



Letters to the Editor

Effects of isoproterenol infusion on the ST segment and r' of the QRS complex in the right precordial leads of the Brugada-type electrocardiogram pattern

I read with interest the report by Omiya et al. on the effects of isoproterenol (ISP) and propranolol on the inducibility of malignant arrhythmia in patients with Brugada syndrome [1]. I would like to call attention to my previous publications on this subject. About 20 years ago, I first reported the effects of several tests including hyperventilation, ISP, and exercise on the Brugada-type electrocardiogram (ECG) pattern in an otherwise healthy subject [2,3]. In those reports, I described the existence of early repolarization in the right precordial leads as the genesis of the Brugada-type ECG pattern. Namely, in a 67-year-old woman with the Brugada-type ECG, ISP infusion reduced the ST-T elevation and unexpectedly demonstrated a lack of late r' wave in lead V₁. Subsequent reports, including the report by Omiya et al., confirmed a similar ECG-ST segment response to ISP infusion [1,4]. Also, association between the fluctuation of the ECG-ST level and the changes in r' of QRS complex in the right precordial leads is described in patients with Brugada-type ECG [4]. Based on my previous observations [2,3,5], there are two Brugada-type ECG patterns, one due to early repolarization [2,3] and the other due to a complicating right bundle branch block [5], and the phenomena of these two types have been confirmed by other investigations of Brugada syndrome. If the occurrence of malignant arrhythmia were to be specifically associated with a different underlying genesis of the Brugada ECG pattern (i.e. early repolarization vs. right bundle branch block), endangering the patient by performing a provocation test using programmed electrical stimulation could be avoided through determining the presence or absence of r' in the right precordial leads with a safe and convenient maneuver to decrease the ST elevation [2,3]. Therefore, I am deeply interested in the following: (1) what is the incidence of each type of Brugada-ECG (early repolarization vs. right bundle branch block) during ISP infusion? and (2) were these two types associated with the inducibility of malignant ventricular tachyarrhythmia in the patients with Brugada syndrome evaluated by Omiya et al. [1]?

References

- [1] Omiya T, Shimizu A, Ueyama T, Yoshiga Y, Doi M, Hiratsuka A, Fukuda M, Yoshida M, Matsuzaki M. Effects of isoproterenol and propranolol on the inducibility and frequency of ventricular fibrillation in patients with Brugada syndrome. *J Cardiol* 2012;60:47–54.
- [2] Kataoka H. Analysis of cove-shaped ST elevation in right precordial leads by several tests. *Shinzo* 1994;26:968–71 [in Japanese].
- [3] Kataoka H. Right precordial coved ST-T segment elevation in a healthy subject evaluated by isoproterenol infusion test: a case report. *Angiology* 1994;45:409–11.
- [4] Kasanuki H, Ohnishi S, Ohtuka M, Matsuda N, Nirei T, Isogai R, Shoda M, Toyoshima Y, Hosoda S. Idiopathic ventricular fibrillation induced with vagal activity in patients without obvious heart disease. *Circulation* 1997;95:2277–85.

- [5] Kataoka H, Kanzaki K, Mikuriya Y. “Coved” shaped ST-T elevation in lead V₁: an ECG marker for right ventricular conduction defect in acute right ventricular infarction or ischemia in humans. *Jpn Circ J* 1989;53:483.

Hajime Kataoka (MD)*

Internal Medicine, Nishida Hospital, 2-266 Tsuruoka
Nishi-machi, Saiki-city, Oita 876-0047, Japan

* Tel.: +81 972 22 0180; fax: +81 972 23 3053.

E-mail address: hkata@cream.plala.or.jp

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Author's reply

Dr. Kataoka's previous proposal that there are two Brugada-type electrocardiographic (ECG) patterns, one due to early repolarization [1,2] and the other due to a complicating right bundle branch block, was interesting, and further, we are grateful that he was interested in our report by Omiya et al. [3]. He focused on the ECG changes, and that an isoproterenol (ISP) infusion reduced the ST-T elevation and unexpectedly demonstrated a lack of a late r' wave in lead V₁. Therefore, he expects that a lack of a later r' during an ISP infusion could identify the high-risk patients from patients with a Brugada type ECG.

First of all, he described those subsequent reports, including the report by Omiya et al., and confirmed a similar ECG-ST segment response to the ISP infusion. However, we need to clarify one point and that is that our study did not mention anything about the ECG-ST segment response to an ISP infusion. We confirmed the suppression of inducible ventricular fibrillation (VF) by the ISP infusion, and it inhibited the shortening of the VF cycle length over time even if VF was induced during the ISP infusion. Therefore the VF did not continue even if VF was induced during the ISP infusion. The mechanism is probably due to an improvement in the conduction delay in the right ventricular outflow tract due to the ISP infusion and/or the increased inward calcium current and attenuation of the excess outward current due to beta-adrenergic stimulation.

