Deep-Inpiration Test
– A Novel and Simple Technique of Unmasking Type 1 ECG in Brugada Syndrome –
Satoshi Nagase, MD, PhD; Kengo F. Kusano, MD, PhD

The Brugada syndrome (BrS) is characterized by ST-segment elevation in the right precordial leads and an episode of ventricular fibrillation (VF). Among the 3 different types of ST-segment elevation, BrS is diagnosed when a type 1 ST-segment elevation (type 1 ECG) is recorded in the right precordial lead in the presence or absence of sodium-channel blocker administration. Several reports have suggested that a spontaneous type 1 ECG is highly predictive of future arrhythmic events. In general, a type 1 ECG manifests immediately after a spontaneous VF episode. Therefore, ECG records should be carefully designed to not overlook any concealed type 1 ST-segment elevation, particularly in patients with a history of syncope, a family history of sudden death and type 2 or 3 BrS ECG.

Several methods for unmasking type 1 ECG have been proposed. Recording the ECG in leads V1 and V2 at the higher (third and second) intercostal space (ICS) is a simple and quick method that increases the sensitivity for detecting BrS. The administration of a sodium-channel blocker can unmask type 1 ECG and increase the sensitivity for detecting BrS. However, it may occasionally cause fatal arrhythmia (AV block, ventricular tachycardia or VF). Therefore, a sodium challenge should be performed carefully and must be avoided if a type 1 ECG was recorded under baseline conditions. In addition, treadmill exercise testing is useful to unmask type 1 ECG. Makimoto et al reported that aggravation of the ST-segment elevation and type 1 ECG during recovery from exercise testing are specific characteristics of BrS and that aggravation of ST elevation is a predictor of future cardiac events. They suggested that ST-segment elevation is amplified by parasympathetic reactivation during early recovery, particularly in the first minutes after cessation of exercise. Nishizaki et al reported the usefulness of a glucose tolerance test to unmask type 1 ECG in BrS. In certain BrS cases, a high insulin level after glucose loading is associated with augmented ST-segment elevation and unmasked type 1 ECG. Thus, glucose-induced insulin secretion may play an important role in the augmentation of ST-segment elevation in patients with BrS. In addition, a full stomach test is reported to be useful for unmasking type 1 ECG in BrS patients. It involves the intake of a large meal within a 20-min time period, which may affect both blood glucose concentration and vagal activity. A positive full stomach test is reported to be associated with a history of cardiac events. Brugada-type ECG, including type 1 ECG, can be unexpectedly unmasked by fever. It has been reported that febrile illnesses unmask BrS, augment ST-segment elevation, and cause premature ventricular complexes and VF.

In this issue of the Journal, Yamawake et al provide new clinical information on BrS by ECG analysis.

The opinions expressed in this article are not necessarily those of the editors or of the Japanese Circulation Society.

Received December 15, 2013; accepted December 15, 2013; released online December 27, 2013
Department of Cardiovascular Medicine, Okayama University Graduate School of Medicine, Dentistry, and Pharmaceutical Sciences, Okayama (S.N.); Department of Cardiovascular Medicine, National Cerebral and Cardiovascular Center, Suita (K.F.K.), Japan
Mailing address: Kengo F. Kusano, MD, PhD, Department of Cardiovascular Medicine, National Cerebral and Cardiovascular Center, 5-7-1 Fujishiro-dai, Suita 565-8565, Japan. E-mail: kusanokengo@hotmail.com
All rights are reserved to the Japanese Circulation Society. For permissions, please e-mail: cj@j-circ.or.jp
ECG leads V1–3 with a standard and higher lead position. In addition, they recorded standard V1–3 leads with deep inspiration (DI test) and in the standing position (Stand test). In 34 BrS patients, 20 patients exhibited type 1 ECG with the higher lead position, 18 by DI test, and 6 by Stand test. In addition, among 17 patients without a previous spontaneous type 1 ECG, 7 presented a type 1 ECG with the higher lead position, 6 by DI test, and 1 by Stand test. Furthermore, they examined the possible mechanism of type 1 ECG unmasking with the DI test. They examined differences in the heart position between the deep inspiratory and shallow expiratory phase by chest X-ray while the patient was supine, and measured the distance of displacement. This investigation showed that the shifting distance during breathing was significantly longer in patients with type 1 ECG, which suggests that DI unmasks type 1 ECG by lowering the position of the heart. Another important factor is that DI potentially increases vagal tone, which has been previously associated with BrS unmasking and spontaneous VF episodes. The mechanism of type 1 ECG unmasking by DI has been indirectly investigated in previous studies.10–12 In 2010, we reported the relationship between the lead positions of type 1 ECG and the location of the right ventricular outflow tract (RVOT) in 60 BrS patients with recording of the ECG at the additional 3rd and standard 4th ICS leads in V1 and V2 with fluoroscopically visible electrodes (Figure, Table).10 The anatomical location was determined via fluoroscopic images with right ventriculography performed in the right anterior oblique (RAO) view. We determined the location of the right ventricle in the end-expiration phase because the position of the heart is considerably influenced by the breathing state, and the end-expiration phase may be equivalent to the state of recording an ECG in the clinical setting. This investigation showed that the RVOT determines the manifestation of type 1 ECG in patients with BrS, and the relationship between the position of the leads and the RVOT varied in individual cases. The ECG leads V1 and V2 at the 4th ICS were located in front of the RVOT in only 11 patients (18%); 41 of 49 patients (84%), in whom the 3rd ICS represented the RVOT did not show a type 1 ECG at the 4th ICS, but at the 3rd ICS instead. These results suggest that the DI test lowers the position of the heart, including the RVOT, and then the right precordial leads with standard ICS are artificially located in front of the RVOT. As a result, type 1 ECG is unmasked in a standard lead position.

In conclusion, Yamawake et al have demonstrated a novel technique of unmasking a type 1 ECG in BrS, using the DI test. This new method is simple and rapidly manifests a concealed type 1 ECG in BrS without unexpected events. Further investigations using DI test are warranted to determine the predictive value for cardiac events using a larger number of BrS patients and control subjects. When BrS is suspected, the DI test should be considered for definitive or differential diagnosis.

**Disclosures**

There are no financial or other relations that could lead to a conflict of interest.

**References**