The diversities in thyroid cytopathology practices among Asian countries using the Bethesda system for reporting thyroid cytopathology

Truong Phan Xuan Nguyen[1], Vien Thanh Truong[2], Kennichi Kakudo[3], Huy Gia Vuong[4,5]

[1]Department of Pathology, Cho Ray Hospital, Ho Chi Minh City, Vietnam; [2]Department of Cardiology, The Christ Hospital Health Network, Cincinnati, OH, USA; [3]Department of Pathology and Thyroid Disease Center, Izumi City General Hospital, Izumi-city, Japan; [4]Department of Pathology, [5]Stephenson Cancer Center, Oklahoma University Health Sciences Center, Oklahoma City, OK, USA

Contributions: (I) Conception and design: HG Vuong, K Kakudo; (II) Administrative support: HG Vuong; (III) Provision of study materials or patients: All authors; (IV) Collection and assembly of data: All authors; (V) Data analysis and interpretation: All authors; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

Correspondence to: Huy Gia Vuong, MD, PhD. Department of Pathology, Oklahoma University Health Sciences Center, Oklahoma City, OK 73104, USA; Stephenson Cancer Center, Oklahoma University Health Sciences Center, Oklahoma City, OK 73104, USA. Email: huyvuong@hotmail.com.

Background: The Bethesda System for Reporting Thyroid Cytopathology (TBSRTC) has been adopted and widely used among Asian countries. This study aims to investigate the application of TBSRTC in thyroid cytology practice among Asian countries

Methods: We searched electronic databases including PubMed and Web of Science from 2010 to 2019. Meta-analysis of proportion and their 95% confidence intervals (CIs) were calculated using the random-effect model. Meta-regression and subgroup analysis were used to search for heterogeneity origins.

Results: We included 42 Asian studies with 84.953 fine-needle aspirations. Among six categories, benign was the most commonly diagnosed category. The resection rate (RR) and risk of malignancy (ROM) were highest in malignant and SM categories, and lowest among benign nodules. Thyroid cytology practice in Asia was characterized by a low RR and high ROM in patients with indeterminate thyroid nodules. There was a significant amount of heterogeneities of TBSRTC outputs (frequency, resection rate, and malignancy risk) among Asian countries. Meta-regression showed that the sources of heterogeneity might stem from the differences in study origin and the application of molecular testing. We highlighted the usefulness of preoperative molecular testing to select patients for surgery.

Conclusions: Our study provided insight regarding thyroid cytology practice among Asian countries. Active surveillance is commonly used in Asian practice resulting in a low RR and high ROM for indeterminate nodules. There are still variations in general thyroid cytology practice in Asia. Future guidelines and consensus regarding the application of TBSRTC in thyroid cytology practice among Asian countries are required.

Keywords: The Bethesda System for Reporting Thyroid Cytopathology (TBSRTC); fine-needle aspiration (FNA); cytology; thyroid; risk of malignancy (ROM); resection rate; Asia

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Introduction

The fine-needle aspiration (FNA) is an accurate, cost-effective, minimally invasive procedure in the management of thyroid nodules and helpful in tailoring therapeutic decisions (1). Currently, the Bethesda System for Reporting Thyroid Cytopathology (TBSRTC) is established to provide uniform terminology and criteria for the diagnosis of thyroid nodules and guide the clinical treatment. TBSRTC includes six categories including nondiagnostic (ND), benign, atypia of undetermined significance/follicular lesion of undetermined significance (AUS/FLUS), follicular neoplasm/suspicious for follicular neoplasm (FN/SFN), suspicious for malignancy (SM), and malignant (2,3).

TBSRTC was designed and originated from the USA, but it has been widely adopted in many European and Asian countries (4). We recently found that Asian cohorts had a significantly higher risk of malignancy (ROM) than Western series in most of TBSRTC categories (4). However, a huge amount of heterogeneity was found among countries (4).

This study aims to focus on the application of TBSRTC in cytopathology practice among Asian countries and to explain any sources of heterogeneity if present. We present the following article in accordance with the PRISMA reporting checklist (available at http://dx.doi.org/10.21037/gs-20-404.)

Methods

Search strategy and identification of target studies

Potential articles were searched in PubMed and Web of Science from 2010 to 2019 using the keywords "Bethesda AND thyroid". Our study protocol generally followed the recommendation of the Preferred Reporting Items for Systematic Review and Meta-analysis (PRISMA) statement (5).

