Figura 1. Le diverse morfologie del pattern di Brugada. (a) Derivazione precordiale destra (V1 o V2) normale. (b) Tipo 1 del pattern di Brugada, con sopraslivellamento convesso di ST. (c-d): Tipi 2 e 3 del pattern, entrambi caratterizzati da sopraslivellamento concavo di ST, con entità ≥1 mm nel tipo 2 e <1 mm nel tipo 3.
Basta la presenza di ECG tipo 1 in una derivazione precordiale destra (sia in posizione standard che superiore: 3° o 2° spazio) per fare diagnosi di “BRUGADA”
Diagnostic and Prognostic Value of a Type 1 Brugada Electrocardiogram at Higher (Third or Second) V₁ to V₂ Recording in Men With Brugada Syndrome

Koji Miyamoto, MD, Miki Yokokawa, MD, Koji Tanaka, MD, Takayuki Nagai, MD, Hideo Okamura, MD, Takashi Noda, MD, PhD, Kazuhiro Satomi, MD, PhD, Kazuhiro Suyama, MD, PhD, Takashi Kurita, MD, PhD, Naohiko Aihara, MD, Shiro Kamakura, MD, PhD, and Wataru Shimizu, MD, PhD*

To evaluate the diagnostic and prognostic value of an electrocardiogram (ECG) recorded at a higher (third or second) intercostal space, 98 men (17 to 76 years of age, mean ± SD 47 ± 13; with documented ventricular fibrillation [VF] in 22 and syncope in 32) were categorized into 3 groups: 68 men had a spontaneous type 1 ECG in standard leads V₁ and V₂ (S group), 19 had a spontaneous type 1 ECG only in the higher V₁ and V₂ leads (H group), and 11 had a type 1 ECG only after receiving class Ic sodium channel blockers (Ic group). There were no significant differences in baseline clinical characteristics, including VF episodes, syncope, atrial fibrillation, family history, late potentials, and inducibility of VF during electrophysiologic study across the 3 groups. During prospective follow-up periods (779 ± 525, 442 ± 282, and 573 ± 382 days, respectively), subsequent cardiac events occurred in 11 men (16%) within the S group, in 2 men (11%) in the H group, and in 0 men (0%) in the Ic group (p = NS, S vs H group). In men with previous episodes of VF, subsequent cardiac events occurred in 7 (44%) within the S group and in 2 (50%) in the H group (p = NS). In conclusion, men with a spontaneous type 1 Brugada ECG recorded only at higher leads V₁ and V₂ showed a prognosis similar to that of men with a type 1 ECG in using standard leads V₁ and V₂. © 2007 Elsevier Inc. All rights reserved. (Am J Cardiol 2007;99:53–57)
Fig. 4 Twelve-lead ECG from patient II-1 from family 2. Type 1 ST elevation is present at baseline in inferior leads with mirror ST depression in VL and V1. This ST elevation is somewhat similar to previously reported cases (see ref [3])
Fig. 2 Twelve-lead ECG at baseline (a) and after ajmaline (b) from patient II-2 from family 1. Type 1 ST elevation is present in III, VF and V3R-V4R leads with mirror ST depression in V2-V3 and lateral leads.
Risk Stratification in Brugada Syndrome

Results of the PRELUDE (PREProgrammed ELECTrical stimULation preDictive valuE) Registry

Alto valore predittivo negativo specie negli asintomatici

Non indicato negli asintomatici con solo test provocativo positivo
Conclusions—In patients with Brugada syndrome, arrhythmias induced with programmed ventricular stimulation are associated with future ventricular arrhythmia risk. Induction with fewer extrastimuli is associated with higher risk.

However, clinical risk factors are important determinants of arrhythmia risk.

Lack of induction does not necessarily portend low ventricular arrhythmia risk, particularly in patients with high-risk clinical features.
Risk Stratification in Brugada Syndrome

Results of the PRELUDE (PRogrammed ELectrical stimUlation preDictive valuE) Registry

Figure 4: Survival According to Syncope Before Enrolment and ECG Presentation

Kaplan-Meier survival analysis of arrhythmic event-free survival according to (A) history of syncope before enrolment and (B) presence or absence of spontaneous type 1 electrocardiogram (ECG).
Risk Stratification in Brugada Syndrome

Results of the PRELUDE (PRogrammed ELectrical stimUlation prcDictive valuE) Registry

