ISSN 2672-9393

JAN.-APR. 2026 ● Volume XXVII Number I

THE ASEAN
JOURNAL OF RADIOLOGY

Highlight

- Original Article
- Case Report
- Perspectives
- Letter to the Editor and Reply
- ASEAN Movement in Radiology
- Memorial

Official Journal of The

Royal College of Radiologists of Thailand

Radiological Society of Thailand

Foundation for Orphan and Rare Lung Disease

Thai Society of Vascular and Intervention Radiology

ASEAN Association of Radiology

The ASEAN
Journal of Radiology

CONTENTS

THE ASEAN JOURNAL OF RADIOLOGY
ISSN 2672-9393

From The Editor

Climate and scam that we share

Received 29 January 2026; accepted 1 Febuary 2026
doi:10.46475/asean-jr.v27i1.1012

On 21 November 2025, heavy rain and sudden floods struck the lower eight provinces of southern Thailand and northern Malaysia. The most severe damage occurred in Hat Yai District, Songkhla Province, where the whole downtown and urban areas submerged under three meters of water. Floodwaters significantly impacted local communities, reaching the upper floors of homes and leaving numerous residents trapped on rooftops. The resulting conditions led to acute shortages of essential supplies like food and water, with rescue efforts hampered by strong currents. The disaster claimed 170 lives in southern Thailand, 131 of them in Hat Yai, and only two deaths in northern Malaysia. Within the same week, three cyclones occurred simultaneously across South and Southeast Asia, and flood-related deaths exceeded 700 in Indonesia, 98 in Vietnam and 410 in Sri Lanka [1]. Earlier that month, the Philippines was hit by two typhoons, leaving more than 200 deaths [2]. Throughout 2025, Vietnam was hit by 14 typhoons.

Hat Yai, Songkla, Thailand on 21 November 2025, with its center submerged underwater (courtesy of Kamonwon Cattapan, M.D.).

East, South and Southeast Asia are likely the regions most affected by global warming. Since 2019, it has been reported that three quarters of the cities in the Southeast Asia would experience more frequent flooding, potentially affecting tens of millions of people every year and that internally displaced people from cyclones, floods and typhoons in Southeast and East Asia have already been recorded as representing almost 30% of all global displacements [3]. With ASEAN energy demand expected to increase by 2.6 times by 2050 [4], it is crucial for the region to address the climate crisis and find solutions to reduce emissions while simultaneously strengthening climate resilience. Greater public awareness should be raised, and sustainable practices should be promoted. Radiology, which consumes a large amount of energy and resources, and of which heavy equipment is usually installed on the lowest floor of buildings, is not an exception. Green radiology, a sustainable approach that focuses on minimizing negative environmental impacts by reducing energy, water, helium, and waste, should be widely adopted and practiced, following the concept of "think globally, act locally" [5]. Prevention from being paralyzed due to flooding should be considered every time radiological equipment is installed, as all CT and MRI machines in the affected area during the last flood in Hat Yai were submerged.

From the Chinese-owned scam compounds on the western side where Thailand and Myanmar share their 1,200-km border, a similar or even worse situation is now being reported on the eastern side where Thailand shares its 800-km border with Cambodia. It is estimated that Thai people have lost 60 billion Baht to the scammers in Cambodia. AI technology is used to elevate the success rates, and the digital currencies accelerates money transfers. Among more than 200, 000 forced laborers, recruited from various nationalities all over the world due to the low operating costs of the business, it is estimated that around 5,000 are Thai and 72,000 are Indonesian. The situation has reached the level of a humanitarian and human rights crisis, according to the United Nations experts [6]. Unlike scammer bases in Myanmar which are embedded in areas where ethnic independent groups are active, the scammer centers in Cambodia appear to have certain connections with politicians, government officers, and state institutions including banks, weakening law enforcement and facilitating illegal operations. Thailand is believed to be a money-laundering transit point before funds are moved to Singapore. The Thailand-Cambodia border crisis, starting in July and ending in December, displaced over 200, 000 civilians, once believed to be solely due to a territorial dispute but could partly stem from conflicts following the efforts to eliminate the criminal ecosystem in Thailand.

On 22 December 2025, the Department of Thai Traditional and Alternative Medicine announced the cabinet's approval of the regulations requiring cannabis shops to upgrade their operations to comply with new medicinal standards by January–February 2026. The goal is to upgrade over 10,000 licensed cannabis shops into medical facilities or clinics that meet the Ministry of Public Health's approval [7].

Wiwatana Tanomkiat, M.D.
Editor,
The ASEAN Journal of Radiology
Email: aseanjournalradiology@gmail.com

References

1. Sharman L. More than 1,100 killed as deadly storms cause flooding and landslides across Asia. CNN World [Internet]. 2025 Nov 30 [updated 2025 Dec 2; cited 2026 Jan 31].Available from: https://edition.cnn.com/2025/11/30/asia/flooding-senyar-ditwah-indonesia-malaysia-thailand-intl-hnk

2. Nierenberg A, Suhartono M, Mulkey SK, Suhartono M. An intense monsoon season Is battering parts of Asia. Here's what we know. Unusually destructive storms have killed at least 1,350 people across the region and displaced millions in South and Southeast Asia. The New York Times [Internet]. 2025 Dec 1 [updated 2025 Dec 3; cited 2026 Jan 31]. Available from: https://www.nytimes.com/2025/12/01/world/asia/flooding-sri-lanka-indonesia-thailand-vietnam-cyclone-rain.html

3. Soo-Chen K, McCoy D. Climate change in South-East Asia: Where are we and what are we bound for?. United Nations University [Internet]. Tokyo: UNU; 2025 [cited 2026 Jan 31]. Available from: https://ourworld.unu.edu/en/climate-change-in-south-east-asia-where-are-we-and-what-are-we-bound-for

4. ASEAN Centre for Energy (ACE) [Internet]. Jakata: ACE; 2024 Sept 26 [cited 2026 Jan 31]. 8th ASEAN Energy Outlook. Available from: https://aseanenergy.org/publications/the-8th-asean-energy-outlook/

5. Ho ELM, Cho DHY, Chuapetcharasopon C, Tomiyama N. A pulse check on environmental sustainability awareness in Asia-Oceania. ASEAN J Radiol [Internet]. 2025 [cited 2026 Feb. 1];26:262-9. Available from: https://asean-journal-radiology.org/index.php/ajr/article/view/967

6. United Nations [Internet]. Geneva: OHCHR; c1996-2026 [cited 2026 Feb 1]. UN experts urge immediate human rights-based action to tackle forced criminality in Southeast Asia scam centres. 21 May 2025. Available from: https://www.ohchr.org/en/press-releases/2025/05/un-experts-urge-immediate-human-rights-based-action-tackle-forced

7. Regan H, Olarn K. Thailand was the first country in Asia to legalize marijuana. Things didn't go as planned. CNN Travel [Internet]. 2025 June 28 [cited 2026 Feb 1]. Available from: https://edition.cnn.com/2025/06/28/travel/thailand-cannabis-laws-tourism-intl-hnk

THE ASEAN JOURNAL OF RADIOLOGY
ISSN 2672-9393

Original Article

The study of relationships between bladder volume and intravesical prostatic protrusion on transabdominal ultrasound in patients with benign prostatic hyperplasia

Watinee Suwankesa, M.D.
From Department of Radiology, Rayong Hospital, Rayong, Thailand.
Address correspondence to W.S. (email: mmwatineesuwankesa@gmail.com)

Received 6 November 2025; revised 11 December 2025; accepted 11 January 2026
doi:10.46475/asean-jr.v27i1.994

Abstract

Background: Benign prostatic hyperplasia (BPH) is a common cause of lower urinary tract symptoms (LUTS) in aging men, primarily resulting from bladder outlet obstruction (BOO). Intravesical prostatic protrusion (IPP), assessed by transabdominal ultrasonography, has emerged as a reliable and non-invasive imaging marker reflecting the degree of BOO. However, IPP measurements may vary depending on bladder volume (BV), and the optimal filling level for consistent evaluation remains uncertain.

Objective: To examine the relationships between IPP, BV, prostate volume (PV), post-void residual urine (PVR), and symptom severity (IPSS) in patients with BPH.

Materials and Methods: A prospective cohort study was conducted at Rayong Hospital, Thailand, from May to October 2025. Fifty-four men aged ≥50 years with clinically diagnosed BPH underwent four standardized transabdominal ultrasound scans: three for BV, PV, and IPP, and one for PVR. Baseline IPSS was recorded. Pearson correlation and group comparisons were performed, with statistical significance defined as $p < 0.05$. The study was approved by Rayong Hospital Ethics Committee (RYH REC No. E016/2568), and written informed consent was obtained from all participants before data collection.

Results: The mean age of participants was 69.4 ± 8.9 years, with mean PV and PVR of 64.5 ± 31.1 mL and 91.8 ± 80.9 mL, respectively. IPP showed significant positive correlations with PV ($p = 0.007$) and PVR ($p < 0.001$), but not with BV ($p = 0.762$) or IPSS ($p = 0.887$). Patients with Grade 3 IPP had the largest PV and highest PVR ($p = 0.038$ and $p = 0.016$).

Conclusion: IPP was significantly associated with PV and PVR but not with IPSS. Measurements were most consistent at bladder volumes of 200–299 mL, highlighting this range as the optimal filling level for reproducible and accurate IPP assessment in clinical practice.

Keywords: Benign prostatic hyperplasia, Bladder volume, Intravesical prostatic protrusion, Prostate volume, Post-void residual.

Introduction

Benign prostatic hyperplasia (BPH) is a nonmalignant enlargement of the prostate gland caused by abnormal proliferation of stromal and epithelial cells. It is one of the most common urological conditions in aging men and a major cause of progressive lower urinary tract symptoms (LUTS). Globally, BPH affected approximately 94 million individuals in 2019 compared with 51 million in 2000 [1]. The lifetime prevalence is estimated at 26.2% (95% CI: 22.8–29.6%), increasing markedly with age [2]. The global disease burden continues to rise, particularly in low- and middle-income countries [1]. In Thailand, data from the Bureau of Policy and Strategy, Ministry of Public Health, reported 113,552 inpatient cases of BPH in 2023, which is equivalent to 174.47 cases per 100,000 population [3].

Prostate enlargement leads to urethral compression and bladder outlet obstruction (BOO), resulting in LUTS such as hesitancy, a weak urinary stream, incomplete emptying, urgency, frequency, and nocturia. Severe cases may develop complications such as bladder stones, hematuria, and recurrent urinary tract infections [4]. Clinical evaluation typically includes history taking, physical examination, urinalysis, and assessment using the International Prostate Symptom Score (IPSS), which categorizes symptom severity as mild (0–7), moderate (8–19), or severe (20–35) [5].

Although BOO can be clinically suspected based on LUTS and physical examination, the gold standard for confirming BOO is a pressure–flow urodynamic study, which objectively evaluates the relationship between detrusor pressure and urinary flow [6]. However, urodynamic testing is invasive, time-consuming, uncomfortable for patients, and not routinely performed in many clinical settings [7]. These limitations have increased interest in noninvasive surrogate markers of BOO, among which intravesical prostatic protrusion (IPP) has shown promising diagnostic value.

Among several sonographic parameters, intravesical prostatic protrusion (IPP), defined as the vertical distance from the tip of the prostate protruding into the bladder to the bladder neck, has emerged as a reliable indicator of BOO and disease progression [8]. IPP is generally classified as <5 mm, 5–10 mm, or >10 mm [9], and higher grades are associated with more severe obstruction and an increased likelihood of requiring surgical intervention [8,10]. Measurement of IPP using transabdominal ultrasonography provides a rapid, noninvasive, and cost-effective method for evaluating BOO [11].

The accuracy of IPP measurement depends on bladder volume (BV). A sufficiently filled bladder provides an optimal acoustic window for ultrasound imaging, whereas an underfilled bladder may yield unreliable results [12]. Previous research, such as the study by Yuen et al. [12], demonstrated that IPP values tend to decrease as bladder volume increases, with the most accurate measurements obtained when the BV is between 100 and 200 mL. Furthermore, IPP has been shown to correlate with IPSS, prostate volume (PV), maximum urinary flow rate (Qmax), and post-void residual urine volume (PVR), reflecting disease severity [13].

However, evidence regarding the optimal bladder volume for accurate IPP measurement remains limited, particularly in routine clinical practice. Therefore, this study aims to investigate the relationships between IPP, BV, PV, and PVR among patients with BPH at Rayong Hospital.

Materials and methods

Study Design and Setting

This prospective cohort study was conducted at Rayong Hospital, Thailand between May and October 2025. This study aimed to investigate the relationship between IPP, BV, PV, and PVR in patients diagnosed with BPH. The study protocol was reviewed and approved by the Rayong Hospital Ethics Committee (RYH REC No. E016/2568).

Study Population and Sample Size

The study population comprised male patients aged ≥50 years who were diagnosed with BPH and demonstrated intravesical prostatic protrusion on ultrasonography. The required sample size was estimated using a single-proportion formula, based on a previously reported BPH prevalence of 16.67% among men in a suburban Nigerian population [14], as no robust local prevalence data were available. Wayne's formula [15] was applied:

$$n = \frac{z^2_{1-\alpha/2}\ P\ (1-P)}{d^2}$$

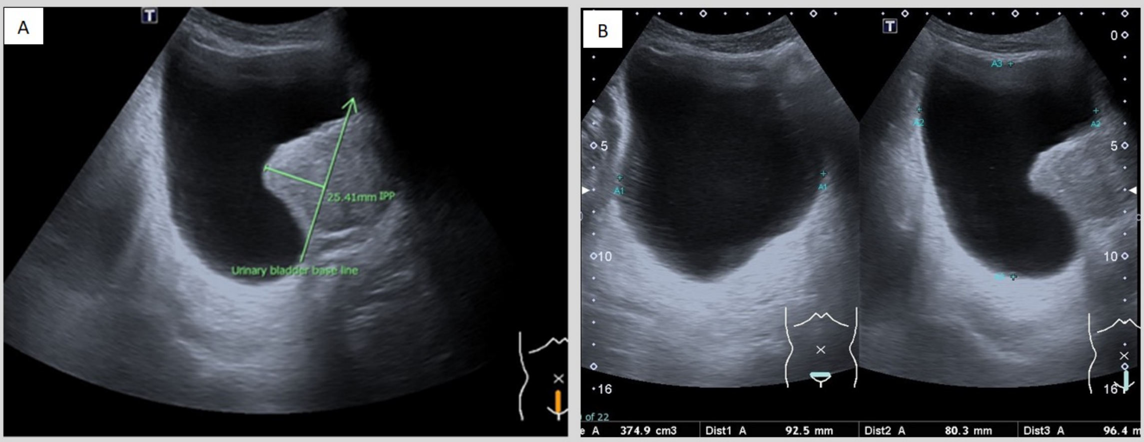
where n is the required sample size, $Z_{1-\alpha/2}$ is the standard normal deviate corresponding to the desired confidence level, P is the expected prevalence, and d is the allowable margin of error. Assuming a 95% confidence level ($Z_{1-\alpha/2}$ = 1.96), an expected prevalence of P = 0.167, and a precision of d = F0.10, the calculated minimum sample size was approximately 53. We, therefore, aimed to recruit at least 54 participants, which was achieved in the present study.

Inclusion and Exclusion Criteria

Participants were recruited from male patients aged ≥50 years [16-18] who had been clinically diagnosed with benign prostatic hyperplasia (BPH) by attending physicians as part of routine care. For the inclusion, the presence of intravesical prostatic protrusion (IPP) was subsequently confirmed by the radiologist investigator using transabdominal ultrasonography. Exclusion criteria included a history of lower urinary tract surgery, prostate or bladder malignancy, bladder stones, indwelling catheter use, a neurogenic bladder, neurological disorders (e.g., stroke, Parkinson's disease), chronic kidney disease with fluid restriction, inability to provide informed consent, or inability to complete the ultrasound procedure.

Study Procedure

After obtaining informed consent, demographic data and clinical information—including age and the IPSS were recorded. Each participant underwent four standardized transabdominal ultrasonography (US) examinations using the same ultrasound device operated by a radiologist. Participants were instructed to empty their bladder before the first scan and then consume 500 mL of water. The first scan was performed 30 minutes later to assess BV, PV, and IPP. Participants subsequently consumed an additional 500 mL of water, followed by a second scan after another 30 minutes or earlier if they experienced a strong urge to void. The third scan was performed at a similar interval, and BV, PV, and IPP were recorded in all three scans. After the third measurement, participants were instructed to void, and the fourth scan was performed immediately afterward to measure PVR. Each examination session took approximately two hours per participant. All ultrasound measurements were performed with participants in the supine position. BV, PV, and IPP—defined as the vertical distance from the tip of the prostate protruding into the bladder to the bladder neck—were measured in millimeters (Figure 1). Radiologic data were stored digitally and subsequently extracted for statistical analysis. Primary outcomes included BV, PV, PVR, IPSS, and IPP.



A: Measurement of intravesical prostatic protrusion (IPP) **B:** Measurement of bladder volume (BV)

Figure 1. *Transabdominal ultrasound showing measurement of IPP and BV.*

Statistical Analysis

Descriptive statistics were used to summarize participant characteristics. Continuous variables (e.g., BV, PV, PVR) were presented as mean ± standard deviation (SD), while categorical variables (e.g., IPSS severity, IPP grade) were expressed as frequencies and percentages. Pearson correlation analysis was applied to examine the relationships among BV, PV, PVR, IPSS, and IPP. To compare IPP measurements across different bladder volumes, paired t-tests were performed. Missing paired-volume data were handled using pairwise deletion; analyses involving IPP–bladder volume pairs included only participants with complete measurements for the respective filling levels. No data imputation was performed. Statistical significance was set at $p < 0.05$. Data analysis was performed using STATA version 16 (StataCorp, College Station, TX, USA).

Results

A total of 54 male patients with BPH were included in the study. The mean age was 69.37 ± 8.90 years, with an average body mass index (BMI) of 23.37 ± 3.60 kg/m^2. The mean PV was 64.49 ± 31.14 mL, and the mean PVR was 91.76 ± 80.89 mL. The average IPSS was 15.37 ± 10.34, with 27.8% of patients classified as having mild symptoms, 31.5% as moderate, and 40.7% as severe (Table 1).

Table 1. *General characteristics of the study population (n=54).*

Baseline characteristics	Mean	SD
Age (years)	69.37	8.90
Weight (kg)	65.06	11.89
Height (cm)	166.62	7.38
Body mass index (kg/m^2)	23.37	3.60
Prostate volume (mL)	64.49	31.14
Post-void residual urine volume (mL)	91.76	80.89
IPSS	15.37	10.34
Severity of lower urinary tract symptoms (IPSS), N%		
Mild (0-7)	15	27.78
Moderate (8-18)	17	31.48
Severe (19-35)	22	40.74

Correlation between IPP and Clinical Parameters

The degree of IPP demonstrated a significant positive correlation with PV (r = 0.365, p = 0.007) and PVR (r = 0.490, p < 0.001). However, there was no significant correlation with BV (r = –0.042, p = 0.762) or IPSS (r = 0.020, p = 0.887) (Table 2).

Table 2. *Correlation between IPP and BV, PV, PVR, and IPSS.*

Variables	Correlation coefficient	p-value
Bladder volume (BV, mL)	-0.042	0.762
Prostate volume (PV, mL)	0.365	0.007*
IPSS	0.020	0.887
Post-void residual urine (PVR, mL)	0.490	<0.001*

**p < 0.05 indicates statistical significance.*

Comparison among IPP Grades

Significant differences were found in median PV (p = 0.038) and PVR (p = 0.016) among the three IPP grades. Patients with Grade 3 IPP showed the largest PV and the highest residual urine volume. No significant differences were observed in BV (p = 0.528) or IPSS (p = 0.745) (Table 3).

Table 3. *Comparison of BV, PV, PVR, and IPSS among IPP grades.*

Variables	IPP, Median (IQR)			p-value
	Grade 1	Grade 2	Grade 3	
BV (mL)	225.97 (225.27-237.53)	249.07 (214.40-277.48)	244.37 (185.90-268.23)	0.528
PV (mL)	48.60 (34.90-50.13)	49.57 (36.42-59.47)	76.23 (43.80-100.20)	0.038*
PVR (mL)	17.50 (8.90-42.60)	57.95 (28.50-107.00)	67.50 (53.50-189.40)	0.016*
IPSS	18.00 (2.00-24.00)	17.00 (9.00-23.00)	13.00 (5.00-23.00)	0.745

Effect of BV on IPP Measurement

When stratified by BV, IPP was significantly correlated with BV only in the range of 50-199 mL (r = 0.348, p = 0.011), while no significant correlations were observed at higher BV (Table 4).

Table 4. *Correlation between IPP and BV.*

Bladder volume (mL)	Correlation coefficient	p-value
50-199	0.348	0.011*
200-299	0.055	0.711
≥ 300	-0.092	0.548

**p < 0.05 indicates statistical significance.*

Relationship between IPP Grade and BV Levels

Further analysis stratified by IPP grades revealed that the correlation between IPP and BV varied by both IPP grade and the bladder filling level (Table 5). For Grade 3 IPP (>10 mm), a strong and statistically significant positive correlation was found when BV was between 50–199 mL (r = 0.640, p = 0.003). In contrast, Grade 1 (<5 mm) and Grade 2 (5–10 mm) IPP showed no statistically significant correlation across any BV range. No significant correlations were found for any IPP grade when BV exceeded 200 mL.

Table 5. *Correlation between IPP grades and BV levels.*

Bladder volume (mL)	Intravesical Prostatic Protrusion					
	Grade 1 (<5 mm)		Grade 2 (5-10 mm)		Grade 3 (>10 mm)	
	r	p-value	***r***	p-value	***r***	p-value
50 - 199	0.278	0.594	0.362	0.069	0.640	0.003*
200 - 299	0.135	0.829	0.038	0.874	-0.108	0.623
≥300	0.167	0.753	-0.202	0.381	-0.195	0.439

**p-value < 0.05, r = correlation coefficient.*

Comparison of IPP at Different BV

Among the 46 participants who had IPP measured at two bladder filling levels (V1: 50-199 mL and V2: 200-299 mL), the mean difference in IPP was 0.22 mm, which was not statistically significant (p = 0.540), as shown in Table 6. Similarly, among 43 participants with paired measurements at V1 (50-199 mL) and V3 (≥300 mL), no significant difference was observed (mean difference = 0.18 mm, p = 0.647). In contrast, a statistically significant difference was observed in 39 participants who had IPP measured at moderate (V2: 200-299 mL) and high (≥300 mL) bladder volumes (mean difference = 0.70 mm, p = 0.045), as shown in Table 6.

Table 6. *Comparison of IPP at different bladder volume levels.*

Comparison of volume groups	Mean difference in IPP (mm)	p-value
V1 vs V2	0.22	0.540
V1 vs V3	0.18	0.647
V2 vs V3	0.70	0.045*

Bladder volume groups: V1 = 50-199 mL, V2 = 200-299 mL, V3 ≥300 mL.

