



**Joint Symposium of the Working Group of Asian Thyroid FNA Cytology
25th Thai-Japanese Workshop in Diagnostic Cytopathology**



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PROGRAM

January 19th, 2018, 13:00-15:30

Welcome to the 2nd Joint Symposium of the Working Group of Asian Thyroid FNA Cytology
S. Rangdaeng (Thailand)

Session I. Co-Chairs: *S. Keelawat (Thailand)* and *S.W. Hong (Korea)*

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K. Kakudo (Japan)
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- Oral 3 A survey of current thyroid cytology practice in Taiwan
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- Oral 4 Histopathological review of diagnostic categories of the Bethesda system for reporting thyroid cytopathology – An institutional experience of five years
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Session II. Co-Chairs: *S. Rangdaeng (Thailand)* and *C.R. Lai (Taiwan)*

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- Oral 7 Diagnostic impact of BRAF testing in thyroid FNA
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- Oral 9 How the introduction of NIFTP has changed our practice – Results of survey by the Working Group of Asian Thyroid FNA Cytology
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- Oral 11 Evaluation of follicular patterned lesions “including oncocytic” by FNA based on the new WHO classification
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A. Salillas (Philippines)
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T. Hayashi (Japan)

Discussion

Closing remarks

S. Keelawat (Thailand)

Organizers:

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Oral 1

The Working Group of Asian Thyroid FNA Cytology: Recent achievements, current activities, and prospective directions

Kennichi Kakudo

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The Working Group of Asian Thyroid FNA Cytology was established and had the first face to face meeting at the AOTA Congress in Busan, Korea in 2017. Twenty five members from 11 countries (China, India, Indonesia, Japan, Korea, Nepal, Philippines, Taiwan, Thailand, Turkey and Vietnam) have joined this activity as of November, 2017. Since 2016, some of our members started group activities in publication as listed below:

1. Thyroid FNA Cytology, Differential Diagnoses and Pitfalls. Editors, Kakudo K, Liu Z, Hirokawa M, S&S Publications, Maryland, 2016, distributed by *Smashwords* and print edition distributed in 2016 by *BookWay Global*.
2. Nine articles by our members were published in the Journal of Pathology and Translational Medicine, as a special issue (November 2017) on the current practices of thyroid FNA cytology in Asian countries.
3. Several authors contributed to a special NIFTP issue of the Journal of Basic and Clinical Medicine.
4. More original multi-institutional studies and reviews were published in well-recognized international journals:
 - Bychkov A, Hirokawa M, Jung CK et al.: Low rate of noninvasive follicular thyroid neoplasm with papillary-like nuclear features in Asian practice. *Thyroid* 2017; 27:983-984.
 - Kakudo K, Higuchi M, Hirokawa M et al.: Thyroid FNA cytology in Asian practice – Active surveillance for indeterminate thyroid nodules reduces overtreatment of thyroid carcinomas. *Cytopathology* [Epub ahead of print].
 - Bychkov A, Keelawat S, Agarwal S, et al. Impact of noninvasive follicular thyroid neoplasm with papillary-like nuclear features on risk of malignancy for the Bethesda categories: A multi-institutional study in five Asian countries. *Pathology* (in press).

From this experience, we are confident to achieve more good collaborations in 2018. The following are current group projects conducted by our members:

1. Validation study on papillary carcinoma type nuclear features (Z. Liu, China).
2. Hurthle cell lesions in Asian practice (D. Jain, India).
3. Validation study on capsular invasion (J.F. Hang, Taiwan).
4. Meta-analysis of TBSRTC outputs adjusted with Asian series (A Bychkov, Thailand).

I am looking forward to seeing new achievements and to harvest meaningful results in anticipated publications in 2018. I believe these group efforts will also promote careers of our junior members.

Schedule of future meetings:

1. Joint symposium of the Working Group of Asian Thyroid FNA Cytology during the 25th Thai-Japanese Workshop in Diagnostic Cytopathology (Chiang Mai, Thailand; January 2018). Organizers: S. Keelawat, A. Bychkov, and S. Rangdaeng.
2. A symposium of thyroid FNA cytology will be conducted by our Asian Working Group at the 20th International Congress of Cytology (Sydney, Australia; May 2019).
3. Asian Forum at the 58th Japanese Society of Clinical Cytology Fall Meeting (Okayama, Japan; November 2019). Organizers: M. Hirokawa and K. Kakudo.

