Arrhythmia in Acute Coronary Syndrome

E. Pruvot, MD, CHUV
Background

• 10-15% of survivors of acute myocardial infarction (AMI) with ↓LVEF die within the first 2 y after the event \(^1,2\)

• 80% of death are cardiac in post-MI patients:
  – with 50% of sudden cardiac death (SCD) due to tachy- and bradyarrhythmias \(^1\)

## Prevalence of arrhythmias in the acute phase of MI

<table>
<thead>
<tr>
<th></th>
<th>Prevalence</th>
<th>Prognostic Impact ?</th>
<th>Treatment required ?</th>
</tr>
</thead>
<tbody>
<tr>
<td>AF</td>
<td>6-28%</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>OAC/Rate vs Rhythm ctrl</td>
</tr>
<tr>
<td>VPCs</td>
<td>~ 100%</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Non sustained VT</td>
<td>13%</td>
<td>No likely</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Except incessant</td>
</tr>
<tr>
<td>Sustained VT (&gt;120 bpm)</td>
<td>3%</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>VF</td>
<td>3%</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

ESC guidelines. Management of acute MI. EHJ 2012;33:2569-619
• EU/US guidelines do not recommend early ICD implantation for peri-MI VF/VT because of the potential reversibility of arrhythmic triggers (i.e. ischemia) ⇒ weak level of evidence
Gap in knowledge

Do peri-MI ventricular tachyarrhythmias impact on the prognosis on the short- and long-term?

– Shall I implant an ICD to prevent recurrences?

Conflicting results regarding the prognostic value of peri-MI VT/VF

• Several studies have shown that patients who develop peri-MI unstable VT/VF are at risk of † in the short-term (i.e. in-hospital) ¹,²

• Data on the mid-to-long term survival of patients with peri-MI VF/VT are controversial:
  – No impact on long-term † (Demidova M. EHJ-ACC 2012;1(4):302-11)
  – Increase in long-term † (Piccini J. Circulation 2012;126:41-9)

Incidences of SCD after peri-MI VF/VT

FAST-MI. Bourgoin W. EHJ 2014;35:116-22

- Registry including 3’670 pts with AMI (NON/STEMI <48h), over 1-month (223 centers), followed-up for 5y

- **VF occurred in 3.2% of the cases:**
  - VF occurred 1.8 days (1.4-2.2) from Dx of AMI
  - 80% as **EARLY** VF (<48h after MI)
  - 20% as **LATE** VF (>48h after MI)

- **MVA of factors predictive of VF:**
  - STEMI (OR 2.4)
  - AF on 1ST ECG (OR 2.5)
  - Hx of STROKE (OR 2.4)
  - AGE <60y (OR 1.7)

  (anterior MI, TIMI flow, nb of diseased vessels, etc: not significant)
In-hospital mortality according to VF occurrence. *FAST-MI. Bourgoin W. EHJ 2014;35:116-22*

- In-hospital ↑ rate of AMI = 5.6%

After adjustment for multiple variables, VF remained significantly associated with in-hosp ↑ (OR 7.4)

- Late VF: poorer in-hospital prognosis than *Early VF*
Long-term mortality according to VF occurrence. FAST-MI. Bourgoin W. EHJ 2014;35:116-22

- LVEF at discharge in VF survivors (47%) < non-VF pts (52%)
- Survival rate at 5y in VF survivors (81%) ≡ non-VF pts (74%)
- MVA after adjustments for other prognostic factors:
  - peri-MI VF, VF+VT, sustained VT alone = not associated with long-term †
  - similar distribution of † causes including SCD:

  ![Graph showing survival rates](image)

  SCD rate : 0.68% vs 0.76%/y
Polymorphic VTs complicating STEMI
Prognosis and treatment: ESC guidelines

• Level of evidence = C:
  – Not RCT!
  – Except for the VALLIANT study: i.v. B-blockers in the 1st 24H after AMI in pts with early sustained VF/VT was associated with decreased early † w/o worsening HF (= Level B)

---

Table 25: Management of ventricular arrhythmias and conduction disturbances in the acute phase

