

REVIEW ARTICLE—INTRODUCING THE JSNC TECHNICAL AWARD

¹²³I-Metaiodobenzylguanidine SPECT and Myocardial Perfusion Mismatch in Pediatric Patients with Congenital Heart Disease: Comparison with Simultaneous ^{99m}Tc-Sestamibi SPECT Image and Phase Analysis

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Abstract

The Japanese Society of Nuclear Cardiology (JSNC) has given out its Technical Award for outstanding technologists since 2012 to promote nuclear cardiology research. Mieko Ota, RT, MHSc won the 6th JSNC Technical Award. The issue of “Shinzo Kaku Igaku” (Japanese Journal of Nuclear Cardiology) contains her original award-winning article. She and her colleagues aimed to assess the differences between ¹²³I-metaiodobenzylguanidine (MIBG)-SPECT scan accumulation patterns and ^{99m}Tc-sestamibi (MIBI)-SPECT scan images with phase analysis observed in pediatric patients with congenital heart disease (CHD). Her results showed that decreased cardiac MIBG uptake reflected sympathetic denervation secondary to CHD operative procedures in patients with CHD who exhibited a mismatch in uptake between the MIBG and MIBI. In cases with normal perfusion and abnormal MIBG, it was shown that her group should consider the possibility of underlying CHD and its associated procedures in adult CHD patients.

Keywords: CHD, Denervation, MIBG, MIBI, Mismatch, Pediatric patient, Technical award

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The Japanese Society of Nuclear Cardiology (JSNC) has given Technical Awards for outstanding technologists since 2012 to promote nuclear cardiology research conducted by them. Candidates are selected among the participants submitting abstracts to the section of the technical presentation in the annual meeting of JSNC. The selection committee determines the best work considering the quality of the work itself and presentation in the meeting, and expected performances toward the future. There were 3 candidates of the prize in 2017. Shota Nakama, RT introduced the phantom study that applied the super-resolution method for improvement of the cardiac function index using ECG gated myocardial SPECT, and Souichiro Kashiwaya, RT tried image standardization for the myocardial SPECT with 2 isotopes simultaneous acquisition using the new EMIT (the evaluation system of myocardial image based on technical grounds)

phantom. Both candidates were very interesting research topics, but, as a result of discussion, Mieko Ota, RT, MHSc finally won the 6th JSNC Technical Award through a strict review. The winner of the prize is recommended to submit a review article or an original paper depending on whether the work has been published or not. Her original article related to her group work winning the prize appeared in the issue of “Shinzo Kaku Igaku” (Japanese Journal of Nuclear Cardiology) and follows hereafter in English (1).

Topics from JSNC Technical Award

Therapeutic outcomes for congenital heart disease (CHD) are improving and the number of patients who reach adulthood is increasing. Patients with adult congenital heart disease (ACHD) are increasing by approximately 10,000 people annually and are already estimated to number close to 500,000

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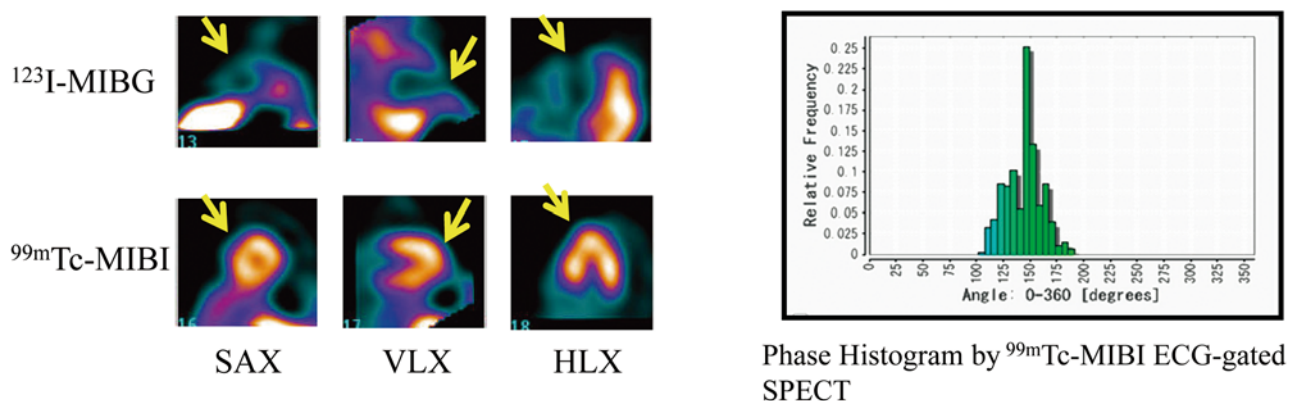


Fig. 1 Mismatch group: ^{123}I -MIBG SPECT image, $^{99\text{m}}\text{Tc}$ -MIBI SPECT image and Phase Histogram of a 6-month-old boy with TGA post Jatene operation (15-days-old) and post CABG (from LITA to LAD #7) (4-months-old).

