καναλοπάθειες

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Θεσσαλονίκη
Also known as cardiac channelopathies, **primary electrical disorders** respond to mutations in genes encoding cardiac ion channels and/or their regulatory proteins, which result in modifications in the cardiac action potential or in the intracellular calcium handling that lead to electrical instability and life-threatening ventricular arrhythmias.

Hereditary primary electrical disorders may account for up to **30% of all SCD in the young**.

With very few exceptions, cardiac channelopathies are **autosomal dominant disorders with incomplete penetrance** (meaning that some individuals will not express the trait even though they carry the mutated allele) and **variable expressivity** (meaning that the level of phenotypic expression will be diverse for individuals with the same genotype).

This represents a significant **limitation** when the diagnosis is based exclusively on clinical findings.
Genetic testing

- **Genetic testing** may
  - (1) offer a *definite confirmation* of a particular electrical disorder, which becomes particularly useful in patients with inconclusive clinical data;
  - (2) confirm or exclude the presence of a disease-causing mutation in *family members* of an index case; and
  - (3) help *personalize treatment* recommendations and management of a patient's specific disorder.

- However, genetic screening of mutations in genes known to cause cardiac channelopathies might result **unsuccessful**, providing negative results in around 20% of patients with LQTS, 40% of patients with CPVT, and 80% of patients with BS and sort QT.

- This indicates that there is still a long way to go in the field of genetics in primary electrical
cardiac channelopathies

- long QT syndrome (LQTS), prevalence: **1 : 2000**
- short QT syndrome (SQTS), prevalence: **very rare**, 200 cases worldwide
- Brugada syndrome (BrS) prevalence: Europe: **0 to 0.017%**, NE Asia: 0.15 to 0.27%
- catecholaminergic polymorphic ventricular tachycardia (CPVT), prevalence: **1:10,000**
- early repolarization
Mutations in **20 different genes** encoding direct or indirect mediators of these currents have been found in one or several families with LQTS.

LQTS is characterized by **prolonged AP duration**
- **increase in inward** currents (mainly INa and ICaL) or
- **decrease in outward K+** currents (mainly IKs, IKr, IK1)
subtypes of LQTS

- **Autosomal dominant LQTS** *(Romano–Ward syndrome; prevalence 1 in 2500)*, which includes LQT1–6 and LQT9–13 and is characterized by an isolated prolongation of the QT interval.

- **Autosomal dominant LQTS with extracardiac manifestation**, comprising
  - LQT7 *(Andersen–Tawil syndrome)*, which shows a prolonged QT interval with prominent U wave, polymorphic or bidirectional VT, facial dysmorphisms and hyper-/hypokalaemic periodic paralysis and
  - LQT8 *(Timothy syndrome)*, characterized by prolonged QT, syndactyly, cardiac malformations, autism spectrum disorder and dysmorphisms.

- **Autosomal recessive LQTS** *(Jervell and Lange–Nielsen syndrome)*, which combines an extremely prolonged QT interval with congenital deafness.
Genetic screening

- Genetic screening identifies a disease-causing mutation in 75% of LQTS cases and three main genes (KCNQ1, KCNH2 and SCN5A) account for 90% of positively genotyped cases.

- This implies that, when the clinical diagnosis is certain, a negative genetic test should not modify confidence in the diagnosis.

- Conversely, when the clinical suspicion is weak, a negative genotype contributes to make the diagnosis even less likely.

- Once the **genotype of the proband** is identified, 2 things should follow.
  - One is *cascade screening* of all first- and second-degree family members, because this is likely to reveal that approximately 50% of them is mutation positive.
  - The second is *gene-specific management*.

- 35% of LQT1, 20% of LQT2, and 10% of LQT3, respectively, have a **normal QT interval**.
A significant percentage of the patients, however, remains asymptomatic during their whole life.

The mean age at presentation is 14 years.

Of the individuals that do become symptomatic, 50% experience their first cardiac event by the age of 12 and 90% by the age of 40.

The annual rate of SCD in patients with untreated LQTS is estimated to be between 0.33% and 0.9%, whereas that for syncope is estimated to be 5%.