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Class</th>
<th>Level</th>
<th>Ref</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polymorphic VT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• must be treated by i.v. beta-blocker ‡</td>
<td>I</td>
<td>B</td>
<td>320, 336</td>
</tr>
<tr>
<td>• or i.v. amiodarone ‡</td>
<td>I</td>
<td>C</td>
<td>-</td>
</tr>
<tr>
<td>• urgent angiography must be performed when myocardial ischaemia cannot be excluded</td>
<td>I</td>
<td>C</td>
<td>-</td>
</tr>
<tr>
<td>• may be treated with i.v. lidocaine</td>
<td>I</td>
<td>C</td>
<td>330</td>
</tr>
<tr>
<td>• must prompt assessment and correction of electrolyte disturbances consider magnesium</td>
<td>IIb</td>
<td>C</td>
<td>-</td>
</tr>
<tr>
<td>• should be treated with overdrive pacing using a temporary transvenous right ventricular lead or isoprotenerol infusion.</td>
<td>IIa</td>
<td>C</td>
<td>-</td>
</tr>
</tbody>
</table>
SECONDARY PREVENTION
Unstable (± polymorphic) VT or VF <48H post MI

- R = rarely appropriate; M = May be appropriate; A = Appropriate
- PMVT : felt as indicative of acute/subacute ischemia ⇒ likely reversible
  - >= sustained monomorphic VT in the same setting ⇒ considered as scar ⇒ poor prognosis
- Failure to revascularize : felt as an aggravating factor ⇒ from R to M

2013 Appropriate Use Criteria for ICD and CRT. JACC 2013;61:1318-68
Conclusions

• High rate of in-hospital † in patients with peri-MI VF and unstable VT ⇒ close monitoring up to 3 days:
  – In-hospital † = unsuccessful resuscitation
  – STEMI, <60y, left main disease, AF and Hx of stroke: ↑ risk of VF
  – Life-vest may be considered

• Natural course of VF/VT survivors (i.e. successful resuscitation) ≡ to non-arrhythmic patients:
  – † rate = 20-25% at 5y
  – Low SCD rate of ~0.7% /y

⇒ ICD unlikely to improve prognosis!
(≡ DINAMIT and IRIS trials in non VF/VT pts)
AFib complicating STEMI
Prognosis and treatment

• AFib complicates 6-28% of AMI:
  – Frequently associated with LV damage and HF
  – Several studies, but not all, have shown that AF peri-AMI is independently associated with in-hospital and with in-hospital and after discharged strokes
  – OAC required
  – Rate control achieved with oral/iv Bblockers and/or CCA
  – In pts with extensive AMI or severe LV dysfunction, rate control with iv digoxin and/or amiodarone

ESC guidelines. Management of acute MI. EHJ 2012;33:2569-619
AFib complicating STEMI
Prognosis and treatment

**Table 24** Management of atrial fibrillation

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Class</th>
<th>Level</th>
<th>Ref</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rhythm control should be considered in patients with atrial fibrillation secondary to a trigger or substrate that has been corrected (e.g. ischaemia).</td>
<td>IIA</td>
<td>C</td>
<td>-</td>
</tr>
<tr>
<td><strong>Acute rate control of atrial fibrillation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intravenous beta-blockers or non-dihydropyridine CCB (e.g. diltiazem, verapamil) are indicated if there are no clinical signs of acute heart failure.</td>
<td>I</td>
<td>A</td>
<td>323</td>
</tr>
<tr>
<td>Amiodarone or i.v. digitalis is indicated in case of rapid ventricular response in the presence of concomitant acute heart failure or hypotension.</td>
<td>I</td>
<td>B</td>
<td>324</td>
</tr>
<tr>
<td><strong>Cardioversion</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Immediate electrical cardioversion is indicated when adequate rate control cannot be achieved promptly with pharmacological agents in patients with atrial fibrillation and on-going ischaemia, severe haemodynamic compromise or heart failure.</td>
<td>I</td>
<td>C</td>
<td>-</td>
</tr>
<tr>
<td>Intravenous amiodarone is indicated for conversion to sinus rhythm in stable patients with recent onset atrial fibrillation and structural heart disease.</td>
<td>I</td>
<td>A</td>
<td>250</td>
</tr>
<tr>
<td>Digoxin (LoE A), verapamil, sotalol, metoprolol (LoE B) and other beta-blocking agents (LoE C) are ineffective in converting recent onset atrial fibrillation to sinus rhythm and should not be used for rhythm control (although beta blockers or digoxin may be used for rate control).</td>
<td>III</td>
<td>A</td>
<td>250</td>
</tr>
</tbody>
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ESG guidelines. Management of acute MI. EHJ 2012;33:2569-619
VTAs complicating STEMI
Prognosis and treatment