Discussion

This prospective cohort study included 54 male patients diagnosed with benign prostatic hyperplasia (BPH) who demonstrated intravesical prostatic protrusion (IPP) on transabdominal ultrasonography. The results showed that IPP was significantly and positively correlated with prostate volume (PV) and post-void residual (PVR), but not with bladder volume (BV) or the International Prostate Symptom Score (IPSS). Further analyses revealed that the correlation between IPP and BV was significant only at lower bladder filling levels (50-199 mL) and disappeared at higher volumes. However, when comparing IPP measurements across different BV ranges, the largest median IPP values were observed at BV between 200-299 mL, suggesting that this range may provide the most stable and representative measurements.

The present study demonstrated significant correlations between IPP, PV, and PVR. The positive correlations observed between IPP and PV ($r = 0.365$, $p = 0.007$) and between IPP and PVR ($r = 0.490$, $p < 0.001$) indicate that higher IPP values are associated with increased residual urine and a greater degree of bladder outlet obstruction. These findings are consistent with several previous studies, which have shown that patients with IPP > 10 mm are more likely to experience moderate-to-severe BOO and to have higher residual urine volumes compared with those with smaller IPP values [19-24], a recent review confirmed that IPP is a more accurate predictor of BOO than prostate volume alone [13]. From a pathophysiological perspective, protrusion of the prostate into the bladder, particularly the median lobe, exerts a “ball-valve” effect that mechanically narrows the bladder outlet. This mechanism increases voiding resistance, leading to incomplete emptying and elevated PVR. Chronic obstruction may subsequently result in detrusor hypertrophy and long-term urinary retention [10,25].

However, the present study found no significant correlation between IPP and IPSS, which contrasts with previous study reporting a significant association between IPP and symptom severity as measured by IPSS [26]. This discrepancy may be explained by differences in patient characteristics and symptom evaluation methods. Our cohort primarily consisted of elderly patients attending a general hospital ultrasound service, many of whom had comorbidities such as diabetes mellitus or neurologic disorders. These conditions can impair detrusor contractility and bladder sensation, leading to a dissociation between symptom perception (e.g., weak stream, frequency) and the degree of mechanical obstruction caused by IPP.

Regarding bladder volume, no overall correlation was found between IPP and BV across all filling levels, consistent with previous reports by Yuen et al. [12] and Brakohiapa et al. [27], which emphasised that bladder distension can influence the apparent length of IPP on ultrasonography. In our study, IPP showed a significant positive correlation with BV only at lower filling levels (50-199 mL), particularly among patients with Grade 3 protrusion, reflecting a dynamic effect in which IPP increases proportionally as the bladder fills. However, this correlation disappeared at higher volumes, indicating that further bladder filling does not substantially alter IPP measurements. To identify the optimal range for clinical assessment, we compared IPP measurements between the higher bladder volumes (V2: 200-299 mL and V3: ≥300 mL), for which no significant correlation was observed. Among these, measurements at V2 (200-299 mL) yielded higher mean IPP values than those at V3, suggesting that this intermediate bladder volume provides the most stable and representative assessment of prostatic protrusion.

Collectively, these findings indicate that bladder volume exerts a biphasic influence on the stability of IPP measurements. At lower bladder volumes, partial filling elevates the bladder base, which reduces the apparent degree of intravesical protrusion as the bladder neck is pushed upward, resulting in lower IPP values. As filling increases and the bladder becomes adequately distended, the bladder wall stretches and the bladder base flattens, allowing the median lobe to project more prominently into the bladder lumen, thereby increasing the measured IPP. This dynamic shift is consistent with prior observations that bladder distension alters prostate–bladder geometry and affects the reproducibility of ultrasonographic measurements[13,28]. Once the bladder reaches a sufficiently distended state, further increases in volume induce minimal additional geometric change, explaining why the correlation between IPP and bladder volume becomes negligible at higher filling levels. Similar findings in pelvic imaging studies have shown that bladder filling modifies the relative position of pelvic organs, including the prostate, emphasizing the importance of standardized bladder conditions for consistent measurements[29]. Taken together, these considerations support the use of an intermediate filling range—particularly 200–299 mL—as a clinically reliable and representative condition for obtaining stable IPP measurements.

The strengths of this study include its prospective design and the standardized assessment of IPP at multiple bladder volumes, which minimizes measurement variability and enables the evaluation of volume-related effects. Nevertheless, several limitations should be acknowledged. This was a single-center study with a relatively small overall sample size, and the distribution of patients across IPP grades and IPSS severity categories was unequal, which may have reduced the statistical power of subgroup analyses and limited the reliability of group comparisons. In addition, all ultrasound measurements were performed by a single operator. Although this approach ensured consistency and minimized intra-operator variability, the use of a single operator may have introduced some degree of operator-related variability, as minor differences in probe positioning, pressure, or insonation angle could affect IPP measurements. Unequal subgroup sizes—particularly the smaller number of patients in certain IPP grades—may also have increased variability in group estimates, reducing the precision of statistical comparisons. These factors, together with recruitment from a single tertiary hospital, may limit external validity, as the findings may not fully represent broader populations with different demographic or clinical characteristics. Finally, IPP measurement using transabdominal ultrasonography is inherently subject to technical variability, including differences in bladder-filling physiology and patient-specific anatomic factors, which may further influence measurement consistency.

Future studies should include larger, multicenter cohorts with more balanced group sizes, employ standardized BV ranges (preferably 200–299 mL), incorporate urodynamic parameters or clinical outcomes such as treatment response and surgical intervention rates, and involve multiple operators with formal evaluation of interobserver agreement to enhance methodological rigor and external validity.

Conclusion

In conclusion, IPP showed significant positive correlations with prostate volume and post-void residual volume but not with patient-reported IPSS. Although IPP increased with bladder filling at lower volumes (50-199 mL), measurements were most consistent and reflective of true prostatic protrusion at 200-299 mL. These findings highlight the value of standardizing bladder-filling protocols within this intermediate range during transabdominal ultrasonography, thereby improving measurement reliability and reinforcing IPP as a practical, non-invasive indicator of anatomical obstruction and urinary retention risk in men with BPH.

Competing Interest
The author declares no competing interest.

Acknowledgements
The author would like to express sincere gratitude to Dr. Piromsiri Koosakul, Radiologist and Head of the Department of Radiology, Rayong Hospital, and Dr. Janejira Chumcheon, Radiologist, Diploma of the Thai Subspecialty Board of Advanced Diagnostic Body Imaging, for their expert guidance and valuable advice throughout this study. The author also gratefully acknowledges Dr. Phanpon Leelahawong, Urologist, Rayong Hospital, for his kind assistance with the diagnosis and management of benign prostatic hyperplasia (BPH), as well as for providing valuable information regarding the International Prostate Symptom Score (IPSS). Finally, the author wishes to thank the patients who participated in this study.

References

1. GBD 2019 Benign Prostatic Hyperplasia Collaborators. The global, regional, and national burden of benign prostatic hyperplasia in 204 countries and territories from 2000 to 2019: a systematic analysis for the Global Burden of Disease Study 2019. Lancet Healthy Longev 2022;3:e754–76. doi: 10.1016/S2666-7568(22)00213-6.

2. Lee SWH, Chan EMC, Lai YK. The global burden of lower urinary tract symptoms suggestive of benign prostatic hyperplasia: a systematic review and meta-analysis. Sci Rep 2017;7:7984. doi:10.1038/s41598-017-06628-8.

3. Institute for Population and Social Research, Mahidol University. Thai Health 2023 : Thailand's Commitment in COP (Conference of Parties) & Responses to Climate Change [Internet]. Nakhon Pathom: Institute for Population and Social Research, Mahidol University with Thai Health Promotion Foundation; 2023 [cited 2025 Feb 11]. Available from: https://bps.moph.go.th/new_bps/sites/default/files/statistic53.pdf

4. Chunhakrai V, Santingamkun A, editors. Common urologic problems for medical student [Internet]. Bangkok: Thai Urological Association under The Royal Patronage; 2015. Thai. [cited 2025 Dec 26]. Available from: https://www.tuanet.org/wp-content/uploads/2020/06/07_Common-Urologic-Problems.pdf

5. Lerner LB, McVary KT, Barry MJ, Bixler BR, Dahm P, Das AK, et al. Management of lower urinary tract symptoms attributed to benign prostatic hyperplasia: AUA guideline part I—initial work-up and medical management. J Urol 2021;206:806–17. doi:10.1097/JU.0000000000002183.

6. European Association of Urology. EAU Guidelines on Management of Male LUTS [Internet]. Arnhem (The Netherlands): EAU; 2013 [cited 2025 Feb 11]. Available from: https://uroweb.org/guidelines

7. Rosier PFWM, Schaefer W, Lose G, Goldman HB, Guralnick M, Eustice S, et al. International Continence Society good urodynamic practices and terms 2016: urodynamics, uroflowmetry, cystometry, and pressure-flow study. Neurourol Urodyn 2017;36:1243–60. doi:10.1002/nau.23124.

8. Eze BU. Intravesical prostatic protrusion as a predictor of need for surgical therapy in benign prostatic hyperplasia patients. EJMED [Internet]. 2023 [cited 2025 Dec 27]; 5:9–12. Available from: https://eu-opensci.org/index.php/ejmed/article/view/41746

9. Al Rashed AA, Isa QM, Mahdi A, Ebrahim M, Abdulaziz K, Hasan O, et al. Clinical outcomes of intravesical prostatic protrusion in patients with benign prostatic hyperplasia. Cureus 2024;16:e52541. doi:10.7759/cureus.52541.

10. Lee LS, Sim HG, Lim KB, Wang D, Foo KT. Intravesical prostatic protrusion predicts clinical progression of benign prostatic enlargement in patients receiving medical treatment. Int J Urol 2010;17:69–74. doi:10.1111/j.1442-2042.2009.02409.x.

11. Hossain AK, Alam AK, Habib AK, Rashid MM, Rahman H, Islam AK, et al. Comparison between prostate volume and intravesical prostatic protrusion in detecting bladder outlet obstruction due to benign prostatic hyperplasia. Bangladesh Med Res Counc Bull 2012;38:14–7. doi:10.3329/bmrcb.v38i1.10446.

12. Yuen JS, Ngiap JT, Cheng CW, Foo KT. Effects of bladder volume on transabdominal ultrasound measurements of intravesical prostatic protrusion and volume. Int J Urol 2002;9:225–9. doi:10.1046/j.1442-2042.2002.00453.x.

13. Gandhi J, Weissbart SJ, Kim AN, Joshi G, Kaplan SA, Khan SA. Clinical considerations for intravesical prostatic protrusion in the evaluation and management of bladder outlet obstruction secondary to benign prostatic hyperplasia. Curr Urol 2018;12:6–12. doi:10.1159/000447224.

14. Esomonu U, Obun C, Ude R, Igwe S, Esomchi C, Ogolekwu S. Prevalence of benign prostatic hyperplasia and prostate cancer among suburban residents in southern Nigeria. Afr J Urol 2024;30:66. doi:10.1186/s12301-024-00470-x.

15. Wayne DW. Biostatistics: a foundation for analysis in the health sciences. 7th ed. New York: John Wiley & Sons; 1995.

16. Iwenofu CA, Amu OC, Affusim EA, Nwachukwu CD, Anyimba SK. Correlation of intravesical prostatic protrusion with severity of lower urinary tract symptoms in men with symptomatic benign prostatic hyperplasia at University of Nigeria Teaching Hospital, Ituku-Ozalla Enugu. Niger J Med 2024;33:19–24. doi:10.4103/NJM.NJM_110_23.

17. Ruamcharoen S. Benign prostatic hyperplasia at Nakhon Phanom Hospital. Sanpasitthiprasong Med J 2021;35(1):1–12. Thai.

18. Wang D, Huang H, Law YM, Foo KT. Relationships between prostatic volume and intravesical prostatic protrusion on transabdominal ultrasound and benign prostatic obstruction in patients with lower urinary tract symptoms. Ann Acad Med Singap 2015;44:60–5.

19. Shin SH, Kim JW, Kim JW, Oh MM, Moon du G. Defining the degree of intravesical prostatic protrusion in association with bladder outlet obstruction. Korean J Urol 2013;54:369–72. doi:10.4111/kju.2013.54.6.369.

20. Lee A, Lee HJ, Lim KB, Huang HH, Ho H, Foo KT. Can intravesical prostatic protrusion predict bladder outlet obstruction even in men with good flow? Asian J Urol 2016;3:39–43. doi:10.1016/j.ajur.2015.10.002.

21. Kurnia IC, Ghinorawa T, Rochadi S. Correlation of PSA, PV, and IPP in detecting bladder outlet obstruction caused by prostate enlargement. Indones J Urol 2014; 21:1–6.

22. Tan YG, Teo JS, Kuo TLC, Guo L, Shi L, Shutchaidat V, et al. A systematic review and meta-analysis of transabdominal intravesical prostatic protrusion assessment in determining bladder outlet obstruction and unsuccessful trial without catheter. Eur Urol Focus 2022;8:1003–14. doi:10.1016/j.euf.2021.09.016.

23. Chia SJ, Heng CT, Chan SP, Foo KT. Correlation of intravesical prostatic protrusion with bladder outlet obstruction. BJU Int 2003;91:371–4. doi:10.1046/j.1464-410x. 2003.04088.x.

24. Keqin Z, Zhishun X, Jing Z, Haixin W, Dongqing Z, Benkang S. Clinical significance of intravesical prostatic protrusion in patients with benign prostatic enlargement. Urology 2007;70:1096–9. doi:10.1016/j.urology.2007.08.008.

25. Foo KT. Pathophysiology of clinical benign prostatic hyperplasia. Asian J Urol 2017; 4:152–7. doi:10.1016/j.ajur.2017.06.003.

26. Sigdel G, Belokar W. Clinical significance of intravesical prostatic protrusion in patients with benign prostatic hyperplasia. J Univ Coll Med Sci 2015;3:6–10. doi:10.3126/jucms.v3i1.13248.

27. Brakohiapa EK, Botwe BO, Sarkodie BD. Prostate volume determination by transabdominal ultrasonography: does accuracy vary significantly with urinary bladder volumes between 50 to 400 mL? J Med Radiat Sci 2019 ;66:81-90. doi: 10.1002/jmrs.320.

28. Chauhan K, Ebner DK, Tzou K, Ryan K, May J, Kaleem T, et al. Assessment of bladder filling during prostate cancer radiation therapy with ultrasound and cone-beam CT. Front Oncol 2023;13:1200270. doi:10.3389/fonc.2023.1200270.

29. Hynds S, McGarry CK, Mitchell DM, Early S, Shum L, Stewart DP, et al. Assessing the daily consistency of bladder filling using an ultrasonic bladderscan device in men receiving radical conformal radiotherapy for prostate cancer. Br J Radiol 2011;84:813–8. doi:10.1259/bjr/50048151.

THE ASEAN JOURNAL OF RADIOLOGY
ISSN 2672-9393

Original Article

Ultrasound-based thyroid volume of Cambodian adults

Sruy Huy, M.D.[1,2]
Vanthy VAR, M.D.[1,2]
Ponndara Ith, M.D.[2]
Chanvohreak Hang, M.D.[2]
Prorpey Khim, M.D.[1,2]
Kimsour Kuch, M.D.[2]
Rathana Kea, M.D.[1,2]
Chhuong Uy, M.D.[1,2]
Chinsorn Khut, M.D.[1]
From [1]Radiology Department, Khmer-Soviet Friendship Hospital, [2]Faculty of Medicine, University of Health Sciences (UHS), Phnom Penh, Cambodia.
Address correspondence to S.H. (email: sruyhuy2@gmail.com)

Received 1 June 2025; revised 24 September 2025; accepted 29 January 2026
doi:10.46475/asean-jr.v27i1.954

Abstract

Background: Accurate assessment of the thyroid gland size is essential for diagnosing and managing thyroid disorders. While ultrasonography is a non-invasive and cost-effective method for evaluating thyroid volume, no reference values currently exist for the adult Cambodian population.

Objective: This study aimed to determine normative ultrasound-based thyroid volume values in euthyroid Cambodian adults, hypothesizing that thyroid volume varies significantly by sex and between lobes.

Materials and Methods: A prospective cross-sectional study was conducted on 513 adults (307 females, 206 males) aged 18–78 years at the a National Hospital between April and November 2020. Inclusion criteria included normal thyroid parenchyma and absence of nodules on ultrasound. Volumes of both lobes were calculated using the ellipsoid formula: height (cm) x thickness (cm) x width (cm) x $\pi/6$. Data were analyzed using Excel and SPSS version 26, with significance set at $p<0.05$.

Results: The mean thyroid volume was 7.52 ± 2.75 mL. Males had significantly larger thyroid volumes (8.05 ± 2.87 mL) than females (7.16 ± 2.60 mL) ($p<0.05$). The right lobe (4.27 ± 1.55 mL) was significantly larger than the left lobe (3.25 ± 1.33 mL) in both sexes ($p<0.05$).

Conclusion: This is the first study to establish ultrasound-based reference values for thyroid volume in Cambodian adults. The findings confirm that thyroid volume is greater in males than females and that the right lobe is typically larger than the left. These values provide a valuable baseline for clinical assessment and future research in Cambodia.

Keywords: Ellipsoid model, Parenchymal texture, Sonography, Thyroid echogenicity, Thyroid gland, Thyroid hypertrophy, Thyroid hypoplasia, Thyroid nodule.

Introduction

A precise estimation of the thyroid size is central to the evaluation and management of thyroid disorders. Given a diagnosis of goiter, ultrasound measurement is a relatively accurate means [1,2,3]. Ultrasound – commonly seen as a quick, safe and non-invasive way to epidemiologically estimate thyroid volume – has become one of the most oft-used imaging modalities to assess cervical region-residing internal secretory glands [4,5].

The limitations of physical examination have made ultrasound an attractive tool for visualizing the thyroid gland. Though Computed tomography (CT) and Magnetic Resonance are also effective tools in such visualization, they are relatively costly [3]. Information such as sex, age-related thyroid volume, and data from healthy product consumption is crucial for the diagnosis of thyroid hypertrophy or hypoplasia. As of now, numerous thyroid biometric studies shed lights on variations including age, gender, environmental factors, and iodine status of the population [2,3,6,7]. For example, a study by Brunn et al found out that a modified correction of 0.479 would make a more accurate evaluation of thyroid volume, compared with the previously recognized correction factor of $\pi/6$ or 0.524 [6]. Yet, the study relied on measuring the volume of cadaver glands that had been submerged in water [6]. The ellipsoid model, which measures and multiplies the height, width, and depth of each lobe to calculate the thyroid gland volume, generates a result that is then multiplied by a correction factor [8].

The local standard volume of thyroid has been non-existent in Cambodia thus far. Hence, the purpose of this study is to sonographically determine normal thyroid volume values in euthyroid adults in Cambodia.

Materials and methods

This study was carried out as a prospective cross-sectional study at the Medical Imaging Department of the Khmer-Soviet Friendship Hospital, Phnom Penh in Cambodia. The study, which took place between 1 April to 30 November 2020, included 513 adults, including 307 females and 206 males. The subjects' ages range from 18 to 78 years old with a mean age of 37.5 ± 13.39 years.

Upon informed consent, all participants answered a questionnaire and underwent a clinical examination to rule out unrecognized thyroid pathology, from which only participants without a clinical sign of thyroid pathology, without clinically palpable thyroid nodules, with normal parenchyma texture, and without thyroid nodules on ultrasound were included in the study. Participants with clinical evidence of thyroid disease, anomaly of thyroid echogenicity and thyroid nodules were excluded from this research. Also, menstruating women, women in pregnancy, women who gave birth in the previous 12 months and those with any systemic disorder were out of this research scope. The ultrasound system used in the research was a real-time greyscale ultrasound machine (HS60, Xario 200 and Aplio 200), equipped with a 7.5 MHz 2D linear ultrasound probe transducer performed by a radiologist. The participants were examined while lying on their backs with their cervical spines hyperextended, and ultrasound gel being applied in the thyroid region.

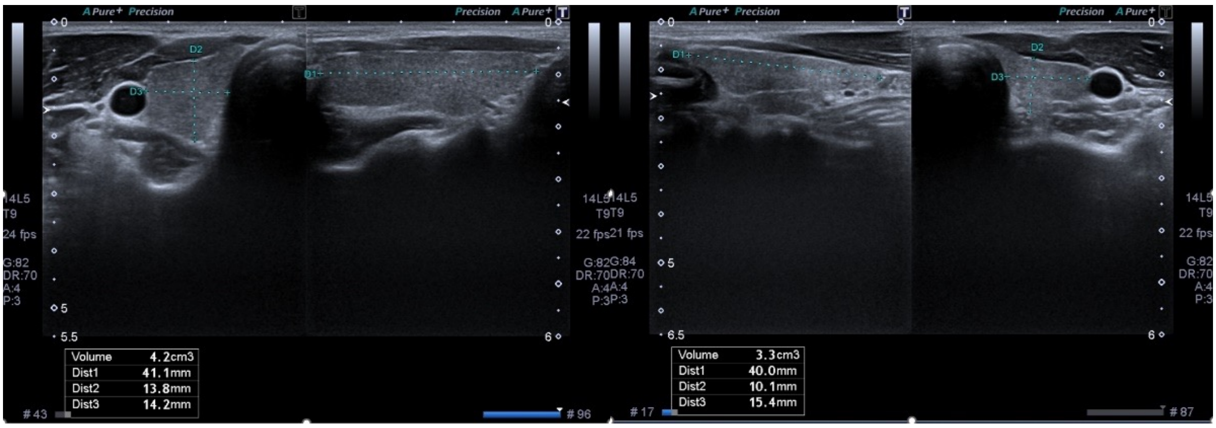


Figure 1. *Ultrasound image of thyroid volume of a 40-year-old female adult.*

The thyroid gland's volume results from the summation of the right lobe volume and the left lobe volume (Figure 1). The volume of each lobe was measured using the ellipse formula: height (cm) x thickness (cm) x width (cm) x π/6. Through a longitudinal section, the height (or length) of the lobe was measured by placing the transducer at the anterolateral part of the neck through the sternocleidomastoid muscle in order to obliquely obtain the greater vertical axis of the lobe between its upper pole and its lower pole.

Calipers were placed at the extreme edges of the upper pole and the lower pole to obtain the greatest distance between the two poles. The transducer was placed transversely on the anterior part of the neck at the thyroid isthmus level to achieve cross section. Whereas placing the calipers between the anterior and posterior edges of the lobe at the height of the middle of isthmus helps measure thickness (anteroposterior diameter), placing them between the lateral and medial edges of the lobe assists with measuring the width (or transverse diameter).

The data was collected and analyzed using both excel 2010 and IBM SPSS Statistic Version 26 to improve the validity of the analysis. Thyroid volume was expressed as the mean standard deviation value. Results were considered significant at $p<0.05$.

The study was approved by a University of Health Science, the National Ethics Committee for Health Research, Khmer-Soviet Friendship Hospital under the study.

