

Original

## Current Status of Respiratory Nuclear Medicine in Asian Countries — A Questionnaire Survey Study —

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### Abstract

**Background and Aim:** Developments in computed tomography pulmonary angiography (CTPA) and magnetic resonance imaging (MRI) have decreased the number of pulmonary scintigraphy procedures. Our objective was to evaluate the current status of respiratory nuclear medicine (NM) in Asian countries.

**Methods:** A questionnaire survey was conducted on eleven Asian graduate students studying NM in Japan and thirteen Japanese NM specialists. Ten questions were asked on a printed questionnaire.

**Results:** Japanese NM specialists preferred a combination of CTPA and ventilation-perfusion scintigraphy (V/P scan), while Asian graduate students chose CTPA only. However, few Japanese NM specialists and Asian graduate students responded that V/P scan was routinely performed. Kr-81m was used for V/P scans by ten Japanese NM specialists, meanwhile, Tc-99m-diethylenetriaminepentaacetic acid (DTPA) was used in seven Asian graduate students' countries. All Japanese NM specialists performed V/P scans on pediatric patients, but only one Asian graduate student did pediatric V/P scans.

**Conclusions:** Few Asian countries performed V/P scans routinely, even though they believed that it was useful in patients suspected of pulmonary embolism (PE). The unavailability, high cost, and lack of knowledge of clinicians might be limiting the popularity of V/P scans.

### Article Information

**Key words:**

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### Introduction

The incidence and prevalence of pulmonary embolism (PE) in Japan and other Asian countries are comparatively low. However, the number of patients diagnosed with PE has increased in recent years.<sup>1,2</sup> The traditional modality for the diagnosis of patients with suspected PE has been the ventilation/perfusion (V/P) scan, which is a combination of ventilation scan and perfusion scan. This examination has high sensitivity in detecting embolic disease.<sup>3</sup> However, a major drawback of this and all nuclear medicine (NM) techniques is the necessity of special equipment, such as single-photon emission computed tomography (SPECT) and radiopharmaceutical use. This, and the emergence of multi-detector CT pulmonary angiography (CTPA)<sup>4</sup> and magnetic resonance imaging (MRI) have led to the value of V/P scan being challenged.<sup>5,6</sup>

The number of NM centers in developing Asian countries is still limited, while they are widely available in developed Asian countries. There are also regional differences in content, structure, and length of NM training and education programs. There is apparently a need for continuing educational meetings among Asian countries to decrease this disparity of knowledge.<sup>7</sup>

The objective of this questionnaire survey study was to evaluate the current status of respiratory NM in Asian countries, including Japan. We also hoped to

devise measures to develop respiratory NM in Asian countries.

## Methods

### Participants

A questionnaire survey was conducted on eleven non-Japanese Asian graduate students in the Department of Diagnostic Radiology and Nuclear Medicine of Gunma University Asian Nuclear Medicine Graduate (ANMEG) Program. The Asian graduate students came from the Republic of China, Indonesia, Mongolia, Nepal, and Vietnam, and consisted of eight medical doctors and three radiologic technologists. The same survey was also conducted on thirteen Japanese NM specialists consisting of eleven NM physicians and two NM technologists. The institutional review board of our institution approved this study, and all participants gave their informed consent.

### Survey and Analysis

Ten questions were printed on a questionnaire sheet, including seven “yes-no” questions and three multiple-choice questions (Table 1). After the partici-

pants answered all questions, the survey sheets were submitted to one author (S.K.) and further analyzed. The results were presented in number of participants. No statistical analysis was performed because of the small number of participants.

## Results

Nine of the eleven Asian graduate students and all thirteen Japanese NM specialists knew of the V/P scan. Eight of the Japanese NM specialists preferred the V/P scan to CTPA, but only two of the Asian graduate students choose the V/P scan. Only five Japanese NM specialists and four Asian graduate students responded that the V/P scan was routinely performed, although 22 of all 24 participants thought that V/P scan was necessary and useful in patients suspected of having PE.

All but three Japanese specialists believed that a V/P scan alone or a combination of a V/P scan and CTPA was the most reliable study for patients suspected of PE. Meanwhile, the Asian graduate students' choice of most reliable study for patients suspected of PE was evenly divided between CTPA and V/P scans.

**Table 1** Questionnaire and results.

No.	Questions	Answers	Asian graduate students (n=11)	Japanese NM specialists (n=13)
Q 1	Do you know V/P scan?	Yes	9	13
		No	2	0
Q 2	What is the study of choice in patients suspected of having pulmonary embolism in your country?	V/P scan	2	8
		CTPA	9	11
		CR	1	3
		DSA	0	0
		Others	1	0
Q 3	Do you agree with the strategy of the examinations in patients suspected of having pulmonary embolism in your country?	Yes	9	13
		No	1	0
		Unknown	1	0
Q 4	What kind of technique is used in ventilation scan in your country?	Xe-133 gas	3	4
		Kr-81m gas	0	10
		Technegas (TG)	3	5
		Tc-99m-DTPA	7	0
		Others/not available	1	0
Q 5	Is ventilation scan routinely performed in patients suspected of having pulmonary embolism in your country?	Yes	4	5
		No	5	8
		Unknown	1	0
		Not available	1	0
Q 6	Is ventilation scan necessary and useful in patients suspected of having pulmonary embolism?	Yes	11	11
		No	0	2
Q 7	What do you think is the most reliable study in patients suspected of having pulmonary embolism?	V/P scan	5	8
		CTPA	5	3
		V/P scan+CTPA	0	2
		CR	0	0
		DSA	1	0
		Others	0	0
Q 8	Is Tc-99m MAA perfusion SPECT or SPECT/CT performed in your country?	Yes	11	13
		No	0	0
Q 9	Does your country have a plan of introducing SPECT or SPECT/CT?	Yes	10	13
		No	1	0
Q 10	Is pulmonary scintigraphy performed in pediatric patients in your country?	Yes	1	13
		No	9	0
		Unknown	1	0