• VPCs and nsVT common peri-AMI:
  – No specific treatment required

• Runs of nsVT not reliable predictive markers for early VF:
  – No treatment unless associated with hypotension/HF that may trigger VF

• Sustained or unstable VT requires suppressive therapy:
  – Electrical CV is the safest method for termination
  – If VT unstable: iv amiodarone, sotalol, lidocaine (lido for acute ischemic VT only) may be used but acute conversion rate LOW!
  – Amiodarone = AA of choice for pts with reduced LV fct.
VTs complicating STEMI
Prognosis and treatment: ESC guidelines

• Level of evidence = C :
  – Not RCT!

Table 25 Management of ventricular arrhythmias and conduction disturbances in the acute phase

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<td>Direct current cardioversion is indicated for sustained VT and VF.</td>
<td>I</td>
<td>C</td>
<td>-</td>
</tr>
<tr>
<td>Sustained monomorphic VT that is recurrent or refractory to direct current cardioversion; should be considered to be treated with i.v. amiodarone.</td>
<td>IIa</td>
<td>C</td>
<td>-</td>
</tr>
<tr>
<td>may be treated with i.v. lidocaine or sotalol.</td>
<td>IIb</td>
<td>C</td>
<td>-</td>
</tr>
<tr>
<td>Transvenous catheter pace termination should be considered if VT is refractory to cardioversion or frequently recurrent despite antiarrhythmic medication.</td>
<td>IIa</td>
<td>C</td>
<td>-</td>
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<tr>
<td>Repetitive symptomatic salvoes of non-sustained monomorphic VT should be considered for either conservative management (watchful waiting) or treated with i.v. beta-blocker, or sotalol, or amiodarone.</td>
<td>IIa</td>
<td>C</td>
<td>-</td>
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Polymorphic VTs complicating STEMI
Prognosis and treatment: ESC guidelines

• Level of evidence = C :
  – Not RCT!
  – Except in the VALLIANT study where B-blockers given in the 1st 24H after AMI in pts with early sustained VF/VF was associated with decreased early † w/o worsening HF (= Level B)

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ESC guidelines. Management of acute MI. EHJ 2012;33:2569-619
VF complicating STEMI
Prognosis and treatment: ESC guidelines

• Immediate defibrillation required

• No benefit of prophylactic lidocaine use:
  – Meta-analysis of 14 trials showed a trend towards higher † (Hine K. Arc Intern Med 1989;149:2694-98)

• Urgent revx mandatory if not performed yet

• No benefit of ICD in this population:
  – Observational data, no RCT

ESC guidelines. Management of acute MI. EHJ 2012;33:2569-619
AV block complicating STEMI
Prognosis and treatment: ESC guidelines

• 2\textsuperscript{nd} degree type I AVB:
  – Associated with inferior MI
  – Seldom causes adverse hemodynamic effect
  – If needed, atropine first then pacing
  – Withholding of agents slowing AV conduction

• 2\textsuperscript{nd} degree type II AVB:
  – Pacing if bradycardia causes hypotension or HF
  – DDD pacing my be needed sometimes
  – Urgent revx if not performed yet
  – Inferior MI results in supra-Hisian block
  – Anterior MI results in infra-Hisian block:
    • Pacing usually required because of low escape rhythm
    • May be prophylactically considered for bifascicular and trifascicular block

• Permanent pacing indicated for:
  – Persistent 3\textsuperscript{rd} degree AVB
  – Persistent 2\textsuperscript{nd} degree AVB with BBB
  – Transient type II or transient complete AVB associated with new onset BBB
AV block complicating STEMI
Prognosis and treatment: AHA/ACC/HRS guidelines