Results

The study covers a total of 513 participants, 307 (59.8%) of whom are females and 206 (40.2%) are males, representing a healthy Cambodian, commensurate with history, palpation and sonography. The subjects' average age is 37.3 ± 13.38 years with a range of 18-78 years. The average thyroid volume in all of the participants under the study is 7.52 ± 2.75 mL. The average thyroid volume is 7.16 ± 2.60 mL, and 8.05 ± 2.87 mL in females and males respectively ($p<0.05$). Amongst all the participants, the average thyroid gland volume is 4.27 ± 1.55 mL, and 3.25 ± 1.33 mL for the right and left lobes respectively. For females, the volumes of the right and left thyroid lobes are 4.05 ± 1.47 mL and 3.10 ± 1.26 mL respectively while for males, the volumes of the right and left thyroid lobes are 4.59 ± 1.61 mL and 3.46 ± 1.41 mL respectively. All participants are found to have more volume in the right thyroid lobe than the left ($p<0.05$) (Table 1).

THE ASEAN JOURNAL OF RADIOLOGY
ISSN 2672-9393

Table 1. *Thyroid gland volume (mean and SD).*

Subjects (number)	Thyroid volume (mL)	Right lobe (mL)	Left lobe (mL)
Females (307)	7.16 ± 2.60	4.05 ± 1.47	3.10 ± 1.26
Males (206)	8.05 ± 2.87	4.59 ± 1.61	3.46 ± 1.41
All (513)	7.52 ± 2.75	4.27 ± 1.55	3.25 ± 1.33

Based on the correlation analysis in Table 2 shows that total volume is positively associated with body size measures, with weak to moderate correlations with weight ($r = 0.275$, $p < 0.001$), height ($r = 0.206$, $p < 0.001$), and body surface area (BSA) ($r = 0.291$, $p < 0.001$). Weight and height are moderately correlated ($r = 0.461$, $p < 0.001$), while BSA demonstrates very strong associations with both weight ($r = 0.954$, $p < 0.001$) and height ($r = 0.703$, $p < 0.001$). All correlations are statistically significant at the 0.01 level, indicating reliable relationships within the sample.

Table 2. *Correlation analysis of the volume, weight, height, and BSA.*

		Total Volume	Weight	Height	BSA
Total Volume	Pearson Correlation	1	0.275**	0.206**	0.291**
	Sig. (2-tailed)	-	0.000	0.000	0.000
Weight	Pearson Correlation	0.275**	1	0.461**	0.954**
	Sig. (2-tailed)	0.000	-	0.000	0.000
Height	Pearson Correlation	0.206**	0.461**	1	0.703**
	Sig. (2-tailed)	0.000	0.000	-	0.000
BSA	Pearson Correlation	0.291**	0.954**	0.703**	1
	Sig. (2-tailed)	0.000	0.000	0.000	-

***. Correlation is significant at the 0.01 level (2-tailed).*

Discussion

A precise measurement of the thyroid gland size is requisite for the evaluation and management of thyroid disorders. Sonography accesses the thyroid gland at ease thanks to its superficial anatomical location and unique echogenicity compared to adjacent soft tissues [9].

Volume measurement of the thyroid gland – given its conical form – is predicated upon the use of an ellipsoid model, that is, height x width x thickness x a correlation factor [9]. Several similar studies present huge variations in their results, suggesting that the thyroid size hinges on regional, environmental, ethical factors and especially on the iodine status of the population (Table 3). In this study, average thyroid volumes for women and men are 7.16 ± 2.60 mL and 8.05 ± 2.87 mL respectively. As of now, research publications in Cambodian on thyroid volumes has been non-existent. Interestingly, the findings show that the size of thyroid volumes in this study is lower than the ones found in studies conducted in Iran [1]. One of the reasons for such difference is probably the large size, heavy weight and a large body surface area of the Iranian population. On top of it, the thyroid volume size found in this study is also smaller than that found in studies conducted in Belgium, Denmark, Croatia, Turkey [5,8,10,11].

Table 3. *Comparison of thyroid volume studies.*

Author	Gender	Age range (years)	Number of subjects	Thyroid volume (mL) ± SD	Country
our study	206 M 307 F	18-78	513	7.52 ± 2.75	Cambodia
Adibi A, et al. [1]	123 M 77 F	37.27 ± 11.8	200	9.53 ± 3.68	Iran
Chanoine JP, et al. [5]		17-20	256	11.6 ± 4.4	Belgium
Hegedüs L, et al. [8]	139 M 132 F	13-91	271	18.6 ± 4.5	Denmark
Ivanac G, et al. [10]		20-38	51	10.68 ± 2.83	Croatia
Sahin E, et al. [11]	169 M 292 F	18-61	461	12.98 ± 2.53	Turkey
Yousef M, et al. [12]	75 M 28 F	19-29	103	6.44 ± 2.44	Sudan
M Arun Prasad, et al. [3]	24 M 76 F	18-60	100	5.95 ± 3.23	North India
Turcios S, et al. [13]	21 M 79 F	18-50	100	6.6 ± 0.26	Cuba
Hsiao YL, et al. [14]	115 M 48 F	17-79	163	7.7 ± 3.3	China
Nguyen TT [15]	54 M 150 F	18-25	204	7.44 ± 2.09	Vietnam

In a study in Sudan from 2007 to 2010, Yousef M, et al. measured an average thyroid volume among volunteers, which is lower than the one in this study, and found that an average thyroid volume for both sex is 6.44 ± 2.44 mL, in which 5.78 ± 1.96 mL and 6.69 ± 2.56 mL is for female and male respectively. Yet, the sample size of the study is lower, 103 subjects, with the age range from 19 to 29 years old, which further attests to the notion that age constitutes an important factor in thyroid volume variations [12]. Furthermore, the results of this study also prove that the thyroid volume size is bigger than that found in studies conducted in North India and Cuba [3,13].

Results from two other studies in China by Hsiao YL, et al. and in Vietnam by Nguyen TT with an average thyroid volume of 7.7 ± 3.3 mL and 7.44 ± 2.09 mL respectively, also prove that the values are aligned with the findings of our study. This may be explained by the similar weight, height and body surface area of the general Chinese and Vietnamese population [14,15].

Similar to several previous studies, we discovered that males have a larger thyroid gland (8.05 ± 2.87 mL) than females (7.16 ± 2.60 mL). This gender difference is statistically significant ($p<0.05$). We concluded that the sex difference in thyroid gland volume is greater in males than in females due to structural anatomy, regardless of Body Mass Index (BMI) [11,16,17].

The thyroid lobe volumes collected in this investigation revealed that the right thyroid lobe volume is bigger than the left, with a statistically significant difference between the right and the left lobe volumes in both sexes. These results are consistent with those of other studies [13,15].

The mean thyroid gland volume in males is larger than in females. The right thyroid lobe volume is larger than left in both sexes. These findings confirm and echo those of the majority of earlier studies. Nonetheless, ultrasound is a method influenced by factors such as the observer, genetics, and environment, which can affect thyroid volume.

Limitations in this study include its single-center design, the absence of normal thyroid function tests, and nutritional lack of information on nutritional status or residence in iodine-deficient areas, all of which may influence thyroid gland size.

Conclusion

This research shows that a typical and average thyroid gland volume of adults in Cambodia is 7.52 ± 2.75 mL, wherein the sizes are 7.16 ± 2.60 mL and 8.05 ± 2.87 mL for females and males respectively. As elaborated earlier, this marks the first ever research study on thyroid volumes using ultrasonography in Cambodia. Beneficial for relevant referencing in the country, these figures further contribute to efforts in developing the national reference values.

As the thyroid volume is associated with anthropometric measurements, and genetic and environmental factors, we believe that future additional research is needed to establish national thyroid volume references in Cambodia and Southeast Asia.

Acknowledgement: The authors would like to thank all of the study participants for their valuable contribution.

References

1. Adibi A, Mehri S, Aminorroaya A, Ehsan R, Mohsen M, Fallah Z, et al. Normal values of thyroid gland in Isfahan, an iodine replete area. J Res Med Sci [Internet]. 2008 [cited 2025 Dec 5];13:55-60. Available from: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://emrc.mui.ac.ir/sites/emrc/files/Articles/2008/Normal%20values%20of%20thyroid%20gland%20in%20Isfahan%2C%20an%20iodine%20replete%20area.pdf

2. Hegedüs L. Thyroid ultrasound. Endocrinol Metab Clin North Am [Internet]. 2001 [cited 2025 Dec 3];30:339-60. Available from: https://pubmed.ncbi.nlm.nih.gov/11444166/

3. Prasad MA, Agrawal SK, Srivastava V, Chauhan M. Normal reference ranges of thyroid volume in North Indian subjects using ultrasound. IJHCR [Internet]. 2020 [cited 2025 Dec 3]; 6:19–20. Available from: https://www.medicalsciencejournal.com/assets/archives/2020/vol6issue7/6-7-16-187.pdf

4. Aydıner Ö, Karakoç Aydıner E, Akpınar İ, Turan S, Bereket A. Normative data of thyroid volume—ultrasonographic evaluation of 422 subjects aged 0–55 years. J Clin Res Ped Endocrinol [Internet]. 2015 [cited 2025 Dec 3];7 :98–101. Available from: https://pubmed.ncbi.nlm.nih.gov/26316430/

5. Chanoine JP, Toppet V, Lagasse R, Spehl M, Delange F. Determination of thyroid volume by ultrasound from the neonatal period to late adolescence. Eur J Pediatr [Internet]. 1991 [cited 2025 Dec 3];150: 395-9. Available from: https://link.springer.com/article/10.1007/BF02093716

6. Brunn J, Block U, Ruf G, Bos I, Kunze WP, Scriba PC.. [Volumetric analysis of thyroid lobes by real-time ultrasound (author's transl)]. Dtsch Med Wochenschr [Internet]. 1981 [cited 2025 Dec 3]; 106:1338–40. German. Available from: https://pubmed.ncbi.nlm.nih.gov/7274082/

7. Gómez JM, Maravall FJ, Gómez N, Gumà A, Soler J.Determinants of thyroid volume as measured by ultrasonography in healthy adults randomly selected. Clin Endocrinol (Oxf) [Internet]. 2000 [cited 2025 Dec 3];53: 629–34. Available from: https://pubmed.ncbi.nlm.nih.gov/11106925/

8. Hegedüs L, Perrild H, Poulsen LR, Andersen JR, Holm B, Schnohr P, et al. The determination of thyroid volume by ultrasound and its relationship to body weight, age, and sex in normal subjects. J Clin Endocrinol Metab [Internet]. 1983 [cited 2025 Dec 3];56:260–3. Available from: https://pubmed.ncbi.nlm.nih.gov/6822636/

9. Henjum S, Strand TA, Torheim LE, Oshaug A, Parr CL. Data quality and practical challenges of thyroid volume assessment by ultrasound under field conditions - observer errors may affect prevalence estimates of goiter. Nutri J [Internet]. 2010 [cited 2025 Dec 4];9:66. Available from: https://nutritionj.biomedcentral.com/articles/10.1186/1475-2891-9-66

10. Ivanac G, Rozman B, Skreb F, Brkljacić B, Pavić L. Ultrasonographic measurement of the thyroid volume. Coll Antropol [Internet]. 2004 [cited 2025 Dec 4];28:287–91. Available from: https://pubmed.ncbi.nlm.nih.gov/15636085/

11. Şahin E, Elboğa U, Kalender E. Regional reference values of thyroid gland volume in Turkish adults. Srp Arh Celok Lek [Internet]. 2015 [cited 2025 Dec 4];143:141–5. Available from: https://pubmed.ncbi.nlm.nih.gov/26012121/

12. Yousef M, Sulieman A, Ahmed B, Abdella A, Eltom K. Local reference ranges of thyroid volume in sudanese normal subjects using ultrasound. J Thyroid Res [Internet]. 2011 [cited 2025 Dec 4];2011:935141. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC3180179/

13. Turcios S, Lence-Anta JJ, Santana JL, Pereda CM, Velasco M, Chappe M, et al. Thyroid volume and its relation to anthropometric measures in a healthy cuban population. Eur Thyroid J [Internet]. 2015 [cited 2025 Dec 4]; 4:55–61. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC4404892/

14. Hsiao YL, Chang TC. Ultrasound evaluation of thyroid abnormalities and volume in Chinese adults without palpable thyroid glands. J Formos Med Assoc [Internet]. 1994 [cited 2025 Dec 4];93:140–4. Available from: https://pubmed.ncbi.nlm.nih.gov/7912585/

15. Nguyen TT. Determination of thyroid volume by ultrasound [dissertation]. Da Nang: Jönköping University; 2016 [cited 2025 Dec 4]. Available from: http://www.diva-portal.se/smash/get/diva2:938179/FULLTEXT01.pdf

16. Langer P. Normal thyroid size versus goiter-postmortem thyroid weight and ultrasonographic volumetry versus physical examination. Endocrinol Exp [Internet]. 1989 [cited 2025 Dec 5];23:67–6. Available from: https://pubmed.ncbi.nlm.nih.gov/2673744/

17. Reiners C, Wegscheider K, Schicha H, Theissen P, Vaupel R, Wrbitzky R, et al. Prevalence of thyroid disorders in the working population of Germany: ultrasonography screening in 96,278 unselected employees. Thyroid [Internet]. 2004 [cited 2025 Dec 4]; 14:926–32. Available from: https://pubmed.ncbi.nlm.nih.gov/15671771/

THE ASEAN JOURNAL OF RADIOLOGY
ISSN 2672-9393

Case Report

Extralobar pulmonary sequestration in the left superior mediastinum with an atypical pulmonary artery supply: A case report

Walit Sowalertrat, M.D.
Pakkapon Laojaroensuk, M.D.
Nantaka Kiranantawat, M.D.
Sitang Nirattisaikul, M.D.
Wiwatana Tanomkiat, M.D.
From Department of Radiology, Faculty of Medicine, Prince of Songkhla University, Songkhla, Thailand.
Address correspondence to W.S. (email: walitsun@gmail.com)

Received 1 May 2025; revised 22 December 2025; accepted 27 December 2025
doi:10.46475/asean-jr.v27i1.955

Abstract

Extralobar pulmonary sequestration is a rare congenital anomaly with a nonfunctional lung mass with no connection to the bronchial tree and a systemic arterial supply. Most cases are located in the lower thorax and involvement of the left upper thorax is exceedingly rare. We present a case of an incidental left superior mediastinal mass in an asymptomatic patient undergoing a screening chest radiography. Further chest CT revealed a large mass in the left superior mediastinum, with arterial supply from the left pulmonary artery. Surgical excision was performed, and histopathology demonstrated ectopic pulmonary tissue with its own pleura without bronchial connection. The case highlights the diagnostic challenges and surgical considerations in rare anatomical variations of pulmonary sequestration at the left superior mediastinum.

Keywords: Congenital lung malformation, Extralobar pulmonary sequestration, Mediastinal mass, Pulmonary sequestration.

Introduction

Pulmonary sequestration is a rare congenital malformation, accounting for approximately 0.15–6.4% of all congenital lung anomalies [1]. It consists of non-functioning lung tissue that lacks communication with the tracheobronchial tree and receives arterial supply from the systemic circulation. Pulmonary sequestration is categorized into two types: intralobar pulmonary sequestration (ILS), which is contained within the lung and has a visceral pleura covering. The other type is extralobar pulmonary sequestration (ELS), which is surrounded by its own separate pleura [1].

According to a comprehensive review of 540 cases, 133 of them are ELS, by Savic et al. [2], and over 77% of ELS cases are located between the diaphragm and the lower lobes, with a left-side predominance (78.9%). Only two cases involved the left mediastinum, without specification of whether they were in the superior or inferior mediastinum. Thus, ELS in the superior mediastinum is exceptionally rare and may present significant diagnostic and therapeutic challenges.

About 80% of the aberrant arterial supply for ELS originates from the descending aorta, including supply from other systemic arteries such as the celiac, splenic, intercostal, or subclavian arteries [3]. Its venous drainage usually occurs into systemic veins, such as the right atrium, azygos vein, or portal vein, although it can also be variable [4]. Importantly, the presence of a pulmonary arterial supply to an ELS is exceedingly uncommon [5]. Such an atypical vascular pattern can complicate the diagnosis, since a pulmonary artery feeder is more typical of intrapulmonary lesions like congenital pulmonary airway malformation (CPAM) [6].

Although a few cases of mediastinal ELS have been reported, they usually have systemic blood supply [7]. Only two cases of superior mediastinal mass with pulmonary artery supply have been reported [8,9]. Of these, only one case, which had two arterial supplies, had feeding vessels that could be identified on CT images pre-operatively [9].

Here, we present a case of left superior mediastinal ELS with a single, exclusive arterial supply from the pulmonary artery that was identifiable on preoperative CT, adding a unique example to this very limited body of literature.

Case summary

A 58-year-old Thai woman, lifelong non-smoker residing in an urban area of southern Thailand, was referred for further evaluation after a routine screening chest radiograph revealed a well-circumscribed mass in the left superior mediastinum. She was asymptomatic, with no history of cough, dyspnea, chest pain, fever, or constitutional symptoms. Her medical and surgical histories were unremarkable.

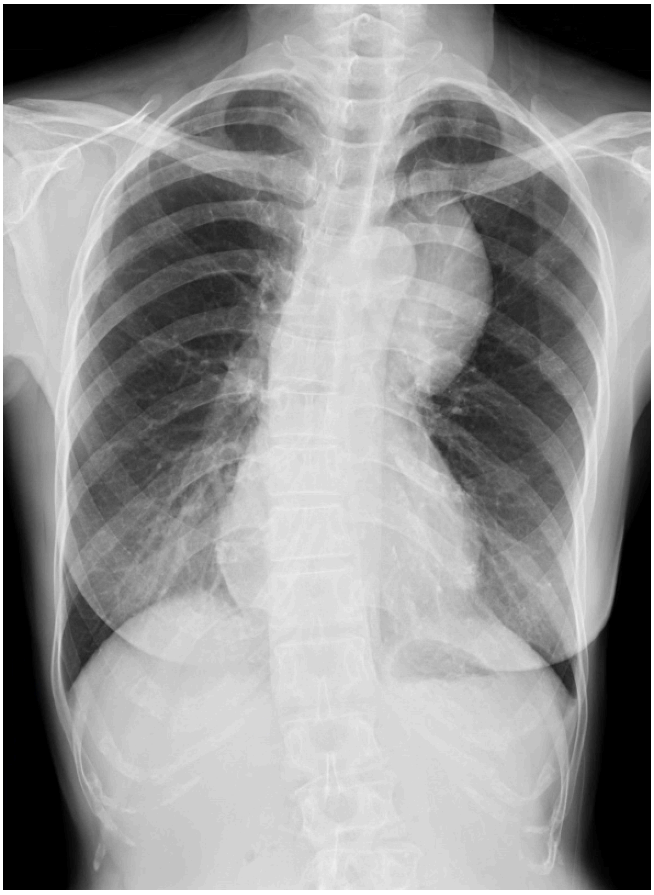


Figure 1. *Chest radiograph from the referring hospital shows a large well-defined hemispherical mass in the left upper hemithorax with preservation of the aortic knob and left hilum. No internal calcification or adjacent rib destruction is demonstrated.*

On physical examination, the patient was alert, afebrile, and hemodynamically stable. Cardiopulmonary examination was unremarkable, and there was no lymphadenopathy or peripheral edema. Contrast-enhanced chest CT demonstrated a 5.1 × 5.2 × 9.0-cm hyperdense, non-enhancing extrapulmonary mass in the superior, anterior and middle mediastinum, containing multiple internal punctate calcifications. The mass was noted to be encasing the adjacent left subclavian artery inferiorly. An arterial supply from the left main pulmonary artery was identified. No invasion of lung parenchyma or major vessels were seen. There was no mediastinal lymphadenopathy or pleural effusion.

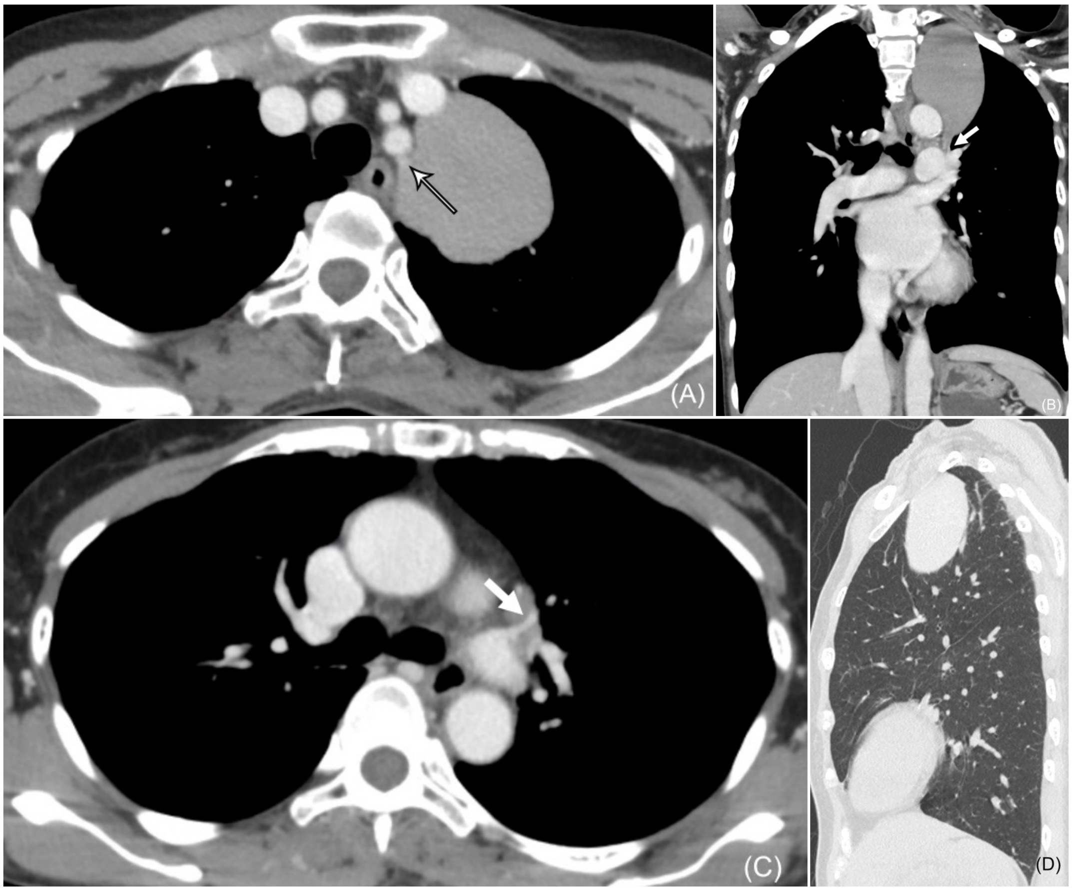


Figure 2. *Axial (A) and coronal (B) contrast-enhanced CT images demonstrate a large, non-enhancing extrapulmonary mediastinal mass containing punctate calcifications and partially abutting the proximal left subclavian artery without invasion. An additional axial image (C) shows arterial supply from the left main pulmonary artery. Lung-window sagittal imaging (D) depicts bronchial displacement without bronchial communication, confirming the extrapulmonary origin.*

The patient underwent surgical excision via an anterior mediastinal approach under general anesthesia. No gross thymic tissue was noted. A well-encapsulated cystic mass, approximately 4.0 × 8.5 cm, was identified in the left superior mediastinum. Its vascular pedicle originated from a branch of the left pulmonary artery. The feeding artery was ligated, and the mass was excised intact without rupture. Postoperative recovery was uneventful, and the patient was discharged on postoperative day 3.