**Figure 5** Survival According to Refractory Period and QRS-I

Kaplan-Meier survival analysis of arrhythmic event-free survival according to presence or absence of (A) ventricular refractory period (VRP) <200 ms and (B) QRS fragmentation (QRS-I).
Risk Stratification in Brugada Syndrome

Results of the PRELUDE (PRogrammed ELectrical stimUlation preDictive valuE) Registry

Figure 6 Survival According to Spontaneous Type 1 ECG and History of Syncope

Kaplan-Meier survival analysis of arrhythmia event-free survival according to the presence of spontaneous (Spont.) type 1 electrocardiogram (ECG) and history of syncope.
P-wave duration of ≥ 120 ms was present in 129 patients (40%), first degree atrioventricular block (AVB) in 113 (35%), right bundle branch block (BBB) in 90 (28%), and fascicular block in 52 (16%).

Increased P-wave duration, first degree AVB, and right BBB were more often present in patients after drug challenge than in patients with spontaneous type 1 ST elevation. Left BBB was present in 3 patients.

In multivariate analysis, first degree AVB was independently associated with sudden death or implantable cardioverter-defibrillator appropriated therapies (odds ratio 2.41, 95% confidence interval 1.01 to 5.73, p [ 0.046) together with the presence of syncope and spontaneous type 1 ST elevation.

In conclusion, conduction disturbances are frequent and sometimes diffuse in patients with BrS. First degree AVB is independently linked to outcome and may be proposed to be used for individual risk stratification.

(Am J Cardiol 2013;112:1384e1389)
Sindrome di Brugada

**Fattori precipitanti:**

Febbre

Colpo di calore

Cocaina

Agenti vagotonici

Squilibri elettrolitici (ipercalcemia, iperpotassiemia, ipopotassiemia)

Farmaci psicotropi

Farmaci antiaritmici (aimalina, flecainide, procainamide, disopiramid, propafenone, piliscainide)

Calcioantagonisti

Betabloccanti

Pasti abbondanti

Uso eccessivo di bevande alcoliche

Corticosteroidi
Atrial Fibrillation and Brugada Syndrome

Table 1: Incidence of Atrial Arrhythmias in Brugada Syndrome

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>No. of Patients</th>
<th>Total</th>
<th>Spontaneous</th>
<th>Inducible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eckardt et al.</td>
<td>2001</td>
<td>35</td>
<td>29%</td>
<td>—</td>
<td>3% (1/35)</td>
</tr>
<tr>
<td>Itoh et al.</td>
<td>2001</td>
<td>30</td>
<td>30%</td>
<td>30% (9/30)</td>
<td>—</td>
</tr>
<tr>
<td>Morita et al.</td>
<td>2002</td>
<td>18</td>
<td>—</td>
<td>39% (7/18)</td>
<td>57% (8/14)</td>
</tr>
<tr>
<td>Park et al.</td>
<td>2003</td>
<td>15</td>
<td>40%</td>
<td>27% (4/15)</td>
<td>8% (1/13)</td>
</tr>
<tr>
<td>Bordachar et al.</td>
<td>2004</td>
<td>59</td>
<td>20%</td>
<td>17% (12/59)</td>
<td>—</td>
</tr>
<tr>
<td>Juntilla et al.</td>
<td>2004</td>
<td>18</td>
<td>6%</td>
<td>6% (1/18)</td>
<td>—</td>
</tr>
<tr>
<td>Sacher et al.</td>
<td>2006</td>
<td>220</td>
<td>15%</td>
<td>10% (23/220)</td>
<td>—</td>
</tr>
<tr>
<td>Yamada et al.</td>
<td>2006</td>
<td>11</td>
<td>100%</td>
<td>0</td>
<td>100% (11/11)</td>
</tr>
<tr>
<td>Kharazi et al.</td>
<td>2007</td>
<td>12</td>
<td>17%</td>
<td>17% (2/12)</td>
<td>—</td>
</tr>
<tr>
<td>Miyamoto et al.</td>
<td>2007</td>
<td>98</td>
<td>20%</td>
<td>20% (20/98)</td>
<td>—</td>
</tr>
<tr>
<td>Bigl et al.</td>
<td>2007</td>
<td>28</td>
<td>53%</td>
<td>53% (15/28)</td>
<td>—</td>
</tr>
</tbody>
</table>
CONCLUSION:
Our results suggest that spontaneous AVNRT and concealed BrS co-occur, particularly in female patients, and that genetic variants that reduce sodium channel current may provide a mechanistic link between AVNRT and BrS and predispose to expression of both phenotypes.
Monomorphic ventricular tachycardia in patients with Brugada syndrome
Classic Definition of Early Repolarization: ST Elevation