- The criteria for pacing in patients with MI and AVB do not necessarily depend on the presence of symptoms.
- The long-term prognosis for survivors of AMI who have had AVB is related primarily to the extent of myocardial injury and the type of intraventricular conduction disturbances, rather than the AVB itself.
- Patients with AMI who have intraventricular conduction defects, with the exception of isolated left anterior fascicular block, have an unfavorable short and long-term prognosis and an increased risk of SCD.
- Whether the AMI is anterior or inferior, the development of an intraventricular conduction delay reflects extensive myocardial damage rather than an electrical problem.
- Although AVB during inferior AMI may have a favorable long-term outcome, in-hospital mortality is impaired irrespective of temporary pacing.
AV block complicating STEMI: 2nd and 3rd degree infra-nodal AVB
Prognosis and treatment: AHA/ACC/HRS guidelines

**CLASS I**

1. Permanent ventricular pacing is indicated for persistent second-degree AV block in the His-Purkinje system with alternating bundle-branch block or third-degree AV block within or below the His-Purkinje system after ST-segment elevation MI. *(Level of Evidence: B)* *(79,126–129,131)*

2. Permanent ventricular pacing is indicated for transient advanced second- or third-degree infranodal AV block and associated bundle-branch block. If the site of block is uncertain, an electrophysiological study may be necessary. *(Level of Evidence: B)* *(126,127)*

3. Permanent ventricular pacing is indicated for persistent and symptomatic second- or third-degree AV block. *(Level of Evidence: C)*
AV block complicating STEMI: 2\textsuperscript{nd} and 3\textsuperscript{rd} degree nodal AVB
Prognosis and treatment: AHA/ACC/HRS guidelines

Class IIb

1. Permanent ventricular pacing may be considered for persistent second- or third-degree AV block at the AV node level, even in the absence of symptoms. (Level of Evidence: B) (58)
AV block complicating STEMI: transient AVB or BBB
Prognosis and treatment: AHA/ACC/HRS guidelines

CLASS III

1. Permanent ventricular pacing is not indicated for transient AV block in the absence of intraventricular conduction defects. *(Level of Evidence: B) (126)*

2. Permanent ventricular pacing is not indicated for transient AV block in the presence of isolated left anterior fascicular block. *(Level of Evidence: B) (128)*

3. Permanent ventricular pacing is not indicated for new bundle-branch block or fascicular block in the absence of AV block. *(Level of Evidence: B) (66,126)*

4. Permanent ventricular pacing is not indicated for persistent asymptomatic first-degree AV block in the presence of bundle-branch or fascicular block. *(Level of Evidence: B) (126)*

Device guidelines: 2012 Update. JACC 2013;61:e6-75
VENTRICULAR ARRHYTHMIA PREVALENCE PERI-AMI PROGNOSTIC IMPACT
Incidence of SCD after VF/VT peri-AMI

FAST-MI. Bourgoin W. EHJ 2014;35:116-22

- Registry including 3’670 pts with AMI (NON/STEMI <48h), over 1-month (223 centers), followed-up for 5y

- **VF occurred in 3.2% of the cases:**
  - VF occurred 1.8 days (1.4-2.2) from Dx of AMI
  - 80% as **EARLY** VF (<48h of admission)
  - 20% as **LATE** VF (>48h of admission)

- **MVA of factors predictive of VF:**
  - STEMI (OR 2.4) - Hx of STROKE (OR 2.4)
  - AF ON 1<sup>ST</sup> ECG (OR 2.5) - AGE <60y (OR 1.7)

  (ant MI, TIMI flow, nb of diseased vessels, etc not significant)
In-hospital mortality according to VF occurrence. FAST-MI. Bourgoin W. EHJ 2014;35:116-22

- In-hospital † rate of AMI= 5.6%

- After adjustment for multiple variables, VF remained significantly associated with in-hosp † (OR 7.4)

- Late VF poorer in-hospital prognosis than Early VF
In-hospital mortality according to VF occurrence. *FAST-MI. Bourgoin W. EHJ 2014;35:116-22*

Table 3: Cause-specific death during hospitalization according to occurrence of VF

<table>
<thead>
<tr>
<th></th>
<th>VF (29/116)</th>
<th>No VF (178/3554)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sudden cardiac death, n (%)</td>
<td>11 (37.9)</td>
<td>52 (29.2)</td>
<td></td>
</tr>
<tr>
<td>Arrhythmic SCD, n (%)</td>
<td>9/11 (81.8)</td>
<td>20/52 (38.5)</td>
<td></td>
</tr>
<tr>
<td>Non-arrhythmic SCD, n (%)</td>
<td>2/11 (18.2)</td>
<td>32/52 (61.5)</td>
<td></td>
</tr>
<tr>
<td>Cardiogenic shock, n (%)</td>
<td>11 (37.9)</td>
<td>98 (55.1)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Other cardiovascular, n (%)</td>
<td>1 (3.5)</td>
<td>12 (6.7)</td>
<td></td>
</tr>
<tr>
<td>Non-cardiovascular death, n (%)</td>
<td>6 (20.7)</td>
<td>16 (9.0)</td>
<td></td>
</tr>
</tbody>
</table>