Selection criteria and abstract screening

All searched results were imported into Endnote. Two reviewers screened the titles and abstracts using the following inclusion criteria: (I) studies reporting of thyroid FNA results utilizing TBSRTC; (II) data must include the number of FNAs, the number of cases undergoing resection, number of malignancies following surgery in at least one of six TBSRTC categories; and (III) the studies were performed in Asian populations. The exclusion criteria were: (I) studies did not meet all of the above inclusion criteria; (II) reviews; (III) conference papers, proceedings, theses; and (IV) studies focusing only on pediatric population. If there were any discrepancies between 2 reviewers, discussion and consensus were reached.

Full-text screening and data extraction

Two reviewers screened the full-text of potential articles and extracted data into a predefined data extraction form. Any discrepancies were resolved by discussion and consensus. The extraction information includes study title, year, journal, institution, city, country, year of publication, study design (prospective or retrospective), number of patients, age, sex, proportion of ultrasound-guided FNAs, and number of FNAs, surgeries, and cancers for each TBSRTC category.

Data analysis

The frequency of thyroid FNA samples is calculated by dividing the number of cases in each TBSRTC category by the total number of FNAs. This value was only calculated for studies providing data for all six categories. Resection rate (RR) was the proportion of surgically resected cases among the total number of FNAs in that category. The risk of malignancy (ROM) was considered the proportion of malignant cases confirmed by histopathological examination among the resected cases. For studies containing potentially overlapping data from the same institution, we selected studies with the largest number of FNAs.

We used the statistical software Comprehensive Meta-analysis (Englewood, New Jersey) and JAMOVI (https://www.jamovi.org), which is built in the R statistical language, for statistical analyses. A meta-analysis of proportion and its 95% confidence intervals (CIs) were pooled using the random-effect model.

The heterogeneity among the included studies was based on the I^2 statistic (6). The degree of heterogeneity was categorized as low, moderate, and high with a value of 25% to 49%, 50% to 74%, and ≥75%, respectively (7). The origins of heterogeneity were further examined using meta-regression and subgroup analysis. For subgroup analysis, if the two range values of 95% CI do not overlap with each other, it signifies a statistical result. Otherwise, no statistical difference between the two subgroups is present.

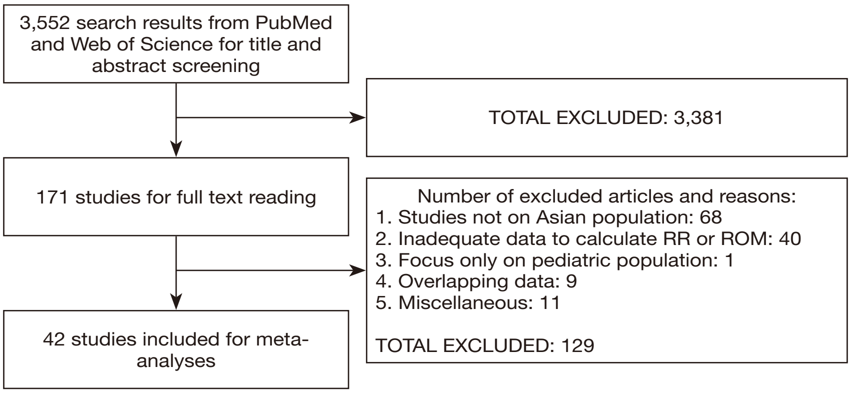

Figure 1 Study flowchart.

Risk of bias and publication bias assessment

We rated the methodological quality of the included studies according to the National Heart, Lung, and Blood Institute (NHLBI) assessment tool (8). To assess the publication bias, we used the Egger's regression test and funnel plot of estimates (9). A P value <0.05 was considered statistically significant publication bias.

Results

A total of 3,552 articles was found for the title and abstract screening and 171 of them were included for the full-text reading. We further excluded 129 studies and finally included 42 Asian studies with 84,953 thyroid nodules for meta-analysis (*Figure 1*). The baseline characteristics of all included studies are presented in *Table 1*.

The majority of studies were retrospective studies. TBSRTC 2009 was used to classify thyroid nodules in all studies. The Asian regions included in this study were Eastern [China (10-13), Japan (25), and Korea (26-42)], South Central [India (14-22), Israel (23,24). Nepal (43)], Middle East [Saudi Arabia (44-47)], and Southeast Asia [Singapore (48,49), Thailand (50,51)].

