Ηλεκτρική Θύελλα: πότε είναι η καταλληλότερη στιγμή για την επεμβατική αντιμετώπιση;

Χατζίδου Σοφία – Διευθύντρια
ΓΝΑ Αλεξάνδρα

Σεμινάρια Ομάδων Εργασίας, Θεσσαλονίκη 2019
Electrical Storm (ES)

Definition (no consensus)

- **In patients without ICD**: ≥3 or more distinct episodes of VT or VF within 24h
- **In patients with ICD**: ≥3 appropriate device therapies within 24h separated from one another by at least 5 minutes
ES - Incidence

- The overall incidence is approximately **2% to 10% per year follow-up period** in patients with ICDs.

- **10% to 58%** of ICD recipients for **secondary** prevention while **4% to 7%** for **primary** prevention experience an ES during their lives.

*JACC 1998;32:1909-1915*
Role of ES as a mortality and morbidity risk factor and its clinical predictors: a meta-analysis (13 studies)

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>Electrical storm</th>
<th>No Electrical storm</th>
<th>Risk ratio Random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Events</td>
<td>Total</td>
<td>Events</td>
<td>Total</td>
</tr>
<tr>
<td>Fries et al. 1997</td>
<td>10</td>
<td>34</td>
<td>1</td>
</tr>
<tr>
<td>Credner et al. 1998</td>
<td>2</td>
<td>14</td>
<td>6</td>
</tr>
<tr>
<td>Bansch et al. 2000</td>
<td>16</td>
<td>30</td>
<td>5</td>
</tr>
<tr>
<td>Greene et al. 2000</td>
<td>10</td>
<td>40</td>
<td>18</td>
</tr>
<tr>
<td>Exner et al. 2001</td>
<td>34</td>
<td>90</td>
<td>69</td>
</tr>
<tr>
<td>Verma et al. 2004</td>
<td>57</td>
<td>208</td>
<td>159</td>
</tr>
<tr>
<td>Stuber et al. 2005</td>
<td>11</td>
<td>51</td>
<td>12</td>
</tr>
<tr>
<td>Gatzoulis et al. 2005</td>
<td>17</td>
<td>32</td>
<td>19</td>
</tr>
<tr>
<td>Hohnloser et al. 2006</td>
<td>4</td>
<td>148</td>
<td>16</td>
</tr>
<tr>
<td>Brigadeau et al. 2006</td>
<td>25</td>
<td>123</td>
<td>28</td>
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<tr>
<td>Sesselberg et al. 2007</td>
<td>15</td>
<td>27</td>
<td>82</td>
</tr>
<tr>
<td>Nordbeck et al. 2010</td>
<td>13</td>
<td>40</td>
<td>24</td>
</tr>
<tr>
<td><strong>Total (95% CI)</strong></td>
<td><strong>837</strong></td>
<td><strong>4911</strong></td>
<td></td>
</tr>
</tbody>
</table>

Total events 213
Heterogeneity: $t^2 = 0.25; \chi^2 = 47.93, df = 11 (P < 0.00001); I^2 = 77\%$
<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>Electrical storm Events</th>
<th>Total Events</th>
<th>No Electrical storm Events</th>
<th>Total Events</th>
<th>Weight</th>
<th>Risk ratio Random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credner et al. 1998</td>
<td>4</td>
<td>14</td>
<td>3</td>
<td>43</td>
<td>10.9%</td>
<td>4.10 [1.04, 16.12]</td>
</tr>
<tr>
<td>Bansch et al. 2000</td>
<td>20</td>
<td>30</td>
<td>9</td>
<td>43</td>
<td>51.0%</td>
<td>3.19 [1.69, 6.00]</td>
</tr>
<tr>
<td>Greene et al. 2000</td>
<td>14</td>
<td>40</td>
<td>9</td>
<td>57</td>
<td>38.1%</td>
<td>2.22 [1.06, 4.62]</td>
</tr>
<tr>
<td><strong>Total (95% CI)</strong></td>
<td><strong>84</strong></td>
<td><strong>143</strong></td>
<td><strong>100.0%</strong></td>
<td></td>
<td></td>
<td><strong>2.85 [1.81, 4.48]</strong></td>
</tr>
</tbody>
</table>

