COMPARATIVE STUDY OF FNAC AND FNCC IN CORRELATION WITH HISTOPATHOLOGY OF THYROID SWELLING IN OUR INSTITUTION

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ABSTRACT

BACKGROUND

Thyroid gland is unique among endocrine organs. It is the largest endocrine gland in the body and the first to develop in foetal life. Thyroid nodules are very frequent. It is estimated 4-7% adults have palpable enlargement of thyroid and 10 times more have impalpable nodules. Most of them are benign and fewer than 5% are actually malignant. A multitude of diagnostic tests like ultrasound, thyroid nuclear scan, Fine Needle Aspiration Cytology (FNAC) and many more are available to evaluate goitre. Final diagnosis requires morphological examination of lesions for which FNAC and Histopathological Examination (HPE) becomes mandatory test. FNAC is considered the gold standard in evaluation of thyroid swelling.(1) It is a simple, cost effective, readily repeated and quick to perform procedure in the outpatient department, with excellent patient compliance. However, it is not without limitations related to specimen adequacy, sampling techniques, skill of performing the aspiration. Fine needle biopsy can be performed with or without aspiration. Advocates for the non-aspiration (Zajdela) technique believe that grasping the needle hub directly improves operator sensitivity in placing the needle tip within a small lesion. It is believed that less bleeding occurs with the non-aspiration technique, an advantage in the biopsy of more vascular tissue such as the thyroid gland.(2)

OBJECTIVES

To derive conclusions on the Sensitivity, Specificity, Positive predictive value and Negative predictive value of FNCC in thyroid swelling in our hospital. To compare the two techniques in terms of diagnostic adequacy and quality of smear obtained, especially with regard to malignant smears.

METHODS

All patients with thyroid swelling treated by the surgical units of Government Rajaji Hospital, Madurai either as outpatients or inpatients during the above study period were randomly divided into two groups. For one group, cytology smear was obtained by aspiration technique, and for the other group the smears were obtained by non-aspiration technique. The relevant clinical details of these patients were also obtained for the purpose of the study.

RESULTS

In our study, age and sex distribution was statistically analysed between the two groups and was found to be equally distributed between the two populations (p values for age and sex distribution were 0.858 and 0.488 respectively between the two populations). It was observed that the non-aspiration technique yielded more diagnostically superior specimens, as compared with FNAC. The number of unsuitable smears was also greater in aspiration samples, as compared with the non-aspiration technique. The difference was statistically significant (p=0.005). In our study, no significant difference between the performances of these two techniques was noted, with respect to making a cytological diagnosis of thyroid swellings.

CONCLUSION

Although no significant difference was seen in the efficacy and diagnostic accuracy of the two techniques in evaluation of thyroid swellings, the non-aspiration technique (FNCC) is simple, easy to perform and produces better results in the form of a better quality of the cellularity and less field obscurity by blood in both neoplastic and non-neoplastic lesions of the thyroid. It has significantly less chances of producing non-diagnostic smears. The technique is free of complications and very much comfortable to the patient.

KEYWORDS

FNAC, FNCC, Cytodiagnosis, Histopathology.

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INTRODUCTION: Thyroid gland is unique among endocrine organs. It is the first gland to develop in foetal life and the largest endocrine gland in our body. The term 'Thyroid' (Greek thyroideis, shield shaped) was given by Thomas Wharton (1614-1673) London, UK. He named it as Glandularis thyroideis (1656) in his book "Adenographia." After diabetes mellitus, the thyroid gland is the most

common organ to cause endocrine disorders, having the spectrum of disease from simple goitre to malignancy or even systemic disease (Grave's Disease). The thyroid gland has the longest phylogenetic history among all endocrine organs, being present not only in all vertebrates but also in protochordates and ascidians. Main purpose of this gland is to produce and store thyroid hormones, which are involved in many basic fundamental process such as body growth, differentiation and thermogenesis. The key element involved in regulating the process is TSH (Thyrotropin-Releasing hormone) secreted by hypothalamus.