Using the NHLBI assessment tool, the majority of included studies were fair to good quality (Table S1).

Overall frequency, RR, and ROM of each TBSRTC category among Asian countries

Pooled frequencies, RRs, and ROMs of the six TBSRTC categories were shown in *Table 2*. Among six categories, benign was most commonly diagnosed accounting for nearly 60% of FNAs, followed by malignant and ND categories. Regarding meta-analyses for frequency, a low and moderate heterogeneity was present in some of the meta-analyses.

The RR was highest in malignant and SM categories and lowest in benign nodules. Among the meta-analyses for RR, a low heterogeneity ($25\leq I^2 <50\%$) was seen in analyses for the ND category. Additionally, a moderate amount of heterogeneity ($50\%\leq I^2 <75\%$) was present in SM and malignant categories.

Similar to RR, ROM was highest in malignant and SM and lowest in the benign subgroup. No significant heterogeneity was present in meta-analyses for ROM (I^2 <25%), except the AUS/FLUS category.

Subgroup analyses and meta-regression to explore the sources of heterogeneity

We ran the meta-regression to search for heterogeneity origins. Meta-regression results showed that the difference in study origin and the use of molecular testing mostly influence the heterogeneity degrees in TBSRTC outputs (*Figure 2*). Other confounding factors such as year of publication, study design, and the use of ultrasound-guided FNA less likely affected the deviations among the log event rate and regression line (data not shown).

We divided studies into two subgroups of using and not using molecular testing (*Table 3*). Among studies using molecular testing, no studies used multigene panel testing (e.g., Afirma gene expression classifier, ThyroSeq) and all used single-gene testing (e.g., pyrosequencing, Sanger sequencing). Following subgroup analyses, there were some significant differences in RR and ROM between studying employing and not employing molecular testing. The ROM significantly increased in the benign, AUS/FLUS, FN/SFN,

Table 1 Baseline characteristics of 42 included studies

Study	Country	Study period	Study design	No. of FNA	No. of patients	No. of surgery	Molecular testing
Ke 2019, (10)	China	2011–2016	Retro	13,351	12,530	3,890	No
Liu 2017, (11)	China	2014–2017	Retro	2,838	NA	791	No
Wu 2019, (12)	China	2018	Pros	479	472	288	Yes
Zhang 2015, (13)	China	2014	Pros	220	220	159	Yes
Arul 2015, (14)	India	2012–2015	Retro	603	NA	392	No
Garg 2017, (15)	India	2013–2014	Retro	76	76	24	No
Hemalatha 2018, (16)	India	2010–2015	Pros	277	277	111	Yes
Kannan 2017, (17)	India	2016–2018	Pros	238	246	77	No
Kumari 2019, (18)	India	NA	Pros	1,050	1,050	111	No
Mahajan 2017, (19)	India	2010–2015	Retro	4,562	NA	334	No
Mehra 2015, (20)	India	2010–2012	Pros	225	NA	40	No
Mondal 2013, (21)	India	2009–2012	Retro	1,020	NA	323	No
Roy 2019, (22)	India	2015–2016	Retro	132	1,018	47	No
Ronen 2019, (23)	Israel	2013–2017	Retro	287	287	58	No
Rosenblum 2019, (24)	Israel	2013–2015	Retro	416	2,674	124	No
Satoh 2017, (25)	Japan	2015–2016	Retro	1,600	NA	522	No
Choi 2014, (26)	Korea	2008–2011	Retro	191	191	142	No
Chung 2019, (27)	Korea	2016	Pros	102	93	80	No
Hwang 2015, (28)	Korea	2012–2014	Pros	564	NA	86	Yes
Hyeon 2014, (29)	Korea	2011–2012	Retro	645	NA	231	Yes
Kang 2012, (30)	Korea	2008–2009	Retro	1,060	1,060	313	Yes
Kim 2011, (31)	Korea	2007–2009	Pros	865	NA	204	Yes
Kim 2014, (32)	Korea	2009–2011	Retro	114	114	8	No
Kim 2017a, (33)	Korea	2010–2011	Retro	35,073	NA	5,084	No
Kim 2017b, (34)	Korea	2010–2014	Retro	903	NA	210	No
Kim 2018, (35)	Korea	2012–2014	Retro	5,549	5,127	1,891	No
Lee 2014, (36)	Korea	2010–2012	Retro	363	NA	152	No
Lee 2015, (37)	Korea	2011–2012	Retro	757	NA	213	No
Lee 2017a, (38)	Korea	2013	Retro	1,925	NA	381	No
Lee 2017b, (39)	Korea	2014–2015	Retro	133	132	59	No
Park 2013, (40)	Korea	2011	Retro	120	120	83	Yes
Yeo 2011, (41)	Korea	2009–2010	Retro	983	973	209	Yes
Yoo 2013, (42)	Korea	2003–2009	Retro	66	NA	36	No
Upadhyaya 2019, (43)	Nepal	2009–2014	Retro	109	NA	49	No