Oral 2

Fine-needle aspiration of the thyroid in the Philippines

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Fine-needle aspiration (FNA) is a well accepted diagnostic tool in the initial management of thyroid nodules. Since its introduction for nearly a century, numerous studies have shown its high sensitivity and specificity in the diagnosis of thyroid malignancies. In the Philippines, FNA of the thyroid started thirty years ago and is considered as a mainstay in the management of thyroid diseases. The procedure is performed by pathologists, endocrinologists, surgeons, and radiologists. Cytodiagnostic reporting uses a combination of The Bethesda System For Reporting Thyroid Cytopathology (TBSRTC) and aspiration biopsy cytology method (ABC method) resembling the

histopathologic diagnosis of thyroid diseases. Endocrinologists and surgeons follow the 2015 American Thyroid Association guidelines in the management of thyroid disorders.

Local studies dealt with cytohistologic correlations with wide sensitivity range from 30.7% to 73%, specificity range from 83% to 100%, and accuracy from 72.8% to 87.2%. The low sensitivity was attributed to poor tissue sampling with majority of lesions aspirated by palpation only. Discordant cases were mainly due to sampling errors due to dual pathology with a dominant benign lesion being aspirated and a small focus of malignancy being missed by the aspirationist. The incidence of each diagnostic category using TBSRTC based on two local studies and a survey of sixteen hospitals all throughout the country revealed the following: 0 to 7% for category I, 50% to 85% for category II, 1% to 20% for category III, 1–14% for category IV, 1% to 13.2% for category V, and 2% to 29% for category VI. Overall risk of malignancy for malignant and suspicious for malignancy thyroid nodules was 71.4%, while 26.5% for benign cytodiagnosis. Risk of malignancy for category III ranged from 35.3% to 50% which was higher than the reference rate of TBSRTC. Conveying these rates to our clinical colleagues with recommendation to repeat FNA should be reconsidered for optimal patient care.

Oral 3

A survey of current thyroid cytology practice in Taiwan

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Background: Thyroid cancer is the most common endocrine gland malignancy in Taiwan and fine-needle aspiration (FNA) cytology has been the gold-standard diagnostic tool for thyroid tumors since the 1980s. However, the general statistics of thyroid cytology practice in Taiwan is lacking.

Design: With the support of Taiwan Society of Clinical Cytology, we performed the first national survey on thyroid cytology. The survey questionnaires were sent to 119 cytology laboratories at medical centers, regional hospitals, and private clinical laboratories.

Results: Fifty-five effective questionnaires were collected after one-month answering period. Among these laboratories with a total of 48,940 thyroid FNA cases annually, there were 143 pathologists, 28 endocrinologists, and 32 clinicians other than endocrinologists signing out thyroid cytology reports and 153 cytotechnologists screening thyroid cytology on a routine basis. There were 78% of laboratories using conventional smear method, 18% using liquid based preparation, and 4% using concurrent conventional and liquid based preparations. For the reporting system, 64% of laboratories applied traditional system (negative, atypical, suspicious, and positive for malignancy), 31% adopted the Bethesda System (TBS), and 5% used other unspecified diagnostic systems. For laboratories which reported data corresponding to each TBS diagnostic category (total number of cases – 41,349), the rate of diagnosis, surgical resection, and malignancy for each category were as followed, TBS-I: 24.04%, 1.96%, 15.9%; TBS-II: 68.84%, 4.76%, 11.07; TBS-III: 4.87%, 17.52%, 35.41%; TBS-IV: 0.35%, 44.06%, 49.21%; TBS-V: 0.89%, 53.01%, 80.41%; TBS-VI: 1.02%, 54.39%, 99.13%.

Conclusion: This survey demonstrates high unsatisfactory rate and relatively low indeterminate diagnosis rate in thyroid cytology in Taiwan, and that can be used to communicate with our clinicians or radiologists for better patient selection and specimen sampling and to guide our next continuing education program for indeterminate diagnosis criteria.

Oral 4

Histopathological review of diagnostic categories of the Bethesda system for reporting thyroid cytopathology – An institutional experience of five years

Paricha Upadhyaya¹, Sushil Dhakal¹, Purbesh Adhikari¹, Bindu Adhikari¹, Dibika Khadka¹, Surya Raj Niraula²

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Background: Fine-needle aspiration (FNA) plays a crucial role in the evaluation of patients with thyroid lesions. The Bethesda system for reporting thyroid cytopathology (TBSRTC) was designed with a mission to standardize the process of diagnosis and management of thyroid lesions by FNA cytology. We aimed to see the benefits of adopting TBSRTC, seek the cytological pitfalls in the diagnosis of thyroid FNA cytology and identify the spectrum of thyroid lesions in our set up.