Disease of thyroid gland are of great importance because they are relatively common in general population and most are amenable to medical or surgical management. They include hyperthyroidism, hypothyroidism and focal or diffuse mass lesion of the thyroid gland. A list of diagnostic tests are available like Ultrasonogram, FNAC, Thyroid nuclear scan and many more are available to evaluate goitre. But for final diagnosis requires morphological examination of lesion for which FNAC and post-operative HPE becomes mandatory tests. FNAC is defined as a fine needle aspiration to take a sample of cells from a doubtful lesion for making cytological diagnosis.[3] Thyroid cytology-Fine Needle Aspiration Cytology (FNAC) was proven as an effective first-line diagnostic tool to evaluate the thyroid lesions because of its cost effectiveness and high patient acceptance.

FNAC is considered as the gold standard in evaluation of the thyroid swelling and it has high sensitivity and specificity in categorising patients with thyroid nodules into operative and non-operative groups.[1] So that one can make decision regarding the management of the particular patient. It can be performed quickly and safely in the outpatient department without the need for local anaesthetic. So, as small as 1 cm and even smaller if the nodule is accessible can be sampled. Skill in interpreting FNAC specimens is readily acquired by qualified cytopathologists after study of reference material and the acquisition of reasonable experience.[2] The benefits of FNAC can be concluded with the acronym SAFE because it is Simple, Accurate, Fast, and Economic.

However, FNAC is not an ultimate diagnostic tool in regards to histopathology of the specimen after surgery. Instead, it should be considered as a crucial component of the pretreatment study of pathological processes in correlation with clinical, radiological, and other laboratory data. FNAC; however, it has demerits regarding adequacy of the specimen, sampling techniques, operator performance in doing the aspiration technique, interpretation of the aspirate and overlapping cytological features between benign and malignant follicular neoplasm and also in the detection of some papillary carcinomas because of associated thyroid pathology including multinodular goitre, thyrotoxicosis and marked cystic changes.[4]

Fine needle biopsy can be performed with or without aspiration. Both techniques are described here. The more commonly used method is FNAC which uses syringe-created negative pressure as well as the shearing effect of the needle to collect material from the biopsied lesion whereas Zajdela et al explained a technique in which only a bare fine needle without suction was used to obtain material from the target lesion. This non-aspiration technique, also called the Zajdela (Pronounced zidel-a) or FNCC, relies on capillary action to draw the sheared cells within the small-calibre needle.

Method of Fine needle capillary cytology described as that having the needle hub directly with the hand improves operator sensitivity in placing the needle tip within a small lesion as compared to FNAC. It was believed that minimal bleeding occurs with fine needle capillary cytology technique, an advantage in the biopsy of more vascular tissue such as the thyroid gland.[5]

Fine Needle Biopsy: Selection of Needle: Twenty-five-gauge, 1/2–inch needles produce excellent specimens and are less likely to cause bleeding that dilutes specimens and thereby greatly reduces their usefulness.[6] The ease with which bleeding is induced depends not only on needle size but also on the structure of the nodule. Occasionally, 22 or 23 gauge needle may be best for particularly hard papillary carcinomas and other fibrotic nodules. Larger needles (23 Gauge) may be used to drain cysts, followed by reaspiration of any remaining solid areas with a 25-gauge needle.

Positioning of the Patient: The patient lies supine, with a pillow kept beneath the shoulders so that neck comes to extension and then asked not to talk or swallow while the needle is in the neck.[7] The skin is cleaned with alcohol.

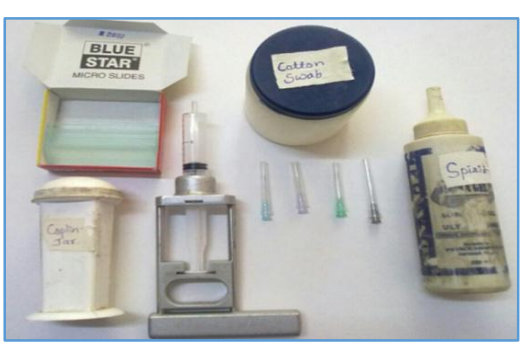
Approach: The operator stands on the side of the patient opposite to that of the thyroid nodule. Present protocol strictly says to use gloves because of concern about blood-borne diseases. The finger of one hand used to fix the nodule, and the needle in the other hand is inserted perpendicular to the anterior surface of the neck. The angle of approach is medial to lateral, placing the needle below the strap muscles and in front of the trachea, making short, rapid strokes with only slight changes in direction.

