid and cystic lesion	Lack of fatty hilum
Fixation of nodule to adjacent structures	Ill-defined lesion	Peripheral vascularity
Paralysis of vocal cords	Hypoechogenicity	Microcalcifications
Regional lymphadenopathy	Mixed echogenicity	
Metastases	Larger vertical than horizontal dimensions	
Age < 20 or > 70 years	Nodule halo	
History of head or neck irradiation	Central vascularity	
Nodule > 4 cm	Microcalcifications	
Partially cystic nodule	Lymphadenopathy	
Family history of thyroid cancer or MEN II syndromes		

tral neck dissections. Though thyroid and LN FNA biopsy was the factor that ultimately influenced surgical management, suspicious US prompted the biopsy. Preoperative detection of malignant thyroid nodules and metastatic LN would likely decrease trips to the operating room as well as overall time spent in the OR and time under anesthesia, which therefore decreases complications, cost, and patient anxiety.

Increased diagnostic accuracy has improved non-operative management of benign thyroid lesions [18]. However, false-negative FNA cytology remains a concern for clinicians treating patients with thyroid nodules.

False-negative rate of thyroid nodule FNA

Evaluation of accuracy of FNA is important due to its clinical implications. Without other indications, most patients with benign FNAs do not receive surgical resection of thyroid nodules. False-negative FNA cytology is thus especially problematic, as it can result in delayed treatment, which may adversely affect patient outcome [17]. Yeh et al [17] performed a retrospective review of FNAs, pre-Bethesda criteria, of 100 patients with histologically proven thyroid cancer. In this study sensitivity, false-negative rate, and rate of inadequate FNAs were 79%, 21%, and 12%, respectively. Undetected carcinoma delayed treatment by an average of 28.2 months, and patients experienced higher rates of vascular and capsular invasion, and they were more likely to have persistent disease [17]. It is imperative that clinicians minimize false-negative results. New cytopathological reporting using the Bethesda criteria aims to ameliorate this dangerous problem.

The Bethesda criteria

Prior to a recently updated cytology classification system for thyroid FNAs, many physicians criticized high false-negative results of thyroid FNAs. Concerns specifically derived from the "indeterminate" category, where rate of malignancy was reported at 40% [3, 31, 32]. Differentiating benign follicular adenomas from malignant follicular neoplasms on cytology, a practice not possible on cytology, was identified as a major contributor to the high incidence of false-negative results [5, 6, 13, 17, 23, 26]. Though the ability to distinguish benign from malignant follicular lesions has not changed, these lesions are more specifically classified in a new reporting system in an attempt to encourage more investigation of these nodules and lower the overall incidence of false-negative FNA results.

The Bethesda criteria (summarized in **Table 2**) for reporting thyroid cytopathology were developed by a committee at the National Cancer Institute meeting in 2007. These criteria were established in attempts to institute a uniform reporting system for thyroid FNA that would facilitate easier and more reliable interpreting and sharing of thyroid cytopathology, as well as improved communication between various healthcare providers involved in the care of patients with thyroid nodules. Each cytopathological category is risk stratified for malignancy and corresponds to specific recommendations for patient management [14, 15, 33]. Though

Table 2. The Bethesda system for reporting thyroid cytopathology: characteristics, management, and risk of malignancy for each diagnostic category

Diagnostic Categories	Characteristics	Usual management	Implied risk of malignancy (%)
Non-diagnostic or unsatisfactory	Cyst fluid only Virtually acellular specimen Other (hematoma, etc)	Repeat FNA with US-guidance	1-4
Benign	No atypical or malignant cells present, specimen adequate	Clinical follow-up	1
Atypia of unknown significance/Follicular lesion of unknown significance	Atypical cells present, no malignant cells present	Repeat FNA	5-10
Suspicious for follicular neoplasm	Follicular cells present, no malignant cells present	Surgical lobectomy	20-30
Suspicious for malignancy	Cells suspicious for malignancy, specimen adequate	Near-total thyroidectomy or surgical lobectomy	50-75
Malignant	Malignant cells present	Near-total thyroidectomy	100

Table adapted from [14, 15, 33].