Table 1 (*continued*)

Table 1 (continued)

Study	Country	Study period	Study design	No. of FNA	No. of patients	No. of surgery	Molecular testing
Al Dawish 2017, (44)	Saudi Arabia	2012–2014	Retro	1,433	1,188	369	No
Al-Abbadi 2013, (45)	Saudi Arabia	2010–2011	Retro	205	186	64	No
Alabdulqader 2015, (46)	Saudi Arabia	2012–2013	Retro	252	218	45	No
Mufti 2012, (47)	Saudi Arabia	2005–2010	Retro	250	NA	85	No
Gan 2017, (48)	Singapore	2008–2014	Retro	309	NA	137	No
Lim 2018, (49)	Singapore	2008–2015	Retro	111	88	88	No
Limlunjakorn 2017, (50)	Thailand	2010–2015	Retro	2,762	NA	457	No
Thewjitcharoen 2019, (51)	Thailand	2010–2017	Retro	2,735	2,115	188	No

FNA, fine-needle aspiration; retro, retrospective; pros, prospective; NA, not available.

Table 2 Summary of frequency, resection rate, and malignancy risk of thyroid cytology practice among Asian countries using TBSRTC

Category	Frequency (%)			Resection rate (%)			Risk of malignancy (%)		
	%	95% CI	I^2	%	95% CI	I^2	%	95% CI	I^2
Nondiagnostic	8.0	6.0–10.6	51.3*	13.5	9.6–18.7	26.9*	37.1	27.8–47.4	8.6
Benign	59.7	52.7–66.3	26.1*	9.3	5.8–14.5	4.6	13.9	10.0–19.0	17.2
AUS/FLUS	7.3	6.1–8.8	74.7*	31.1	26.2–36.4	20.4	54.3	46.4–61.9	26.6*
FN/SFN	2.2	1.5–3.3	20.2	56.1	46.2–65.5	0	33.3	28.1–38.9	21.1
SM	4.4	3.4–5.7	47.1*	68.1	62.4–73.3	53.6*	89.3	83.8–93.1	5.1
Malignant	9.7	7.2–12.8	22	74.0	68.0–79.2	59.5*	98.1	96.5–99.0	0

*, indicates a significant amount of heterogeneity among the included studies (>25%). AUS/FLUS, atypia of undetermined significance/ follicular lesion of undetermined significance; FN/SFN, follicular neoplasm/suspicious for a follicular neoplasm; SM, suspicious of malignancy; CI, confidence interval.

and SM categories following the application of molecular testing (*Table 3*).

Publication bias

To examine the presence of publication bias, funnel plots of effects pooled from individual studies were evaluated. Funnel plots showed no strong evidence of publication bias among the set of included studies and Egger's regression test confirmed the absence of publication bias (*Figure S1*).

Discussion

Asia is the largest continent which has the highest population in the world and includes many geographic regions with varied cultures and religions. Most Asian countries have a modern health care system and update contemporary medical knowledge. Since TBSRTC was introduced in 2009, it has been widely accepted in Asian cytology practice (2,3). Besides that, Asia has a high prevalence of thyroid cancer (52). The GLOBOCAN database estimated that 45.8% of all new thyroid cancer cases in 2018 were diagnosed in Asia (52). Most of the published meta-analyses on thyroid FNA did not include Asian publications (53-56). Our study provided a general insight and experience regarding thyroid cytopathology practices among Asian countries. Hopefully, our meta-analysis result can contribute to the future revision of TBSRTC.

