

# A case of vasospastic angina in the detection of a high signal intensity area by using balanced SSFP with inversion recovery

## Abstract

Image evaluation for vasospastic angina frequently generally utilizes nuclear medicine or cardiac magnetic resonance (CMR). T2-weighted image by CMR particularly is a non-invasive and simple evaluation method with some issues. Those issues might often be an unclear boundary area for high signal intensity, poor visualization due to myocardial saturation by arrhythmia, and difficulty in evaluation.

In the present study, we reported a case in the clear detection of a high signal intensity area compared to the existing T2-weighted image while concurrently utilizing "Inversion Recovery" and "Balanced SSFP (steady-state free precession)" as usable even with a general-purpose equipment for solving the above-mentioned issues.

**Keywords:** CMR, arrhythmia, myocardial, myocardial infarction

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## Kazue Matsumoto

Department of Radiological Technology, Shizuoka City Hospital, Japan

**Correspondence:** Kazue Matsumoto, Department of Radiological Technology, Shizuoka City Hospital, Japan, Email matsumotokazue@gmail.com

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**Abbreviations:** CMR, cardiac magnetic resonance; DM, diabetes mellitus; IHD, ischemic heart disease; VT, ventricular tachycardia; ECG, electrocardiogram; emCAG, emergency coronary angiography; STEMI, st-segment elevation myocardial infarction; CAG, coronary angiography; EF, ejection fraction; BMIPP,  $\beta$ -methyl-iodophenyl pentadecanoic Acid; ACS, acute coronary syndrome; LAD, left anterior descending coronary artery

## Introduction

It is said that vasospastic angina in Japan can be approximately 3 times higher than Europe/the US. Furthermore, it is also said that approximately 80% of angina pectoris and myocardial infarction may be related to coronary vasospasm and also would cause a sudden death. However, since it is difficult to detect vasospastic angina under the electrocardiogram change, we frequently make diagnosis by T2-weighted image using BMIPP, MIBG, CMR with use of nuclear medicine as an ischemic memory. The usage of quantitative evaluation by T1/T2 mapping has recently been increasing for myocardial evaluation by CMR other than T2-weighted image. Yet, these evaluation methods are not generally common due to the requirement of special sequence or software. Thus, we have attempted to visualize edema caused by ischemia with concurrently use of Inversion Recovery and Balanced SSFP as usable even with a general-purpose equipment.

## Case

### Male at the age of 79

**Medical history:** High blood pressure Diabetes mellitus (DM)

**No allergy, hypersensitiveness, and asthma**

**Personal history:** History of alcohol intake Daily drinker.

**History of smoking:** Currently non-smoker, but used to smoke 15 sticks/day until 20-21 years old

## Current medical history

Because the patient felt a sense of discomfort in the left chest at dawn approximately 6 months ago, he visited another clinic. Later, he had a follow-up for a certain period. On September 26 2016, after the patient felt a sense of discomfort in the chest approximately from 3:00 to 8:00 a.m., he visited another clinic. He was referred to our institution on the same date due to a suspicion of ischemic heart disease (IHD). His chest pain was disappeared around 8:00-9:00 a.m.

Because of the confirmation of increase in ST for V2-4 and ventricular tachycardia (VT) in electrocardiogram (ECG), he received emergency coronary angiography (emCAG) due to a suspicion of ST-segment elevation myocardial infarction (STEMI). <Coronary angiography (CAG)>: #1 60, #3 10, #4AV 60, #7AD 50, #9 20/70, #12 30, and ejection fraction (EF) 65.5%. In CAG, significant stenotic lesion was not found according to the electrocardiographic change. He was hospitalized and received treatment due to a suspicion of spasm. Moderate stenosis was found in coronary, but significant stenosis and obstructed site were not found. There was no increase in CK after blood collection.