Gross pathology revealed a well-circumscribed, gray-brown cystic lesion measuring 4.0 × 4.0 × 2.0 cm. Histologic sections revealed cystic spaces lined by benign bronchial-type epithelium with their own pleura. The surrounding stroma contained otherwise normal alveolar structures and pulmonary vessels without evidence of neoplasia. Foci of vascular congestion and a mild chronic inflammatory infiltrate were present in the adjacent connective tissue. No thymic tissue, granulomas, or malignant features was identified. The histological profile supports ELS with associated congestion and chronic inflammation.

At 17-month follow-up, chest CT showed no evidence of residual or recurrent disease.

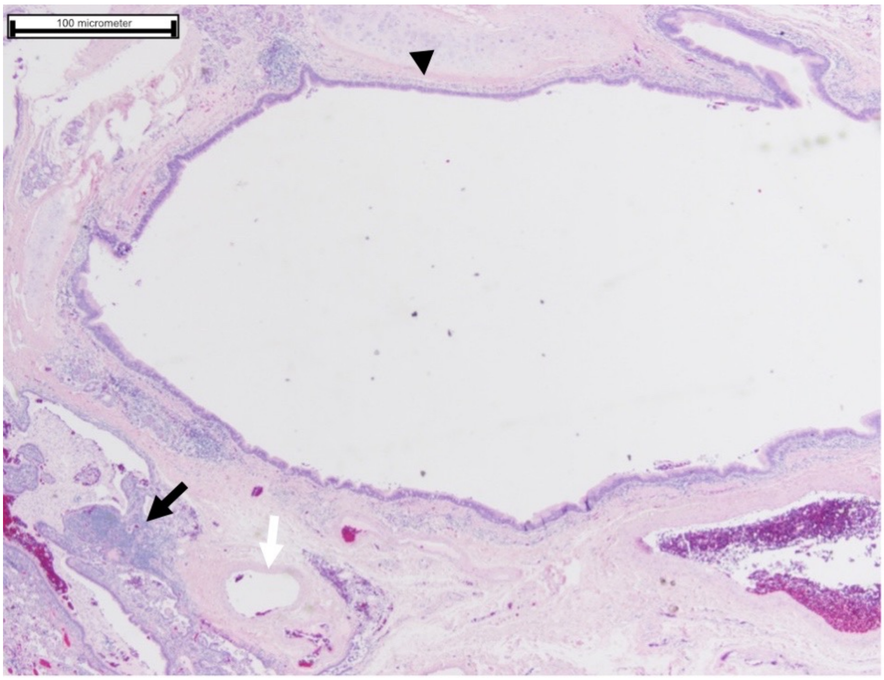


Figure 3. *H&E section (20x) shows a thick-walled vessel (white arrow) adjacent to a large cystic dilated bronchus (black arrowhead), surrounded by fibrosis involving the adjacent cyst and alveoli (black arrow).*

Discussion

Pulmonary sequestration is a rare congenital lung anomaly that arises from an abnormal development of the lung bud during embryogenesis, the extralobar form is less com mon than the intralobar type, and its location is characteristically in the lower thorax [12]. The exact etiology remains unclear, but it is believed to be from the formation of a supernumerary lung bud, which fails to integrate with the normal tracheobronchial tree [10].

A comprehensive review [2] found that the majority of ELS are located between the diaphragm and the lower lobes, with a marked predominance on the left side. A superior mediastinal location, as seen in our patient, is exceptionally rare, with only two cases in that review involving the left mediastinum without further specification. This atypical presentation creates a significant diagnostic challenge, as the lesion can mimic more common superior mediastinal masses, such as thymoma, lymphoma, or neurogenic tumors [13,14].

ELS can present with a wide range of symptoms, depending on the location, size, and associated anomalies. While some patients may be asymptomatic with the lesion being discovered incidentally, others may present with respiratory symptoms such as cough, dyspnea, or recurrent infections [15]. In rare cases, patients may present with acute symptoms such as chest pain, torsion of the sequestration [16] or even hemothorax [17]. The lesion may also be discovered during imaging studies for unrelated reasons, such as trauma or routine health screenings [18]. The diagnostic approach to ELS can be complicated due to its wide range of clinical presentations.

The most significant finding in our case, and a marked deviation from the classical definition of ELS, was the exclusive arterial supply from the left pulmonary artery. ELS is characteristically supplied by a systemic artery, with approximately 80% of vessels originating from the descending aorta or other systemic arteries [3]. An exclusive pulmonary arterial supply is exceedingly uncommon [5]. This atypical vascular pattern further complicates the diagnosis. While a few other cases of superior mediastinal masses with pulmonary artery feeders have been reported, our case remains distinct. For instance, the case reported by Osaki et al. [9] involved a complex supply from both the subclavian (systemic) and pulmonary arteries. Another report by Shadmehr et al. [8] described multiple pulmonary-artery branches but was preoperatively misdiagnosed as a thymoma, highlighting the diagnostic risk and potential for intraoperative complications. Our case is notable because it featured a single, exclusive arterial pedicle from the left main pulmonary artery that was clearly identified on preoperative CT images.

Another unusual feature of this case was the presence of multiple internal punctate calcifications on CT. Calcification in ELS is rare. In our patient, this radiologic finding correlates well with the histopathology, which demonstrated foci of a mild chronic inflammatory infiltrate and congestion. It is plausible that these calcifications were dystrophic in nature, resulting from chronic, subclinical inflammation within the sequestered tissue [19].

From an imaging standpoint, ELS should remain in the differential for well-circumscribed anterior mediastinal masses. Multiphase CTA with 3D reconstructions should document [10] an arterial inflow source, venous egress, and relationships to great vessels. These steps lower surgical hemorrhage risk and inform a limited, targeted approach. Our study identified a left main pulmonary artery pedicle preoperatively, consistent with these recommendations.

The definitive treatment is surgical resection. The goal of surgery is to completely remove the sequestrated tissue and any associated anomalies. The approach may vary depending on the location and size of the lesion, ranging from thoracoscopic resection to open thoracotomy [20]. Video-Assisted Thoracoscopic Surgery (VATS) is a minimally invasive approach that offers several advantages over open surgery, including reduced postoperative pain, shorter hospital stays, and improved cosmesis. However, it is particularly suitable for small and well-circumscribed lesions without significant associated anomalies [21,22]. In selected cases, embolization of the systemic feeding vessels may be performed to reduce blood flow to sequestration. However, this approach is typically used as an adjunct to surgery rather than a definitive treatment [10].

The prognosis for patients with ELS is generally excellent, especially when it is surgically resected [23]. Complete surgical resection is curative in most cases, and the risk of recurrence is low. However, patients with associated congenital anomalies or those who present with complications such as torsion or hemothorax may have a poorer prognosis [16].

This case highlights that ELS, despite its rarity, must be considered in the differential diagnosis of a superior mediastinal mass. The combination of an atypical location and a highly atypical vascular supply makes thorough preoperative planning essential. Our report underscores the critical role of contrast-enhanced CT with multiplanar reconstructions to precisely identify the complete vascular anatomy.

Conclusion

Extralobar pulmonary sequestration, though rare, should be considered in the differential diagnosis of superior mediastinal masses. This case demonstrates that the arterial supply can arise exclusively from the pulmonary artery, a critical variation that must be identified with preoperative imaging to ensure accurate diagnosis and safe surgical planning. With the increasing use of advanced imaging modalities, further studies are warranted to improve early diagnosis and guide surgical intervention.

Conflicts of interest: None declared.

Acknowledgment: We would like to thank Kanet Kanjanapradit, M.D. of the Department of Pathology, Faculty of Medicine, Prince of Songkhla University, for providing the histological images and for his expert review and confirmation of the pathological findings.

References

1. Rai A, S S, Rhakho V, Choudhary A, Kumar S. Extralobar pulmonary sequestration: a rare entity. Cureus 2024;16:e64977. doi:10.7759/cureus.64977.

2. Savic B, Birtel FJ, Tholen W, Funke HD, Knoche R. Lung sequestration: report of seven cases and review of 540 published cases. Thorax 1979;34:96-101. doi:10.1136/thx.34.1.96.

3. Kalenahalli KV, Garg N, Goolahally LN, Reddy SP, Iyengar J. Infradiaphragmatic extralobar pulmonary sequestration: masquerading as suprarenal mass. J Clin Neonatol 2013;2:146-8. doi:10.4103/2249-4847.120009.

4. Rosado-de-Christenson ML, Frazier AA, Stocker JT, Templeton PA. From the archives of the AFIP. Extralobar sequestration: radiologic-pathologic correlation. Radiographics 1993;13:425-41. doi:10.1148/radiographics.13.2.8460228.

5. Mao K, Wang L, Mao Y, Shang X, Zhou G, Zhao P, et al. Posterior mediastinal extralobar pulmonary sequestration in a neonate with pulmonary artery supply: a case report. Front Med (Lausanne) 2024;11:1455978. doi:10.3389/fmed.2024.1455978.

6. Adzick NS, Harrison MR, Crombleholme TM, Flake AW, Howell LJ. Fetal lung lesions: management and outcome. Am J Obstet Gynecol 1998;179:884-9. doi:10.1016/S0002-9378(98)70183-8.

7. Shadmehr MB, Jamaati HR, Saidi B, Tehrai M, Arab M. Extralobar sequestration in anterior mediastinum with pericardial agenesis. Ann Thorac Surg 2009;88:291-3. doi:10.1016/j.athoracsur.2008.12.037.

8. Lee NH, Ahn HY, Cho JS. Superior mediastinal mass revealed as bronchopulmonary sequestration supplied by a branch of the left pulmonary artery. Korean J Thorac Cardiovasc Surg 2020;53:89-91. doi: 10.5090/kjtcs.2020.53.2.89.

9. Osaki T, Kodate M, Takagishi T, Nomi M, Murakami J, Yamamoto H. Unique extralobar sequestration with atypical location and aberrant vessels. Ann Thorac Surg 2010;90:1711-2. doi:10.1016/j.athoracsur.2010.04.031.

10. Nakamura D, Kondo R, Makiuchi A, Itagaki H. Extralobar sequestration with a pulmonary arterial feeding vessel. Gen Thorac Cardiovasc Surg 2021;69:160-2. doi:10.1007/s11748-020-01443-x.

11. Ito F, Asaoka M, Nagai N, Hayakawa F. Upper thoracic extralobar pulmonary sequestration with anomalous blood supply from the subclavian artery. J Pediatr Surg 2003;38:626-8. doi:10.1053/jpsu.2003.50138.

12. Sulhyan KR, Ramteerthakar NA, Gosavi AV, Anvikar AR. Extralobar sequestration of lung associated with congenital diaphragmatic hernia and malrotation of gut. Lung India 2015;32:381-3. doi:10.4103/0970-2113.159585.

13. Jin HJ, Yu Y, He W, Han Y. Posterior mediastinal extralobar pulmonary sequestration misdiagnosed as a neurogenic tumor: a case report. World J Clin Cases 2022;10:9340-7. doi:10.12998/wjcc.v10.i26.9340.

14. Sen S, Kanlıoğlu Kuman N, Sentürk E, Pabuşcu E, Yaman E. Pulmonary sequestration with renal aplasia and elevated SUV level in PET/CT. Case Rep Pulmonol 2012; 2012:276012. doi:10.1155/2012/276012.

15. Cowart MA, Blumenthal BI. Bronchopulmonary sequestration: an unusual presentation. South Med J 1981;74:500-2. doi:10.1097/00007611-198104000-00036.

16. Stover LB, Marchese SM, Saenz NC, Shayan K. Torsion of an extralobar pulmonary sequestration: a rare cause of acute chest and flank pain in an adolescent. J Pediatr Surg Case Rep [Internet]. 2014 [cited 2025 Dec 24];2:322-4. Available from: https://www.sciencedirect.com/science/article/pii/S2213576614000839?via%3Dihub

17. Pinto Filho DR, Avino AJ, Brandão SL. Sequestro extralobar com hemotórax secundário a infarto pulmonar (Extralobar pulmonary sequestration with hemothorax secondary to pulmonary infarction). J Bras Pneumol [Internet]. 2009 [cited 2025 Dec 24];35:99-102. English, Portuguese. Available from: https://www.jornaldepneumologia.com.br/details/1142/pt-BR

18. Kim HK, Choi YH, Ryu SM, Kim HK, Chae YS, Sohn YS, et al. Infected infradiaphragmatic retroperitoneal extralobar pulmonary sequestration: a case report. J Korean Med Sci 2005;20:1070-2. doi:10.3346/jkms.2005.20.6.1070.

19. Zucker EJ, Tracy DA, Chwals WJ, Solky AC, Lee EY. Paediatric torsed extralobar sequestration containing calcification: Imaging findings with pathological correlation. Clin Radiol 2013;68:94-7. doi: 10.1016/j.crad.2012.05.008.

20. Shaffrey JK, Brinker DA, Horton KM, Heitmiller RF, Fishman EK. Atypical extralobar sequestration: CT-pathological correlation. Clin Imaging 1999;23:223-6. doi:10.1016/s0899-7071(99)00137-0.

21. Brown EG, Marr C, Farmer DL. Extralobar pulmonary sequestration: the importance of intraoperative vigilance. J Pediatr Surg Case Rep [Internet]. 2013 [cited 2025 Dec 24];1:74-6. Available from: https://www.researchgate.net/publication/257746202_Extralobar_pulmonary_sequestration_The_importance_of_intraoperative_vigilance

22. DiChiacchio L, Cappiello CD, Greenspon J. Extrapulmonary sequestration with a left internal thoracic arterial feeding vessel in an infant treated with video-assisted thoracoscopic resection: a case report. J Cardiothorac Surg 2018;13:88. doi:10.1186/s13019-018-0775-9.

23. Zhang SX, Wang HD, Yang K, Cheng W, Wu W. Retrospective review of the diagnosis and treatment of pulmonary sequestration in 28 patients: surgery or endovascular techniques? J Thorac Dis. 2017;9:5153-60. doi:10.21037/jtd.2017.10.145.

Perspective

Efficacy, safety, and optimal use of iso-osmolar contrast medium (Iodixanol) in diagnostic and interventional procedures: A Thai multidisciplinary expert meeting report

Pipat Chiewvit, M.D., M.Sc.[1]
Ching Charoenvisal, M.D.[2]
Kampantong Tangweerapong, M.D.[3]
Mann Chandavimol, M.D., F.R.C.P.C. [4]
Nachakorn Kwankajonwong, M.D.[2]
Payia Chadbunchachai, M.D.[5]
Somrach Thamtorawat, M.D.[1]
Supika Kritsaneepaiboon, M.D.[6]
Surapee Amto, M.Sc.[7]
Sureerat Janpanich, B.S.N., R.N.[1]
Tanop Srisuwan, M.D.[8]
Warawut Sukkasem, M.D.[5]
Keerati Hongsakul, M.D. [9]

From [1]Department of Radiology, Faculty of Medicine, Siriraj Hospital, Mahidol University, Bangkok, Thailand,
[2]Department of Radiology, King Chulalongkorn Memorial Hospital, Bangkok, Thailand,
[3]Bhumibol Adulyadej Hospital Kidney Center, Bangkok, Thailand,
[4]Department of Medicine, [7]Department of Diagnostic and Therapeutic Radiology, Faculty of Medicine, Ramathibodi Hospital, Mahidol University, Bangkok, Thailand,
[5]Department of Radiology, Faculty of Medicine, Khon Kaen University, Khon Kaen, Thailand,
[6]Division of Pediatric Radiology, [9]Division of Interventional Radiology, Department of Radiology, Faculty of Medicine, Prince of Songkla University, Songkhla, Thailand,
[8]Department of Radiology, Faculty of Medicine, Chiang Mai University, Chiang Mai, Thailand.

Address correspondence to P.C. (email: pipat8999@gmail.com)

Received 3 July 2025; revised 8 September 2025; accepted 22 January 2026
doi:10.46475/asean-jr.v27i1.966

Abstract

Iodinated contrast media are used in clinical practice for diagnostic and therapeutic purposes. To discuss the position of iso-osmolar contrast media (IOCM) in diagnostic and interventional procedures in Thailand, an expert meeting, including neurologists, cardiologists, nephrologists, radiologists, radiologic technologists and radiologic nurses, was organized to discuss the use of IOCM and low-osmolar contrast media, both in general and in specific risk groups. Topics discussed included acute kidney injury, cardiovascular events, patient discomfort, allergic reactions, and high-risk groups. The experts agreed that IOCM has an overall beneficial safety profile. With the use of IOCM, patients have a low risk of adverse drug reactions, and a reduced risk of contrast-associated acute kidney injury. Moreover, the patient will feel less pain. Therefore, IOCM is considered particularly useful in patients at high risk of acute kidney injury, especially in procedures that involve significant contrast exposure.

Keywords: Acute kidney injury, Contrast media, Osmolality, Patient safety.

Introduction

Iodinated contrast media are essential in diagnostic imaging and interventional procedures, facilitating enhanced visualization across various anatomical systems during X-ray and CT imaging. Their use is particularly critical in radiological and cardiological interventions. Despite their overall safety and diagnostic efficacy, contrast media can be associated with adverse events such as contrast-induced acute kidney injury (CI-AKI), particularly in high-risk populations, including patients undergoing percutaneous coronary intervention for acute myocardial infarction [1-4].

Iodinated contrast agents are categorized into three classes based on osmolarity which are high osmolarity (HOCM), low osmolarity (LOCM), and iso-osmolarity (IOCM). IOCM, with osmolality approximating that of plasma (~290 mOsm/kg), is associated with improved tolerability and reduced physiological perturbation compared to hyperosmolar HOCM and LOCM. Clinical evidence, including randomized trials and meta-analyses, suggests that IOCM may reduce the incidence of CI-AKI and adverse cardiovascular outcomes, particularly in patients with baseline renal impairment and those receiving intra-arterial contrast administration [5-10]. While overall mortality between LOCM and IOCM users appears comparable, some studies have observed higher mortality in chronic kidney disease (CKD) patients receiving LOCM in some studies [11], whereas others have not reported this finding [12].

Observational data indicate that Iodixanol, a commonly used IOCM, is associated with a lower incidence of CI-AKI compared to LOCM, particularly following intraarterial administration [13, 14]. Furthermore, reduced concentrations of iodinated contrast agents in cerebral angiography have not compromised diagnostic image quality [15].

Economic evaluations in Europe [16] and the United States [17] demonstrate that despite higher acquisition costs, the use of IOCM may lead to significant healthcare savings by reducing CI-AKI-related hospitalizations and associated complications. The U.S. model estimated that shifting from an LOCM-only to an IOCM-only strategy could prevent approximately 2,900 major adverse renal and cardiovascular events annually, with a projected cost saving of $30.7 million [17].

Thailand adheres to international guidelines (the American College of Radiology (ACR), the European Society of Urogenital Radiology (ESUR), the Kidney Disease Improving Global Outcomes (KDIGO), and the Royal College of Radiologist of Thailand (RCRT) in contrast media use. To evaluate the clinical positioning of IOCM within the Thai context, an expert panel convened to review current evidence and share local perspectives. In preparation of the meeting, a questionnaire was circulated among the participants to gauge the opinions and guide the discussion. This manuscript reflects a summary of the discussions during the meeting.

Materials and methods

Experts

An expert meeting was organized on November 2, 2024 Bangkok Thailand. The criteria of the experts included a minimum of 10 years of clinical experience, a documented history of research and publications, a reputation for thought leadership in their respective specialties, ensuring a balanced representation of different specialties, hospital types, and geographical regions within Thailand. The expert group consisted of five interventional and two diagnostic radiologists, one neuroradiologist, one pediatric radiologist, one cardiologist, one nephrologist, one radiologic technologist, and one radiologic nurse, affiliated to seven of the major hospitals in Thailand (Bhumibol, Chulalongkorn, Maharaj Nakorn Chiang Mai, Prince of Songkla University, Ramathibodi, Siriraj, Srinagarind). The experts are co-authors on this paper. Conflict of interest statements are provided at the end of this manuscript.

Literature review

We performed a targeted literature review focused on publications evaluating the use of iodinated contrast media, searching Medline through PubMed. The review was restricted to publications in English, and conference abstracts were not included. Titles and abstracts were assessed for eligibility, supported by Artificial Intelligence (Rayyan, [18]) and relevant full texts were obtained and screened.

Questionnaire

Prior to the face-to-face meeting, a questionnaire was distributed to all experts to identify the position of IOCM in diagnostic and intervention procedures in Thailand and the use of contrast media agents in their practices. The full questionnaire is shown in Supplement 1. Agreement with statements was reported as "strongly disagree", "disagree", "neutral", "agree" or "strongly agree". The importance of factors to select contrast media was scored from least important (1) to most important (5). The questionnaire was distributed to the participants in advance of the expert advisory meeting. The replies obtained were used to structure the discussion. To assess importance, scores were calculated by the formula "number of experts times score value, divided by maximum score", leading to a percentage. To assess agreement, the answers "agree" and "strongly agree" were combined. Level of agreement was scored as follows: more than 90% agreement = excellent; 80-90% agreement = very good; 70-80% agreement = good; 50-70% agreement = fair; less than 50% agreement = poor.

Evidence, results and discussion

The evidence base of the benefits of Iodixanol

Experts consistently prioritize patient safety and diagnostic efficacy when selecting contrast media. Key factors influencing their decisions, ranked by importance, are:

- Contrast-Induced Acute Kidney Injury (CI-AKI): This was identified as the paramount concern, receiving a 100% importance rating;
- Adverse Drug Reactions (ADRs): Close behind, ADRs were deemed highly significant, with a 97% rating;
- Cardiovascular Events and Image Quality: Both factors were considered crucial, each scoring 86%;
- Patient Tolerability (Pain, Heat, and Discomfort): The patient experience was also a major consideration, receiving an 85% rating;
- Iodine Toxicity: While still important, iodine toxicity was rated slightly lower at 72%.

Acute Kidney Injury

Potential mechanisms of contrast-associated acute kidney disease (CA-AKI) include renal vasoconstriction, direct tubular toxicity, based on osmotic and chemotoxic effects of contrast media [19-22].

The term contrast-induced nephropathy (CIN) has been replaced by contrast-induced acute kidney disease (CI-AKI), post-contrast AKI (PC-AKI), or contrast-associated AKI (CA-AKI) [19]. AKI is defined as an increase in serum creatinine (sCr) of > 0.3 mg/dL within 48 hours, a > 50% sCr increase within 7 days, or reduced urine output to < 0.5 ml/kg/hour for at least six hours [23, 24]. AKI is a common risk factor for CKD, which is defined as a sustained estimated glomerular filtration rate (eGFR) below 60 mL/min/1.73 m^2 for more than three months [25]. While the overall incidence of AKI after contrast-enhanced CT is low in CKD patients, those with eGFR ≤30 mL/min/1.73 m^2 are at significantly higher risk (1.68-fold increase). Risk factors for CA-AKI include advanced CKD, diabetes, cardiovascular disease, diuretic use, age, dehydration, and repeated contrast exposure within 24 hours [25].