In 10–15% of LQTS patients, the first and only symptom is SCD.
accurate measure of the QTc

- The QT interval is measured from the onset of the QRS complex to the end of the T wave
- qt should be recorded in II or V5 leads where it has demonstrated the most predictive capacity
LQT1 is associated with a broad-based T wave, LQT2 with a low amplitude notched or biphasic T wave, and LQT3 with a long isoelectric segment followed by a narrow-based T wave. The sensitivity of these findings is only about 50% and the genotype prediction is of limited value.

**Assessment of the T-wave morphology**

Peter Schwartz: ‘Don’t (only) measure the QT interval – look at it!’

- LQT1 is associated with a broad-based T wave
- LQT2 with a low amplitude notched or biphasic T wave, and
- LQT3 with a long isoelectric segment followed by a narrow-based T wave

The sensitivity of those findings is only about 50% and the genotype prediction is of limited value.
Lethal cardiac events according to triggers and genotype

- **LQT1**: Swimming-induced and exertion-induced cardiac events
- **LQT2**: Auditory triggers and events occurring during the postpartum period
- **LQT3**: During sleep or rest
• **Exercise test:** QT interval during the recovery phase (3-4 minutes) may reveal a diagnostic QT prolongation in LQTS cases with borderline QTc interval at baseline,
Abnormal QT dynamics rapid postural changes in LQT individuals with normal or borderline resting ECG. Compared to healthy control individuals, the QTc significantly prolongs (‘QT-stretching’) in LQT subjects upon abrupt standing.
2015 ESC Guidelines for the management of patients with ventricular arrhythmias and the prevention of sudden cardiac death

The Task Force for the Management of Patients with Ventricular Arrhythmias and the Prevention of Sudden Cardiac Death of the European Society of Cardiology (ESC)

Table 1. Schwartz score (updated version from 2011)

<table>
<thead>
<tr>
<th>Electrocardiographic findings</th>
<th>Points</th>
</tr>
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<tbody>
<tr>
<td>A resting QTc (ms)</td>
<td></td>
</tr>
<tr>
<td>≥480 ms</td>
<td>3</td>
</tr>
<tr>
<td>460–479</td>
<td>2</td>
</tr>
<tr>
<td>450–459 (men)</td>
<td>1</td>
</tr>
<tr>
<td>B QTc at 4 min of recovery from exercise stress test ≥480 ms</td>
<td>1</td>
</tr>
<tr>
<td>C Torsades de points</td>
<td>2</td>
</tr>
<tr>
<td>D T-wave alternans</td>
<td>1</td>
</tr>
<tr>
<td>E Notched T-wave in three leads</td>
<td>1</td>
</tr>
<tr>
<td>F Low heart rate for age</td>
<td>0.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Clinical history</th>
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<tbody>
<tr>
<td>A Syncope</td>
<td></td>
</tr>
<tr>
<td>With stress</td>
<td>2</td>
</tr>
<tr>
<td>Without stress</td>
<td>1</td>
</tr>
<tr>
<td>B Congenital deafness</td>
<td>0.5</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Family history</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>A Family member with definite LQT syndrome</td>
<td>1</td>
</tr>
<tr>
<td>B Unexplained sudden cardiac death &lt; age 30 years of a first-degree relative</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Recommendation for genetic testing

Unlike its excellent specificity of 99%, the overall sensitivity of the Schwartz score is quite low (19%)
risk stratification I

- **Survivors of a cardiac arrest** have a high risk of recurrence, even when receiving beta blockers (**14% within 5 years on therapy**): this evidence supports the use of ICDs in survivors of cardiac arrest.
- The occurrence of **syncopal events**
- Patients who suffer **arrhythmic events despite being on full medical therapy** are at higher risk.
- High risk is present whenever \( QTc \geq 500 \text{ ms} \)
- becomes extremely high whenever \( QTc \geq 600 \text{ ms} \)
- The presence of **overt T-wave alternans** is a direct sign of electrical instability and calls for preventive measures.
- Patients who **have syncope or cardiac arrest before age 7** have a higher probability of recurrence of arrhythmic events while on beta-blockers.
- Patients who **have syncope or cardiac arrest in the first year of life** are at high risk for lethal events and may not be fully protected by the traditional therapies.
risk stratification II