However, since troponin was slightly increased, we conducted BMIPP-Tl myocardial scintigraphy (Figure 1) on the following day due to a possible ACS by plaque rupture caused by spasm or moderate stenotic lesion. As a result, it is assumed that there would be some sort of ischemic event when hypoperfusion with  $\beta$ -methyl-iodophenyl pentadecanoic acid (BMIPP) was found in the anterior wall and apex. Later, a clear high signal intensity was not found in T2-weighted image (Figure 2) after CMR, but a high signal intensity area was found in the anterior wall by the image of Balanced SSFP with Inversion Recovery. Because a negative T-wave was detected by chest lead in ECG, the event at the time would be spasm or acute coronary syndrome (ACS) event in left anterior descending coronary artery (LAD) peripheral region. Therefore, we initiated oral administration of diltiazem for spasm prevention and aspirin/statin for moderate stenotic lesion (Figure 3) (Figure 4).<sup>1,2</sup>

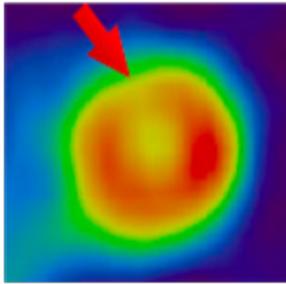


Figure 1 BMIPP.

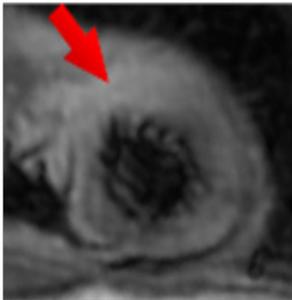


Figure 2 T2weight image.

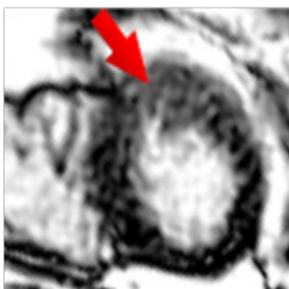


Figure 3 IR+Balanced SSFP.

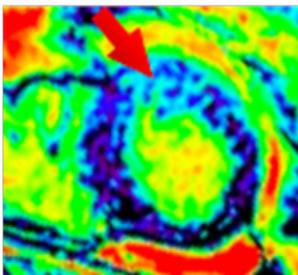


Figure 4 IR+Balanced SSFP color.

## Discussion

The sequence used this time is not a totally new method technologically. Balanced SSFP as a sequence with a capability of high-speed imaging has a high slew rate for gradient magnetic field and a high magnetic homogeneity. Compared to the MRI image equipment sold within 10years, it is considered that the imaging method proposed in the present study could satisfactorily work. Balanced SSFP has some characteristics; less artifact by movement to collect an extremely short TR/TE and a long T2 value (i.e. water) as equivalent to a high signal intensity with contrast T2/T1. In

this manner, it may possibly be similar to T2-weighted image and compensate for the shortcoming, but myocardial signal intensity could be too high if using such method as it is.<sup>3-6</sup>

The solution for the short coming is to use Inversion Recovery simultaneously and set a parameter to be a black (low signal) or null point for myocardium. Because T1 value for myocardium is approximately 1200ms, null point will be approximately 840ms ( $1200 \times 0.69$ ). In addition, as a specific setting method, data collection is also set as single shot for avoiding any influence of arrhythmia and breathing.

On the other hand, in comparison with normal myocardium, impaired myocardium would have an extended T2 value by increase in extracellular fluid compartment ( $\sim 70$ ms) and indicate a high signal intensity as similar to a normal T2-weighted image. It is considered that an extension for T2 value could be small due to an extremely mild ischemia in the present case. For this reason, it was difficult to make a visualization in T2-weighted image. The diagnostic imaging was confirmed after conducting the scintigraphy with use of BMIPP before CMR, but it is assumed that non-invasive diagnosis could have been conducted if performing a process of imaging by Balanced SSFP with Inversion Recovery.<sup>7</sup>

## Acknowledgements

None.

## Conflict of interest

Author declares that there is no conflict of interest.

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