Iodixanol, an IOCM, was introduced in Thailand in 2009 and is considered favorable due to its plasma-like osmolality. Few studies have shown that Intravenous (IV)-administered Iodixanol is associated with fewer high-risk patients developing an increase in serum creatinine levels compared to Iopromide [7]. Contrast-enhanced CT scans with Iodixanol were not associated with a higher incidence of CA-AKI compared to unenhanced scans, suggesting that iodixanol can enhance image quality without significantly increasing risk even in patients with severe CKD [26]. While no significant advantage of IOCM over LOCM was found in several meta-analyses following IV use, they suggested a benefit with intra-arterial (IA) administration in renally impaired patients [9, 27, 28].

Studies comparing contrast media have limitations; often differences in potentially important factors, such as the route of administration (IV versus IA), iodine concentration, and institutional protocols, make it difficult to draw definitive conclusions. For example, the PRESERVE trial, a randomized, double-blind, multicenter study, enrolled high-risk patients undergoing coronary or noncoronary angiography to compare the effectiveness of IV isotonic sodium bicarbonate versus IV isotonic sodium chloride and oral NAC versus oral placebo for the prevention of serious adverse outcomes associated with CI-AKI [29]. The primary end point was a composite of death, the need for dialysis, or a persistent increase of at least 50% from baseline in the serum creatinine level at 90 days. Contrast-associated acute kidney injury was a secondary end point. No significant between-group differences were observed in the rates of contrast-associated acute kidney injury [29]. However, a post-hoc analysis looking at relative risk for and incidence of serious adverse outcomes following the development of CA-AKI from this patient group highlighted the clinical importance of CA-AKI, which was linked to a significant relative risk for 90-day mortality, dialysis, or persistent kidney dysfunction, albeit with a low incidence rate (1.2%) [30]. The consistent evidence for a benefit of IOCM in the specific context of high-risk patients undergoing IA procedures, such as coronary angiography, suggests that the iso-osmolar property of iodixanol provides a clear clinical advantage in these settings by minimizing the physiologic stress on the kidneys [31]. A more definitive answer on the broader use of IOCM vs. LOCM may require a large, prospective, head-to-head trial in a homogeneous patient population with a specific administration route.

eGFR remains essential for risk stratification. Patients with eGFR <30 are high risk; those with eGFR 30–44 are intermediate; those with AKI remain high risk regardless of eGFR. Anuric End-stage renal disease (ESRD) patients without a transplant are not at risk for CA-AKI.

For IA administration considered first pass to the renal artery, IOCM appears to be more favorable [28, 32]. However, IA administration results in higher local concentration and amount of contrast media, increasing the risk of nephrotoxicity.

Furthermore, a matched cohort study from 2003 to 2017 found that Iodixanol is linked to a reduced risk of progression to ESRD following percutaneous coronary intervention compared to Iohexol [33].

To reduce the risk of CA-AKI the following strategies are recommended: use LOCM or IOCM, minimize the contrast dose to achieve a diagnostic quality imaging, and discontinue nonessential nephrotoxic medications. 92.3% of experts agreed that the reduced risk of CA-AKI was the most important reason to choose Iodixanol as contrast media. In the high-risk population of patients with kidney disease or a history of kidney issues, the survey showed that 100% of experts would select Iodixanol. The choice of contrast media in such patients is typically guided by hospital protocols, with most physicians opting for IOCM due to safety concerns, patient comfort and other factors. The eGFR cutoff for considering IOCM varies by institution, but a threshold of 45 mL/min/1.73m^2 is commonly used for patients without co-morbidities.

In cardiology, IOCM is usually injected intra-arterially, especially in high-risk patients with diabetes, CKD stage 3-4 (eGFR 30-59 mL/min/1.73m2), or those requiring high contrast doses. IOCM is often considered due to its potential benefits, in reducing the risk of AKI and cardiovascular outcomes. The survey showed that 58.3% of experts would select Iodixanol for patients with heart disease, with Iohexol and Iopromide selected by 16.7%, each.

In Europe, the use of IOCM has better overall cost-effectiveness in this subgroup. If a patient develops kidney failure, it is a burden not only for the patient and their family, but also for the hospital [16]. The limitations of IOCM in terms of viscosity and imaging quality can be mitigated with appropriate adjustments, such as using a machine injector or modifying the X-ray angle.

In summary, the use of contrast media is critical for accurate imaging and diagnosis but should be minimized to the lowest effective dose to reduce the risk of CA-AKI. Hydration remains a key preventive measure. While IA administration carries a higher risk of CA-AKI compared to IV administration, IOCM appears to offer a safer option for high-risk patients, particularly in procedures that involve significant contrast exposure.

Adverse Drug Reactions (ADRs)

The majority of acute iodinated contrast media (ICM) ADRs are mild, non-life-threatening, and require only observation or minor supportive care. Typically, the reactions, including severe and potentially life-threatening ADRs occur within the first 15 minutes after injection. Consequently, patients should be observed for at least 30 minutes post-administration.

ADRs are categorized in two types: allergic-like reactions and physiologic reactions.

a. Allergic-like reactions are immune-mediated, involving an antigen-antibody response (even if this response cannot be identified), and can be anaphylactoid, allergic-like, or idiosyncratic in nature. These reactions are generally independent of the dose and concentration of the contrast media.

b. Physiologic reactions result from direct chemotoxicity, osmotoxicity, or molecular interactions with specific activators. These reactions are dose- and concentration-dependent, and often affect the cardiovascular system (e.g., cardiac arrhythmias, myocardial depression, or cardiogenic pulmonary edema).

An overview of these reactions is provided in Table 1.

ADRs can further be classified into acute and delayed. Reports of ADRs after HOCM ranged widely, from 1.32% (170 of 12,916 patients) [34] to 29% (213 of 737 patients)

[35]. ADRs were reported less frequently after LOCM (0.34%-1.38%, based on 1,266,688 patients) [36], and IOCM (0.74%, 77 of 9953 patients) [37]. The fatality rate with LOCM and IOCM is similar at 2.1-9 per 1 million patients [38]. Delayed allergic-like reactions, which typically occur later than one hour after injection, affect 9.5% of the patients after LOCM (1,058 of 11,121) [39], and 0.39% of patients after IOCM (40 of 9953) [37]. Most ADRs are mild, self-limiting and require topical or no treatment at all [40].

The use of iso-osmolar contrast media (IOCM) has demonstrated specific safety benefits over low-osmolar contrast media (LOCM) in certain high-risk populations. While both LOCM and IOCM have significantly reduced the incidence of allergic-like reactions compared to older high-osmolality agents, there is no conclusive evidence to suggest a difference in allergic-like reaction rates between the two modern classes, IOCM and LOCM [19]. The primary advantage of IOCM lies in its reduced rate of physiologic-like reactions, specifically contrast-induced nephropathy (CIN), in high-risk patients. A meta-analysis of pooled patient data from randomized controlled trials found that the use of Iodixanol (an IOCM) was associated with a significantly lower rate of CIN and smaller increases in serum creatinine compared to LOCM, particularly in patients with pre-existing renal disease and diabetes [31]. For patients with a history of a previous allergic-like reaction to contrast media, premedication protocols involving corticosteroids and antihistamines are often employed as a primary strategy to minimize the risk of recurrence [19].

84.6% of experts strongly agreed that Iodixanol results in fewer ADRs compared to LOCM, and 92.3% of experts agreed or strongly agreed that they would recommend Iodixanol for patients to reduce ADRs with contrast media.

Table 1. *The most frequent ADRs, by severity.*

Bladder volume (mL)	Correlation coefficient
Mild	
Limited urticaria / pruritis	Limited nausea / vomiting limited
Cutaneous Edema	Transient flushing / warmth / chills
Limited "itchy"/"scratchy" throat	Headache / dizziness / anxiety / altered taste
Nasal congestion	Mild hypertension
Sneezing / conjunctivitis / rhinorrhea	Vasovagal reaction that resolves spontaneously
Moderate	
Diffuse urticaria / pruritis	Protracted nausea / vomiting
Diffuse erythema, stable vital signs	Hypertensive urgency
Facial edema without dyspnea	Isolated chest pain
Throat tightness or hoarseness without dyspnea	Vasovagal reaction that requires, and is responsive to, treatment
Wheezing / bronchospasm, mild or no hypoxia	
Severe	
Diffuse edema, or facial edema with dyspnea	Vasovagal reaction resistant to treatment
Diffuse erythema with hypotension	Arrhythmia
Laryngeal edema with stridor and/or hypoxia	Convulsions, seizures
Wheezing / bronchospasm, significant hypoxia	Hypertensive emergency
Anaphylactic shock (hypotension + tachycardia)	

Adapted from the American College of Radiology guideline [19].

Cardiovascular Event

A 2021 meta-analysis, by McCullough et al. found that IA administration of Iodixanol significantly reduces the relative risk of major adverse renal cardiovascular events in high-risk patients compared to pooled LOCM [41]. For this retrospective database study, administrative claims data were used. The analysis relied on the ICD-9/10 coding of outcomes, without laboratory values for the diagnosis of AKI by serum creatinine levels, assessment of heart failure by ejection fraction, or other clinical conditions, potentially underestimating the occurrence of MARCE. Additionally, patients were not tracked longitudinally, which may have resulted in incorrect estimation of the true occurrence of MARCE [41]. Using the Premier Healthcare Database, the use of IOCM versus LOCM was compared with respect to the primary endpoint of MARCE in high-risk patients undergoing peripheral endovascular procedures. IOCM was associated with a significant absolute risk reduction in MARCE [42]. Because this was also a retrospective database study, the same limitations apply.

In newborns with congenital heart disease, very small volumes of contrast media are used, followed by saline flushing, with an injection rate of 0.5-0.6 cc/sec to prevent overly concentrated contrast in the heart chambers that could obscure morphology. While contrast is typically injected in the right arm, IOCM can also be administered intravenously in the leg. A central venous catheter is contraindicated for cardiac CT angiography in newborns due to the risks associated with contrast use.

In summary, most physicians prefer Iodixanol for its safety profile, as it may have advantages in high-risk cardiovascular patients and/or with comorbidity, and 92.3% of experts agreed or strongly agreed with recommending Iodixanol for patients with comorbidity.

Patient Discomfort

Lower osmolarity enhances patient comfort. The optimum is with the osmolarity of blood (iso-osmolarity), as with lower osmolarity patient discomfort will increase again. A randomized controlled trial comparing Iodixanol and Iopamidol for IV injection in CT scans of the abdomen or pelvis showed that Iodixanol resulted in significantly less moderate to severe discomfort, particularly in terms of heat, when assessed on a 0-10 scale [43]. Similarly, in a study using IA administration for peripheral arteriography, Iodixanol was associated with significantly less discomfort, especially in the moderate to severe categories [44]. However, the clinical significance of these differences is small, especially in sedated or anesthetized patients.

Nevertheless, 92.3% of experts agreed or strongly agreed that reduced patient discomfort is a key reason for choosing IOCM over LOCM. For instance, during angioplasty, patients unable to tolerate the discomfort from LOCM had immediate relief when switched to Iodixanol. Additionally, higher osmolarity contrast media, particularly when administered at higher concentrations, tend to cause more pain [45]. In contrast, IOCM results in much less pain, even in cases of contrast media leakage, where tissue reactions are reported to be milder with IOCM. During various interventions, the absence of heat sensation with IOCM helps patients to remain still, improving lesion visualization.

Iodine Dose and Image Quality

In body interventions, the choice of contrast media depends on the body mass index (BMI). For patients with low to normal BMI, IOCM 320 mg/ml is typically used. If the image quality is suboptimal, a higher iodine concentration contrast media may be considered. CT technology nowadays allows for high-quality imaging with lower contrast media doses, making iodine concentration just one of many factors influencing the quality of a CM protocol.

A study in pediatric patients with congenital heart disease compared low-dose Iodixanol (270 mg I/ml) with high-dose Iopamidol (370 mg I/ml) and found no difference in diagnostic accuracy when using Iodixanol with low kilovoltage peak (kVp) CT [46]. However, Iodixanol provided a significantly lower iodine load and radiation dose, which is particularly beneficial for pediatric patients. Using lower iodine concentrations with reduced kVp enhances iodine visibility due to improved absorption near the iodine K-edge, resulting in better contrast at reduced doses. Despite increased noise from lower milliampere (mA) settings, the contrast-to-noise ratio remains high enough to maintain quality vascular imaging with low-iodine contrast media.

Real-world evidence supports the use of 270 mg/ml Iodixanol, showing comparable image quality to more than 300 mg I/ml LOCM in pediatric patients undergoing abdominopelvic CT across various tube voltages [47]. Given its safety profile and lower iodine concentration, some hospitals now use IOCM in all pediatric cases. The expertise of multidisciplinary teams ensures optimal imaging while minimizing toxicity.

High-risk Patient Groups

Beyond patients with renal impairment, experts identified several key patient groups as suitable candidates for IOCM. These included pediatric patients, emergency cases, individuals undergoing interventional radiology procedures, and cancer patients. A discussion of these patient populations and their specific considerations regarding IOCM administration followed.

Pediatric Patients

Special consideration is required when using contrast media in children, as they are more sensitive to its effects. On March 30, 2022, the U.S. FDA issued a drug safety communication recommending that infants and young children through 3 years of age undergo monitoring of thyroid function within 3 weeks of intravascular administration of iodine-based contrast media [48]. Nevertheless, hospitalized children with stable mildly diminished renal function have a low risk of developing contrast-induced nephropathy, suggesting that clinically indicated intravenous contrast-enhanced CT can be safely performed [49, 50].

There are two concerns of ICM: osmolarity and viscosity.

a. The osmolarity of contrast media is especially critical in neonates and young children, as they are more vulnerable to fluid shifts and have a lower tolerance for intravascular osmotic loads than adults [51]. Administering hyperosmolar contrast media IV can cause fluid to move from the extravascular to the intravascular space, leading to an expansion in blood volume. If this shift is significant, it may result in severe complications, including cardiac failure and pulmonary edema, particularly in children with pre-existing cardiac dysfunction.

b. Viscosity is particularly relevant in pediatric patients, as ICM is often administered through small-gauge angio catheters. High-viscosity ICM can make rapid injection challenging through small catheters, potentially leading to catheter failure, vessel injury, or an inability to achieve the necessary injection rate. Therefore, it is advisable to pre-warm iodixanol.

In a randomized, double-blind, parallel group, phase III multicenter trial, Iodixanol was compared with Iohexol to assess safety and efficacy during contrast enhanced gastrointestinal radiography examinations of children [52]. There was no statistically significant difference with regard to efficacy. The frequency of adverse events was lower for patients receiving Iodixanol, with adverse events occurring in 12 patients (16.2%) in the Iodixanol group and 28 patients (35.9%) in the Iohexol group.

Pediatricians witness patients who experience "waking up" during sedation. Commonly, CT in pediatrics uses mild to moderate sedation. Previously, IOCM was not used in every case and children occasionally woke up during sedation. After changing to the use of IOCM in all cases, waking up during sedation was found much less frequently. The need for a repeat scan due to unexpected moving is low.

In summary, the significantly lower iodine load and radiation dose of IOCM, less pain, and reduced waking up during sedation offer benefits for pediatric patients.

Emergency case

Siriraj and Srinagarind Hospitals use IOCM in the majority of emergency cases without lab results, such as fast-track stroke. In an emergency, even if the lab results are available, the baseline values are still unknown. Moreover, these patients often have acute hemodynamic instability and are at high risk of developing AKI [53]. Thus, Iodixanol has more benefits in this group to improve outcomes in the future.

Cancer patients

The use of Iodixanol is considered beneficial in vulnerable cancer patients, in particular when undergoing chemotherapy or radiation, and increasing risk of AKI with every additional nephrotoxic event. Iodixanol was associated with a significant reduction in CA-AKI in cancer patients undergoing a CT exam vs Iopromide [54].

In summary, Iodixanol demonstrates suitability across the patient groups discussed, with particularly strong agreement regarding its application in patients with impaired renal function. Furthermore, research supports the safety and efficacy of Iodixanol in other patient populations.

Limitations

This discussion of the use of iodinated contrast agents in Thailand has several limitations. First of all, while involving 13 multidisciplinary experts from seven of the major Thai hospitals, this may not reflect broader national practices, especially across diverse healthcare settings. Secondly, no established consensus-building methods such as the Delphi technique or GRADE framework were followed, reducing the outcome to expert statements, rather than a consensus. Thirdly, not for all topics published evidence was available, limiting validity to expert opinion. Finally, specifically regarding cost-effectiveness, no local data were available, which is a gap given the national focus of the manuscript.

Conclusion

ICM are substances used in diagnostic or interventional radiology to enhance visibility of organs and tissues. ICM are used for X-ray examinations such as CT, angiography, coronary angiography, arthrography, myelography and gastrointestinal fluoroscopy. They are essential for accurate diagnoses, especially in emergency departments and outpatient hospital settings, for interventions in case of acute disease, and for cancer surveillance. Radiologists and healthcare professionals must be knowledgeable about the proper use, indications, and potential risks of ICM to ensure patient safety and optimal diagnostic outcomes. In this report, the position of IOCM in Thailand was discussed. The applicability to other regional healthcare settings with different contrast usage protocols or reimbursement structures remains unclear.

From the Thai experience, there are many differences between IOCM and LOCM, especially regarding the safety and patient discomfort; IOCM is safer and has fewer side effects in some circumstances. IOCM may be related to a lower risk of CA-AKI, and may offer advantages in specific patient populations, although consensus about its direct superiority over LOCM remains debatable. In the context of interventional cardiology, a comprehensive assessment necessitates a balanced evaluation of immediate procedural costs and long-term patient outcomes, specifically the risk of CA-AKI. In practice, the experts recommend using IOCM because of its perceived long-term clinical benefits, emphasizing a patient-centric approach that prioritizes overall health and well-being.

References

1. Chawla LS, Amdur RL, Amodeo S, Kimmel PL, Palant CE. The severity of acute kidney injury predicts progression to chronic kidney disease. Kidney Int [Internet]. 2011 [cited 2025 Dec 25];79:1361-9. Available from: https://doi.org/10.1038/ki.2011.42

2. Ad-hoc working group of ERBP; Fliser D, Laville M, Covic A, Fouque D, Vanholder R, Juillard L, et al. A European Renal Best Practice (ERBP) position statement on the Kidney Disease Improving Global Outcomes (KDIGO) clinical practice guidelines on acute kidney injury: part 1: definitions, conservative management and contrast-induced nephropathy. Nephrol Dial Transplant [Internet]. 2012 [cited 2025 Dec 25];27:4263-72. Available from: https://doi.org/10.1093/ndt/gfs375

3. Kooiman J, Le Haen PA, Gezgin G, de Vries JP, Boersma D, Brulez HF, et al. Contrast-induced acute kidney injury and clinical outcomes after intra-arterial and intravenous contrast administration: risk comparison adjusted for patient characteristics by design. Am Heart J [Internet]. 2013 [cited 2025 Dec 25];165:793-99, 9.e1. Available from: https://doi.org/10.1016/j.ahj.2013.02.013

4. Andreucci M, Faga T, Serra R, De Sarro G, Michael A. Update on the renal toxicity of iodinated contrast drugs used in clinical medicine. Drug Healthc Patient Saf [Internet]. 2017 [cited 2025 Dec 25];9:25-37. Available from: https://doi.org/10.2147/dhps.S122207

5. Aspelin P, Aubry P, Fransson SG, Strasser R, Willenbrock R, Berg KJ. Nephrotoxic effects in high-risk patients undergoing angiography. N Engl J Med [Internet]. 2003 [cited 2025 Dec 25];348:491-9. Available from: https://doi.org/10.1056/NEJMoa021833

6. Solomon RJ, Natarajan MK, Doucet S, Sharma SK, Staniloae CS, Katholi RE, et al. Cardiac Angiography in Renally Impaired Patients (CARE) study: a randomized double-blind trial of contrast-induced nephropathy in patients with chronic kidney disease. Circulation [Internet]. 2007 [cited 2025 Dec 25];115:3189-96. Available from: https://doi.org/10.1161/circulationaha.106.671644

7. Nguyen SA, Suranyi P, Ravenel JG, Randall PK, Romano PB, Strom KA, et al. Iso-osmolality versus low-osmolality iodinated contrast medium at intravenous contrast-enhanced CT: effect on kidney function. Radiology [Internet]. 2008 [cited 2025 Dec 25];248:97-105. Available from: https://doi.org/10.1148/radiol.2481071484

8. Heinrich MC, Häberle L, Müller V, Bautz W, Uder M. Nephrotoxicity of iso-osmolar iodixanol compared with nonionic low-osmolar contrast media: meta-analysis of randomized controlled trials. Radiology [Internet]. 2009 [cited 2025 Dec 25];250:68-86. Available from: https://doi.org/10.1148/radiol.2501080833

9. Dong M, Jiao Z, Liu T, Guo F, Li G. Effect of administration route on the renal safety of contrast agents: a meta-analysis of randomized controlled trials. J Nephrol [Internet]. 2012 [cited 2025 Dec 25];25:290-301. Available from: https://doi.org/10.5301/jn.5000067

10. Zhang J, Jiang Y, Rui Q, Chen M, Zhang N, Yang H, et al. Iodixanol versus iopromide in patients with renal insufficiency undergoing coronary angiography with or without PCI. Medicine (Baltimore) [Internet]. 2018 [cited 2025 Dec 25];97:e0617. Available from: https://doi.org/10.1097/md.0000000000010617

11. Yang X, Huang W, Liu W, Zhu Y, Xu Y, Yang G, et al. The influence of contrast agent's osmolarity on iodine delivery protocol in coronary computed tomography angiography: comparison between iso-osmolar iodixanol-320 and low-osmolar iomeprol-370. J Comput Assist Tomogr [Internet]. 2018 [cited 2025 Dec 25];42:62-7. Available from: https://doi.org/10.1097/rct.0000000000000651

12. From AM, Bartholmai BJ, Williams AW, McDonald FS. Iodixanol compared to iohexol for contrast procedures: a case-matched retrospective cohort study. Acta Radiol [Internet]. 2008 [cited 205 Dec 26];49:409-14. Available from: https://doi.org/10.1080/02841850801901791

13. Karlsberg RP, Dohad SY, Sheng R; Iodixanol Peripheral CTA Study Investigator Panel. Contrast-induced acute kidney injury (CI-AKI) following intra-arterial administration of iodinated contrast media. J Nephrol. 2010;23:658-66.