- **Women** with LQTS have an increased risk during the **9-month postpartum** period (especially women with the **LQT2** genotype).
- In LQT1 and LQT2 patients, the **location and type of mutation** further study before application in clinical practice.
- Patients with **two unequivocally pathogenic variants and a QTc ≥ 500 ms** are also at high risk.
- **Prophylactic ICD therapy**
  - in high-risk patients such as women with LQT2 and QTc >500 ms,
  - patients with QTc >500 ms and signs of electrical instability and
  - patients with high-risk genetic profiles (carriers of two mutations, including Jervell and Lange–Nielsen syndrome or Timothy syndrome).
- **Silent carriers** of pathogenic mutations present a modest risk of cardiac events estimated at **10% between birth and age 40 years**; the use of beta-blockers should be considered in this group of patients.
The 2015 AHA/ACC Scientific Statement

- For athletes with a suspected/diagnosed cardiac channelopathy, a comprehensive evaluation by a heart rhythm specialist or genetic cardiologist with sufficient experience and expertise with these disorders is recommended (class I).

- It is recommended that symptomatic athletes with any suspected or diagnosed cardiac channelopathy be restricted from all competitive sports until a comprehensive evaluation has been completed, the athlete and his or her family are well informed, a treatment program has been implemented, and the athlete has been asymptomatic on therapy for 3 months (class I).

- It is reasonable for an asymptomatic athlete with genotype positive/phenotype-negative (concealed channelopathy) LQTS to participate in all competitive sports with appropriate precautionary measures, including: avoidance of QT-prolonging drugs; electrolyte/hydration replenishment and avoidance of dehydration; avoidance or treatment of hyperthermia from febrile illnesses, training-related heat exhaustion, or heat stroke; acquisition of a personal AED as part of the athlete’s personal sports safety gear; and establishment of an emergency action plan with the appropriate school or team officials (class IIa).

- For an athlete with either symptomatic LQTS or ECG manifest LQTS (QTc >470 ms men and >480 ms in women), competitive sports participation (except competitive swimming in a previously symptomatic LQT1 host) may be considered after institution of treatment and appropriate precautionary measures, assuming the athlete has been asymptomatic on treatment for at least 3 months (class IIb).
• indications for competitive athletes should not differ from those applicable to the general population with appropriate diagnoses and clinical profiles (class I).
• Although data are limited with regard to athletes with ICDs, it suggests they may play sports safely.
• According to the 2015 AHA/ACC guidelines, an athlete with an ICD may be permitted to participate in sports if there have been no shocks for 3 months.
• Permitting athletes to return to their preferred sport, including those with ICDs, remains highly dependent on the values of the patient and their family.
• Clearly the patient’s autonomy and their decision should be the most important factor in returning to play, assuming adequate counseling and discussions with providers with sufficient expertise.
Beta-blockers

• Beta-blocker treatment is life-saving and reduces the risk of cardiac events by more than 95% in LQT-1, by 70–80% in LQT-2 and by 80% in LQT-3

• Beta-blockers are recommended in patients with a clinical diagnosis of LQTS (I, B)

• Beta-blockers should be considered in carriers of a causative LQTS mutation and normal QT interval. (IIa, B)
  – at least 10% of asymptomatic LQT individuals will develop symptoms over time.
• We systematically treat all LQT individuals with beta blockers in our practice

• a clear superiority of nadolol (first-line treatment) and propranolol compared with metoprolol in LQT-1 and LQT-2.
  – Propranolol doses of 2–3 mg/kg per day
  – nadolol received doses of 1–1.4 mg/kg per day
• In clinical practice, dose titration is often limited by patient tolerance

• To optimize beta-blocker titration, we recommend a repeat treadmill test after 4–6 weeks on a stable dose. Reduction of the peak heart rate at least 30 bpm has been suggested as surrogate marker for an adequate beta-blocking effect by some experts
long QT3

- **mexiletine, ranolazine, and flecainide** in LQT3 (IIb, C)

- All three sodium-channel blockers have similar effects on the resting QTc (mean reduction by 53–63 ms)

- Addition of a sodium-channel blocker should be considered in **high-risk LQT-3** individuals including those with resting QTc at least 500 ms who shorten their QTc by more than 40 ms upon challenge with one of the above mentioned molecules
Left cardiac sympathectomy

- **Reducing the risk of arrhythmic events by 91%** with a risk of sudden cardiac death of 3% at 5 years post procedure

- Most effective in LQT-1 with lower success rates in LQT-2 and LQT-3

- Because of its invasive nature and significant side effects, LCSD is currently used as bailout procedure for the **management of very high risk LQT individuals** including those with refractory arrhythmia despite appropriate medical treatment and multiple ICD shocks
Implantable cardioverter defibrillator