^{123}I -MIBG SPECT image detects denervation in the apical region (arrowhead; left upper panel).

$^{99\text{m}}\text{Tc}$ -MIBI SPECT image demonstrates normal perfusion (left lower panel), $^{99\text{m}}\text{Tc}$ -MIBI ECG-gated myocardial SPECT demonstrates no dyssynchrony (PhaseSD 16.4 [degree] Bandwidth 63 [degree]) using cardioREPO (right panel).

TGA: Transposition of the great arteries

LITA: Left internal thoracic artery

LAD: Left anterior descending artery

CABG: coronary artery bypass grafting

(2). Alongside a prolonged survival period, ACHD patients are believed to have problems associated with inherent heart malformation, as well as ischemic heart disease and heart failure of other causes. Opportunities to encounter CHD in adults appear to have increased despite CHD previously only being encountered in childhood. However, little nuclear medicine data exists on ACHD patients and reports of nuclear medicine imaging data including that on CHD present since childhood are extremely scarce despite the importance of such data in diagnosis.

In the present study, Ota et al. examined patient characteristics for mismatches between ^{123}I -metaiodobenzylguanidine (MIBG) and $^{99\text{m}}\text{Tc}$ -sestamibi (MIBI) uptake based on phase analysis values and uptake distributions on MIBG myocardial single-photon emission computed tomography (MIBG-SPECT) and simultaneous MIBI electrocardiography-gated myocardial SPECT (MIBI-Gated SPECT) in 15 consecutive patients with pediatric heart disease.

Their examination revealed no association between phase analysis values and the presence or absence of MIBG uptake, but did show elevated values in patients with the absence of MIBI. Three patients showed mismatch of MIBG and MIBI uptakes and all had previously undergone surgery for CHD. Denervation findings of reduced MIBG uptake, likely caused by surgical operations to separate the aortic root and periphery of the superior vena cava, were seen in all three of these patients, but myocardial perfusion and phases were maintained, suggesting that MIBG and MIBI findings were unrelated to each other. A patient who underwent the Jatene

procedure with complete transposition of the great vessels is presented in Fig. 1.

Post-surgical CHD patients sometimes present with residual heart failure after surgery, making the evaluation of cardiac autonomic nervous activity important. The cardiac autonomic nerves form a nerve plexus around the great vessels and are distributed within the proper myocardium along the coronary artery (3). According to one report, MIBG uptake findings on myocardial sympathetic scintigraphy exhibit a consistent pattern of absence of denervation findings from the inferior wall to the septum of the left ventricle due to surgical operations around the great vessels in pediatric CHD patients following right ventricular outflow tract reconstruction (4). Furthermore, in adult heart transplant patients, myocardial perfusion distribution is normal but MIBG uptake is reduced in areas other than the basal anterior wall of the left ventricle (5). By contrast, few papers have reported on the characteristics of MIBG uptake on myocardial sympathetic scintigraphy in pediatric heart transplant patients. Even in the present study, the patients who showed a mismatch between MIBG and MIBI uptakes exhibited the same trend in denervation findings after surgery for CHD and had maintained myocardial perfusion.

In patients with pediatric heart disease, including CHD, the exact pathology and surgical procedure influence the sympathetic nerves, perfusion and phase analysis values, thereby exhibiting a host of variations. Regardless of the type of cardiac nuclear medical examination, such examinations are necessary for the evaluation of pediatric heart disease and could also be useful in diagnoses once patients reach

adulthood.

Conclusions

The 6th JSNC Technical Award was won by Mieko Ota, RT, MHSc. Her original article appeared in the issue of “Shinzo Kaku Igaku”. The session of next technical award will be expected to provide JSNC members with information on the latest significant research topics.

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Conflicts of interest

None.

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^{123}I -Metaiodobenzylguanidine SPECT and myocardial perfusion mismatch in pediatric patients with congenital heart disease: comparison with simultaneous $^{99\text{m}}\text{Tc}$ -sestamibi SPECT image and phase analysis

Ota M et al.

Abstract

With advances in diagnostic methods, surgical and medical management, most patients with congenital heart disease (CHD) can reach adulthood. It would be expected to increase the numbers of diagnostic approaches using nuclear medicine (NM) images in patients with adulthood who have CHD. We aimed to assess the differences between ^{123}I -Metaiodobenzylguanidine (MIBG)-SPECT scan accumulation patterns and $^{99\text{m}}\text{Tc}$ -Sestamibi (MIBI)-SPECT scan images with phase analysis observed in pediatric patients with CHD. In patients with CHD who exhibited a mismatch in uptake between the MIBG and MIBI, decreased cardiac MIBG uptake was considered to reflect sympathetic denervation secondary to CHD operative procedures. However, findings of myocardial perfusion imaging and phase analysis were normal. In cases with normal perfusion and abnormal MIBG, we must consider the possibility of an underlying CHD and its associated procedures in adult CHD patients.