Table 3. Malignancy rates reported for AUS/FLUS and SFN cytopathologic categories as compared to Bethesda guidelines

Study	Year	# FNAs	# with surgical intervention	Overall % malignancy	False Negative Rate (%)	% malignancy in AUS/FLUS	% malignancy in SFN
Bethesda criteria [14]					1	5-10	31
Theoharis [34]	2009	3207	378	8	NR*	15	34
Bohacek [21]	2012	1000	451	13	2.3	12	21
Nayar [35]	2009	5194	986	5	9**	6	14
Faquin [36]	2010	857	524	NR	NR	19	25

*NR-not reported. **9% false negative rate calculated only from surgical cases.

some small studies have concluded that the Bethesda criteria appropriately stratifies malignancy risk in thyroid nodules, controversy continues to exist regarding their accuracy and reliability in decision making.

Based on a review of the literature, only two groups have evaluated the Bethesda criteria in their practice [32, 34], one group analyzed their FNA data by retrospective conversion of cytopathologic reports to meet the Bethesda criteria [35], and one other group limited their analysis to specific categories of the Bethesda criteria [36] (**Table 3**). Other groups have evaluated thyroid FNA with earlier cytopathological classification systems (**Table 4**).

In Theoharis et al's evaluation of the Bethesda criteria, 3207 FNAs from 2468 patients were analyzed, 378 (15%) of whom underwent surgery [34]. FNAs were 11.1% unsatisfactory, 73.8% benign, 3.0% AUS/FLUS, 5.5% SFN, 1.3% suspicious, and 5.2% malignant. The positive predictive values for an SFN, suspicious, and malignant cytologic diagnosis were 34%, 87%, and 100%, respectively. The false-positive rate was 2.2%. The specificity for diagnosing malignancy was 93%. The false-negative rate and sensitivity was not calculated because the authors believed that the large number of non-operative cases would influence the ability to calculate accurate statistical data. Additionally, this institution further separates SFN into two subcategories: predominantly follicular cells and predominantly Hürthle cells, based on the principle that lesions with predominantly Hürthle cell cytology have higher incidence of malignancy. An analysis of nine such patients in this study did not support this notion. Finally, going forward, this group proposes to improve the quality of their biopsies and decrease unsatisfactory FNA samples by

Table 4. Previous original analyses of thyroid FNA with non-Bethesda cytopathological classification systems

Author	Year	Total cases (n)	Cases with preoperative FNA managed surgically (n)	Overall malignancy rate (%)	False Negative Rate (%)	False Positive Rate (%)	Sensitivity (%)	Specificity (%)	Notes
Bouvet [7]	1992	78	54	50	3.7		93.5	75.0	
Gharib [13]	1993	10971	1750	6.2	2	0.7			
Blansfield [43]	2002	282	183	38	18				
Sclabas [5]	2003	240	240		4	4			
Yassa [10]	2007	3589	1242		0.3	3			
Yang [22]	2007	4703	1052		10.9		94	85	*Reported specificity for follicular neoplasm using one classification for all indeterminate/follicular lesions: 74%*
Banks [32]	2008	468*	468	37					**exclusive to patients with indeterminate or suspicious cytology*
Bhatki [44]	2008	447			1.1				
Seiberling [45]	2008	271	54				100	73	
Lew [1]	2011	797	797	46	8.6	2			

introducing on-site cytologic aspirate adequacy assessment.