A

Classic Early Repolarization Without a J-wave

B

Classic Early Repolarization With a J-wave

New Definitions of Early Repolarization

C

Slurred QRS Downstroke without STE

D

J-wave or the new "J-point Elevation" without STE

Figure 1. Examples of the original benign and new malignant definitions of early repolarization. A and B, Original definition based on ST-segment elevation (STE), with or without J waves. New definition, based on J-wave slurring (C) and notching (D) followed by a horizontal or downsloping ST segment. Reprinted from Perez et al with permission of the publisher.
Prognostic significance of early repolarization in inferolateral leads in Brugada patients with documented ventricular fibrillation: A novel risk factor for Brugada syndrome with ventricular fibrillation

Heart Rhythm 2013;10:1161–1168

Figure 1  A: Twelve-lead ECGs in a patient with Brugada syndrome and early repolarization (ER) in the inferior leads. Arrows indicate ER. B: Twelve-leads ECG in a patient with Brugada syndrome but without ER repolarization in the inferolateral leads.

Da rilevare che l'associazione tra la ripolarizzazione precoce e rischio aritmico è tipicamente a riposo o durante il sonno e non durante l'attività fisica.
aVR sign as a risk factor for life-threatening arrhythmic events in patients with Brugada syndrome

Heart Rhythm 2007;4:1009 –1012

Figure 4  Kaplan-Meier analysis of arrhythmic events during follow-up depending on positive aVR sign (R wave ≥ 0.3 mV or R/q ratio ≥ 0.75 in lead aVR) or negative aVR sign (R-wave amplitude < 0.3 mV or R/q ratio < 0.75 in lead aVR).
Spontaneous electrocardiogram alterations predict ventricular fibrillation in Brugada syndrome

Heart Rhythm 2011;8:1014-1021
A New Electrocardiographic Marker of Sudden Death in Brugada Syndrome: The S-Wave in Lead I

J Am Coll Cardiol 2016;67:1427–40
A New Electrocardiographic Marker of Sudden Death in Brugada Syndrome
The S-Wave in Lead I

Survival Analysis

Log-Rank Test $p < 0.002$

Paced QRS Fragmentation is Associated With Spontaneous Ventricular Fibrillation in Patients With Brugada Syndrome

Heart Rhythm 2016 in press

**Figure 1:** Representative electrocardiograms showing fragmentation in V1 in patients with Brugada syndrome (BrS). Red arrows indicate spikes and N indicates number of spikes. Duration of fragmentation was defined as the time from the beginning of the first spike to the end of the last spike.

A: In a 43-year-old patient (Patient No. 4 in Table 1) with a history of documented spontaneous ventricular fibrillation (VF), only one spike was observed during sinus rhythm (SR). However, 3 spikes were detected during right ventricular apical pacing (RVAP) at 80 bpm, and the number of spikes increased to 7 at 110 bpm. The duration of the fragmentation prolonged from 56 ms at 80 bpm to 156 ms at 110 bpm.

B: In contrast, in a 61-year-old patient (Patient No. 14 in Table 1) without a history of out-of-hospital cardiac arrest and documented spontaneous VF, only one spike was observed during both SR and RVAP.
The Impact of Clinical and Genetic Findings on The Management of Brugada Syndrome Patients

The absence of a SCN5A mutation may then denote a lower risk of events and might be taken into account.

Andorin A et al Heart Rhythm  Feb 24 2016

Predictors of the occurrence of ventricular arrhythmias during sodium blocking challenge may be young age, conduction disturbance at baseline ECG, and mutations in the SCN5A gene

Dobbeis B et al Europace 2016 Mar 3
Therefore, $T_{pTe} \geq 77$ ms was associated with an odds ratio (OR) for life-threatening events (VT/VF) of 5.0 (95% CI 1.7 – 14.4; $P = 0.003$) and a $T_{pTe}/QT$ ratio of $\geq 0.205$ with an OR of 5.8 (95% CI 1.9 – 17.4; $P = 0.002$), respectively.
Prolonged right ventricular ejection delay identifies high risk patients and gender differences in Brugada syndrome