Total events: 38, 21

Heterogeneity: $\tau^2 = 0.00; \chi^2 = 0.84, \text{df} = 2 (P = 0.66); I^2 = 0\%$
Clinical Factors associated with ↑ incidence of ES

- Lower EF
- Implantation of a secondary prevention ICD
- Treatment with Class I AAD
- Monomorphic VT
Mechanism of ES

- Triggers:
  - Previous ventricular arrhythmias
  - Genetic diseases (e.g., LQT)
  - Poor ventricular function
  - Electrolyte disturbances
  - Ischemia
  - Heart Failure
  - Changes/non-compliance to medications
  - Excess alcohol

- Structural Vulnerability:
  - Autonomic remodeling
  - Tissue specific remodeling

- Electrical Storm

- Electrophysiologic Vulnerability
### Implications of ES

#### A

<table>
<thead>
<tr>
<th>Shock Type</th>
<th>Hazard Ratio for Death (95% CI)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥1 App vs. no App</td>
<td>5.68 (3.97–8.12)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>≥1 Inapp vs. no Inapp</td>
<td>1.98 (1.29–3.05)</td>
<td>0.002</td>
</tr>
<tr>
<td>Both shock types vs. no shock</td>
<td>11.27 (6.70–18.94)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

#### B

<table>
<thead>
<tr>
<th>Shock Type</th>
<th>Hazard Ratio for Death (95% CI)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 App vs. no App</td>
<td>3.98 (2.52–6.30)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>≥2 Apps vs. no App</td>
<td>8.23 (4.64–14.59)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>≥2 Apps plus 1 Inapp vs. no shock</td>
<td>15.89 (7.42–34.02)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

• AVID: ↑mortality 5.6 fold in 3 months
• MADIT II: ↑mortality 18 fold in 3 months
Treatment of ES

• Underlying mechanism
• Device reprogramming
• Pharmacotherapy
• Sedation
• Neuraxial modulation
• Radiofrequency ablation
Underlying mechanism

• Electrolyte disturbances
• Acute ischemia
• Volume overload
Device reprogramming

ICD interrogation

ICD programming

• Lower VF detection rate
• Reduced detection time
• ↑ ATP (slow VTs)
ES treatment

Hemodynamically unstable PATIENTS
- ACLS protocol with elective cardioversion

Hemodynamically stable PATIENTS
- Initial antiarrhythmic medical therapy
  - IV amiodarone + beta blocker

Patients with active myocardial ischemia
- urgent coronary revascularization
Treatment of ES - hemodynamic stability

- While patients with ES or incessant VT who are hemodynamically stable do not usually require emergent electrical cardioversion, **but** urgent therapy and decrease of adrenergic nervous system is necessary.

**Hemodynamically stable PATIENTS**

**Initial antiarrhythmic medical therapy**

- **IV amiodarone**
  - (150 mg IV over 10 minutes, followed by 1 mg/minute IV infusion for 6 hours, followed by 0.5 mg/minute IV infusion for 18 additional hours)

- **PO propranolol**
  - (40 mg every 6 hours for the first 48 hours, with additional doses as needed for recurrent breakthrough ventricular arrhythmias)
Propranolol Versus Metoprolol for Treatment of Electrical Storm in Patients With Implantable Cardioverter-Defibrillator

Sofia Chatzidou, MD, PhD, a, * Christos Kontogiannis, MD, a, * Diamantis I. Tsilimigras, MD, b, * Georgios Georgiopoulos, MD, PhD, a Marinos Kosmopoulos, MD, b Elektra Papadopoulou, MD, a Georgios Vasilopoulos, MD, PhD, a Stylianos Rokas, MD, PhD a
Patients were randomly assigned to either a nonselective β-blocker (propranolol) or a β1-selective blocker (metoprolol) along with intravenous amiodarone in a 1:1 ratio.