In Bohacek et al's study, 1000 surgeon-performed US-guided FNAs evaluated with Bethesda criteria were examined. 451 nodules were surgically removed [21]. Fine-needle aspiration results were reported as: cancer (7%), suspicious for cancer (2%), SFN (17%), AUS/FLUS (1%), benign (67%), and insufficient (6%). Of nodules with FNA results of cancer, suspicious for cancer, SFN, and AUS/FLUS, 94% were operated on, with malignancy rates of 97%, 58%, 21%, and 12%, respectively. Of nodules with benign FNA, 26% underwent surgery. In surgically removed nodules, there were 322 (71.4%) benign nodules and 129 (28.6%) malignant nodules. Excluding seven nodules that increased in size over time, the overall sensitivity, specificity, positive predictive value, negative predictive value, false-negative rate, and false-positive rates of the study were 84.4%, 99.6%, 97.0%, 2.3%, and 3.0%, respectively.

Nayar et al evaluated the Bethesda criteria by retrospective conversion of old cytopathologic terms to fit the Bethesda criteria in 5194 interventional radiology-performed FNA biopsies resulting in 986 (19%) resected nodules [35]. FNAs were 5% unsatisfactory, 64% benign, 18% AUS/FLUS, 6% SFN, 2% suspicious for malignancy, and 5% malignant. Surgically resected nodules were malignant in 9%, 2%, 6%, 14%, 53%, and 97%, respectively. These three studies all concluded that the Bethesda classification system appropriately risk stratified patients preoperatively.

A final group analyzing the Bethesda criteria, Faquin et al, specifically focused on the AUS/FLUS and SFN categories in 857 cases from two academic centers [36]. This study was performed under the premise that including all follicular patterned thyroid lesions in one diagnostic category leads to unnecessary surgeries, and splitting FNAs into AUS/FLUS and SFN may more appropriately risk-stratify patients and influence surgical management. Further, FNAs with AUS/FLUS cytology should be minimized and FNA should be repeated rather than automatically managing these nodules surgically. 273 out of 509 patients with AUS/FLUS cytology on FNA biopsy underwent surgery. Excluding papillary microcarcinoma, 19% of lesions were malignant. Repeat FNA influenced management in this group of patients; when patients with repeat FNA were compared to patients without repeat FNA, 43% versus 60% of

patients underwent surgical excision of their nodules. 251 out of 348 patients with SFN cytology on FNA biopsy underwent surgery, and 25% were malignant.

Controversy exists for the use of FNA in nodules greater than 4 cm. It has been proposed that larger nodules are more frequently malignant, and that false-negative FNAs are more common in larger nodules [3, 23]. Accurate diagnosis is especially important in larger nodules due to the positive correlation of increasing recurrence and mortality with malignant nodules of increasing size [37].

McCoy et al [31] first studied false-negative FNA biopsy rate of larger nodules. Nodules greater than 4 cm in diameter were more often associated with malignancy than their smaller counterparts, though an analysis of 223 nodules showed the difference to be statistically insignificant. The false-negative rate of FNAs on large nodules was 13% in this study.

Pinchot et al [23] argued that thyroid nodules 4 cm or larger should all be surgically removed due to unacceptably high false-negative FNA biopsy rates. 155 patients who received surgery for thyroid nodules 4 cm or greater were studied. 132 (85.2%) nodules were benign, 21 (13.6%) were malignant, and 2 (1.3%) contained a single focus of micropapillary thyroid carcinoma in the nodule. 97 (62.5%) patients underwent FNA; 58 (37.4%) did not. False-negative result rate, including nodules with micropapillary thyroid carcinoma, was 8%.

On the other side, Porterfield et al [2], argued that nodules with benign FNA, even if 3 cm or larger, should not receive surgical intervention. 696 FNAs of nodules greater than or equal to 3 cm were studied, 145 of which received surgery, and 551 of which were followed up without surgical intervention. Only one patient in the second group was later found to have malignancy. Though the majority of the patients did not have surgical histology, this study reported a false-negative FNA rate in nodules greater than or equal to 3 cm as 0.7%.