Specimen Adequacy: Several factors influence non-diagnostic rates for fine needle biopsy results including the skill of the operator, vascularity of the nodule, criteria used to judge adequacy of the specimen, and the cystic component of the nodule. Studies have shown average insufficiency rates in the 15% to 20% range. The non-diagnostic thyroid aspirate can pose a dilemma in clinical management, with cancer rates of 4% to 9% among non-diagnostic thyroid fine needle biopsies. On-site microscopic assessment, with reaspiration when necessary, can minimise the number of inadequate specimens. Reaspiration yields satisfactory specimens in at least 50% of cases that are considered inadequate for making diagnosis on initial fine needle biopsies. Although it has been suggested that more aspirations will increase the diagnostic rates, in general four to five passes through the gland per nodule is recommended.

While it is generally agreed that the presence of follicular cells is a minimum requirement for thyroid cytology adequacy, the absolute number of cells is subject to debate. Some authors propose adequacy criteria of four to five groups of well-preserved follicular cells, with each group containing ten or more cells. Others require eight to ten fragments of well-preserved follicular cells on at least two smears. To increase chances of adequate cellular material, at least six separate specimens that appear grossly satisfactory are necessary. Preferably, the aspirates should be obtained from the peripheral areas and different parts of the nodule, in a sequential manner, to ensure representative sampling.[8] For larger nodules, the deep centres of the mass should be avoided because it is more likely to contain degeneration and fluid, decreasing the chance of a diagnostic specimen. For cystic lesions, the fluid should be completely aspirated and fine needle aspiration attempted on residual tissues.

Fine Needle Aspiration Cytology (FNAC): A 10-mL syringe is used, the plunger is withdrawn about two thirds of the way to produce negative pressure, and one looks for fluid in the needle hub. At the first appearance of fluid, negative pressure is released and the needle withdrawn. No fluid should enter the syringe. If this happens, the specimen will be too dilute and may be lost in the syringe. Materials may appear in the syringe if too large a needle is used, if negative pressure is too vigorous, if the nodule is extensively degenerated or unusually vascular, or if the nodule is cystic. For the first two possibilities, adjustments can be made to improve the chances for success with subsequent punctures.[9] The last two situations are beyond control, although it may help to insert the needle at the nodule periphery, where degeneration is less likely.

The initial aspiration may produce no specimen if the needle is not in the nodule, if the nodule is too fine, if negative pressure is not vigorous enough, or if the nodule is fibrotic. If negative pressure fails to produce fluid, the simplest method to disrupt the tissue is to move the needle in and out within the nodule through a vertical distance of 1 to 2 mm. This manoeuvre nearly always yields a specimen, but if not, one can combine in and out movements with rotation of the needle, to sever small tissue fragments. If the nodule is purely cystic, it will collapse with aspiration. If there is solid component, fine needle biopsies should be taken from any residual mass. Examining the sediment from cyst fluid rarely yields useful information.



Materials Required for the Fine Needle Biopsies

FNAC

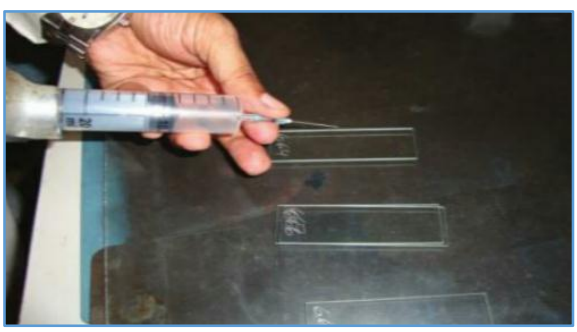
FNCC

Fine Needle Capillary Cytology (FNCC): It relies on the property of capillary tension in narrow channels. This physical principle states that a fluid (or Semi Fluid Substance) will ascend spontaneously into a narrow tube in inverse proportion to the diameter of that tube. The needle is held in a pencil grip, which facilitates precise needle placement for small nodules, and allows the needle to be moved both in and out over a few millimetres and rotated. This combined motion uses the bevel of the needle for cutting, which frees cells that flow into the needle by capillary action while the needle is held steady for about 10 seconds. Material entering the hub of the needle is readily visible.