Design: This was a hospital based cross sectional study conducted at B.P. Koirala Institute of Health Sciences, Dharan, Nepal from June

2010 to June 2014 on all thyroid FNA with available histopathology. Cases were designated a specific diagnostic category according to TBSRTC. A total of 109 cases were studied. Sixty eight cases had been reported without using TBSRTC and were reviewed and reclassified according to TBSRTC seeking the common reasons for interpretative errors.

Results: In both pre- and post-TBSRTC era, benign neoplasms constituted the major bulk (62%). After the use of TBSRTC, there was increased ability to look for follicular neoplasms, improvement in making definitive diagnosis of the cases, decline in the suspicious category and an improvement in diagnostic accuracy. Our results were in line with the implied risk provided by TBSRTC in most of the cases except the non-diagnostic category.

Conclusion: Application of TBSRTC results in less interobserver variability among pathologists and better interdisciplinary communication and patient management.

Oral 5

Thyroid FNA in single vs. multiple unit service

Pichet Sampatanukul

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Fine-needle aspiration (FNA) is a first line approach for thyroid nodule assessment, which is acknowledged in the most of international and local guidelines on the management of thyroid nodules and thyroid cancer. Essentially, there are two common platforms of service. The single unit is usually run by endocrinologist or pathologist, who is responsible for all steps including aspiration, smear preparation, and reading of the cytologic slides. The entire process can be accomplished within one hour to serve a one-stop service. However, increased number of patients may significantly delay reading of smears. In this scenario, the single unit approach is less efficient, and the whole workflow of thyroid FNA may benefit from sharing responsibilities among several specialists. The multiple unit setting considers that FNA aspirator and reader of cytology smears is not the same person. There are both advantages and limitations of either system. A key person in the whole workflow is the one who makes management decision based on the results of cytologic diagnosis and ancillary tests.

FNA is a minimal sampling technique, which makes clinical correlation mandatory. Experienced aspirators with validated biopsy performance are eligible for interpretation and management decision. Cytologic readers, if they are not the aspirators themselves, basically just assist to provide cytologic diagnosis. Adherence to certain systematic reporting schemes is important to make a communication between cytologists and clinicians effective. However, it should be noted that cytologic diagnosis alone is not a single decision-making parameter, which should be taken in account by the clinician responsible for management strategy. In certain circumstances, more liberate terminology (e.g., categories of atypical cells and/or neoplastic follicular cells) may facilitate communication between cytopathologist and clinician. On the other hand, inconclusive diagnoses for cyst fluid only, colloid or paucicellular aspirates may cause difficulties for clinician to make explanation to a patient. Dialogue between cytologic reader and aspirator is essential to achieve the best practice standards in thyroid FNA.

Oral 6

Active surveillance for indeterminate thyroid nodules and risk of malignancy

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Despite the fact that Asian thyroid practices have implemented the American Thyroid Association management guidelines for thyroid nodules and thyroid cancer and the Bethesda system for reporting thyroid cytopathology, significant deviations in actual risk of malignancy (ROM) have been reported. With review of the literature, we examined the underlining reasons why actual ROMs reported in Asia are so different from those in Western practice.

The most popular diagnostic system for thyroid cytology used in Asian countries is the Bethesda system. As slight modifications were often applied to fit the different clinical managements of patients with thyroid nodules, the Japan Thyroid Association published clinical

guidelines, including a national reporting system for thyroid cytology, to adapt conservative clinical management for low-risk thyroid carcinomas. Active surveillance and strict triage patients for surgery are the mainstays of this approach. As less aggressive clinical management is favored in Asian societies, low resection rates and high ROMs for indeterminate thyroid nodules were achieved in Asian practices using the same Bethesda system.

Recently, borderline tumors were introduced in the WHO classification of thyroid tumors and significant decreases in ROMs have been reported in the indeterminate categories in Western practice. However, ROMs of indeterminate nodules remained high in Asian practice even after borderline tumors were deemed benign. These results suggested that the diagnostic threshold of papillary thyroid carcinoma-type nuclear features varied among practices, being stricter in the Asian than in Western practice. As a result, diagnostic surgery was not performed for a significant number of indeterminate nodules with benign clinical features in Asian practice, which converted in low incidence of borderline tumors in surgically-treated patients.