Yoon et al [26] proposed that false-negative FNAs were prevalent in larger nodules (> 3 cm) because large nodules harbored eccentric malignant foci of papillary thyroid carcinoma that were often not sampled, and the FNA of the surrounding tissue of these foci in the nodule was negative. 206 nodules underwent FNA biopsy and surgical removal. An additional 455 nodules with benign FNA did not receive surgical intervention. Of the total 661 nodules, including those that did not undergo surgery, 88.8% were benign and 11.2% were malignant; false-negative rate was reported as 2%, sensitivity was 96.7%, specificity was 85.9%, positive predictive value was 76.6%, negative predictive value was 98.2%, and accuracy was 89.4%.

Mazzaferri et al [38] studied the utility of FNA in smaller thyroid nodules. Based on their data, the authors concluded that FNA should not be performed on thyroid nodules less than 5 mm in diameter because those nodules had an unacceptably high rate of non-diagnostic FNA. The authors suggest following this group of patients with serial US exams rather than performing FNA biopsy to monitor for growth or other suspicious change over time.

Last, Bohacek et al [21] performed a size subanalysis of 1000 nodules, 451 of which underwent surgical resection. There was no statistically significant difference in risk of malignancy or increased rate of false-negative FNA with increasing nodule size. Nodules less than 1 cm paradoxically had a higher rate of malignancy, but difference was not statistically significant.

Reported accuracy of FNA obviously varies between different studies and medical groups. Some papers have explored discrepancies in diagnostic accuracy and treatment plans.

Surgeon-performed FNA

Surgeon-performed FNAs offers potential benefit due to familiarity of in vivo anatomy and surgical perspective [19]. Al-Azawi et al [20] performed a 3-year retrospective comparison of US-guided FNAs performed by endocrine surgeons and by radiologists. Data is based on both nodules that received surgery (31% in the surgeons' group and 13.7% in the radiologists' group) and patients who received follow up with serial imaging. FNA inadequacy rate was 5.3% for the surgeons and 9.3% for the radiologists. The sensitivity, specificity, and false negative result rates of FNA for the endocrine surgeons was 87%, 98%, and 3%, respectively, while that for the radiologists was 88%, 95%, and 3.5%.

Additionally, patients with thyroid cancer had a shorter time from FNA to surgery in the endocrine surgeons' group (mean 15.3 days) compared to the radiologists' group (mean: 53.3 days).

Karadeniz et al evaluated patients who received thyroid US by a radiologist prior to surgeon-performed US-guided FNA. The study found the surgeon's diagnosis altered treatment in 30 (5.5%) patients; however, this comparison is likely influenced by the fact that the radiologists were analyzing nodules based on ultrasonographic characteristics and without any cytopathologic data [19].

Discrepancies in diagnosis may also occur due to interpretation of thyroid FNA cytology by different pathologists. Wang et al [12]. questioned the diagnostic accuracy of benign FNA cytopathology upon finding malignant surgical pathology in 11% of surgically removed thyroid nodules with benign cytology on FNA biopsy. Interestingly, this study also found a statistically significant difference in false-negative FNA results between community (10%) and academic centers (2%) based on a meta-review of 11 reports including 8937 FNA biopsies. Finally, FNA cytopathologic analysis was compared between community and expert pathologists and between expert pathologists to examine variability in cytopathologic reporting as a possible contributing cause to false-negative results. Community and expert pathologists disagreed on specific cytopathologic subtype in 37% of cases and whether the nodule was benign or malignant in 11% of cases. Two opposing experts disagreed on specific cytopathologic subtype in 33% of cases and whether the nodule was benign or malignant in 8% of cases. When the two experts conferred, they disagreed in only 3% of all cases.

Thyroid microcarcinomas

Finally, thyroid microcarcinomas have been a recent topic of controversy, especially regarding appropriate management. Traditionally, FNA is recommended for nodules greater than 1 cm due to low risk of malignancy in smaller lesions [18]. Recent studies, however, have suggested FNA sampling of lesions less than 1 cm in diameter if there is increased suspicion of malignancy due to family history of thyroid cancer, personal history of radiation exposure (specifically to the head, neck and chest), suspicious cervical lymph nodes, or suspicious characteristics on US. Microcarcinomas, defined as malignant lesions < 1 cm in size and found incidentally, continue to increase in prevalence worldwide [39-41].