Smear Preparation: Slides are labelled and placed on the table before aspiration, ready for use. Five millilitres of air is aspirated into the syringe, and the needle placed on the syringe. With needle bevel pointing down, one drop of aspirated material is expelled onto each of several glass slides. A grossly satisfactory fine needle biopsy specimens consists of a small amount of red-orange fluid. Smears are prepared in a manner similar to that for blood smears, in which a second slide is held at a 45- to 60-degree angle to the specimen on an underlying slide. Then, the specimen is allowed to spread out along the edge of the upper slide, which is then advanced along the lower slide, drawing the specimen into a smear. This method may produce thick, uneven smears.

The following alternative manoeuvre produces flat on the bottom, specimen slide, and, with the index finger, the top slide is pressed down onto the specimen and drawn over the bottom slide. Slides are then immediately wet-fixed by placing them in alcohol bottle. Air-dried smears are often prepared with a Romanowsky stain.

Some pathologists use air-dried smears stained with a modified Romanowsky stain called May-Giemsa-Grunwald (MGG) stain, which enhances cytoplasmic detail, but one research study described a mutation in the thyroid-stimulating hormone receptor gene in autonomously functioning thyroid adenomas, using RNA obtained by fine needle biopsies as a template for complementary DNA synthesis, followed by polymerase chain reaction amplification.



Smear Preparation

ANCILLARY STUDIES: Effective criteria for the cytological diagnosis of thyroid lesions are well established, yet areas of diagnostic uncertain remain. This has led to a search for useful markers of thyroid malignancy that can be applied to cytologic specimens. Studies of Vimentin, lectins, and different molecular weight cytokeratins as indicators of thyroid malignancy have met with only limited success, particularly in cytologic material. More promising results were reported in studies describing the immunodetection of the enzyme thyroperoxidase (TPO) in fine needle aspirates of thyroid malignancies. CD44, lactoferrin, and HBME-1 are other markers with specificity for thyroid malignancies in preliminary studies.

Sequelae of Thyroid Fine Needle Biopsies: A range of tissue effects has been described in thyroid resections following fine needle biopsies. The observed tissue alterations are grouped into acute (Within 3 weeks of Fine Needle Biopsies) and chronic categories. The acute changes include hemorrhage, granulation tissue, giant cells, hemosiderin-laden macrophages, necrosis, and, rarely, infarction. Among the chronic changes are various types of metaplasia (oncocytic, spindle cell, and squamous), linear fibrosis, Infarction, pseudo-invasion of the capsule, random nuclear atypia, and papillary degeneration. In a comprehensive review of 3,000 thyroidectomies, LiVolsi and Merino observed post-fine needle biopsy changes in 300 cases. Others have reported similar rates of tissue damage. These reports highlight the critical importance of providing information on prior fine needle aspiration procedure and the cytological diagnosis to the pathologist handling subsequent tissue samples of a thyroid nodule.[10]

Limitations of Thyroid Needle Biopsy: The principle limitations is inexperience, both in obtaining adequate specimens and in interpreting the specimens. Fine needle biopsies are not applicable to all nodules.

Some are too small and too inaccessible for accurate needle placement, or too far down in the chest to be aspirated safely. Others are so degenerated that useful material cannot be obtained. Several authors have discussed the problem of follicular neoplasm. Kini believes that follicular adenomas and follicular carcinomas usually can be differentiated on the basis of nuclear size, but Hurthle cell lesions are problematic to diagnose cytologically. Other pathologists maintain that benign and malignant follicular/Hurthle cell tumours cannot distinguished on the basis of aspirated cells only as it requires the demonstration of vascular or capsular invasion and the lesion must be removed for histopathological examination.

Recent studies suggest that immunohistochemical and genetic markers may be useful in improving diagnostic accuracy in this group. Two such markers, HBME-1 and galectin-3, have shown most promise. Hypercellular specimens from follicular or Hurthle cell lesions may have features suggestive of, but diagnostic for, malignancy. Thus the cytopathologist labels these "suspicious for malignancy" because cytological features neither confirm nor rule out malignancy. Histological examination is necessary for definitive diagnosis. Finally, fine needle biopsies of benign for one nodule says nothing about other nodules, whether palpable or impalpable.