Chatzidou S et al. JACC 2018 May 1;71(17):1897-1906.
Patients in Group A (presented significantly increased odds for event-free 6-h time periods compared with Group B in all examined time points (p < 0.05) except for the 0 to 6 h and 42 to 48 h periods.

Kaplan-Meier curve for time to arrhythmia termination. The median time from initiation of therapy to termination of VT or VF events was 3 h in Group A vs 18 h and Group

At the end of the first 24-h, 27 of 30 patients (90%) in Group A were free of arrhythmic events, whereas 16 of 30 patients (53.3%) in Group B remained free of events.

Chatzidou S et al. JACC 2018 May 1;71(17):1897-1906.
OPTIC STUDY

![Graph showing cumulative rate of shock over time since randomization for different treatments: β-Blocker, Sotalol, Amiodarone + β-Blocker.]

**No. at Risk**
- β-Blocker: 138, 119, 109, 91, 42
- Sotalol: 134, 118, 108, 94, 35
- Amiodarone + β-Blocker: 140, 124, 115, 106, 56
Electrical storm and Catheter Ablation

• Catheter ablation of ventricular tachyarrhythmias is an important and effective therapy for ES or incessant VT.

• **RECOMMENDATIONS:**
  - When ES persists or recurs in spite of medical therapy with amiodarone and a beta blocker (propranolol)
  - In patients whose ventricular tachyarrhythmias are controlled with medical therapy but who are intolerant of medical therapy due to side effects.
From a systematic review and meta-analysis of 471 patients with ES compiled from 39 publications:

- high initial **success rate** for ablation of all ventricular arrhythmias (72%)
- low **procedural mortality** rate (0.6%)
- relatively low **recurrence rate** of over 61 weeks mean follow-up (6%)
Long Term Outcomes of catheter ablation of ES in NIDCM compared with ICM

A. Overall Death/Transplant free Survival

B. Death/Transplant free survival according to Etiology

C. Overall VT recurrence free Survival

D. VT recurrence free survival according to Etiology

E. Overall ES recurrence free Survival

F. ES recurrence free survival according to Etiology

JACC Clin Electrophysiol 2017:767-768
Neuraxial Modulation

- Thoracic epidural anesthesia (TEA)
- Stellate ganglion blockade (SG)
- Surgical CSD
- RSD
CSD in patients for refractory VA

A

B

Follow Up (months)

Freedom from VT/ICD Shocks

Freedom from Death or OHT

No. at Risk 121 67 55 44 36 26 23

No. at Risk 121 92 76 65 54 41 37

JACC 2017;69:3070-3078
Electrical storm and Maintenance antiarrhythmic therapy

Antiarrhythmic therapy should be maintained in the following patients:

• Patients who have not undergone catheter ablation, in whom stopping antiarrhythmic therapy would put them at risk for recurrent arrhythmias.

• Patients who have undergone catheter ablation, until there is evidence of no recurrent arrhythmias following the procedure, at which point the treating clinician may consider stopping the antiarrhythmic medication.
Electrical storm and Maintenance antiarrhythmic therapy

- In patients who require an antiarrhythmic drug, we typically prefer amiodarone in patients with HF and LV dysfunction.

- Often, a beta blocker is co-administered with antiarrhythmic drugs. Beta blockers are often separately indicated in patients with ventricular arrhythmias due to coexistent HF, LV dysfunction, and/or CAD.

- Other therapeutic options: sotalol (III) or mexiletine (IB) (To reduce the frequency of ventricular arrhythmias, to suppress supraventricular arrhythmias)
Σας ευχαριστώ