14. Breglia A, Godi I, Virzì GM, Guglielmetti G, Iannucci G, De Cal M, et al. Subclinical contrast-induced acute kidney injury in patients undergoing cerebral computed tomography. Cardiorenal Med [Internet]. 2020 [cited 2025 Dec 26];10:125-36. Available from: https://doi.org/10.1159/000505422

15. Baek J, Jeong HW, Heo YJ, Yun S, Kang M, Kim B, et al. Comparison of safety and diagnostic efficacy of iohexol 240 mgI/mL, iopamidol 250 mgI/mL, and iodixanol 270 mgI/mL in cerebral angiography: a prospective, multicenter study. Neurointervention [Internet]. 2023 [cited 2025 Dec 26];19:82-91. Available from: https://doi.org/10.5469/neuroint.2024.00129

16. De Francesco M, Ronco C, Wacinski PJ, Wessely R, Hernández F, Lamotte M. Economic impact of contrast-induced acute kidney injury associated with invasive cardiology: role of iso-osmolar contrast media in Germany, Italy, Poland, and Spain. J Med Econ [Internet]. 2016 [cited 2025 Dec 26];19:158-68. Available from: https://doi.org/10.3111/13696998.2015.1105809

17. Keuffel E, McCullough PA, Todoran TM, Brilakis ES, Palli SR, Ryan MP, et al. The effect of major adverse renal cardiovascular event (MARCE) incidence, procedure volume, and unit cost on the hospital savings resulting from contrast media use in inpatient angioplasty. J Med Econ [Internet]. 2018 [cited 2025 Dec 26];21:356-64. Available from: https://doi.org/10.1080/13696998.2017.1415912

18. Ouzzani M, Hammady H, Fedorowicz Z, Elmagarmid A. Rayyan-a web and mobile app for systematic reviews. Syst Rev [Internet]. 2016 [cited 2025 Dec 26];5:210. Available from: https://doi.org/10.1186/s13643-016-0384-4

19. American College of Radiology. ACR Manual on Contrast Media [Internet]. Reston (VA): ACR Committee on Drugs and Contrast Media; 2024 [cited 2025 Dec 26]. Available from: https://doi.org/https://www.acr.org/-/media/acr/files/clinical-resources/contrast_media.pdf

20. Scolari F, Ravani P. Atheroembolic renal disease. Lancet [Internet]. 2010 [cited 2025 Dec 26];375:1650-60. Available from: https://doi.org/10.1016/s0140-6736(09)62073-0

21. Mehran R, Dangas GD, Weisbord SD. Contrast-associated acute kidney injury. N Engl J Med [Internet]. 2019 [cited 2025 Dec 26];380:2146-55. Available from: https://doi.org/10.1056/NEJMra1805256

22. Wang Z, Wang Q, Gong X. Unveiling the mysteries of contrast-induced acute kidney injury: new horizons in pathogenesis and prevention. Toxics [Internet]. 2024 [cited 2025 Dec 26];12:620. Available from: https://doi.org/10.3390/toxics12080620

23. Kellum JA, Lameire N; KDIGO AKI Guideline Work Group. Diagnosis, evaluation, and management of acute kidney injury: a KDIGO summary (Part 1). Crit Care [Internet]. 2013 [cited 2025 Dec 26];17:204. Available from: https://doi.org/10.1186/cc11454

24. Lameire N, Kellum JA; KDIGO AKI Guideline Work Group. Contrast-induced acute kidney injury and renal support for acute kidney injury: a KDIGO summary (Part 2). Crit Care [Internet]. 2013 [cited 2025 Dec 26];17:205. Available from: https://doi.org/10.1186/cc11455

25. Obed M, Gabriel MM, Dumann E, Vollmer Barbosa C, Weißenborn K, Schmidt BMW. Risk of acute kidney injury after contrast-enhanced computerized tomography: a systematic review and meta-analysis of 21 propensity score–matched cohort studies. Eur Radiol [Internet]. 2022 [cited 2025 Dec 26];32:8432-42. Available from: https://doi.org/10.1007/s00330-022-08916-y

26. McDonald JS, McDonald RJ, Williamson EE, Kallmes DF. Is Intravenous administration of iodixanol associated with increased risk of acute kidney injury, dialysis, or mortality? A propensity score-adjusted study. Radiology [Internet]. 2017[cited 2025 Dec 26];285:414-24. Available from: https://doi.org/10.1148/radiol.2017161573

27. Eng J, Wilson RF, Subramaniam RM, Zhang A, Suarez-Cuervo C, Turban S, et al. Comparative effect of contrast media type on the incidence of contrast-induced nephropathy: a systematic review and meta-analysis. Ann Intern Med [Internet]. 2016 [cited 2025 Dec 26];164:417-24. Available from: https://doi.org/10.7326/m15-1402

28. McCullough PA, Brown JR. Effects of intra-arterial and intravenous iso-osmolar contrast medium (iodixanol) on the risk of contrast-induced acute kidney injury: a meta-analysis. Cardiorenal Med [Internet]. 2011 [cited 2025 Dec 26];1:220-34. Available from: https://doi.org/10.1159/000332384

29. Weisbord SD, Gallagher M, Jneid H, Garcia S, Cass A, Thwin SS, et al. Outcomes after angiography with sodium bicarbonate and acetylcysteine. N Engl J Med [Internet]. 2018 [cited 2025 Dec 26];378:603-14. Available from: https://doi.org/doi:10.1056/NEJMoa1710933

30. Weisbord SD, Palevsky PM, Kaufman JS, Wu H, Androsenko M, Ferguson RE, et al. Contrast-associated acute kidney injury and serious adverse outcomes following angiography. J Am Coll Cardiol [Internet]. 2020 [cited 2025 Dec 26];75:1311-20. Available from: https://doi.org/10.1016/j.jacc.2020.01.023

31. McCullough PA, Bertrand ME, Brinker JA, Stacul F. A Meta-analysis of the renal safety of isosmolar iodixanol compared with low-osmolar contrast media. J Am Coll Cardiol [Internet]. 2006 [cited 2025 Dec 26];48:692-9. Available from: https://doi.org/10.1016/j.jacc.2006.02.073

32. Cheng W, Wu X, Liu Q, Wang HS, Zhang NY, Xiao YQ, et al. Post-contrast acute kidney injury in a hospitalized population: short-, mid-, and long-term outcome and risk factors for adverse events. Eur Radiol [Internet]. 2020 [cited 2025 Dec 26];30:3516-27. Available from: https://doi.org/10.1007/s00330-020-06690-3

33. Chang DR, Lu SY, Lin ZH, Kuo CC, Chiang HY. Contrast-related risk of progressing to ESRD in patients undergoing percutaneous coronary intervention: iohexol vs. iodixanol: SA-PO086. J Am Soc Nephrol [Internet]. 2023 [cited 2025 Dec 26];34 (11S):746-7. Available from: https://doi.org/10.1681/ASN.20233411S1746d

34. Cochran ST, Bomyea K, Sayre JW. Trends in adverse events after IV administration of contrast media. AJR Am J Roentgenol [Internet]. 2001 [cited 2025 Dec 26];176: 1385-8. Available from: https://doi.org/10.2214/ajr.176.6.1761385

35. Barrett BJ, Parfrey PS, Vavasour HM, O'Dea F, Kent G, Stone E. A comparison of nonionic, low-osmolality radiocontrast agents with ionic, high-osmolality agents during cardiac catheterization. N Engl J Med [Internet]. 1992 [cited 2025 Dec 26];326:431-6. Available from: https://doi.org/10.1056/nejm199202133260702

36. Wei Y, Jiang X, Hibberd M, Sampedro A, Rautenbach J. Estimating the rate of acute adverse reactions to non-ionic low-osmolar contrast media: a systematic review and meta-analysis. Eur Radiol [Internet]. 2025 [cited 2025 Dec 26];35:6240-9. Available from: https://doi.org/10.1007/s00330-025-11526-z

37. Müller FH. Post-marketing surveillance of the safety profile of iodixanol in the outpatient CT setting: a prospective, multicenter, observational study of patient risk factors, adverse reactions and preventive measures in 9953 patients. Rofo [Internet]. 2014 [cited 2025 Dec 26];186:1028-34. Available from: https://doi.org/10.1055/s-0034-1366370

38. Reed M, Meier P, Tamhane UU, Welch KB, Moscucci M, Gurm HS. The relative renal safety of iodixanol compared with low-osmolar contrast media: a meta-analysis of randomized controlled trials. JACC Cardiovasc Interv [Internet]. 2009 [cited 2025 Dec 26];2:645-54. Available from: https://doi.org/10.1016/j.jcin.2009.05.002

39. Hosoya T, Yamaguchi K, Akutsu T, Mitsuhashi Y, Kondo S, Sugai Y, et al. Delayed adverse reactions to iodinated contrast media and their risk factors. Radiat Med 2000;18:39-45.

40. Hunt CH, Hartman RP, Hesley GK. Frequency and severity of adverse effects of iodinated and gadolinium contrast materials: retrospective review of 456,930 doses. AJR Am J Roentgenol [Internet]. 2009 [cited 2025 Dec 26];193:1124-7. Available from: https://doi.org/10.2214/AJR.09.2520

41. McCullough P, Ng CS, Ryan M, Baker ER, Mehta R. Major adverse renal and cardiovascular events following intra-arterial contrast media administration in hospitalized patients with comorbid conditions. Cardiorenal Med [Internet]. 2021 [cited 2025 Dec 26];11:193-9. Available from: https://doi.org/10.1159/000517884

42. Prasad A, Amin AP, Ryan MP, Gunnarsson C, Brilakis ES. Use of iso-osmolar contrast media during endovascular revascularization is associated with a lower incidence of major adverse renal, cardiac, or limb events. Catheter Cardiovasc Interv [Internet]. 2022 [cited 2025 Dec 26];99:1335-42. Available from: https://doi.org/10.1002/ccd.30006

43. Weiland FL, Marti-Bonmati L, Lim L, Becker HC. Comparison of patient comfort between iodixanol and iopamidol in contrast-enhanced computed tomography of the abdomen and pelvis: a randomized trial. Acta Radiol [Internet]. 2014 [cited 2025 Dec 26];55:715-24. Available from: https://doi.org/10.1177/0284185113505277

44. Rosenberg C, Martínez-Rodrigo JJ, Lonjedo Vicent E, Macho J, Lim L, Todoran TM; Peripheral Discomfort Study Investigator Panel. Randomized, double-blind study comparing patient comfort and safety between iodixanol 320 mg I/mL and iopamidol 370 mg I/mL in patients undergoing peripheral arteriography - the COMFORT II trial. J Invasive Cardiol 2017 ;29:9-15.

45. McCullough PA, Capasso P. Patient discomfort associated with the use of intra-arterial iodinated contrast media: a meta-analysis of comparative randomized controlled trials. BMC Med Imaging [Internet]. 2011 [cited 2025 Dec 26];11:12. Available from: https://doi.org/10.1186/1471-2342-11-12

46. Hou QR, Gao W, Sun AM, Wang Q, Qiu HS, Wang F, et al. A prospective evaluation of contrast and radiation dose and image quality in cardiac CT in children with complex congenital heart disease using low-concentration iodinated contrast agent and low tube voltage and current. Br J Radiol [Internet]. 2017 [cited 2025 Dec 26];90:20160669. Available from: https://doi.org/10.1259/bjr.20160669

47. Kim M, Hwang JY, Choo KS, Ryu H, Reid SNS, Kim YW, et al. Comparison of image quality of abdominopelvic CT in paediatric patients: low osmolar contrast media versus less iodine-containing iso-osmolar contrast media at different peak kilovoltages. Clin Radiol [Internet]. 2019 [cited 2025 Dec 26];74:896.e9-.e16. Available from: https://doi.org/10.1016/j.crad.2019.06.027

48. Callahan MJ, Iyer RS, Wassner AJ. Is thyroid monitoring warranted in infants and young children after intravascular administration of iodine-based contrast media? AJR Am J Roentgenol [Internet]. 2023 [cited 2025 Dec 26];220:144-5. Available from: https://doi.org/10.2214/ajr.22.28007

49. Paltiel HJ. Hospitalized children with stable kidney function rarely develop contrast-induced nephropathy. Radiology [Internet]. 2020 [cited 2025 Dec 26];294:557-8. Available from: https://doi.org/10.1148/radiol.2019192666

50. Gilligan LA, Davenport MS, Trout AT, Su W, Zhang B, Goldstein SL, et al. Risk of acute kidney injury following contrast-enhanced CT in hospitalized pediatric patients: a propensity score analysis. Radiology [Internet]. 2020 [cited 2025 Dec 26];294:548-56. Available from: https://doi.org/10.1148/radiol.2020191931

51. Dennhardt N, Schoof S, Osthaus WA, Witt L, Bertram H, Sümpelmann R. Alterations of acid-base balance, electrolyte concentrations, and osmolality caused by nonionic hyperosmolar contrast medium during pediatric cardiac catheterization. Paediatr Anaesth [Internet]. 2011 [cited 2025 Dec 26];21 :1119-23. Available from: https://doi.org/10.1111/j.1460-9592.2011.03706.x

52. Wright NB, Carty HM, Sprigg A, Kampenes VB, Friis M, Petersen KK, et al. Iodixanol in paediatric gastrointestinal imaging: safety and efficacy comparison with iohexol. Br J Radiol [Internet]. 2002 [cited 2025 Dec 26];75:127-35. Available from: https://doi.org/10.1259/bjr.75.890.750127

53. Kume K, Yasuoka Y, Adachi H, Noda Y, Hattori S, Araki R, et al. Impact of contrast-induced acute kidney injury on outcomes in patients with ST-segment elevation myocardial infarction undergoing primary percutaneous coronary intervention. Cardiovasc Revasc Med [Internet]. 2013 [cited 2025 Dec 26];14:253-7. Available from: https://doi.org/10.1016/j.carrev.2013.07.009

54. Terrenato I, Sperati F, Musicco F, Pozzi AF, di Turi A, Caterino M, et al. Iodixanol versus iopromide in cancer patients: evidence from a randomized clinical trial. J Cell Physiol [Internet]. 2018 [cited 2025 Dec 26];233:2572-80. Available from: https://doi.org/10.1002/jcp.26132

THE ASEAN JOURNAL OF RADIOLOGY
ISSN 2672-9393

Letter to the Editor and Reply

Sharing the thoughts of Radiology in India stands at the crossroads: Friends, foes, and the future

Received 29 January 2026; accepted 1 Febuary 2026
doi:10.46475/asean-jr.v27i1.1013

Dear editor,

After having read the article titled "Radiology in India Stands at the Crossroads: Friends, Foes, and the Future," we have felt compelled to highlight a resemblance of a certain issue that can be seen beyond the Asian region and that we, as authors, feel in Mexico too.

Specialty impingement

It is clear that certain specialties such as those mentioned in the article; obstetrics, neurology, and gastroenterology have infringed upon the limits of radiology with the intent of becoming self-sufficient while ignoring that most diseases are multidisciplinary and therefore may need a systematic approach that could go beyond their specific specialty reach and that only a trained radiologist can provide [1].

To that list we would like to add specialties such as emergency medicine, internal medicine and general surgery, as these specialties have gained much ground on the use of basic ultrasound techniques which can sometimes delay more advanced imaging options and counsultation from the imaging department. This ongoing fight for the ultrasound has sometimes been referred to as a "turf-battle" but you can only have a "turf-battle" if both parties wish to be a part of it, therefore, predictions have been made that one day, radiologists may have a reduced role in ultrasound since not all of them enjoy performing ultrasound examinations [2].

In order to further contextualize the sense of being overwhelmed felt due to other specialties breaching the bounds of radiology, we present a table with summaries of other publications that further explore this topic (Table 1).

Table 1. *Publications alluding to the use of ultrasonography beyond the imaging department [2, 3].*

Authors	Years	Conclusions
Chang SD, Munk PL et al.	2014	"What many radiologists have found is that these bedside examinations by clinicians often result in referral either for detailed formal ultrasound examinations or other imaging studies. We are in no danger of finding ourselves under- let alone unemployed"
Sidhu, Paul S., et al.	2023	"In many countries, ultrasound was initially positioned under the umbrella of radiology, but it is important to bear in mind that initial research and practice was performed in a collaboration between engineers and different medical specialties, not just radiology, and has always been an inter-disciplinary modality. This is one of the reasons that ultrasound remains so attractive to practitioners from many medical specialties"

Conclusion

Specialty interest in radiology will inevitably continue to grow as other specialties increase their independence from the imaging department; however, radiologists will preserve their role as guiding clinical counselors for as long as the other specialties feel the need to refer patients to alleviate any imaging-related doubts. Patient-centered care should always remain our primary goal.

Conflict of interest: The authors declare no conflicts of interest.

Funding: No funding was received.

Jose E. Velazquez-Amador, M.D.[(1)]
Isis Perez-Oseguera, M.D.[(2)]
From [(1)]Faculty of Medicine, Autonomous University of Guadalajara, Zapopan, Jalisco, Mexico,
[(2)]Department of Diagnostic and Therapeutic Imaging, General Zone Hospital No. 1, Instituto Mexicano del Seguro Social, Villa de Alvarez, Colima, Mexico.
Address correspondence to J.E.VA. (email: j_enriqueva@hotmail.com)

References

1. Rana L, Gurnal P, Chowdary D. Radiology in India stands at the crossroads: Friends, foes, and the future . ASEAN J Radiol [Internet]. 2025 [cited 2026 Jan 31];26(3):252-61. Available from: https://asean-journal-radiology.org/index.php/ajr/article/view/968

2. Chang SD, Munk PL. The changing landscape of radiology: ultrasound training for nonradiologists. Can Assoc Radiol J 2014;65:1. doi: 10.1016/j.carj.2013.12.001.

3. Sidhu PS, Ewertsen C, Piskunowicz M, Secil M, Ricci P, Fischer T, et al. Diversity of current ultrasound practice within and outside radiology departments with a vision for 20 years into the future: A position paper of the ESR ultrasound subcommittee. Insights Imaging 2023;14:202. doi: 10.1186/s13244-023-01548-w.

Reply

We thank the authors for bringing our article to attention and the thoughtfully written letter. Diagnostic radiology is often described as "the eyes of modern medicine" as it provides powerful visual information that leads to early diagnosis and increased agreement among doctors, and even patients. With the widespread use of Picture Archive Communicating System (PACS) and standardized reporting systems, radiology has become or is becoming "the backbone of modern medicine". Closely linked to and driven by technologies, capitalism and evidence-based medicine, radiology is rapidly expanding and has become highly attractive even to non-radiologists who expect to share this exciting journey. In the expanding world of diagnostic imaging, which continues to offer new areas of interest and welcomes more and more new players, roles beyond "interpretation, diagnosis, or minimally invasive treatment", which can strengthen the system, and best serve patients should be more actively introduced to the radiologists and radiological residents. These roles include providing expert consultation, serving as trainers, developing curricula, contributing to accreditation, monitoring safety, performing cost-effectiveness analyses, among others.

Wiwatana Tanomkiat, M.D.
From Department of Radiology, Faculty of Medicine, Prince of Songkla University, Hat Yai, Songkla, Thailand.
Address correspondence to W.T. (email: twiwadha@hotmail.com)

ASEAN Movement in Radiology

Report from the 2025 annual meeting of thoracic radiologists in Thailand: Advances and consensus on standards, guidelines, and practices for thoracic disorders

Warat Setasuban, M.D.[1]
Boripat Hirunpat, M.D.[1]
Tatcha Wongtom, M.D.[1]
Walit Sowalertrat, M.D.[1]
Nutcha Pinjaroen, M.D.[2]
Tanop Srisuwan, M.D.[3]
Nantaka Kiranantawat, M.D.[1]
Warawut Sukkasem, M.D.[4]
Sutarat Tungsagunwattana, M.D.[5]
Thitiporn Suwatanapongched, M.D.[4]
Panruethai Trinavarat, M.D.[2]
Chayaporn Kaewsathorn, M.D.[6]
Thanisa Thongbai, M.D.[2]
Chayanin Nitiwarangkul, M.D.[4]
Sitang Nirattisaikul, M.D.[1]
Wiwatana Tanomkiat, M.D.[1]

From [1]Department of Radiology, Faculty of Medicine, Prince of Songkla University, Hat Yai, Songkla, Thailand,
[2]Department of Radiology, Faculty of Medicine, King Chulalongkorn Memorial Hospital, Chulalongkorn University, Bangkok, Thailand,
[3]Department of Radiology, Faculty of Medicine, Maharaj Nakorn Chiang Mai Hospital, Chiang Mai University, Chiang Mai, Thailand,
[4]Department of Diagnostic and Therapeutic Radiology, Faculty of Medicine Ramathibodi Hospital, Mahidol University, Bangkok, Thailand,
[5]Department of Radiology, Central Chest Institute of Thailand, Department of Medical Services, Bangkok, Thailand,
[6]Department of Radiology, Surat Thani Hospital, Surat Thani, Thailand.
Address correspondence to W.T. (email: twiwadha@hotmail.com)

Received 27 January 2026; accepted 2 Febuary 2026
doi:10.46475/asean-jr.v27i1.1011

Figure 1. *(A) Engaging atmosphere during the comprehensive meeting discussion (B) Group photo of the panel captured post-meeting.*

On 12 September 2025, a panel of thoracic radiology experts from across Thailand (Figure 1) convened to address key topics in thoracic diagnostic imaging across both the private and public sectors. Organized by the Royal College of Radiologists of Thailand (RCRT) in collaboration with the Foundation for Orphan and Rare Lung Disease (FORLD), the meeting was held at the Conrad Hotel, Pathum Wan, Bangkok. The agenda covered twelve main topics: (1) the new organizational structure of the Radiological Society of Thailand (RST) and the Thai Subsociety of Thoracic Radiology (TSTR), (2) management guidelines for lung nodules detected on CT screening in Thailand, (3) reporting recommendations for coronary arterial calcium scoring on chest CT, (4) CT Protocol and reporting guidelines for chronic obstructive pulmonary disease (COPD) of the Asian Society of Thoracic Radiology (ASTR), (5) guidelines for reporting chronic obstructive pulmonary disease (COPD) findings on CT lung cancer screening, (6) enhancing the competency of junior radiologists in chest radiograph interpretation to support artificial intelligence (AI) integration, (7) updates on national high-resolution computed tomography (HRCT) diagnostic reference levels (DRLs), (8) a review of the national HRCT protocol, (9) a proposal for a national low-dose CT (LDCT) protocol for lung cancer screening, (10) imaging and LDCT for screening of ILD in CTD patients, (11) structured reporting guidelines and software for HRCT in patients with suspected or confirmed ILD, and (12) outcomes of estimating fibrotic extent on HRCT.

Agenda 1: The New Organizational Structure of the Radiological Society of Thailand and the Thai Subsociety of Thoracic Radiology

Presented by Wiwatana Tanomkiat, M.D.

At present, professional radiological societies in Thailand are primarily organized in a traditionally adopted imaging modality–based structure, rather than an organ system–based subspecialty model. The Radiological Society of Thailand (RST) has encouraged the development of organ system–based subspecialty groups. In response, the Thai Subsociety of Thoracic Radiology (TSTR) was established under the auspices of the RST.

Participants' conclusion: The meeting unanimously approved the establishment of the TSTR, with the following founding committees:

1.	Wiwatana Tanomkiat	President
2.	Nisa Muangman	Vice President
3.	Nantaka Kiranantawat	Secretary
4.	Sitang Nirattisaikul	Treasurer
5.	Warawut Sukkasem	Registration and Public Relation
6.	Tanisa Tongbai	Committee Member
7.	Phakphoom Thiravit	Committee Member
8.	Pannaya Tumsatan	Committee Member
9.	Yuthapan Wannasopha	Committee Member
10.	Sutarat Tungsagunwattana	Committee Member

Subsociety embler

Agenda 2: Management Guidelines for Lung Nodules Detected on CT Screening in Thailand

Presented by Nutcha Pinjaroen, M.D.