Potential Complications of Needle Biopsy: Occasionally, there is a local haematoma after Fine needle biopsies. An ice pack is adequate treatment. Rarely, the entire gland swells actually; this spontaneously resolves within 24 to 48 hours. The use of anticoagulants or salicylates does not preclude fine needle biopsies. Seeding a malignancy in the needle track has been reported very rarely after large needle biopsies, but had no unfavourable impact on prognosis. Although fine needle biopsies, like an ordinary venepuncture, is a clear rather than strictly sterile procedure, infection has not been reported with thyroid fine needle biopsies.

If the needle enters the trachea, which occasionally happens when a medially situated nodule is sampled, the specimen consists of mucus and air, and the patient may cough, but no harm is done. If a serum thyroglobulin measurement is desired, it should be done on blood drawn either before or at least 10 to 14 days after thyroid fine needle biopsies because the serum thyroglobulin concentration can increase substantially after fine needle biopsies. The social and legal consequences of false-positive or false negative diagnosis are of concern.

AIM OF THE STUDY:

AIM: To compare FNAC and FNCC in correlation with HPE in terms of diagnostic accuracy of thyroid swelling.

OBJECTIVE:

1. To derive conclusions on the Sensitivity, Specificity, Positive predictive value and Negative predictive value of FNAC in thyroid swelling in our hospital.

2. To compare the two techniques in terms of diagnostic adequacy and quality of smear obtained, especially with regard to malignant smears.

Inclusion Criteria:

1. All patients admitted in general surgery ward with thyroid swelling.
2. Patients who gave consent for inclusion in the study according to designed Proforma.

Exclusion Criteria:

1. Patients who are not willing to give consent.
2. Patients who are not undergoing surgery.

MATERIALS AND METHODS: The study was undertaken in the Department of General Surgery and the Department of Pathology, Madurai Medical College, Madurai, Tamilnadu, India for a period of 12 months, from September 2014 to August 2015. The design of the study was cross sectional diagnostic test evaluation. All patients with thyroid swelling treated by the surgical units of Government Rajaji Hospital, Madurai either as outpatients or inpatients during the above study period were randomly divided into two groups.

For one group, cytology smear was obtained by aspiration technique, and for the other group the smears were obtained by non-aspiration technique. The relevant clinical details of these patients were also obtained for the purpose of the study. 25 gauge, one and half inch needles were used for obtaining smears by both aspiration and non-aspiration techniques (10 mL syringes were used for aspiration technique). Smears were fixed in 95% alcohol for Papanicolaou and haematoxylin & eosin staining. All the smears were obtained by a single observer. The smears were reported by cytopathologist, blinded to the technique employed.

All the smears in both the category, which had the corresponding postoperative histopathological diagnosis, were included for the study purpose. This amounted to 54 smears in the FNAC group and 45 smears in the FNCC group. For histological examination, specimens were fixed in formalin with H&E and PAP stains. Special stains were used as and when required (Congo red for demonstration of amyloid in cases of medullary carcinoma). The cytological smears were classified into one of the six categories for diagnostic purpose by the cytopathologist. In addition, the smears were classified into one of the three categories described below with regards to the quality of smear by the cytopathologist.

The cytology diagnosis were tabulated with respect to the corresponding postoperative histopathology diagnosis in both categories and the efficacy of cytology smear interpretation in relevance to diagnosis of thyroid swelling, in particular the malignancies were evaluated by specific parameters namely sensitivity, specificity, accuracy, percentage of false negatives and false positives.

SUMMARY:

1. Total number of cases studied – 99.
2. 58.8% of the cases were benign lesions, whereas malignancies accounted for 41.2% of the cases.
3. Most common histological diagnosis was follicular adenoma (42.6%).
4. Papillary carcinoma (28.8% of all the cases) was the most common among the malignancies.
5. Male to female ratio – 1:7.25, females constituted 88% of total cases; the male to female ratio for malignancies was 1:4.
6. Malignancies account for 68% of histological diagnosis in males and 38% in females.
7. Overall, thyroid swelling was more common in the 21 to 30 years age group.
8. Benign lesions were more common in the age group of 21 to 30 years, whereas malignancies were more common in the age group of 31 to 40 years.
9. Sensitivity and specificity of FNAC were 93.33% and 83.33% whereas those for FNCC were 93.33% and 83.33% respectively.
10. Overall, the diagnostic accuracy of FNAC and FNCC for malignancy of thyroid were observed as 90.48% and 90.48% respectively.
11. For both benign and malignant smears, more number of diagnostically superior smears were obtained with FNCC (44.59% overall) when compared to FNAC (16.26%).
12. Among the malignant smears, 17.5% were diagnostically superior in the FNAC group whereas the same for the FNCC group was 41.3%.
13. The inadequate smears constituted 14.18% and 2.02% of the total number of smears respectively for FNAC and FNCC.