In our meta-analysis, the patients with indeterminate

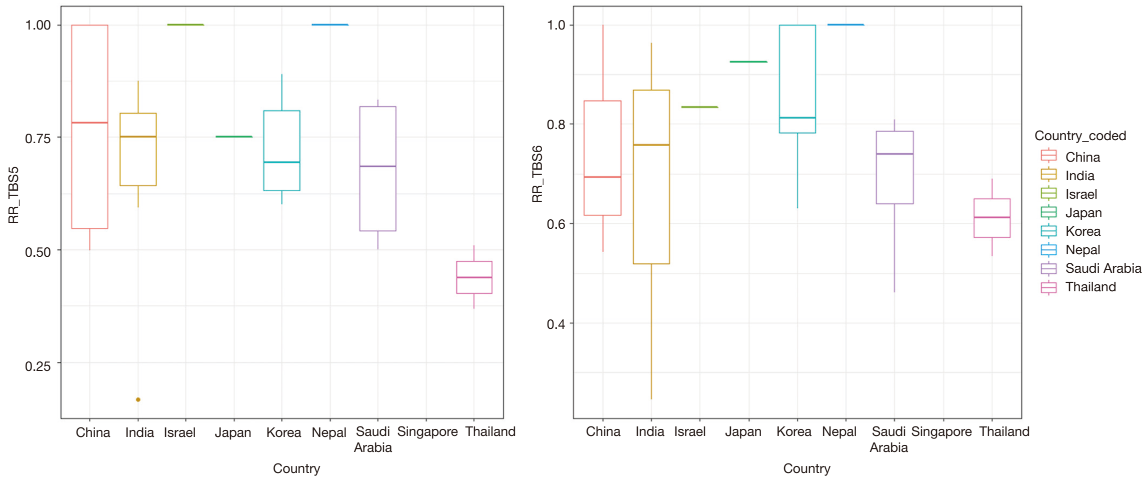

Figure 2 Boxplots illustrating the resection rate of TBSRTC categories V (left) and VI (right) among Asian countries show a higher resection rate among Eastern Asian countries (China, Korea, Japan), South-central Asia (India, Nepal, Israel), and Middle East (Saudi Arabia), and a lower resection rate among Southeast Asian countries (Thailand).

thyroid nodules (AUS/FLUS and FN/SFN) account for about 10% of preoperative FNAs. Compared to results from Western countries, this rate was lower (4,55). The reason for this difference might be because the prevalence of follicular variant papillary thyroid carcinoma (PTC) has been increasing over the years in Western countries (57), and the rate of follicular variant PTC in Asia tends to be much lower in comparison with the classical variant (58). Many encapsulated follicular variant PTC are preoperatively diagnosed as FN/SFN. The RR of AUS/FLUS and FN/SFN nodules among Asian countries were lower as compared to Western practice (31.1% versus 40.5%, and 56.1% versus 63.4%, respectively) (4). Conversely, the ROM of AUS/FLUS and FN/SFN among Asian institutions were higher than the implied ROM of Western countries (54.3% versus 21.5% and 33.3% versus 27.3, respectively) (4). A low RR and high ROM of indeterminate categories is a distinctive feature of Asian cytology practice as compared with Western countries (4). The underlying reason for this difference is the active surveillance strategy to those with benign clinical findings until they are determined any suspicious features. Japan has established the Japan Thyroid Association (JTA) guidelines for the treatment of thyroid nodules (59). According to the JTA guidelines, patients with FN/SFN nodules having benign clinical information are not indicated for surgery and they should be routinely followed-up (59,60). Thus, diagnostic surgery is only indicated for patients with suspicious clinical and sonographic findings. This management approach can help reduce the overtreatment of borderline/precursor thyroid tumors and low-risk thyroid carcinomas (60). Korean clinicians flexibly and selectively adopted the ATA 2015 guideline and recommended active surveillance for patients with PTC <1 cm in diameter as well as molecular testing for the indeterminate nodules (31,61). The most characteristic features of Korea thyroid cytology practice are the applications of core-needle biopsy and molecular testing which are not commonly used in other Asian countries (31,62). Additionally, Asian cytopathologists have stricter diagnostic criteria for PTC type nuclear features. The majority of cases with incomplete PTC type nuclear features were categorized in AUS/FLUS in most Asian practice, but Western cytopathologists often classified in the SM category. Hirokawa *et al.* observed that the frequency of diagnosis of encapsulated follicular variant PTC among American pathologists (25%) was remarkably higher than that (4%) among Japanese pathologists (63). A recently inter- and intra-observer variation study by Liu *et al.* regarding the diagnosis of noninvasive follicular thyroid neoplasm with papillary-like nuclear features (NIFTP) among nine Asian cytopathologists showed a moderate agreement (kappa value =0.452), which is different from a report by Thompson *et al.* (kappa value =0.66) (64,65). Several factors can lead to these discrepancies including working and geographic differences, individual interpretation of diagnostic criteria, and investigation method (virtual slide versus still image).