Thailand is currently in the process of developing national guidelines for lung cancer screening and management. Due to the shortage of radiologists in public hospitals—especially in provincial areas—the National Health Security Office (NHSO) has introduced AI technology to assist in interpreting chest X-rays (AI Chest X-ray). The program has been piloted in 167 public hospitals, with plans to expand coverage to 887 hospitals within three years. While this policy is expected to substantially increase the detection of abnormal findings, it will likely result in a significant increase in downstream investigations, including chest CT, PET-CT, invasive procedures, and unnecessary or redundant follow-up imaging. The development of clear and appropriate guidelines is, therefore, essential, not only to standardize clinical practice but also to ensure an appropriate balance between proactive early lung cancer detection and the efficient, judicious use of healthcare resources.

Participants' conclusion: The meeting participants agreed that developing such guidelines would benefit from the formal involvement of the RCRT and/ or the RST during the guideline formulation process. In addition, there was consensus that explicit recommendations are required to address medico-legal responsibilities and liabilities when discrepancies arise between radiologists' interpretations and AI-generated results.

THE ASEAN JOURNAL OF RADIOLOGY
ISSN 2672-9393

Agenda 3: Reporting Recommendations for Coronary Arterial Calcium Scoring on Chest CT

Presented by Tanop Srisuwan, M.D.

In 2021, acute ischemic heart disease was one of the leading causes of death worldwide, with an estimated 9.1 million cardiovascular-related deaths, accounting for approximately 13% of all global mortality [1]. Patients with certain thoracic conditions requiring a radiologic evaluation, such as chronic obstructive pulmonary disease (COPD), have also been shown to have a higher prevalence of concomitant cardiovascular diseases, including heart failure, ischemic heart disease, and atrial fibrillation [2]. Accordingly, the identification and reporting of coronary arterial calcification (CAC) on CT, a marker of atherosclerotic cardiovascular disease (ASCVD), is considered clinically relevant.

The standard and widely accepted method for coronary calcium assessment is the Agatston score, which requires ECG-gated cardiac CT. However, chest CT examinations commonly performed for pulmonary evaluation—such as in COPD, interstitial lung disease (ILD), or pulmonary nodule assessment—are typically non–ECG-gated. In 2016, the Society of Cardiovascular Computed Tomography (SCCT) and the Society of Thoracic Radiology (STR) issued recommendations for the assessment of coronary calcium on non-cardiac, non–ECG-gated chest CT. These guidelines recommend reporting CAC in all patients using one of several approaches, including visual assessment, nongated ordinal scoring, or nongated Agatston scoring, with severity classified as none, mild, moderate, or severe [3]. A clear clinical benefit of CAC reporting is its role in guiding statin therapy among patients aged 40–75 years with a 10-year ASCVD risk estimate of 5–20% [4].

Reporting coronary calcium on non–ECG-gated chest CT should, therefore, be simple, concise, and clearly worded to avoid misinterpretation. The following reporting phrases were recommended:

- **No CAC identified:** *No identified coronary calcification (not tailored for calcium scoring; subtle calcification may be overlooked),*
- **CAC present:** *Mild / moderate / severe coronary artery calcification by visual assessment.*

Participants' conclusion: The meeting acknowledged the clinical value of reporting coronary calcium on non–ECG-gated chest CT. However, it was agreed that detailed indications, recommendations, and limitations should be clearly defined before being applied in clinical practice.

Agenda 4: CT Protocol and Reporting Guidelines for COPD of the Asian Society of Thoracic Radiology (ASTR)

Presented by Nantaka Kiranantawat, M.D.

This presentation outlines guidelines for CT reporting in patients suspected of or diagnosed with COPD, based on recommendations issued by the ASTR [5].

Indications for CT examination

- Recommendation (one of the following)
  - Persistent exacerbations,
  - Symptoms out of proportion to disease severity on pulmonary function test (PFT),
  - FEV1 < 45% of predicted value, combined with significant hyperinflation and gas trapping,
  - According to lung cancer screening criteria.

- Consideration (one of the following)
  - COPD patients requiring the exclusion of comorbidities (e.g., lung cancer, ILD),
  - Patients at high risk or with clinical suspicion of COPD whose (one of the following):
    - PFT is unable to perform,
    - PFT is unavailable,
    - PFT results are normal, but early screening of COPD is desired.

CT Scanning Recommendations

- Patients already diagnosed with COPD:
  - Use the standard dose or low dose combined with paired inspiratory/expiratory phases.

- Middle-aged and elderly patients (suspected COPD or high risk, but without clear diagnostic criteria):
  - Use low-dose CT combined with paired inspiratory and expiratory phases.

- Young adults (20–40 years) with risk factors (e.g., history of premature birth, asthma, or respiratory infections in childhood; family history of respiratory disease; smoking, passive smoking, or e-cigarette exposure):
  - Use low-dose CT without the expiratory phase.

CT Report Recommendations

When writing a CT report for a COPD patient, the following sections should be described:

- Emphysema: Specify the type and distribution of emphysema,
- Airway: Describe bronchial wall size, thickening, and narrowing,
- Pulmonary vessels: Note any vascular changes in the lungs,
- Goddard score: Should be included in every report to quantify the extent of emphysema.

Participants' conclusion: The meeting acknowledged the ASTR recommendation on CT scanning and reporting COPD.

Agenda 5: Guidelines for Reporting COPD Findings on CT Lung Cancer Screening

Presented by Warawut Sukkasem, M.D.

The report template for COPD (Figure 2) based on Agenda 4 was proposed.

CT Report Checklist for COPD

ID(HN) ☐☐☐☐☐☐☐

Date of Examination (date-month-year) ☐☐-☐☐-☐☐☐☐

1 Imaging Quality

☐ Good ☐ Suboptimal ☐ Inadequate

If not good, mark the boxes that apply

☐ Not full inspiration ☐ Not full expiration ☐ Artifact ☐ Others ....

2 Parenchymal Abnormalities Consistent with COPD

☐ Yes (Complete Section 2.1 and 2.2)

☐ No (Proceed to Section 3)

2.1 Major Emphysematous Phenotypes with Severity

	Centrilobular emphysema										Paraseptal emphysema				Panlobular emphysema	
	Trace (<0.5%)		Mild (0.5-5%)		Moderate (>5%)		Confluent		Destructive		Mild (≤1cm)		Substantial (>1cm)			
	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L
Upper																
Middle																
Lower																

2.2 Visual Goddard scoring (Mild ≤ 8, Moderate 8-16, Severe > 16)

	R	L
Upper (The aortic arch level)	0 1 2 3 4	0 1 2 3 4
Middle (The carina level)	0 1 2 3 4	0 1 2 3 4
Lower (1 cm above right diaphragm)	0 1 2 3 4	0 1 2 3 4

Total score = ...

Score	% emphysema
0	0%
1	0-25%
2	25-50%
3	50-75%
4	75-100%

3 Airway Abnormalities Consistent with COPD

☐ Yes (Complete Section 3.1 and 3.2)

☐ No (Proceed to Section 4)

3.1 Large Bronchial Disease

☐ Bronchial wall thickening
☐ Mucous plugging
☐ Saber sheath trachea

3.2 Small Airway Disease (SAD)

☐ Inflammatory SAD (Centrilobular opacities)
☐ Obstructive SAD (Air trapping without significant emphysema)

4 Comorbidities

☐ Bronchiectasis
☐ Enlarged pulmonary artery
☐ ILA/ILD ....
☐ Combined pulmonary fibrosis with emphysema (CPFE)
☐ Airspace enlargement with fibrosis (AEF)/Thick-walled cystic lesion (TWCL)
☐ Tracheobronchomalacia
☐ Excessive dynamic airway collapsed
☐ Giant bulla
☐ Lung cancer
☐ Pleural lesion ....
☐ Coronary calcifications
☐ Pulmonary cachexia/sarcopenia
☐ Osteoporosis
☐ Others ....

Figure 2. *CT Report Checklist for COPD.*

The checklist is designed to ensure that radiologists provide consistent and actionable data when COPD characteristics are identified incidentally or as part of a screening protocol.

Participants' conclusion: The committee unanimously agreed with the proposed reporting guidelines. Furthermore, the meeting emphasized the critical importance of disseminating these guidelines to both clinicians and radiologists to ensure effective and appropriate implementation in the clinical practice.

Agenda 6: Enhancing the Competency of Junior Radiologists in Chest Radiograph Interpretation to Support AI Integration

Presented by Sutarat Tungsagunwattana, M.D.

Due to the current integration of AI into various medical contexts in Thailand, including the interpretation of radiological images, it is vital for radiologists to prioritize accuracy, precision, and inter-observer agreement. This is essential for maximizing patient benefits and preventing professional disputes. Currently, Thailand offers two primary programs aimed at improving the interpretation competency and diagnostic consistency: the Air Pneumo Program [6] and the NIOSH B-reader Training Course and Examination, which is conducted by the Central Chest Institute of Thailand under the Department of Medical Services. However, these programs are not currently integrated into the official curriculum of the Royal College of Radiologists of Thailand, neither for diagnostic radiology residents nor for advanced diagnostic body imaging fellows.

Participants' conclusion: Representatives from all ten institutions acknowledged the significant impact of AI on chest radiograph interpretation. There was a collective agreement on the need for additional training to reinforce fundamental interpretative skills and promote a deeper understanding of the chest radiograph analysis. The meeting concluded that these educational efforts should be specifically targeted at first-year (R1) diagnostic radiology residents.

Agenda 7: Updates on the Development and Implementation of National HRCT Diagnostic Reference Levels (DRLs)

Presented by Thitiporn Suwatanapongched, M.D., and Panruethai Trinavarat, M.D.

The objective of this session was to promote radiation dose control in HRCT examinations by ensuring alignment with established Global DRLs. Inter-institutional comparisons were discussed using standardized dose metrics, including Computed Tomography Dose Index (CTDIvol), Dose–Length Product (DLP), and Size-Specific Dose Estimate (SSDE), for each examination. In this context, dose optimization was emphasized as a practical and essential strategy to balance radiation safety and diagnostic image quality [7,8].

Several protocol-related parameters were identified as key areas for improvement. These included reducing unnecessary radiation during expiratory and prone imaging by favoring axial acquisition over helical scanning; selecting appropriate patient positioning and restricting the field of view to the region of interest; optimizing the craniocaudal scan length; and ensuring the adequate breath-hold technique during inspiratory acquisition and active, forced expiration during expiratory acquisitions to obtain diagnostically interpretable images in a single acquisition.

Participants' conclusion: The panel agreed that general recommendations for HRCT protocols can be defined at the national level. However, given the variability in CT scanner performance across institutions, a higher radiation dose may still be required in certain settings to achieve acceptable image quality. If markedly elevated DRL values are identified at a specific institution, direct communication may be undertaken to understand the contributing factors and support further protocol optimization, rather than enforcing uniform dose-reduction targets indiscriminately.

Agenda 8: A Review of the National HRCT Protocol

Presented by Chayaporn Kaewsathorn, M.D.

Following the release of the National HRCT Protocol for ILD in 2019 [9], several revisions were proposed to improve its use for other thoracic conditions.

For collimation, a change from <1.5 mm to ≤1.25 mm was proposed based on recent recommendations for CT evaluation of COPD issued by the Asian Society of Thoracic Radiology in 2025 [5]. The meeting, however, noted that most CT scanners currently available in Thailand are unable to achieve a collimation of ≤1.25 mm. Furthermore, assessment of emphysema and bronchitis using a collimation of ≤1.5 mm remains clinically acceptable. Therefore, no major change to the existing protocol was recommended, aside from revising the wording from "<1.5 mm" to "≤1.5 mm."

Regarding mediastinal window reconstruction, increasing the slice thickness from ≤1.5 mm to 2.5–3 mm was proposed to facilitate coronary calcium assessment, in accordance with the 2016 guidelines issued by the SCCT and the STR [3]. The panel considered that thinner slice thickness provides higher sensitivity for the detection of coronary calcification. Furthermore, visual assessment on non–ECG-gated chest CT does not require the same degree of quantitative precision as formal Agatston scoring. When thicker reconstructions are required, they can be generated from thin-section source images. Accordingly, no modification of the current recommendation was deemed necessary.

Participants' conclusion: The existing National HRCT Protocol remains suitable for routine practice in Thailand and does not limit the evaluation of COPD or coronary artery calcification. Future updates should mainly focus on further reducing radiation dose to patients.

HRCT Protocol for ILD: Version.2/2026

	Supine/Inspiration (ทำทุกราย ทั้งครั้งแรกและ follow-up)	Supine/Expiration (ทำทุกรายในครั้งแรก ในกรณี follow-up ให้พิจารณาเป็นรายๆ ไป)	Prone/inspiration (Optional ให้พิจารณาเป็นรายๆ ไป)
Scan coverage	Whole chest[1]	Whole chest[1]	limited to region of interest[2] (เช่น lower chest) หรือ Whole chest1
Technique	Volumetric[3]	Recommended: sequential[4] (every 10-20 mm interval) ในช่วง end expiration Optional: ถ้ากลั้นใจไม่ได้นานหรือสงสัยภาวะ TBM อาจทำ volumetric scan ในขณะ forced expiration และควรใช้ ultralow radiation dose (*) และ pitch สูงสุด[7]	Recommended: sequential[4] (every 10-20 mm interval) Optional: ถ้ากลั้นใจไม่ได้นาน อาจทำ volumetric scan เฉพาะ region of interest[2] และควรใช้ radiation dose ที่น้อยกว่าหายใจเข้า และ pitch สูงสุด[7]
Collimation	Thinnest (≤1.5 mm)[5]	Thinnest (≤1.5 mm)[5]	Thinnest (≤1.5 mm)[5]
Rotation time	Shortest (<0.5 s)[6]	Shortest (<0.5 s)[6]	Shortest (<0.5 s)[6]
Pitch	Highest (>1)[7]	-	-
Radiation dose	120 kVp, auto mAs[8] (1-3 mSv)	120 kVp, 20-60 mAs[8] *100 kVp, 40-60 mAs[8] (<1 mSv)	100 or 120 kVp, 20-30 mAs[8] (<1 mSv)
Reconstruction[12]	1. Axial, lung-window[9] (high-spatial algorithm) ≤1.5 mm thicknessม overlap (30-50%)[9] 2. Axial, mediastinal-window[10] (low-spatial algorithm), ≤1.5 mm thick ness, overlap (30-50%) 3. Coronal[11], mediastinal- window (low-spatial algorithm), ≤1.5 mm thickness contiguous	Axial, lung-window[9] (high-spatial algorithm), ≤1.5 mm thickness	Axial, lung-window[9] (high-spatial algorithm), ≤1.5 mm thickness

<u>หมายเหตุ</u> *WL/WW for lung-window setting: -450 to -600 HU/1450 to 1600 HU*
WL/WW for mediastinal-window setting: 30 to 50 HU/350 to 450 HU
TBM = tracheobronchomalacia

<u>เหตุผลหรือประโยชน์ที่ได้</u>

[1,3] *เพิ่ม rate of detection ถึงแม้จะเป็น focal lesion ขนาดเล็ก นอกจากนี้ยังสามารถสร้าง multiplanar reformation เพื่อศึกษาการกระจายตัวได้ดีอีกด้วย*
[2] *อาจจะทำเฉพาะที่เพื่อลด radiation dose*
[4] *โดยเฉพาะในผู้ป่วยที่เป็นผู้หญิง และ/หรือ ที่อายุ <45 ปี*
[5] *หากบางกว่า 1 mm สามารถกระทำได้แต่จะมี noise มาก*
[6,7] *เพื่อสร้างภาพที่ motion-free (shortest rotation time และ high pitch จะใช้เวลา scan ทั้งทรวงอกไม่เกิน 5 วินาที)*
[8] *เครื่อง CT ในปัจจุบัน จะสามารถตั้ง auto mA (automatic exposure control) ได้ ซึ่งจะสะดวกกว่า เพราะไม่ต้องปรับ mA ในผู้ป่วยที่ขนาดไม่เท่ากัน โดยเฉพาะทรวงอกด้านบนที่มี soft tissue มากกว่า ในผู้ป่วยอายุน้อยโดยเฉพาะเพศหญิงที่ follow up ต่อเนื่อง หากต้องการลดปริมาณรังสีมากกว่านี้ สามารถใช้โปรแกรมอัตโนมัติ low dose ซึ่งจะสามารถกำหนดเพดาน mA ได้ หรือกำหนด mA คงที่ตลอดทั้งทรวงอก อย่างไรก็ตามควรหลีกเลี่ยง ultralow dose ในการทำ supine inspiratory HRCT*
[9] *เพื่อความคมชัด*
[10] *เพื่อแสดงพยาธิสภาพที่เกี่ยวข้องใน mediastinum และ soft tissue*
[11] *เพื่อแสดงระนาบบนล่าง (vertical distribution)*
[12] *แนะนำให้ใช้ Iterative reconstruction (IR) เพื่อลด noise*

จัดทำเอกสารโดย : ศ.พญ.ฐิติพร สุวัฒนะพงศ์เชฎ, รศ.นพ.วิวัฒนา ถนอมเกียรติ, รศ.พญ.จันทิมา เอื้อตรงจิตต์, และ ผศ.นพ.ธนพ ศรีสุวรรณ

เอกสารอ้างอิง:

1. *Raghu G, Remy-Jardin M, Myers JL, et al. American Thoracic Society, European Respiratory Society, Japanese Respiratory Society, and Latin American Thoracic Society. Diagnosis of Idiopathic Pulmonary Fibrosis. An Official ATS/ERS/JRS/ALAT Clinical Practice Guideline. Am J Respir Crit Care Med 2018;198(5):e44-e68.*

Figure 3. *National HRCT Protocol for ILD, version 2/2026.*

Agenda 9: A Proposal for a National Low-dose CT (LDCT) Protocol for Lung Cancer Screening

Presented by Thitiporn Suwatanapongched, M.D., and Thanisa Thongbai, M.D.

Following the discussion on lung nodule management in CT-based screening, the use of LDCT for lung cancer screening was proposed. The discussion emphasized the need for a standardized, dose-optimized protocol that is feasible within the context of available CT technology and clinical practice in Thailand. Particular attention was given to balancing sufficient image quality for early lung cancer detection with radiation dose minimization, especially in the setting of population-based screening [7,8].

Several key technical factors were highlighted for consideration [7,8], including:

- Scan coverage, ensuring complete lung coverage from lung apices to costophrenic angles;
- Acquisition technique parameters, including detector collimation, gantry rotation time, pitch, and the use of tube current modulation);
- Radiation dose parameters, including tube voltage (kVp), tube current–time product (mAs), and target dose metrics such as CTDIvol and DLP appropriate for screening purposes; and
- Reconstruction parameters, including slice thickness and interval, reconstruction kernel, iterative reconstruction technique, and generation of multiplanar reformation.

Participants' conclusion: The participants agreed that a dedicated LDCT protocol for lung cancer screening should be developed. This protocol will be refined by an appropriate working group and presented for further discussions and endorsement at a future meeting.

Agenda 10: Imaging and LDCT for Screening of ILD in Connective Tissue Disease (CTD) Patients

Presented by Chayanin Nitiwarangkul, M.D.

It is well established that the prevalence of ILD is increasing, driven by improved access to medical information and diagnostic technology. Adhering to the principle of "early detection and early treatment" to improve therapeutic outcomes, diagnostic and monitoring tools are of paramount importance. Based on the Guideline for screening and monitoring CTD-ILD from the American College of Rheumatology (ACR)/American College of Chest Physicians (CHEST) 2023 [10] and ERS/EULAR 2026 [11], the following recommendations were presented:

- Screening
  - HRCT: Recommended for patients with Systemic Sclerosis (SSc), Mixed Connective Tissue Disease (MCTD), and high-risk Idiopathic Inflammatory Myopathies (IIM). It is also indicated for patients with Rheumatoid Arthritis (RA) and Sjögren's syndrome (SjS) who possess risk factors, serving as a baseline for newly diagnosed individuals.
  - CXR: Not recommended for screening due to insufficient diagnostic sensitivity.

- Monitoring
  - HRCT:
    - Every 1-2 years for SSc, MDCT, RA, and SjS;
    - Every 3-6 months for IIM if rapidly progressive disease, annually in others; and
    - May obtain promptly if progression is suspected (e.g. new crackles, hypoxia, or >10% FVC decline).
  - CXR: May be utilized for monitoring, but is limited in detecting subtle worsening, typically revealing changes only when disease progression is distinct.

Given that monitoring lung fibrosis requires HRCT at least annually, accumulating radiation exposure is a concern. Consequently, LDCT has gained significance, offering a radiation dose reduction of 60% to 80% compared to standard HRCT while maintaining diagnostic reliability for assessing ground-glass opacities, reticulations, and honeycombing. Furthermore, advanced reconstruction techniques, such as iterative reconstruction and deep learning, play a vital role in achieving image quality comparable to HRCT.

Participants' conclusion: The meeting reached an agreement on these recommendations.

Agenda 11: Structured Reporting Guidelines and Software for HRCT in Patients with Suspected or Confirmed ILD

Presented by Chayanin Nitiwarangkul, M.D.

The increasing prevalence of ILD and the subsequent rise in HRCT indications necessitate efficient and adequate reporting, as the quality of radiological data directly impacts treatment decisions. Research indicates that Structured Reporting (SR) enhances the quality of HRCT reports, particularly in complex contexts such as suspected CTD-ILD [12]. Consequently, a reporting program for chest HRCT (Figure 4) was developed with the following objectives:

1. To serve as a guideline for HRCT reporting in patients suspected of having fibrotic-ILD, such as Idiopathic Pulmonary Fibrosis (IPF) or CTD-associated ILD,
2. To provide comprehensive data to enhance the efficiency of assessment and treatment for fibrotic-ILD patients, and
3. To apply to fibrotic ILD, not for use as a primary reference in other conditions.

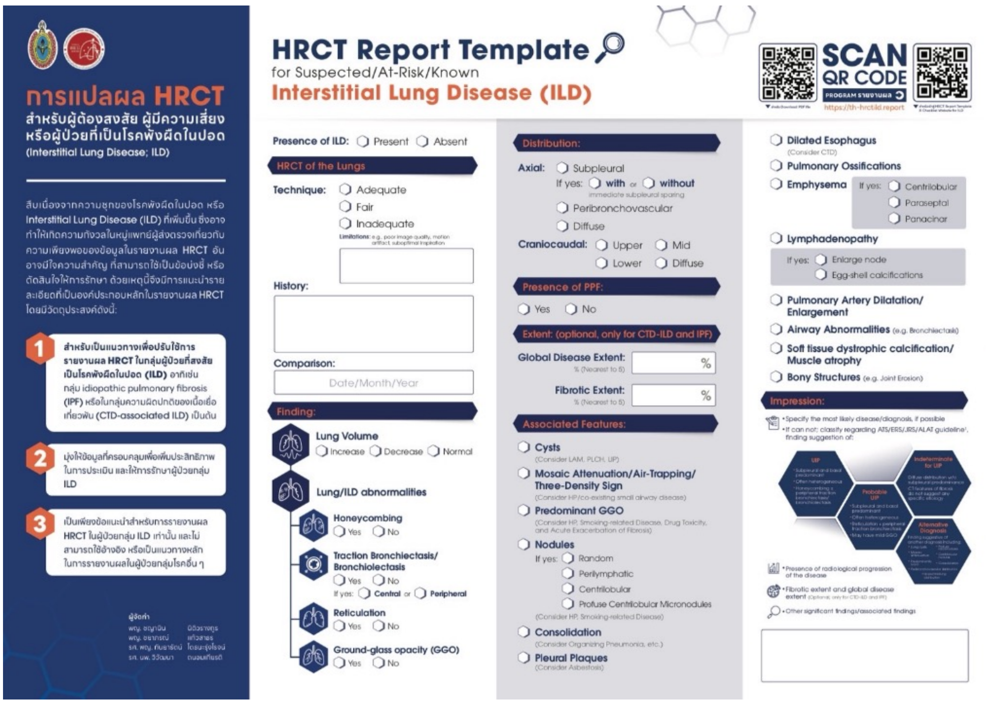


Figure 4. *HRCT Report Template for suspected/at-risk/known IILD.*

Participants' conclusion: The participants expressed a mutual understanding and supported the wider promotion of the reporting program to identify advantages and areas for improvement in the future (Figure 5).

