

## CURRENT MINISTRY APPROVAL OF CARDIAC PET &amp; SPECT IN JAPAN

## Current Japanese Ministry of Health, Labor, and Welfare Approval of Cardiac Single Photon Emission Computed Tomography

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Received: May 7, 2015/Revised manuscript received: May 20, 2015/Accepted: May 26, 2015

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### Abstract

The current Japanese Ministry of Health, Labor, and Welfare (JMHLW) approvals of cardiac single photon emission computed tomography (SPECT) include myocardial perfusion, cardiac function, sympathetic nervous activity and fatty metabolism imaging.  $^{99m}\text{Tc}$ -pyrophosphate (PYP),  $^{201}\text{Tl}$ ,  $^{99m}\text{Tc}$ -sestamibi,  $^{99m}\text{Tc}$ -tetrofosmin,  $^{123}\text{I}$ -metaiodobenzylguanidine (MIBG) and  $^{123}\text{I}$ -beta-methyl-p-iodophenylpentadecanoic acid (BMIPP) are widely used with a uniform delivery system in Japan. The numbers of myocardial perfusion scan are decreasing but myocardial sympathetic nerve imaging using  $^{123}\text{I}$ -MIBG is increasing.

**Keywords:** Approval • Japanese Ministry of Health, Labor, and Welfare • myocardial perfusion imaging • single photon emission computed tomography

*Ann Nucl Cardiol* 2015 ; 1 (1) : 108-109

**J**apanese Ministry of Health, Labor, and Welfare (JMHLW) initially approved  $^{99m}\text{Tc}$ -PYP in 1979 for the diagnosis of myocardial infarction. This agent accumulates infarcted myocardium with calcium deposition in necrotic myocardium.  $^{201}\text{Tl}$  (Thallium ( $^{201}\text{Tl}$ )) was permitted in 1987. Actually,  $^{201}\text{Tl}$  as an analog of potassium is the most frequently used myocardial perfusion agent in Japan. Single injection in stress-rest protocol with a manpower shortage and its redistributing features which mean myocardial viability would be the major reasons.  $^{123}\text{I}$ -MIBG was approved prior to Europe and the United States in 1992.  $^{123}\text{I}$ -MIBG is recognized as an analog of norepinephrine. Therefore,  $^{123}\text{I}$ -MIBG reflects sympathetic nerve activity which would be activated in patients with heart failure. Mainly using the planer imaging, heart/mediastinum ratio (H/M ratio) and washout rate of  $^{123}\text{I}$ -MIBG are calculated.  $^{123}\text{I}$ -BMIPP is a tracer of myocardial fatty acid metabolism and was approved in 1993. Uptake of

$^{123}\text{I}$ -BMIPP is decreased in ischemic condition which reflects metabolic shift from fatty acid to anaerobic glycolysis. The differences of photo-energy spectrum between  $^{123}\text{I}$  (159KeV) and  $^{201}\text{Tl}$  (69-80KeV) allows the simultaneous acquisition of fatty acid metabolism and myocardial perfusion. The discordance of those agents is called as a mismatch between metabolism and perfusion.  $^{99m}\text{Tc}$  Hexakis (2-Methoxy-Isobutyl Isonitrite: MIBI) and  $^{99m}\text{Tc}$  tetrofosmin were approved in 1993 and 1994, respectively. Both tracers depict myocardial perfusion in the detection of coronary artery disease, but basically do not show redistribution into the myocardium. Recently, a syringe type of  $^{99m}\text{Tc}$  agent is more popular than  $^{99m}\text{Tc}$  generator derived agent. JMHLW also approves the assessment of cardiac function which obtained by  $^{99m}\text{Tc}$  first-pass method. However, the most studies are electrocardiogram (ECG)-gated myocardial perfusion SPECT using ECG-gated SPECT software. Summary of these agents is depicted in Table 1.

doi : 10.17996/ANC. 01. 01. 108

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**Table 1** JMHLW approval of SPECT agents in clinical nuclear cardiology

Agents	Date of approval	Indication
Technetium ( $^{99m}\text{Tc}$ )-pyrophosphate	April, 1979	Diagnosis of heart disease
$^{201}\text{Tl}$	October, 1987	Diagnosis of heart disease
$^{123}\text{I}$ -metaiodobenzylguanidine (MIBG)	November, 1992	Diagnosis of heart disease
$^{123}\text{I}$ -beta-methyl-p-iodophenylpentadecanoic acid (BMIPP)	March, 1993	Diagnosis of heart disease
Technetium ( $^{99m}\text{Tc}$ )-Hexakis (2-Methoxy-Isobutyl Isonitrile: MIBI)	May 21, 1993	Diagnosis of heart disease, Cardiac function by first-pass method
Technetium ( $^{99m}\text{Tc}$ )-tetrofosmin	April, 1994	Diagnosis of heart disease, Cardiac function by first-pass method

### Cardiac SPECT practice in Japan

According to the Japanese Isotope Association's a survey of nuclear medicine practice in 2012, about 19% of decrease in single-photon tracer examination was noted in comparison to that in 2007. Cardiovascular scintigraphy was a second leading examination (29.4%, 26,813 cases/month) within the country. The order of myocardial scintigraphy study numbers in 2012 was as follows,  $^{201}\text{Tl}$ ; 14,250,  $^{99m}\text{Tc}$ -tetrofosmin; 5,321,  $^{123}\text{I}$ -MIBG; 3,502,  $^{99m}\text{Tc}$ -sestamibi; 1,986, and  $^{123}\text{I}$ -BMIPP 1,764/month, respectively (1). The numbers of myocardial scan are showing a tendency to decrease using  $^{201}\text{Tl}$ ,  $^{99m}\text{Tc}$ -tetrofosmin,  $^{99m}\text{Tc}$ -sestamibi and  $^{123}\text{I}$ -BMIPP. However, the numbers of  $^{123}\text{I}$ -MIBG increased during the past decade.

### Japanese Circulation Society guidelines for Cardiac SPECT

The current guidelines of nuclear cardiology in Japanese Circulation Society (JCS) addressed the clinical indication of SPECT. Myocardial perfusion agents ( $^{201}\text{Tl}$ ,  $^{99m}\text{Tc}$ -tetrofosmin,  $^{99m}\text{Tc}$ -sestamibi) are class I or IIa indication for the diagnosis of myocardial ischemia, infarction, viability, chest pain, prognosis, risk stratification and therapeutic evaluation (2).  $^{123}\text{I}$ -MIBG is useful (class I, IIa) for the evaluation of severity, prognosis and therapy of heart failure. The indications of  $^{123}\text{I}$ -BMIPP are as follows, diagnosis of unstable angina (class I) and vasospastic angina (class IIa). Radionuclide angiography is categorized class I for the assessment of left ventricular function, class IIa for right ventricular function, class I for the observation of cardiac function with the agent of cardiac toxicity and diagnosis of ischemic heart disease.

### Future directions

The guideline on myocardial revascularization by European Society of Cardiology recommends the quantification of stress induced ischemia for the coronary revascularization (3). Actually, >10 % of left ventricular ischemia is required for the improvement of prognosis and symptom. This recommendation would be spread widely in terms of limited health care resources.

### Acknowledgments

Authors thank to Ms. Fumie Anzai for her assistance.

### Sources of Funding

None

### Conflicts of Interest

None

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