Table 3 Subgroup analyses of studies employing molecular testing and without employing molecular testing

Category	Resection rate						Risk of malignancy					
	With molecular testing			Without molecular testing			With molecular testing			Without molecular testing		
	%	95% CI	I^2	%	95% CI	I^2	%	95% CI	I^2	%	95% CI	I^2
Nondiagnostic	29.8*	18.5–44.2*	41.5*	10.7*	7.9–14.4*	47.2*	58.6	37.7–76.8	14.2	31.6	21.9–43.3	0
Benign	4.3	0.9–19.2	0	11.1	6.7–17.9	0	36.4*	20.7–55.7*	0*	11.6*	8.2–16.2*	11.6*
AUS/FLUS	36.8	25.4–49.8	0	29.5	24.1–35.4	27.1	76.1*	65.2–84.4*	30.9*	47.1*	38.2–56.2*	5.4*
FN/SFN	65.7	49.3–79.1	0	53.7	43.0–64.0	0	56.4*	36.7–74.2*	1.1*	31.4*	26.5–36.7*	16.6*
SM	84.7*	72.1–92.2*	54.2*	63.0*	56.6–68.9*	39.4*	96.3*	92.8–98.2*	0*	85.3*	77.3–90.9*	0*
Malignant	86.0	76.3–92.1	62.3	70.4	63.4–76.6	55.9	99.3	97.8–99.8	0	97.8	97.2–98.2	84.8

*, indicate a significant difference between two subgroups of using and not using molecular testing since the 95% confidence intervals do not overlap each other. AUS/FLUS, atypia of undetermined significance/follicular lesion of undetermined significance; FN/SFN, follicular neoplasm/suspicious for a follicular neoplasm; SM, suspicious of malignancy; CI, confidence interval.

Interestingly, the pooled ROM for the benign category in this study was 13.9% which is higher than the implied ROM (0–3%) by the Bethesda system (2,3). A close follow-up of patients with benign cytological nodule is recommended in most Asian countries to minimize false negative diagnosis to confirm they are truly benign. During follow-up of benign nodules, malignant cases are inevitably identified in later years, as false negative cases in a certain proportion, which increases ROM in this category. Another potential reason is that aspirates with "cystic fluid only" are usually included in this category by Asian cytopathologists (11,59,60,66,67), instead of in the ND category as recommended by TBSRTC (2,3). It may result in the presence of cystic PTCs and a higher ROM.

Our meta-analysis also showed that there is a significant amount of heterogeneity among the Asian cytology practice. The amount of heterogeneity was low to moderate (*Table 2*). These heterogeneities might origin from diverse clinical approaches and diagnostic concepts among the institutions, different prevalence of thyroid cancer among countries, or individual pathologists. Our meta-regression results showed that the difference in study origin and the use of molecular testing are the two major factors causing these heterogeneities (*Figure 2* and *Table 3*). Regarding RR, a low heterogeneity was present for ROM in the AUS/FLUS category. A low RR and high ROM were seen in Korea because clinicians recommended active surveillance for patients with PTC <1 cm in diameter and applied molecular testing (31,61). Other countries such as India and Southeast Asian countries usually follow the ATA or TBSRTC guidelines resulted in a lower ROM (4,60). On the other side, a moderate amount of heterogeneity was present in SM and malignant categories; while no significant heterogeneity was seen among indeterminate categories. An explanation for this finding is the low rates of patients undergoing surgery in Southeast Asian countries (*Figure 2*). In these countries, patients are transferred to institutions in large cities due to the lack of formal cytopathology department and educational courses in rural areas (66,68,69). After FNA and thyroid workup, many patients returned to their hometown for the thyroid operation. Unfortunately, their surgical and histopathological reports were not available to access due to the lack of connections between hospitals resulting in missing surgical data and a lower RR in these countries.