Figure 5. *Subsequent signing of a Memorandum of Understanding (MoU) between RST and Boehringer Ingelheim (Thailand) on 14 November 2025 to improve ILD diagnosis by joint development of the HRCT Checklist & Structured Report Program through the website https://th-hrctild.report. This digital tool is designed to establish a nationwide standard for HRCT reporting, which serves as a cornerstone of ILD diagnosis, and aims to empower radiologists across Thailand, enhancing the diagnostic efficiency and fostering confident decision-making for all physicians involved in ILD care.*

Agenda 12: Outcomes of Estimating Fibrotic Extent on HRCT

Presented by Sitang Nirattisaikul, M.D.

Songklanagarind Hospital has implemented ILD diagnostic guidelines based on the ATS/ERS/JRS/ALAT 2011 recommendations [13]. However, challenges persisted in interpreting HRCT patterns, specifically in distinguishing between Idiopathic Pulmonary Fibrosis (IPF) and Connective Tissue Disease-related Interstitial Lung Disease (CTD-ILD), which require distinct therapeutic approaches [14]. Following the publication of the 2018 ATS/ERS/JRS/ALAT guidelines [15], this study aimed to share experiences on survival rates and predicted 10-year changes in pulmonary function using these updated criteria.

A retrospective review of 356 ILD patients from January 1, 2006, to December 31, 2016, was conducted. HRCT images were evaluated by three radiologists to assess morphology, fibrotic extent, and severity scores using a consensus-based three-level method [16] combined with ICOERD criteria. These findings were correlated with clinical data. Survival analysis was performed using Kaplan-Meier curves, and 10-year changes in lung function were predicted using a linear mixed-effects regression model.

Results:

- Prevalence: The probability of CTD-ILD was 64.3%, compared to 26.7% for IPF,
- Survival: The mean survival time for IPF patients was 3.5 years (95% CI: 0.61, 0.70), whereas CTD-ILD patients had a significantly longer mean survival of 11.3 years (95% CI: 0.35, 0.46) ($p < 0.0001$),
- Lung Function: The 10-year prediction showed a significant decline in %predicted FVC for IPF patients, while CTD-ILD patients exhibited a decline in %predicted DLCO. Other disease groups showed increases in FVC0 and %predicted FVC ($p < 0.05$).

Conclusion: CTD-ILD is the most common subtype and is associated with the best survival outcomes, whereas IPF presents the poorest prognosis. Patients younger than 60 years demonstrated significantly better prognoses in the CTD-ILD and other groups. The study underscores the role of Multidisciplinary Discussion (MDD) and the 2018 guidelines in improving diagnostic accuracy.

Participants' conclusion: The meeting acknowledged the findings.

Panelists

1.	Wiwatana Tanomkiat	Songklanagarind Hospital, Prince of Songkla University
2.	Nantaka Kiranantawat	Songklanagarind Hospital, Prince of Songkla University
3.	Sitang Nirattisaikul	Songklanagarind Hospital, Prince of Songkla University
4.	Siwasak Juthong	Songklanagarind Hospital, Prince of Songkla University
5.	Juntima Euathrongchit	Maharaj Nakorn Chiang Mai Hospital, Chiang Mai University
6.	Yuttaphan Wannasopha	Maharaj Nakorn Chiang Mai Hospital, Chiang Mai University
7.	Pakorn Prakaikietikul	Maharaj Nakorn Chiang Mai Hospital, Chiang Mai University
8.	Tanop Srisuwan	Maharaj Nakorn Chiang Mai Hospital, Chiang Mai University
9.	Panaya Tumsatan	Srinagarind Hospital, Khon Kean University
10.	Wannaporn Soontrapa	Srinagarind Hospital, Khon Kean University
11.	Watanya Jaidee	Faculty of Medicine, Burapha University
12.	Thitiporn Suwatanapongched	Ramathibodi Hospital, Mahidol University
13.	Warawut Sukkasem	Ramathibodi Hospital, Mahidol University
14.	Chayanin Nitiwarangkul	Ramathibodi Hospital, Mahidol University
15.	Narisara Chobaroon	Ramathibodi Hospital, Mahidol University
16.	Nisa Muangman	Siriraj Hospital, Mahidol University
17.	Kanyarat Totanarungroj	Siriraj Hospital, Mahidol University
18.	Suwimon Wonglaksanapimon	Siriraj Hospital, Mahidol University
19.	Nitra Piyavisetpat	King Chulalongkorn Memorial Hospital, Chulalongkorn University
20.	Thanisa Tongbai	King Chulalongkorn Memorial Hospital, Chulalongkorn University
21.	Nutcha Pinjaroen	King Chulalongkorn Memorial Hospital, Chulalongkorn University
22.	Wariya Chintanapakdee	King Chulalongkorn Memorial Hospital, Chulalongkorn University
23.	Itthi Itthisawatpan	King Chulalongkorn Memorial Hospital, Chulalongkorn University

24. Teerapat Singwicha	King Chulalongkorn Memorial Hospital, Chulalongkorn University
25. Panruethai Trinavarat	King Chulalongkorn Memorial Hospital, Chulalongkorn University
26. Krisna Dissaneevate	Rajavithi Hospital, Department of Medical Services, Ministry of Public Health
27. Amolchaya Kwankua	Faculty of Medicine, Thammasat University
28. Massupa Krisem	Faculty of Medicine, Thammasat University
29. Sutarat Tungsagunwattana	Central Chest Institute of Thailand, Department of Medical Services, Ministry of Public Health
30. Adisorn Plongmai	Central Chest Institute of Thailand, Department of Medical Services, Ministry of Public Health
31. Kittika Jiamjit	Central Chest Institute of Thailand, Department of Med-ical Services, Ministry of Public Health
32. Kamolwan Jungmeechoke	Phramongkutklao College of Medicine
33. Metha Aungaphinant	Phramongkutklao College of Medicine
34. Chayaporn Kaewsathorn	Surat Thani hospital, Office of Permanent Secretary, Ministry of Public Health

Observers

1. Warat Setasuban	Songklanagarind Hospital, Prince of Songkla University
2. Boripat Hirunpat	Songklanagarind Hospital, Prince of Songkla University
3. Tatcha Wongtom	Songklanagarind Hospital, Prince of Songkla University
4. Walit Sowalertrat	Songklanagarind Hospital, Prince of Songkla University

Reviewer

Wiwatana Tanomkiat

References

1. World Health Organization [Internet]. Geneva: WHO; c2026; [cited 2026 Jan 31]. The top 10 causes of death. 7 August 2024. Available from: https://www.who.int/news-room/fact-sheets/detail/the-top-10-causes-of-death

2. Vogelmeier CF, Friedrich FW, Timpel P, Kossack N, Diesing J, Pignot M, et al. Comorbidities and cause of death in COPD patients compared to non-COPD controls: An 8-year observational retrospective healthcare claims database cohort study. Int J Chron Obstruct Pulmon Dis 2025;20:2117-30. doi: 10.2147/COPD.S488701.

3. Hecht HS, Cronin P, Blaha MJ, Budoff MJ, Kazerooni EA, Narula J, et al. 2016 SCCT/STR guidelines for coronary artery calcium scoring of noncontrast noncardiac chest CT scans: A report of the Society of Cardiovascular Computed Tomography and Society of Thoracic Radiology. J Cardiovasc Comput Tomogr 2017;11:74-84. doi: 10.1016/j.jcct.2017.02.011.

4. Greenland P, Blaha MJ, Budoff MJ, Erbel R, Watson KE. Coronary Calcium Score and Cardiovascular Risk. J Am Coll Cardiol 2018;72:434-47. doi: 10.1016/j.jacc.2018.05.027.

5. Fan L, Seo JB, Ohno Y, Lee SM, Ashizawa K, Lee KY, et al. Chest CT in the evaluation of COPD: Recommendations of Asian Society of Thoracic Radiology. Br J Radiol 2025;:tqaf111. doi: 10.1093/bjr/tqaf111.

6. Tungsagunwattana S, Lertrojanapunya S. AIR Pneumo, a project to standardize chest radiograph interpretation of occupational lung diseases in Thailand and ASEAN countries: Challenges and future trends. ASEAN J Radiol [Internet]. 2025 [cited 2026 Jan 31];26:56-76. Available from: https://www.asean-journal-radiology.org/index.php/ajr/article/view/942

7. Vañó E, Miller DL, Martin CJ, Rehani MM, Kang K, Rosenstein M, et al. ICRP Publication 135: Diagnostic Reference Levels in Medical Imaging. Ann ICRP 2017;46:1–144. doi: 10.1177/0146645317717209.

8. Kalra MK, Sodickson AD, Mayo-Smith WW. CT radiation: key concepts for gentle and wise use. Radiographics 2015;35:1706–21. doi: 10.1148/rg.2015150118.

9. Tanomkiat W, Suwatanapongched T, Euathrongchit J, Srisuwan T. HRCT protocol for ILD: Version 1/2019. 2019 [cited 2026 Jan 31]. Available from: https://www.radiologythailand.org/wp-content/uploads/2024/10/HRCT-Protocol-for-ILD-Version.1-2019.pdf

10. Johnson SR, Bernstein EJ, Bolster MB, Chung JH, Danoff SK, George MD, et al. 2023 American College of Rheumatology (ACR)/American College of Chest Physicians (CHEST) Guideline for the treatment of interstitial lung disease in people with systemic autoimmune rheumatic diseases. Arthritis Care Res (Hoboken) 2024;76:1051-69. doi: 10.1002/acr.25348.

11. Antoniou KM, Distler O, Gheorghiu AM, Moor CC, Vikse J, Bizymi N, et al. ERS/EULAR clinical practice guidelines for connective tissue disease-associated interstitial lung disease developed by the task force for connective tissue disease-associated interstitial lung disease of the European Respiratory Society (ERS) and the European Alliance of Associations for Rheumatology (EULAR) Endorsed by the European Reference Network on rare respiratory diseases (ERN-LUNG). Ann Rheum Dis 2026; 85:22-60. doi: 10.1016/j.ard.2025.08.021.

12. Cereser L, Marchesini F, Di Poi E, Quartuccio L, Zabotti A, Zuiani C, et al. Structured report improves radiology residents' performance in reporting chest high-resolution computed tomography: a study in patients with connective tissue disease. Diagn Interv Radiol 2022;28:569-75. doi: 10.5152/dir.2022.21488

13. Raghu G, Collard HR, Egan JJ, Martinez FJ, Behr J, Brown KK, et al. An official ATS/ERS/JRS/ALAT statement: idiopathic pulmonary fibrosis: evidence-based guidelines for diagnosis and management. Am J Respir Crit Care Med 2011;183:788-824. doi: 10.1164/rccm.2009-040GL.

14. Wiwatana T, Nontakorn A, Siwasak J, Asma N, Boonjing S, Geater SL. High-Resolution Computed Tomography (HRCT) disease patterns and survival times in patients with interstitial lung disease at a University Tertiary Hospital in Southern Thailand from 2006 to 2012. Asian J Med Radiol Res 2021;9:80-6. doi: dx.doi.org/10.47009/ajmrr.2021.9.2.16.

15. Raghu G, Remy-Jardin M, Myers JL, Richeldi L, Ryerson CJ, Lederer DJ, et al. Diagnosis of idiopathic pulmonary fibrosis. An official ATS/ERS/JRS/ALAT clinical practice guideline. Am J Respir Crit Care Med 2018;198:e44-e68. doi: 10.1164/rccm.201807-1255ST.

16. Sánchez RP, Fernández-Fabrellas E, Samper GJ, Montañana MLD, Vilar LN. Visual HRCT score to determine severity and prognosis of idiopathic pulmonary fibrosis. Int J Respir Pulm Med 2018;5:084. doi: 10.23937/2378-3516/1410084.

THE ASEAN JOURNAL OF RADIOLOGY
ISSN 2672-9393

Memorial

In remembrance of Emeritus Professor Makumkrong Poshyachinda, M.D.

Received 29 January 2026; accepted 30 January 2026
doi:10.46475/asean-jr.v27i1.1014

Emeritus Professor Makumkrong Poshyachinda, M.D.
1934-2026

Emeritus Professor Dr. Makumkrong Poshyachinda was a pioneering figure in Thai nuclear medicine at the Faculty of Medicine, Chulalongkorn University. She passed away on January 26, 2026, at the age of 91. Over four decades of service in nuclear medicine, she contributed to clinical excellence, workforce development, radiation safety governance, and the international visibility of Thai nuclear medicine.

Brief biography

Dr. Makumkrong graduated with an M.D. degree in 1959 (B.E. 2502) and belonged to the 9th class of Chulalongkorn medical graduates. After graduation, she began her professional career in the Isotope Unit—an early service that later evolved into today's Nuclear Medicine Unit and ultimately the Division of Nuclear Medicine.

She is widely recognized as one of the early pioneers who established and advanced nuclear medicine within the Faculty of Medicine, Chulalongkorn University, working closely with Associate Professor Dr. Wichai Poshyachinda during the formative years of the field. Through sustained effort, she helped build the division's reputation to a level recognized nationally and internationally.

A hallmark of her leadership was strengthening international collaboration—especially with the International Atomic Energy Agency (IAEA). She helped position the Chulalongkorn nuclear medicine program as a trusted partner for training, capacity building, and research support, including equipment assistance, expert missions, research funding, and recurring hands-on training activities. The program also regularly hosted IAEA fellows and trainees, reflecting the confidence placed in the division she helped develop.

Dr. Makumkrong's administrative service was extensive and influential. She served as Head of the Nuclear Medicine Division (1979–1986), Vice Dean for Research (1985–1988), and Head of the Department of Radiology (1986–1990). She chaired the Faculty committee overseeing radioactive materials use (1981–1984) and led national specialist training and board-examination activities in nuclear medicine under the Medical Council of Thailand (1989–2001). She also served on national committees related to atomic energy in medicine and nuclear-facility safety. In professional societies, she held senior leadership roles, including Vice President of the Radiological Society of Thailand and President of the Nuclear Medicine Society of Thailand.

In recognition of her contributions, she received the "Distinguished Nuclear Professional" honor (นักนิวเคลียร์ดีเด่น) in 1996 (B.E. 2539) from Thailand's Office of Atoms for Peace.

Even after retirement, she continued to serve as a special lecturer at the Faculty of Medicine, Chulalongkorn University, and as a special physician at King Chulalongkorn Memorial Hospital, while also acting as a consulting physician at the National Cancer Institute. Colleagues recall that she remained a steady advisor to departmental leadership, continued teaching medical students and residents, and sustained clinical service—particularly for thyroid patients—well beyond formal retirement. Her forward-looking vision also helped secure Thailand's first bone densitometer for teaching and patient care.

In addition, she authored the Thai-language textbook "การตรวจรักษาโรคของต่อมไทรอยด์ด้วยสารกัมมันตรังสี" (Diagnosis and Treatment of Thyroid Diseases with Radioactive Tracers), reflecting her enduring commitment to structured education and knowledge transfer in nuclear medicine.

ISSN 2672-9393

Thai-language textbook "การตรวจรักษาโรคของต่อมไทรอยด์ด้วยสารกัมมันตรังสี" (Diagnosis and Treatment of Thyroid Diseases with Radioactive Tracers)

Words of remembrance

To her colleagues, Dr. Makumkrong is remembered as an architect of systems: she built services, strengthened governance, and created pathways for trainees to become confident specialists. Her career combined academic rigor with an uncommon willingness to assume responsibility.

To her trainees, she represented consistency and high standards. She taught not only by instruction, but also by example: the discipline of clinical decision-making, the seriousness of radiation safety, and the importance of serving patients with steadiness and competence. Even after retirement, her continued presence in teaching and thyroid care conveyed a simple message—that medicine is a lifelong duty rather than merely a job description.

Her legacy is visible in the national structures she helped shape for nuclear medicine training and professional governance, and in the generations of clinicians and technologists who learned under the standards she set. With gratitude and respect, we remember Emeritus Professor Dr. Makumkrong Poshyachinda for a life dedicated to patients, education, and the advancement of nuclear medicine in Thailand.

Supatporn Tepmongkol, M.D.
Professor and Head, Nuclear Medicine Division,
Department of Radiology,
Faculty of Medicine, Chulalongkorn University

ISSN 2672-9393

Acknowledgement of Reviewers

Reviewer acknowledgement, 2025

Wiwatana Tanomkiat, M.D.
Editor-in-Chief
The ASEAN Journal of Radiology

The editor-in-chief of The ASEAN Journal of Radiology would like to thank all our reviewers who have contributed to the journal during the period from January 2024 through December 2024.

Reviewers

1. Anchalee Churojana, M.D.	Siriraj Hospital, Mahidol University, Thailand
2. Arintaya Phrommintikul, M.D.	Chiang Mai University, Thailand
3. Arthur Edward Brown, M.D.	Mahidol University, Thailand
4. Ausanai Prapan, Ph.D.	Naresuan University, Thailand
5. Chanon Ngamsombat, M.D	Siriraj Hospital, Mahidol University, Thailand
6. Chayanin Nitiwarangkul, M.D.	Ramathibodi Hospital Mahidol University, Thailand
7. Chitkasaem Suwanrath, M.D.	Prince of Songkla University, Thailand
8. Cholatip Wiratkapun, M.D.	Ramathibodi Hospital Mahidol University, Thailand
9. Dinesh Chinchure, M.D.	Khoo Teck Puat Hospital, Singapore
10. Dittapong Songsaeng, M.D.	Siriraj Hospital, Mahidol University, Thailand
11. Evelyn Lai Ming Ho, M.D.	ParkCity Medical Centre, Malaysia
12. Ittichai Sakarunchai, M.D	King Taksin Memorial Hospital, Thailand
13. Jenjeera Prueksadee, M.D.	Chulalonglorn University, Thailand
14. Jitladda Wasinrat, M.D.	Siriraj Hospital, Mahidol University, Thailand
15. Jitpreedee Sungsiri, M.D.	Prince of Songkla University, Thailand
16. Juntima Euathrongchit, M.D.	Chiang Mai University, Thailand
17. Kamonwon Cattapan, M.D.	Prince of Songkla University, Thailand
18. Karen Law, B.A.	Hongkong College of Radiologists, China
19. Keerati Hongsakul, M.D.	Prince of Songkla University, Thailand
20. Kitiwat Khamwan, Ph.D	Chulalonglorn University, Thailand
21. Krisna Dissaneevate, M.D.	Rajavithi Hospital, Thailand

22. Linda Brown, M.D.	Bumrungrad International Hospital, Thailand
23. Monchai Phonlakrai, M.D.	Chulabhorn Royal Academy, Thailand
24. Nakarin Inmutto, M.D.	Chiang Mai University, Thailand
25. Nantaka Kiranantawat, M.D.	Prince of Songkla University, Thailand
26. Napapong Pongnapang	Mahidol University, Thailand
27. Narongpon Dumavibhat, M.D.	Siriraj Hospital, Mahidol University, Thailand
28. Narumol Chaosuwannakit, M.D.	Khon Kaen University, Thailand
29. Natee Ina, Ph.D.	Prince of Songkla University, Thailand
30. Natthicha Chainarong, M.D.	Prince of Songkla University, Thailand
31. Nichanan Ruangwattanapaisarn, M.D.	Ramathibodi Hospital Mahidol University, Thailand
32. Niketa Chotai, M.D.	Tan Tock Seng Hospital, Singapore
33. Norlisah Binti Mohd Ramli, M.D.	University Malaya, Malaysia
34. Nucharin Supakul, M.D.	Indiana University School of Medicine, USA
35. Nutcha Pinchareun, M.D.	Chulalonglorn University, Thailand
36. Nuttaya Pattamapaspong, M.D.	Chiang Mai University, Thailand
37. Nuttha Sanghan, M.D.	Prince of Songkla University, Thailand
38. Palanan Siriwanarangsun, M.D.	Siriraj Hospital, Mahidol University, Thailand
39. Panaya Tumsatan, M.D.	Khon Kaen University, Thailand
40. Panjai Choochuen, M.D.	Prince of Songkla University, Thailand
41. Pattarawit Withayasuk, M.D.	Siriraj Hospital, Mahidol University, Thailand
42. Pattira Boonsri, M.D.	Prince of Songkla University, Thailand
43. Payia Chadbunchachai, M.D.	Khon Kaen University, Thailand
44. Payothorn Decharin, M.D.	Chulabhorn Hospital, Thailand
45. Phakphoom Thiravit, M.D.	Siriraj Hospital, Mahidol University, Thailand
46. Piyakan Pathanasethpong, M.D.	Khonkaen University, Thailand
47. Rathachai Kaewlai, M.D.	Siriraj Hospital, Mahidol University, Thailand
48. Rujimas Khumtong, M.D.	Prince of Songkla University, Thailand
49. Shanigarn Thiravit, M.D.	Siriraj Hospital, Mahidol University, Thailand
50. Sornsupha Limchareon, M.D.	Burapha University, Thailand
51. Supawitoo Sookpeng, Ph.D.	Naresuan University, Thailand
52. Supika Kritsaneepaiboon, M.D.	Prince of Songkla University, Thailand
53. Surachate Siripongsakun, M.D.	Chulabhorn Royal Academy, Thailand
54. Surasit Akkakrisee, M.D.	Prince of Songkla University, Thailand
55. Suwimon Wonglaksanapimon, M.D.	Siriraj Hospital, Mahidol University, Thailand
56. Tanop Srisuwan, M.D.	Chiang Mai University, Thailand
57. Teeranan Laohawiriyakamol, M.D.	Prince of Songkla University, Thailand
58. Teeravut Tubtawee, M.D.	Prince of Songkla University, Thailand

ASEAN

This journal provide 4 areas of editorial services: language editing, statistical editing, content editing, and complete reference-citation check in 8 steps:

Step	Services to authors	Services providers
I	Manuscript submitted	Editor
II	Language editing/ A reference-citation check	Language consultant/Bibliographer
III	First revision to ensure that all information remains correct after language editing	Editor
IV	Statistical editing	Statistical consultant
V	Content editing*	Three reviewers
VI	Second revision	Editor
VII	Manuscript accepted/ rejected	Editor/Editorial board
VIII	Manuscript published	Editorial office

*Content editing follows a double-blind reviewing procedure

JOURNAL OF RADIOLOGY