DISCUSSION: The thyroid gland was selected for the study of FNCC, as it is a vascular organ that frequently produces heavily blood stained aspirates. Furthermore, many diagnostic pitfalls exist in the interpretation of thyroid specimens, making excellence of cellular material a prerequisite for diagnosis. In our study, age and sex distribution was statistically analysed between the two groups and was found to be equally distributed between the two populations (p values for age and sex distribution were 0.858 and 0.488 respectively between the two populations).

In our study, it was observed that the FNCC (Non-aspiration technique) yielded more diagnostically superior specimens, as compared with FNAC. The number of unsuitable smears was also greater in aspiration samples, as compared with the non-aspiration technique. The difference was statistically significant (p=0.005). In our study, no significant difference between the performances of these two techniques was noted, with respect to making a cytological diagnosis of thyroid swellings. Although the presence of blood cannot be entirely prevented in thyroid cytology samples, its effect on smear quality is minimised by the spontaneous capillary action of the non-aspiration technique as opposed to the active, often high suction pressures of conventional FNAC procedures. The cellular material is more concentrated, less traumatised and less obscured by blood or distorted within blood clots in the non-aspiration smears.

It also offers many other advantages. Fewer patients complain of pain or discomfort. The technique is simple, easy to perform and enables an enhanced appreciation of the consistency of the mass being sampled. No complications were encountered in any of the patients sampled by the non-aspiration technique. The only disadvantage being acellularity, was noticed in one patient in our study. Thus, the diagnostic accuracy of thyroid cytology in interpretation of malignancy primarily depends on various other factors irrespective of the technique employed being Aspiration or Non-aspiration.

CONCLUSION: Although no significant difference was seen in the efficacy and diagnostic accuracy of the two techniques in evaluation of thyroid swellings, the non-aspiration technique has got its own merits. The non-aspiration technique is simple, easy to perform and produces better results in the form of a better quality of the cellularity and less field obscurity by blood in both neoplastic and non-neoplastic lesions of the thyroid. It has significantly less chances of producing non-diagnostic smears. The technique is free of complications and very much comfortable to the patient. Adhering to a set of guidelines would serve to improve the accuracy of cytodiagnosis irrespective of the technique and enables better evaluation and management of thyroid swellings.

REFERENCES

1. Gharib H. Changing concepts in the diagnosis and management of thyroid nodules. Endocrinol Metab Clin North Am 1997;26(4):777-800.
2. Mazzaferri EL. Management of a solitary thyroid nodule. N Engi I Med 1993;328(8):553-559.
3. Burch HB. Evaluation and management of the solid thyroid nodule. Endocrinol Metab Clin North Am 1995;24(4):663-710.
4. Daniels GH. Thyroid nodules and nodular thyroids: a clinical overview. Compr Ther 1996;22(4):239-250.
5. Gharib H. Fine-needle aspiration biopsy of thyroid nodules: advantages, limitations, and effect. Mayo Clin Proc 1994;69(1):44-49.
6. Solomon BL, Wartofsky L, Burman KD. Current trends in the management of well differentiated papillary thyroid carcinoma. J Clin Endocrinol Metab 1996;81(1):333-339.
7. Lowbagen T, Willems JS, Lundell G, et al. Aspiration biopsy cytology in diagnosis of thyroid cancer. World J Surg 1981;5(1):61-70.
8. Zajdela A, Zillhardt P, Voillemet N. Cytological diagnosis by fine needle sampling without aspiration. Cancer 1987;59(6):1201–1205.
9. Zollinger JEC, Ruth G. Non aspiration fine needle cytology: in nodular thyroid disease. Acta Cytol 2008;42(3):343-346.
10. Redman R, Zalaznick H, Mazzaferri EL, et al. The impact of assessing specimen adequacy and number of needle passes for fine-needle aspiration biopsy of thyroid nodules. Thyroid 2006;16(1):55-60.