- is indicated in LQT patients with **resuscitated cardiac arrest** or

- those individuals experiencing **arrhythmogenic syncope or sustained ventricular arrhythmia despite adequate beta-blocker therapy**

- **Prophylactic ICD insertion** may be considered in selected individuals at very high risk such as **JLN or Timothy syndrome** as well as in high-risk patients with **contraindications for beta-blockers**

- ICD programming in LQT should include a single treatment zone with a high cutoff rate of at least 220 bpm and prolonged arrhythmia detection duration (30/40 intervals or more than 2.5 s) to avoid inappropriate shocks

- **ICD-related complications** are relatively common over time with an estimated annual incidence of 7%
Brugada syndrome

at present genetic testing is not useful for determining future risk.
## Diagnosis of Brugada Syndrome

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Class</th>
<th>Level</th>
<th>Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brugada syndrome is diagnosed in patients with ST-segment elevation with type 1 morphology ≥ 2 mm in one or more leads among the right precordial leads V1 and/or V2 positioned in the second, third, or fourth intercostal space, occurring either spontaneously or after provocative drug test with intravenous administration of sodium channel blockers (such as ajmaline, flecainide, procainamide or pilscainide).</td>
<td>I</td>
<td>C</td>
<td>This panel of experts</td>
</tr>
</tbody>
</table>

### Type I
![Type I ECG](image1.png)

### Type II
![Type II ECG](image2.png)

### Type III
![Type III ECG](image3.png)
Polymorphic ventricular tachycardia or ventricular fibrillation

- Cardiac events (cardiac arrest, syncope thought to be of arrhythmic origin or appropriate ICD therapy) typically occur in **men in the fourth and fifth decades of life**

- Usually develops **during rest or sleep**, most often between midnight and 6 a.m., during **fever** and rarely during exercise

- **Supraventricular arrhythmias** are also frequently observed in patients with the Brugada syndrome, including atrial fibrillation

- **Bradycardia, sick sinus node syndrome, and atrioventricular conduction disturbances** are frequently reported in patients with the Brugada syndrome with SCN5A mutations
The risk varies from 7.7% to 10.2% in resuscitated patients to 0.6% to 1.9% in patients with a history of syncope. (SCD, cardiac arrest, or appropriate ICD therapy) in asymptomatic BrS patients was lower (0.5–1.5%/year) than first described. In the largest pooled analysis of Brugada syndrome the risk of spontaneous VF among 696 asymptomatic patients was only 0.3% per year when their type 1 Brugada ECG was only observed in response to a drug challenge.
management of BS

<table>
<thead>
<tr>
<th>Management</th>
<th>Level</th>
<th>Evidence</th>
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<tbody>
<tr>
<td>ICD implantation is recommended in patients with a diagnosis of Brugada syndrome who (a) Are survivors of an aborted cardiac arrest and/or (b) Have documented spontaneous sustained VT.</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>ICD implantation should be considered in patients with a spontaneous diagnostic type I ECG pattern and history of syncope.</td>
<td>IIa</td>
<td>C</td>
</tr>
<tr>
<td>ICD implantation may be considered in patients with a diagnosis of Brugada syndrome who develop VF during PVS with two or three extrastimuli at two sites.</td>
<td>IIb</td>
<td>C</td>
</tr>
<tr>
<td>Quinidine or isoproterenol should be considered in patients with Brugada syndrome to treat electrical storms.</td>
<td>IIa</td>
<td>C</td>
</tr>
<tr>
<td>Quinidine should be considered in patients who qualify for an ICD but present a contraindication or refuse it and in patients who require treatment for supraventricular arrhythmias.</td>
<td>IIa</td>
<td>C</td>
</tr>
<tr>
<td>Catheter ablation may be considered in patients with a history of electrical storms or repeated appropriate ICD shocks.</td>
<td>IIb</td>
<td>C</td>
</tr>
</tbody>
</table>
with longer follow-up periods it became evident that **only 2%** of patients with bona-fide Brugada syndrome display the **type-I pattern at all times**.

In fact, among patients with **spontaneous type-I ECG** who undergo repeated ECG recordings over time, only **every third** ECG is diagnostic, one third is suspicious, and every third one is normal.