His two questions are interesting, but we cannot answer them directly because we were unable to review the old data before and after the ISP infusion in the subjects due to mechanical problems with our recording system. We are currently trying to fix our system. Therefore, we reviewed the recent data from 10 Brugada syndrome patients. His first question was what is the incidence of each type of Brugada-ECG (early repolarization vs. right bundle branch block) during an ISP infusion? Answer: A late r' in lead V₁ appeared before the ISP infusion in 2 patients and it still appeared after the ISP in only 1 patient. There were no patients who newly had a late r' after the ISP infusion. The ISP infusion depressed the

ST elevation in 3 patients in lead V1. His second question was, were these two types associated with the inducibility of malignant ventricular tachyarrhythmias in the patients with Brugada syndrome? Answer: VF episodes were induced in 8 patients (2 with a late r' and 6 with a lack of a late r') before the ISP infusion and VF episodes were induced in 2 patients (2 with a lack of a late r'). These data suggested that there was no association to the inducibility of VF whether or not there was a late r' in lead V1. Further, previous papers [4,5] have shown the changes in the QRS-ST morphology during the day, week, and year, or after food ingestion even inpatients with a history of VF. Further, the QRS-ST morphology exhibits different patterns of Brugada syndrome ECGs, including a lack of a late r' or the existence of a late r' (see Fig. 3 in [5]), in the different positions for the V1 lead (standard position, and 1 and 2 intercostal spaces above lead V1). This indicates the difficulty of dividing these patients into two Brugada-type ECG pattern groups, one due to early repolarization and the other due to a complicating right bundle branch block. Last of all, a high induction rate of VF was observed even in the asymptomatic Brugada patients. Those findings suggest that it is difficult to identify high-risk Brugada patients only by observing the surface ECG lead V1 before and after an ISP infusion.

References

- [1] Kataoka H. Analysis of cove-shaped ST elevation in right precordial leads by several tests. *Shinzo* 1994;26:968–71 [in Japanese].
- [2] Kataoka H. Right precordial coved ST-T segment elevation in a healthy subject evaluated by isoproterenol infusion test: a case report. *Angiology* 1994;45:409–11.
- [3] Omiya T, Shimizu A, Ueyama T, Yoshiga Y, Doi M, Hiratsuka A, Fukuda M, Yoshida M, Matsuzaki M. Effects of isoproterenol and propranolol on the inducibility and frequency of ventricular fibrillation in patients with Brugada syndrome. *J Cardiol* 2012;60:47–54.
- [4] Ueyama T, Shimizu A, Esato M, Kanemoto M, Kametani R, Sawa A, Suzuki S, Matsuzaki M. A case of a concealed type of Brugada syndrome with a J wave and mild ST-segment elevation in the inferolateral leads. *J Electrocardiol* 2007;40:39–42.
- [5] Ueyama T, Shimizu A, Yamagata T, Esato M, Ohmura M, Yoshiga Y, Kanemoto M, Kametani R, Sawa A, Suzuki S, Sugi N, Matsuzaki M. Different effect of the pure Na⁺ channel-blocker pilsicainide on the ST-segment response in the right precordial leads in patients with normal left ventricular function. *Circ J* 2007;71:57–62.

Akihiko Shimizu (MD, PhD, FJCC)*

Toshihide Omiya (MD, PhD)

Takeshi Ueyama (MD, PhD)

Yasuhiro Yoshiga (MD, PhD)

Masahiro Doi (MD, PhD)

Atsushi Hiratsuka (MD, PhD)

Masakazu Fukuda (MD)

Masaaki Yoshida (MD, PhD)

Masunori Matsuzaki (MD, PhD, FJCC)

Masafumi Yano (MD, PhD, FJCC)

*Division of Cardiology, Department of Medicine and
Clinical Science and Faculty of Health Sciences,
Yamaguchi Graduate School of Medicine,
Yamaguchi, Japan*

* Corresponding author at: Faculty of Health
Sciences, Yamaguchi Graduate School of Medicine,
Minami Kogushi, Ube, Yamaguchi 755-8505, Japan.
Tel.: +81 836 22 2856; fax: +81 836 22 2856.
E-mail address: ashimizu@yamaguchi-u.ac.jp
(A. Shimizu)

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