Fig. 2. Right ventricular ejection delay (RVED) determined either by syncope (A) or spontaneous sustained ventricular arrhythmia (B). BS indicates Brugada syndrome; CTR, controls; VA sustained ventricular arrhythmia. Values are mean ± SD. *p < 0.05 vs BS patients with a previous history of either syncope or VA.
Le diverse morfologie del fenomeno di Brugada. Lo schema a rappresenta una derivazione precordiale destra (V1 o V2) normale, in b si osserva il tipo 1 del fenomeno di Brugada, con sopraslivellamento convesso in ST. Gli schemi c e d i tipi 2 e 3 del fenomeno, entrambi caratterizzati da sopraslivellamento concavo di ST, con entità $\geq 1$ mm nel tipo 2 e $< 1$ mm nel tipo 3.
Figure 1. Leads V₁ to V₃ of a very lean 15-year-old man without heart disease. The rSr' morphology is due to a misplaced V₁ electrode in the second right intercostal space (see negative P wave) and disappears when the electrode is properly positioned (fourth right intercostal space).
The positions given by the subjects for placement of electrodes V1 (open circles), V2 (squares), V3 (open triangles) and V4 (filled circles).

- Incorrect positioning of electrodes is a well established cause of artefactual changes in the ECG.

- Patients may receive potentially harmful treatment.
No test is too routine to do properly!

The finding that only 50% of nurses and less than 20% of cardiologists can correctly place lead V1 of a standard 12-lead ECG is a figure that will surprise many. But perhaps it is not so surprising, because this is an age where the simple bedside disciplines of clinical assessment are considered too routine for many professional groups.
Figure 4. Leads V₁ and V₂ in four athletes without heart disease.

Figure 5. Different examples from patients with pectus excavatum. Note the negative P wave in lead V₁.
Figure 7. (A) Mitral stenosis with moderate pulmonary hypertension and functional tricuspid regurgitation, (B) A 9-year-old girl with mild pulmonary stenosis, (C) Chronic cor pulmonale secondary to chronic obstructive pulmonary disease (COPD) in elderly, (D) Ostium secundum-type atrial septal defect, (E) ECG pattern after regression of RVE in postsurgery of tetralogy of Fallot, (F) epsilon wave (arrow) in lead V₁ in a patient with ARVD, (G) Ebstein disease (note massive atrial enlargement), and (H) Biventricular enlargement in a 8-year-old patient with ventricular septal defect and hyperkinetic pulmonary hypertension (Katz-Watchell pattern).
Base of the triangle ≥ 4 mm
Fig. 2. A: Duration of the base of the triangle at 0.5 mV from the r′-wave (ms). B: Duration of the base of the triangle at the isoelectric line (ms). C: Beta angle formed from r′-wave upslope to r′-wave downslope (degrees). Positive criteria for Brugada Type 2 pattern: duration of the base of the triangle at 0.5 mV from r′-wave ≥ 160 ms (4 mm), duration of the base of the triangle at the isoelectric line ≥ 60 ms (1.5 mm) and β-angle ≥ 58°.
Fig. 4. The “Corrado Index” for distinguishing anterior early repolarization from Brugada ECG pattern. From Ref. [43].
Unmasking Brugada-Type Electrocardiogram on Deep Inspiration

Noriyoshi Yamawake, MD; Mitsuhiro Nishizaki, MD; Masato Shimizu, MD; Hiroyuki Fujii, MD; Harumizu Sakurada, MD; Masayasu Hiraoka, MD

Figure 1. Electrocardiogram (ECG) of a 34-year-old man with aborted sudden death due to ventricular fibrillation (VF). Type 1 was seen on ECG on the previous day. In the present study, the ECG showed ST elevation <0.2mV (non-Brugada type ECG or type S) in V1, and type 2 in V2 at baseline. Type 1 ECG was observed at the third intercostal space (3ICS), during deep inspiration (DI) test and in the standing position (Stand test) in V2. 4ICS, fourth intercostal space.
La distinzione fra le due condizioni è abbastanza agevole, poiché nel blocco di branca destra il tratto ST (cioè il punto J) non è sopraslivellato, e inoltre la R (o R’) terminale è sincrona con l’onda S allargata che si osserva in I derivazione e in V6.

Nel fenomeno di Brugada, invece, non si riscontra una S larga nelle derivazioni sinistre, perché la positività terminale del complesso ventricolare è un’onda J, fenomeno che può essere registrato solo da derivazioni toraciche poste in prossimità della sede in cui la ripolarizzazione è anormale (l’infundibolo) e non evidente in derivazioni “lontane”.