Oral 7

Diagnostic impact of BRAF testing in thyroid FNA

Ju Yeon Pyo

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Background: Fine-needle aspiration (FNA) of thyroid nodules is considered a safe and accurate preoperative test and diagnosed as benign to malignant according to The Bethesda System for Reporting Thyroid Cytopathology. About 30% of the thyroid FNA samples are categorized as indeterminate, and the difficulty of diagnosis affects the decision of treatment method and scope of surgery. Hence, ancillary studies and molecular tests including detection of *BRAF*^{V600E} mutation are recommended to make a precise diagnosis of thyroid nodules. According to recently published reports, combined *BRAF*^{V600E} mutation testing with FNA cytology revealed increased diagnostic sensitivity and decreased false negative rate. The purpose of this study was to evaluate the role and efficacy of *BRAF*^{V600E} mutation in making diagnosis of thyroid FNA in our institution.

Design: We retrospectively reviewed thyroid FNA including conventional and Thin prep liquid based cytology samples with Papanicolaou stain from January 2016 to August 2017 (3164 nodules), and selected 622 nodules accompanying *BRAF*^{V600E} mutation test by a pyrosequencing (PyroMarkQ24). Indeterminate cases of TBSRTC categories III (n = 196), IV (n = 12), and V (n = 51) were put in focus.

Results: Among all the indeterminate nodules, 114 out of 269 were histologically confirmed and composed of benign (19 nodules, 16.7%) and malignant (87 cases, 76.3%) thyroid lesions. The mutation rate of *BRAF*^{V600E} of indeterminate group was 15.8% and varied among the categories (8.7% in category III, 0% in category IV, and 47.1% in category V). Many of benign nodules of the indeterminate category were negative for *BRAF*^{V600E}; however cases of follicular variant of papillary thyroid carcinoma were also negative for *BRAF*^{V600E} mutation.

Conclusion: Although it is necessary to confirm whether there is a statistically significant difference for diagnostic sensitivity and false negative rate of combined *BRAF*^{V600E} mutation and thyroid FNA in indeterminate nodules, *BRAF*^{V600E} mutation testing is promising tool and can improve the diagnostic accuracy of thyroid FNA.

Oral 8

Molecular profile of noninvasive follicular thyroid neoplasm with papillary-like nuclear features

Chan Kwon Jung

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Noninvasive follicular thyroid neoplasm with papillary-like nuclear features (NIFTP) shares common molecular profiles with other follicular patterned thyroid tumors, such as invasive encapsulated follicular variant of papillary thyroid carcinoma, follicular adenoma, and follicular carcinoma. The most frequently mutated genes are *RAS* family, including *N-RAS*, *H-RAS*, and *K-RAS*. *PPARG* fusions, *THADA* fusions, and *BRAF*^{K601E} sometimes occur in NIFTP. Further possible mutations include the genes *TG*, *GNAS*, *PTEN*, and *DNMT3A*. NIFTPs must not have *BRAF*^{V600E}, *RET* fusions, and mutations that occur as late driver events in thyroid carcinogenesis (i. e., mutations of *AKT1*, *CTNNB1*, *TERT* promoter, and *TP53*). Some NIFTP cases with *BRAF*^{V600E} have been reported recently; however, this likely was due to applying loose histological criteria for NIFTP and/or incomplete histologic examination of the tumor and capsule. Molecular testing can help to avoid diagnostic misclassification that may result from the different threshold for diagnosing NIFTP and inadequate sampling of the thyroid specimens.

Oral 9

How the introduction of NIFTP has changed our practice – Results of survey by the Working Group of Asian Thyroid FNA Cytology

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The Working Group of Asian Thyroid FNA Cytology conducted a survey to identify the opinions and the changes in practices and the impact of noninvasive follicular thyroid neoplasm with papillary-like nuclear features (NIFTP) on surgical pathology. We surveyed 58 thyroid pathologists from China, India, Japan, Korea, and Thailand from August to September 2017.

Only 34% of the respondents used NIFTP alone in their pathology reports; however, 28% of them used NIFTP in conjunction with noninvasive encapsulated follicular variant of papillary thyroid carcinoma (eFV-PTC) to have a better understanding of the term. The remaining 38% still preferred to use the term “noninvasive eFV-PTC” instead of NIFTP. We also surveyed the opinion of clinicians about the NIFTP based on the perception of pathologists from the same multidisciplinary teams. Of the 56 hospitals, 11% have adopted the concept of NIFTP, 45% had mixed reception due to some uncertainty, and 45% have not started using the term NIFTP in the clinical practice. Interestingly, pathologists and clinicians from several hospitals from China and India expressed their complete unfamiliarity with the term NIFTP.

