INTRODUCTING JSNC TECHNICAL AWARD

A Novel Method for Measuring Heart-to-mediastinum Ratio in ^{123}I-MIBG Scintigraphy Using Image Fusion Techniques

Jun Hashimoto, MD

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Abstract

The Japanese Society of Nuclear Cardiology (JSNC) has given Technical Award for outstanding technologists since 2012 to promote nuclear cardiology research. Tomohiko Kobota won the 5th JSNC Technical Award. The February issue of "Shinzo Kaku Igaku" (Japanese Journal of Nuclear Cardiology) contains his review article related to his work wining the prize. He and his colleagues developed a method to automatically measure the heart-to-mediastinum ratio in ^{123}I-MIBG scintigraphy, which is expected to reduce the intra- and inter-observer differences of the calculated values. The major feature of this method is the use of chest X-ray data to guarantee the accuracy of the measurement even when myocardial tracer uptake is markedly reduced.
Keywords: Heart-to-mediastinum ratio, Japanese Society of Nuclear Cardiology, MIBG scintigraphy, 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 5 candidates of the prize in 2016, and Tomohiko Kobota finally won the 5th 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. His review article related to his work wining the prize appeared in the February issue of "Shinzo Kaku Igaku" (Japanese Journal of Nuclear Cardiology) (1).

Topics from JSNC technical award

In Japan, ^{123}I-MIBG myocardial scintigraphy is quite often used to assess the severity and prognosis of heart failure, and to differentiate Parkinson disease/Lewy-body diseases from other related neurological disorders. Quantification of myocardial MIBG uptake is essential in the above diagnoses. The heart-to-mediastinum ratio (HMR) is most frequently used because of its simplicity in data acquisition and processing. One of the drawbacks of this method is that the inter-observer difference of the region of interest (ROI) settings on the heart and mediastinum, which affects the reproducibility of the measurement.

To overcome this problem, smartMIBG software was developed to automatically determine the ROIs (2), and it has gain a widespread acceptance in Japan. Since the ROI setting of this software is based on the radionuclide image, the accuracy of the position of the heart ROI may be degraded when myocardial tracer uptake is low. It deserves consideration to contrive a method that provides the accurate ROI setting not depending on myocardial tracer uptake.

Tomohiko Kobota and his colleagues developed a method to automatically measure the heart-to-mediastinum ratio in ^{123}I-MIBG scintigraphy, which is expected to reduce the intra- and inter-observer differences of the calculated values, even when myocardial tracer uptake is markedly reduced. The major feature of this method is the use of chest X-ray data to generate ROIs.

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Jun Hashimoto
Department of Radiology, Tokai University School of Medicine, Shimokasuya 143, Isehara, Kanagawa 259-1193, Japan
E-mail: junhashi@tokai-u.jp

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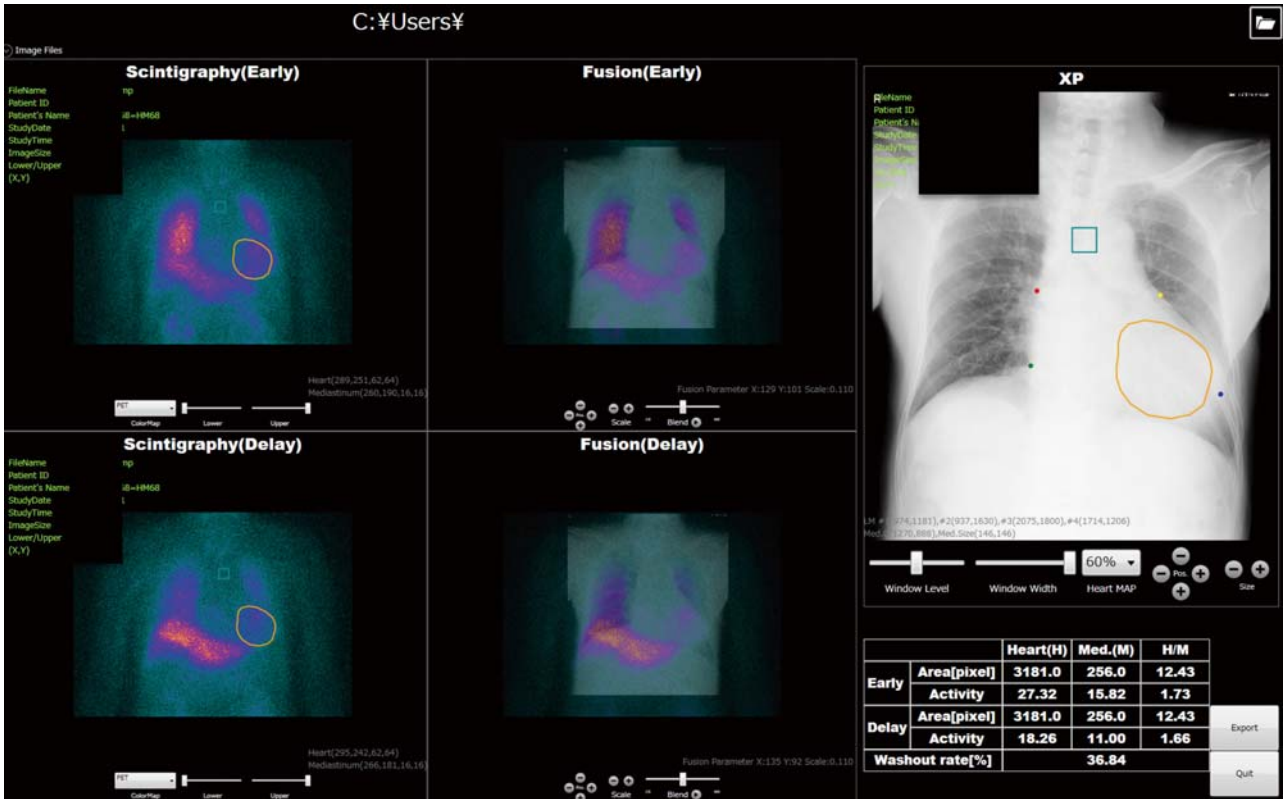