Blocco di branca destra o Fenomeno di Brugada?
New Electrocardiographic Criteria for Discriminating Between Brugada Types 2 and 3 Patterns and Incomplete Right Bundle Branch Block

Figura 2. L’ECG in alto appare a prima vista come un blocco incompleto di branca destra: in V1 e V2 i complessi ventricolari hanno morfologia rSr', e inoltre si osservano in I e V6 onde S leggermente slargate. L’onda positiva terminale in V2, tuttavia, è molto larga (dura non meno di 0,05 s) ed è seguita da un ST sospesellato, aspetti che solitamente non si riscontrano in un blocco incompleto di branca destra di minima entità. Inoltre la durata del QRS è 0,12 s se misurata in V1-V2, mentre raggiunge il massimo 0,10 s nelle altre derivazioni. Tutti questi dati generano il sospetto di un pattern di Brugada di entità appena percepibile. Il tracciato in basso appartiene allo stesso soggetto, ed è stato registrato una settimana dopo il precedente. Le derivazioni periferiche sono praticamente sovrapponibili a quelle del primo tracciato, mentre le precordiali destre presentano ora il quadro caratteristico del pattern di Brugada tipo 1.
Brugada Syndrome Behind Complete Right Bundle-Branch Block

Figure 5. Patient 11. The baseline ECG was diagnosed as complete right bundle-branch block (CRBBB). He had out-of-hospital ventricular fibrillation and was rescued (A). After admission, a class Ic drug, pilsicainide, was given to exclude Brugada syndrome (BS), but the drug induced coved-type ST-segment elevation in V1, B4, and V3, and the patient was diagnosed with BS behind CRBBB (B).
un fenotipo indotto da fattori ambientali che imita quello solitamente prodotto da un genotipo specifico.

Fenotipo s.m. : Insieme dei caratteri fisici di un individuo, determinati sia dal patrimonio genetico sia dall'azione ambientale (si contrappone a genotipo)
Causes of Brugada Phenocopy

Brugada phenocopies may be induced by a multitude of clinical circumstances that have been characterized into six distinct etiological categories:\textsuperscript{1,3}

I. Metabolic conditions
II. Mechanical compression
III. Ischemia
IV. Myocardial and pericardial disease
V. ECG modulation
VI. Miscellaneous

Diagnosis of Brugada Phenocopy

The diagnostic criteria for Brugada Phenocopy are (I-V are mandatory):\textsuperscript{1,3,6}

I. An ECG pattern that has a type-1 or type-2 Brugada morphology
II. The patient has an underlying condition that is identifiable
III. The ECG pattern resolves upon resolution of the underlying condition
IV. There is a low clinical pretest probability of true Brugada syndrome determined by a lack of symptoms, medical history, and family history
V. The results of provocative testing with a sodium channel blocker such as ajmaline, flecainide, or procainamide are negative
VI. Provocative testing is not mandatory if surgical RVOT manipulation has occurred within the last 96 hours.
VII. The results of genetic testing are negative (desirable but not mandatory because the SCN5A mutation is identifiable in only 20\% to 30\% of probands affected by true BrS\textsuperscript{63}).
Figure 1. Comparison of various type 1 Brugada phenocopies. (A) True congenital type 1 Brugada syndrome electrocardiogram shown in comparison to (B) congenital hypokalemic periodic paralysis (type 1B BrP); (C) acute inferior ST-elevation myocardial infarction with right ventricular involvement (type 1A BrP); (D) concurrent hyperkalemia, hyponatremia, and acidosis (type 1A BrP); and (E) acute pulmonary embolism (type 1B BrP). Numbers under figures are International Registry of Brugada Phenocopies identification numbers. BrP, Brugada phenocopy.
Figure 2. Comparison of various type 2 Brugada phenocopies. (A) True congenital type 2 Brugada syndrome shown in comparison to (B) congenital pectus excavatum causing mechanical mediastinal compression (type 2A BrP), (C) acute pericarditis (type 2A BrP), (D) after accidental electrocution injury (type 2A BrP), and (E) as a result of using inappropriate high-pass electrocardiographic filters (type 2C BrP). Numbers under figures are International Registry of Brugada Phenocopies identification numbers. BrP, Brugada phenocopy.