The grossing technique for encapsulated thyroid tumor has been changed in 24% of the respondents after implementing the use of NIFTP. Of the 58 respondents, 53% used to submit the whole capsule before the NIFTP introduction, whereas 22% replied that they have certain limitations and can only submit a part of the capsule. The PTC nuclear score was submitted as part of pathology report in 5% of the respondents. In 34% of the respondents, the PTC nuclear score was used for diagnostic purposes, but rarely mentioned in the report.

Although the survey was only conducted to a few Asian countries, it showed different patterns of NIFTP adoption. The majority of respondents from China, India, Korea, and Thailand provided educational programs related to the introduction of the term NIFTP, such as local seminars. As a result, most of the pathologists from these countries adopted the term NIFTP in their daily practice. On the other hand, 55% of the surveyed Japanese endocrine pathologists did not use the term NIFTP as a diagnosis and still favored to call such tumors as noninvasive eFV-PTC. Accordingly, a substantial amount of Japanese (79%) and Korean (46%) clinicians were not familiar with NIFTP. Pathologist is a key person in the thyroid multidisciplinary team who is responsible for the adoption and promotion of the NIFTP terminology through the provision of educational programs.

Oral 10

Where is the NIFTP in thyroid FNA cytology

SoonWon Hong

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Since its first introduction in 2016, there have been several studies on how noninvasive follicular thyroid neoplasm with papillary-like nuclear features (NIFTP) affects thyroid fine needle aspiration cytology (FNAC). Even though the WHO has defined NIFTP as a borderline entity, recent studies have reported NIFTP to be considered as a kind of follicular adenoma in the category of follicular neoplasm. In FNAC, follicular neoplasm (category IV in the Bethesda System for Reporting Thyroid Cytopathology) is the appropriate diagnosis for follicular variant papillary thyroid carcinoma (FVPTC) showing NIFTP cytomorphology. If category IV includes FVPTC containing NIFTP, the risk of malignancy for category IV should inevitably increase because invasive FVPTC comprises up to 88% of FVPTC containing NIFTP whereas invasive follicular carcinoma comprises only 15% of follicular neoplasm. Previously, a number of studies were conducted on similar lesions (so called follicular patterned lesions), and the nuclear features alone were emphasized for the diagnosis of papillary thyroid carcinoma (PTC) while the papillary structures were overlooked. In such lesions, we need to look for the papillary structures, psammoma bodies, and nuclear pseudoinclusions for the differential diagnosis between conventional PTC and follicular variant PTC. Therefore, FVPTC containing NIFTP, at least, should not be diagnosed as category V or VI, and it is also necessary to make a clear differential diagnosis between NIFTP and benign thyroid lesions using the nuclear score.

Oral 11

Evaluation of follicular patterned lesions “including oncocytic” by FNA based on the new WHO classification

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In thyroid cytology, follicular-patterned lesions (FPL) refers to a cellular aspirates comprised of follicular cells arranged in an altered architectural pattern characterized by cell crowding and/or microfollicle formation. The so-called follicular lesions, comprises nodular hyperplasia, follicular adenoma, follicular variant of papillary carcinoma (FVPTC) and follicular carcinoma. When these aspirates consists exclusively or almost exclusively of Hurthle cells, most of these lesions are considered as Hurthle cell tumours; however Hurthle cells with nuclear features of papillary carcinoma (PTC) are excluded from this category. In the 4th edition of the WHO classification of thyroid tumors (2017), new FPL were included, such as tumors of uncertain malignant potential (well differentiated tumor and follicular tumor of uncertain malignant potential) and non-invasive follicular thyroid neoplasm with papillary-like nuclear features (NIFTP). These entities pose diagnostic difficulties due to uncertainty as to whether the nuclear changes are sufficient to justify a diagnosis of PTC or due to uncertainty about the presence of capsular or vascular invasion. The latter cannot be appreciated on cytology, but if follicular-patterned aspirates showed mild nuclear changes, such as increased nuclear size, nuclear contour irregularity and/or chromatin clearing, they can still be classified as follicular neoplasm on cytology, especially when true papillae and intranuclear pseudoinclusions are absent or scarce. If the follicular cells show definitive nuclear features of PTC, including frequent intranuclear pseudoinclusions, and if there are at least focal elements associated with classical PTC (psammoma bodies and/or true papillae), the specimen should be classified as PTC. If nuclear features of PTC are not definitive or architectural features of PTC are absent, such aspirates raise concern for invasive FVPTC, well-differentiated tumor of uncertain malignant potential or NIFTP. Whether such aspirates are better classified as follicular neoplasm or suspicious for malignancy, will be dictated by the quality and quantity of the cytologic changes. In either instance, an explanatory note regarding concern for NIFTP or invasive FVPTC is warranted. There are still few studies exploring cytomorphological features that can favor the diagnosis of NIFTP over classical PTC on FNA. Although further studies in larger series are still lacking, it is predictable that in some cases, the association of the morphological findings with molecular results (*RAS*-positive and *BRAF*-negative) can be used to distinguish the majority of NIFTP and other follicular-patterned lesions from classical PTC, with important clinical impact and cost-benefits for the patients.