V/P scan: ventilation-perfusion scan, CTPA: computed tomography pulmonary angiography, CR: computed radiography, DSA: digital subtraction angiography

Kr-81m was the most commonly used tracer in ventilation scans in Japan, although seven of eleven Asian graduate students choose Tc-99m-DTPA, followed by Xe-133 gas and Technegas® (TG) (Cyclomedica Australia Pty Ltd, Kingsgrove NSW, Australia). All participants employed Tc-99m-macroaggregated albumin (MAA) for perfusion scans in their countries.

Only one of thirteen Asian graduate students responded that V/P scan was employed for pediatric patients. All Japanese NM specialists responded that V/P scans were performed on pediatric patients.

## Discussions

Although nearly all participants thought that both CTPA and V/P scans were potentially necessary and useful in patients suspected of having PE, the V/P scan was not a common choice for Asian graduate students. The reason for this difference may be that CTPA is more widely available than V/P scans in developing Asian countries. The number of SPECT scanners in developing Asian countries is still limited. This keeps the cost of NM examinations, including V/P scans, high. Improved distribution and availability of SPECT or SPECT/CT scanners will probably change diagnostic strategies in patients suspected of having PE.<sup>7</sup>

Kr-81m gas is the most common radio-aerosol used by Japanese NM specialists for ventilation scans, followed with TG and Xe-133 gas. Ventilation scans using Kr-81m gas and Xe-133 gas are reimbursed by Japanese health insurance, but Kr-81m gas is preferred for its higher availability, diagnostic capability, and lower cost.<sup>8</sup> Most Asian graduate students prefer Tc-99m DTPA for their ventilation scans. Although Tc-99m DTPA shows better diagnostic performance in PE detection than both Kr-81m and Xe-133,<sup>9,10</sup> Tc-99m DTPA is difficult to use in patients with ventilation disorders because of its inhomogeneous distribution, which can lead to misdiagnosis. Recently, TG appears to be the radio-aerosol of choice for ventilation scans, particularly in patients with ventilation disorders. TG is more homogeneously distributed in the lungs and has less focal deposition in airways. However, TG is less desirable in Asian countries due to cost and the limited availability of TG generators lead to. In the absence of TG, V/P scans using SPECT techniques with Tc-99m DTPA are recommended.<sup>11,12</sup> All participants used Tc-99m MAA for perfusion scans in their countries. Tc-99m MAA is the tracer of choice for lung perfusion scans and recommended in Europe and the USA.<sup>13,14</sup>

The shift from V/P scan to CTPA for patients suspected of PE is widely known. This is because CTPA is more widely available and has higher sensitivity, although the trend toward CTPA apparently has not lead to a decline in mortality rate.<sup>3</sup> In a patient with contrast material contraindication prohibiting CTPA, a V/P scan should be considered an acceptable alternative. Mismatch is not the only finding in V/P scans. Data quantification enables diagnosis of perfusion defects and pulmonary right-to-left shunts.<sup>14</sup>

In Asian countries, V/P scans in pediatric patients are rare, while they are widely used in Japan. Many clinicians, radiologists, and NM physicians are highly concerned about radiation exposure from V/P scans on pediatric patients (or to the fetus in pregnant women); in fact, the radiation dose of adult CTPA is greater, especially to female breast tissue. CTPA with non-optimized technology is associated with a nearly sevenfold higher radiation dose than V/P scans<sup>15,16</sup>. Lack of knowledge on the part of clinicians about radiation dose of the two studies may also limit V/P scan utilization in PE diagnosis. Training and education are required to improve knowledge on radiation exposure.

The small number of participants of this questionnaire survey study is a limitation. China is considered a developed country in Asia, especially in the field of NM; however, Chinese students were included in the Asian graduate student group. An additional, large-scale questionnaire survey study including more countries is needed to depict the status of respiratory NM in Asian countries in detail.

## Conclusions

Few Asian countries performed V/P scan routinely, even though the Asian graduate students believed that it was useful in patients suspected of PE. The unavailability, high cost, and lack of knowledge of referring clinicians may be the reason of the limited popularity of V/P scans for PE diagnosis in these countries. We suspect that V/P scans using SPECT in developing Asian countries will become more widely available as SPECT/CT scanners become more common.

## Disclosure

The authors declare that they have no conflict of interest.

## Abbreviations

PE: pulmonary embolism; CTPA: computed tomography pulmonary angiography; V/Q: ventilation-perfusion; ANMEG: Asian nuclear medicine graduate program; SPECT: single photon emission computed tomography; DTPA: diethylenetriaminepentaacetic acid; MAA: macroaggregated albumin; MDCT: multi-detector CT.

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