**We intuitively expected patients with spontaneous and drug-induced type-I to have a comparable arrhythmic risk**.

However, in every single series, patients with drug-induced type-I end up having lesser risk.
• as many as **45% of healthy control** subjects had “minor imperfections in the right precordial leads” that could be interpreted as **type 2/3 Brugada**

• the percentage of patients with an **ajmaline-based diagnosis** increased significantly over the last decade **from 50% to 74%**

• **two-thirds** of BrS patients being evaluated are **asymptomatic**

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**EDITORIAL COMMENTARY**

*Everybody has Brugada syndrome until proven otherwise?*

Sami Viskin, MD, Raphaël Rosso, MD, Limor Friedensohn, MD, Ofer Havakuk, XX, Arthur Wilde, MD†

From the *Tel Aviv Sourasky Medical Center and Sackler School of Medicine, Tel Aviv University, Tel Aviv, Israel,* and †*Heart Center, Academic Medical Center, Amsterdam, The Netherlands.*
• By 2006, **one-half of the ICD** implantations performed in Europe for BrS were in completely **asymptomatic** patients.

• Moreover, the **most common indication for ICD** implantation in the asymptomatic group was a “**positive ajmaline test with positive EPS**” (76).

• Sure enough, at **3 years of follow-up**, only **1.6%** of the initially asymptomatic patients who had type I Brugada ECGs revealed by the ajmaline test had experienced spontaneous VF, whereas **31%** had serious ICD-related complications
the **specificity of the ajmaline test is not as perfect** as was originally proposed not even when the patient population studied has a **high pre-test probability** for a congenital arrhythmic disorder **8% false positive**
A Tale of 2 Diseases

The History of Long-QT Syndrome and Brugada Syndrome

Ofer Havakuk, MD, Sami Viskin, MD

ABSTRACT

The Brugada syndrome (BrS) and long-QT syndrome (LQTS) present as congenital or acquired disorders with diagnostic electrocardiograms (ST-segment elevation and prolonged QT interval, respectively) and increased risk for malignant arrhythmias. Our understanding of the 2 disease forms (congenital vs. acquired) differs. A female patient on quinidine for atrial fibrillation who develops ventricular fibrillation is diagnosed with "acquired LQTS" and is discharged with no therapy other than instructions to avoid QT-prolonging medications. In contrast, an asymptomatic male patient who develops a Brugada electrocardiogram on flecainide is diagnosed with "asymptomatic BrS" and could be referred for an electrophysiological evaluation that could result in defibrillator implantation. The typical patient undergoing defibrillator implantation for BrS is asymptomatic but has a Brugada electrocardiogram provoked by a drug. The authors describe how the histories of LQTS and BrS went through the same stages, but in different sequences, leading to different conclusions. (J Am Coll Cardiol 2016;67:100-8) © 2016 by the American College of Cardiology Foundation.
40% of unrelated patients who came to Mayo Clinic with a heart rhythm specialist–rendered diagnosis of LQTS were dismissed as otherwise normal.

LQTS and the other cardiac channelopathies reside outside the sweet spot of most pediatric and adult heart rhythm specialists, and it is always worthy to carefully assess the veracity of the clinical diagnosis before initiating potentially life-long therapy.
There are programs out there with a 75% to 80% ICD utilization rate;

in contrast, the largest LQTS specialty centers throughout the world utilize an ICD in LQTS-directed treatment programs less than 20% of the time

The 85% of our patients who are managed without an ICD are as alive (correction, more alive) than the 15% who own one
• CPVT can be currently diagnosed (class I recommendation):

• (1) in the presence of a structurally normal heart, normal ECG, and exercise- or emotion-induced bidirectional or polymorphic ventricular tachycardia

• (2) in patients who are carriers of a pathogenic mutation in RYR2 or CASQ2 genes
The current estimated prevalence of CPVT is approximately **1 in 10,000**

- predominantly presents **before puberty** at the **mean age of 10**
- with syncope or cardiac arrest triggered by **exercise or emotion** or **swimming**

Even though it is rare, recognition of CPVT is vital importance due to its **high mortality rate of up to 50% in affected untreated individuals up to the age of 20**