Fig. 1 Overview of Software (Cited from Shinzo Kaku Igaku 2017 with permission).
Four landmarks and determined ROIs are indicated in the right and left panels, respectively.

The overview of the software is indicated in Fig. 1. First, a database reflecting the likelihood of the presence of the myocardium is constructed as follows. The images of ^{201}Tl myocardial scintigraphy and chest X-ray (CXP) of the same patient obtained with the supine position are used. A myocardial ROI is placed on the ^{201}Tl image by an experienced technologist. The ^{201}Tl image is fused to the CXP image with a mutual information technique. On the CXP, four landmark points are automatically set as indicated in Fig. 1. Although these points are automatically determined, they can be corrected manually afterwards, if necessary. Then the quadrangle determined by the four points is non-linearly converted to a square. The ^{201}Tl image undergoes the same conversion. After completing the above process in a series of patients, a map can be obtained reflecting the likelihood of the presence of the myocardium in the square. The area in which the myocardium is expected to be present with the likelihood of 60% or more is defined as the left ventricular region (LVR). This map is used as a database to identify the myocardial contour in processing images of a *de novo* patient. In the *de novo* patient, SPECT and CXP images are automatically fused by using the mutual information technique. After determining the above four landmarks in CXP of the patient, the quadrant is converted to the square offering the LVR. The LVR is used as the heart ROI to obtain the myocardial count in the patient's planar image fused with CXP. Similarly, the mediastinal ROI is also determined on the CXP image, and the count is obtained by placing the ROI on the fused ^{201}Tl image as follows. First, three lines are drawn on the CXP image: the vertical midline, two horizontal lines passing through the apex and base of the lungs. On the midline, a point dividing the distances between the apical and basal lines into 1 : 2 is identified. The mediastinal ROI is centered on this point.

This method requires the CXP image obtained with the supine position for the accurate ROI setting, even though CXP is usually taken with the upright position. The authors are now seeking a method to convert the upright CXP data to prone one for the convenience of data analysis.

Conclusions

The 5th JSNC Technical Award was won by Tomohiko Kobota. His review article appeared in the February issue of Shinzo Kaku Igaku focusing on the development of a new algorithm for automatically calculating the HMR in ^{123}I-MIBG myocardial scintigraphy. This method is expected to allow accurate ROI settings even when myocardial tracer uptake is markedly reduced.

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Conflicts of interest

None.

Reprint requests and correspondence:
Jun Hashimoto, MD
Department of Radiology, Tokai University School of Medicine, Shimokasuya 143, Isehara, Kanagawa 259-1193, Japan
E-mail: junhashi@tokai-u.jp

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Abstract

Computerized schemes take an important role in maintaining the reproducibility of results in quantitative analysis of ^{123}I meta-iodobenzyl guanidine (^{123}I MIBG) scintigraphy. The authors studied a computerized scheme for obtaining heart-to-mediastinum ratios from scintigram data. The computerized scheme is based on image registration between chest radiograms and scintigrams. The use of registered images enables location of myocardial and mediastinum regions in scintigram because these regions are easily recognized even in case of low myocardial MIBG uptake. The registered result is utilized to reduce the variation in determined shapes for myocardial regions by manual procedure. At the 2016 Japanese Society of Nuclear Cardiology Annual Scientific Meeting, the authors, by summarizing their fundamental techniques, reported the prototype computer software, examples of measurement results using the software, and future aspects of developing such computerized schemes by clinical application of their research. An overview of the scheme is provided in this review article.