Interestingly, increasing prevalence of thyroid cancer worldwide is in large part attributed to increased detection of microcarcinoma. Elisei et al [41] sought to analyze the changing trends in thyroid carcinoma detection and studied 4187 patients with thyroid carcinoma from a single Italian institution by comparing them as two groups: those diagnosed between 1964 and 1989, and those diagnosed between 1990 and 2004. Not only had the incidence of microcarcinoma increased from 8% in the first group to 17% in the second group, but overall prognosis of the patients in the second group was better. Patients in the second group had smaller tumors detected at less advanced stages. 7.9% of the first group had tumors < 1 cm as compared to 28.7% of the second group, and 17.4% of the first group had tumors > 4 cm compared to 11.8% of the second group. The second group also had less suspicious cervical lymph nodes on preoperative US than the first group, less LN metastases, and less distant metastases: 7% versus 17%, 34.2% versus 22.4%, and 5.4% versus 2.0%, respectively. From these data, the authors dispute the relevance of increased prevalence of thyroid carcinoma given earlier detection and better prognosis.

Management for microcarcinoma was studied by Ito et al [40], who compared patients with micropapillary thyroid carcinoma: 1055 patients who underwent immediate surgery and 340 patients who were observed non-surgically, for an average of 74 months. Of the observed group, 31 patients (9.1%) showed nodule enlargement, and enlargement by 3 mm or more at 5 and 10 year follow up was observed in 6.4% and 15.9% of patients, respectively. Novel LN metastasis was observed in 1.4% and 3.4% of the observed group at 5 and 10 years, respectively. 109 of the 340 observed patients eventually underwent surgery, and no patients had recurred at the time of publication. Of the patients in the original surgical group, 32 out of 1055 patients recurred and 2 patients, both of whom had clinically apparent lateral LN metastases at the time of presentation, died due to

disease. The authors concluded that patients without adverse prognostic features with micropapillary thyroid carcinoma can be observed safely without immediate surgery.

Less aggressive management of microcarcinoma is also supported by a retrospective study using data from 1985-1998 in the American College of Surgeons National Cancer Data base [37]. Bilimoria et al demonstrated that papillary thyroid cancers < 1 cm in size were less aggressive than their larger counterparts with significantly less chance of recurrence and higher survival rates. In tumors < 1 cm, there was no difference in recurrence or survival between total thyroidectomy and lobectomy. Conversely, total thyroidectomy, as compared to lobectomy, did significantly increase survival benefit and decrease risk of recurrence in patients with malignant thyroid neoplasms > 1 cm by 31% and 15%, respectively.

Noguchi et al [42], however, advise more definitive management of micropapillary carcinomas. Of 2070 patients with micropapillary thyroid carcinoma, one patient experienced a lung metastasis and four patients experienced bone metastases post operatively. Four additional patients presented with lung metastases after their first episode of recurrence. The authors caution that microcarcinoma may behave more aggressively than some believe and that there may in fact be little difference between the behavior or micropapillary carcinoma and papillary thyroid carcinoma. Based on these data, the authors recommend long term follow up with US-imaging in patients with microcarcinoma.

Thyroid microcarcinoma continues to be an ill-defined subject and more data is needed to better categorize and manage these lesions, especially as they continue to be more frequently detected and at earlier stages.

Conclusion

FNA has a low false-negative rate for diagnosis of thyroid malignancy; however, controversy exists regarding the accuracy of FNA for nodules smaller than 1 cm or greater than 4 cm. Surgeon-performed US-guided FNA interpreted in academic centers may result in superior diagnostic accuracy and improved patient care. Appropriate management of thyroid microcarcinoma remains a topic of debate.

Acknowledgments

This work was fully supported by Tulane University and Tulane University Hospital.

Disclosure of conflict of interest

None.

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