Oral 12

Atypia of undetermined significance: It's cytohistologic outcome and risk of malignancy

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Background: Atypia of undetermined significance (AUS) is the most discussed category in the Bethesda system for reporting thyroid cytopathology because of the high variation of its use. This study was conducted to determine the cytohistologic outcome and risk of malignancy for AUS category.

Design: A retrospective cross-sectional study was done over a five year period in two major islands of the Philippines. 3,799 thyroid fine needle aspiration (FNA) specimens from 3,789 patients were accessioned to a private cytology clinic and Department of Pathology of GCGMH. Histopathology slides of patients who underwent surgery were retrieved and reviewed.

Results: Of the 3,789 patients, 3,225 (85%) were women with a mean age of 48 years and 584 (15%) were men with a mean age of 52 years. Sizes ranged from 0.35 to 8.0 cm with an average size of 4.0 cm. The distribution of the cases according to the Bethesda system was as follows: 1.3% unsatisfactory, 56% benign, 5.5% AUS, 11% suspicious for follicular neoplasm/Hurthle cell neoplasm, 13% suspicious for malignancy, and 12.8% malignant. Only 33/207 (16%) of thyroid AUS cases underwent thyroidectomy with an overall risk of malignancy of 39%, while 84% were lost to follow-up. Of the resected AUS cases, 61% turned out benign, comprised of 75% multinodular colloid goiters, 10% Hashimoto's thyroiditis, 10% follicular adenomas, and 5% chronic lymphocytic thyroiditis. Remaining 39% of resected AUS cases were malignant on histology represented by follicular variant of PTC (77%) and follicular thyroid carcinoma (23%).

Conclusion: A higher risk of malignancy for AUS category in our settings implies that the number of AUS cases can be decreased by strict adherence to criteria in diagnosing thyroid aspirates on the first visit of patient.

Oral 13

Fine needle aspiration cytology in the diagnosis of thyroid needle tract implantation

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Background: Fine needle aspiration cytology (FNAC) plays an important role in the management of patients with thyroid nodules. Nevertheless, FNAC is rarely followed by complications, such as needle tract implantation (NTI). Our aim was to investigate the value of FNAC and to compare the result of cytology with ultrasound and thyroglobulin measurement using fine needle aspirate washouts (Tg-FNA) results in the diagnosis of NTI.

Design: Forty-four patients evaluated by preoperative FNAC from 74 patients with thyroid carcinoma related NTI were identified between 2006 and 2017 at Kuma Hospital. The cytological, ultrasonographic and Tg-FNA results were retrospectively evaluated.

Results: The cytologic diagnoses included papillary carcinoma (n = 32; 72.7%), follicular carcinoma (n = 8; 18.2%), poorly differentiated carcinoma (n = 2; 4.5%), and anaplastic carcinoma (n = 2; 4.5%). All of them matched with histopathological diagnosis of resected NTI (n = 44; 100%). Sonographic diagnostic categories were benign pattern (n = 1; 2.3%) and high suspicion pattern (n = 43; 97.7%), respectively. Elevated Tg-FNA (> 16 mg/ml) was found in 29 out of 36 NTI nodules. Among the seven nodules with non-elevated Tg-FNAC, five revealed hypocellular material with few carcinoma cells.

Conclusion: FNAC and ultrasonography are reliable tests for diagnosis of NTI, especially FNAC is related to good agreement with histopathological diagnosis. On the other hand, Tg-FNAC is a useful complementary tool to FNAC but it may show false negative results in small and/or hypocellular materials.