Recently, preoperative molecular testing has been recommended in international guidelines (3,70), especially for indeterminate thyroid nodules to decrease the rate of overdiagnosis and overtreatment, and to reduce the potential complication of diagnostic surgery. Our study results indicated that ROM significantly increases in the benign, AUS/FLUS, FN/SFN, and SM categories after the application of molecular testing. Therefore, preoperative molecular testing has an important role to accurately select the patients for surgery. However, these methods are not readily available in many Asian countries, especially in developing countries due to the expensive cost. In the USA, the patients have to pay $300 if they have an insurance provider and $3,200 to $4,875 without insurance coverage to undergo molecular testing (71). In contrast, most Asian clinicians apply active surveillance for indeterminate nodules which has a lower cost.

In 2016, the NIFTP reclassification was introduced to reduce the risk of overdiagnosis and overtreatment of encapsulated follicular variant PTC. TBSRTC 2017 adopted the NIFTP terminology and provided two ranges of ROM, one considering NIFTP malignancy and another not (3). In the present study, all included studies used the TBSRTC 2009 so it would not affect the overall analysis. The changes in ROM following the NIFTP reclassification were summarized in a recent meta-analysis which showed a reduced ROM in all categories, particularly the indeterminate nodules (72). The impact of NIFTP reclassification on ROM was more significant in Western than in Asian practice (72).

There are some limitations in this study that need to be addressed. These are unavoidable selection bias because the majority of our data were retrospective. Besides, a considerable amount of heterogeneity is still present following subgroup analyses. Another limitation is that incidentalomas data were not provided in most of the included studies and it might affect the true ROM. Finally, difference in the number of studies between countries is a potential factor that can affect the analysis. Data from Korea were predominant in our study while data from Japan, the Middle East, and Southeast Asian countries were not commonly reported.

Conclusions

In conclusion, our meta-analysis provided insight regarding thyroid cytology practice among Asian countries. Active surveillance to reduce unnecessary diagnostic surgery is common in Asian practice resulting in a low RR and high ROM for indeterminate nodules. We also highlighted the usefulness of preoperative molecular testing to classify the patient accurately for surgery. There were still variations in general thyroid cytology practice which might originate from different practice guidelines among Asian countries. Future guidelines and consensus regarding the application of TBSRTC in thyroid cytology practice among Asian countries are required to reduce these heterogeneities.

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Footnote

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Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Supplementary

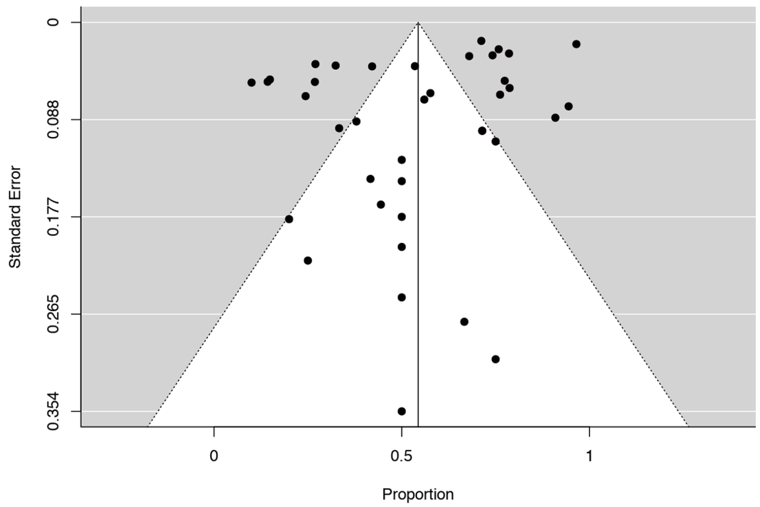

Figure S1 Funnel plot showed no strong evidence of publication among the set of studies regarding the resection rate in AUS/FLUS category. Egger's regression test confirmed the absence of publication bias (P=0.491). AUS/FLUS, atypia of undetermined significance/ follicular lesion of undetermined significance.