- More than 30% of patients with CPVT have a positive family history of premature SCD. This number increases to approximately 60% of families hosting CPVT1-associated RyR2 mutations.
ryanodine-positive CPVT
(a) 0:00 Pre-exercise  HR: 75 bpm
(b) 3:21 Exercise  HR: 91 bpm
(c) 3:36 Exercise  HR: 128 bpm
(d) 4:21 Exercise  HR: 138 bpm
(e) 4:46 Exercise  HR: 148 bpm
(f) 5:00 Recovery  HR: 72 bpm
<table>
<thead>
<tr>
<th>Therapy</th>
<th>Expert Guideline Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lifestyle changes (disqualification from competitive sports and avoidance of strenuous exercise, stressful situations)</td>
<td>Recommended for all patients (class I, 2013 HRS/EHRA). But, if shared decision making is being considered, an athlete with CPVT who desires to remain an athlete should be evaluated, risk stratified, treated, and counseled by a cardiologist with expertise in CPVT (class I, 2015 AHA/ACC).</td>
</tr>
<tr>
<td>β-Blockers (nadolol, propranolol, or carvedilol)</td>
<td>Recommended for all symptomatic patients (class I). Can be useful in asymptomatic, mutation-positive patients (class IIa).</td>
</tr>
<tr>
<td>Flecainide</td>
<td>Can be useful as an addition to β-blockers in patients with recurrent syncope or polymorphic/bidirectional VT while on β-blockers (class IIa).</td>
</tr>
<tr>
<td>ICD</td>
<td>Recommended in patients with a previous cardiac arrest, or recurrent syncope of polymorphic/bidirectional VT despite optimal medical treatment and/or LCSD (class I).</td>
</tr>
<tr>
<td>LCSD</td>
<td>May be considered in patients with recurrent syncope or polymorphic/bidirectional VT while on β-blockers, or contraindicated for ICD (Class IIb by 2013 guidelines, class IIa by current evidence).</td>
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</tbody>
</table>
short QT syndrome

- one of the **rarest** inheritable cardiac channelopathy
- substrate for the development of life threatening **ventricular arrhythmias**
- fewer than **200 SQTS cases** have been reported in the literature worldwide
- The cumulative probability of experiencing a **cardiac arrest by the fifth decade of life** approaches 40%

SQTS is an autosomal dominant disease
five identified causative genes, including three that encode for potassium channels (**KCNH2**, **KCNQ1**, **KCNJ2**) and
**two that encode for subunits** of the L-type calcium channels (**CACNA1C** and **CACNB2**).
## Diagnosis of Short QT Syndrome

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Class&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Level&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Ref. &lt;sup&gt;c&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>SQTS is diagnosed in the presence of a QTc ≤ 340 ms.</td>
<td>I</td>
<td>C</td>
<td>This panel of experts</td>
</tr>
<tr>
<td>SQTS should be considered in the presence of a QTc ≤ 360 ms and one or more of the following:</td>
<td>IIa</td>
<td>C</td>
<td>This panel of experts</td>
</tr>
<tr>
<td>(a) A confirmed pathogenic mutation</td>
<td></td>
<td></td>
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<tr>
<td>(b) A family history of SQTS</td>
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<tr>
<td>(c) A family history of sudden death at age &lt; 40 years</td>
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<tr>
<td>(d) Survival from a VT/VF episode in the absence of heart disease.</td>
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### Risk stratification and management in Short QT Syndrome

<table>
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<tr>
<th>Recommendations</th>
<th>Class&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Level&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Ref. &lt;sup&gt;c&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICD implantation is recommended in patients with a diagnosis of SQTS who</td>
<td>I</td>
<td>C</td>
<td>119, 447</td>
</tr>
<tr>
<td>(a) Are survivors of an aborted cardiac arrest, and/or</td>
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<td></td>
<td></td>
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<tr>
<td>(b) Have documented spontaneous sustained VT.</td>
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<tr>
<td>Quinidine or sotalol may be considered in patients with a diagnosis of SQTS who</td>
<td>IIb</td>
<td>C</td>
<td>118, 448</td>
</tr>
<tr>
<td>who qualify for an ICD but present a contra-indication to the ICD or refuse it.</td>
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<tr>
<td>Quinidine or sotalol may be considered in asymptomatic patients with a diagnosis</td>
<td>IIb</td>
<td>C</td>
<td>118, 448</td>
</tr>
<tr>
<td>of SQTS and a family history of SCD.</td>
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</tr>
<tr>
<td>Invasive EPS with PVS is not recommended for SCD risk stratification.</td>
<td>III</td>
<td>C</td>
<td>118, 119</td>
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ΕΥΧΑΡΙΣΤΩ