Table S1 Quality assessment of included studies

Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Quality rating
Bak 2015	Yes	Yes	NR	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	NR	Yes	Yes	Good
Bohacek 2012	Yes	Yes	NR	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	NR	Yes	Yes	Good
Bongiovanni 2012	Yes	Yes	NR	Yes	Yes	Yes	Yes	Yes	Yes	No	No	NR	Yes	Yes	Fair
Cristo 2016	Yes	Yes	NR	Yes	No	Yes	Yes	Yes	Yes	No	Yes	NR	Yes	Yes	Good
Faquin 2016	Yes	Yes	NR	Yes	Yes	Yes	Yes	Yes	Yes	No	No	NR	Yes	Yes	Fair
Guney 2017	Yes	Yes	NR	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	NR	Yes	Yes	Good
Guo 2017	Yes	Yes	NR	Yes	No	Yes	Yes	Yes	Yes	No	Yes	NR	Yes	Yes	Fair
Jo 2010	Yes	Yes	NR	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	NR	Yes	Yes	Good
Krauss 2016	Yes	Yes	NR	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	NR	Yes	Yes	Good
Nayar 2009	Yes	Yes	NR	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	NR	Yes	Yes	Good
Olson 2013	Yes	Yes	NR	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	NR	Yes	Yes	Good
Paajanen 2017	Yes	Yes	NR	Yes	No	Yes	Yes	Yes	Yes	No	Yes	NR	Yes	Yes	Fair
Renshaw 2010	Yes	Yes	NR	Yes	Yes	Yes	Yes	Yes	Yes	No	No	NR	Yes	Yes	Fair
Sullivan 2014	Yes	Yes	NR	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	NR	Yes	Yes	Good
Tepeoglu 2014	Yes	Yes	NR	Yes	No	Yes	Yes	Yes	Yes	No	Yes	NR	Yes	Yes	Fair
Theoharis 2009	Yes	Yes	NR	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	NR	Yes	Yes	Good
Ugurluoglu 2015	Yes	Yes	NR	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	NR	Yes	Yes	Good
Wu 2007	Yes	Yes	NR	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	NR	Yes	Yes	Good
Wu 2012	Yes	Yes	NR	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	NR	Yes	Yes	Good
Yang 2007	Yes	Yes	NR	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	NR	Yes	Yes	Good
Yassa 2007	Yes	Yes	NR	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	NR	Yes	Yes	Good
Zhou 2018	Yes	Yes	NR	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	NR	Yes	Yes	Good
Alabdulqader 2015	Yes	Yes	NR	Yes	No	Yes	Yes	Yes	Yes	No	Yes	NR	Yes	Yes	Fair
Al-Abbadi 2013	Yes	Yes	NR	Yes	No	Yes	Yes	Yes	Yes	No	Yes	NR	Yes	Yes	Fair
Al Dawish 2017	Yes	Yes	NR	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	NR	Yes	Yes	Good
Arul 2015	Yes	Yes	NR	Yes	No	Yes	Yes	Yes	Yes	No	Yes	NR	Yes	Yes	Fair
Bhartiya 2016	Yes	Yes	NR	Yes	No	Yes	Yes	Yes	Yes	No	Yes	NR	Yes	Yes	Fair
Bychkov 2018	Yes	Yes	NR	Yes	Yes	Yes	Yes	Yes	Yes	No	No	NR	Yes	Yes	Good
Kannan 2017	Yes	Yes	NR	Yes	No	Yes	Yes	Yes	Yes	No	No	NR	Yes	Yes	Poor
Kim 2011	Yes	Yes	NR	Yes	No	Yes	Yes	Yes	Yes	No	Yes	NR	Yes	Yes	Fair
Kim 2017	Yes	Yes	NR	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	NR	Yes	Yes	Good
Kim 2018	Yes	Yes	NR	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	NR	Yes	Yes	Good
Lee 2017	Yes	Yes	NR	Yes	Yes	Yes	Yes	Yes	Yes	No	No	NR	Yes	Yes	Fair
Limlunjakorn 2017	Yes	Yes	NR	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	NR	Yes	Yes	Good
Liu 2017	Yes	Yes	NR	Yes	Yes	Yes	Yes	Yes	Yes	No	No	NR	Yes	Yes	Fair
Mahajan 2017	Yes	Yes	NR	Yes	Yes	Yes	Yes	Yes	Yes	No	No	NR	Yes	Yes	Fair
Mehra 2015	Yes	Yes	NR	Yes	No	Yes	Yes	Yes	Yes	No	Yes	NR	Yes	Yes	Fair
Mondal 2013	Yes	Yes	NR	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	NR	Yes	Yes	Good
Mufti 2012	Yes	Yes	NR	Yes	No	Yes	Yes	Yes	Yes	No	Yes	NR	Yes	Yes	Fair
Naz 2014	Yes	Yes	NR	Yes	No	Yes	Yes	Yes	Yes	No	Yes	NR	Yes	Yes	Fair
Satoh 2017	Yes	Yes	NR	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	NR	Yes	Yes	Good