† 25% vs. † 5%

• Causes of death in VF ≠ non-VF pts:
  - SCD † (unsuccessful resuscitation), Cardiac shock ↓ in VF
  - SCD ↓, Cardiac shock † in non-VF
Long-term mortality according to VF occurrence. *FAST-MI. Bourgoin W. EHJ 2014;35:116-22*

**Table 5** Cause-specific deaths at 5 years among survivors at discharge, by occurrence of VF

<table>
<thead>
<tr>
<th></th>
<th>VF (23/87)</th>
<th>No VF (1001/3376)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sudden cardiac death, n (%)</td>
<td>3 (13.1)</td>
<td>129 (12.9)</td>
<td>0.71</td>
</tr>
<tr>
<td>Non-sudden cardiac death, n (%)</td>
<td>5 (21.7)</td>
<td>331 (33.1)</td>
<td></td>
</tr>
<tr>
<td>Non-cardiovascular death, n (%)</td>
<td>8 (34.8)</td>
<td>242 (24.2)</td>
<td></td>
</tr>
<tr>
<td>Unknown or unclassifiable, n (%)</td>
<td>7 (30.4)</td>
<td>299 (29.8)</td>
<td></td>
</tr>
</tbody>
</table>

• Causes of death in VF = non-VF pts:
  – SCD ↓, cardiac death ~1/3, non cardiac death ~1/3
Long-term mortality according to VF occurrence. *FAST-MI. Bourgoin W. EHJ 2014;35:116-22*

- LVEF at discharge in VF survivors (47%) < non-VF pts (52%)
- Survival rate at 5y in VF survivors (81%) ≡ non-VF pts (74%)
- MVA after adjustments for other prognostic factors:
  - Peri-AMI VF, VF+VT, sustained VT alone = not associated with long-term †
  - Similar distribution of † causes including SCD:
    
    SCD rate: 0.68% vs 0.76%/y
Conclusions

• High rate of in-hospital † in patients with VF peri-AMI ⇒ close monitoring up to 3 days:
  – STEMI, <60y, AF and Hx of stroke: ↑ risk of VF
  – † due to unsuccessful resuscitation

• Natural course of VF survivors (i.e. successful resuscitation) ≡ to non-VF patients:
  – † rate = 20-25% at 5y
  – Low SCD rate of ~0.75% /y

⇒ ICD unlikely to improve prognosis!
(e.g. DINAMIT and IRIS trials in non VF/VT pts)
SECONDARY PREVENTION

1A. Unstable (± polymorphic) VT or VF <48H post MI

- R = rarely appropriate; M = May be appropriate; A = Appropriate
- PMVT: felt as indicative of acute/subacute ischemia ⇒ likely reversible
  - => sustained monomorphic VT in the same setting ⇒ considered as scar ⇒ poor prognosis
- Failure to revascularize: felt as an aggravating factor ⇒ from R to M

2013 Appropriate Use Criteria for ICD and CRT. JACC 2013;61:1318-68
Sustained VT/VF peri-NSTEMI

Piccini J. Circulation 2012;126:41-9

- 9’211 patients with NSTE, 440 centers, 1y-FU
- Sustained VT/VF defined as >30 sec requiring Tx w/o hemodynamic compromise.
- In-hospital sust-VT/VF rate: 1.5% (0.6% <48h, 0.9% >48h admission), 0.8% sust-VT, 0.9% VF (some with both)
- Median time to sust-VT/VF = 5 days
Sustained VT/VF peri-NSTEMI

Piccini J. Circulation 2012;126:41-9

• Higher Killip class, ↑ Trop at BL and prior angina in VF/VT vs non VF/VT pts

• ↓ LVEF with 22% <40% vs 5% in VT/VF vs non-VT/VF:
  – But 40% of VF/VT pts had LVEF >40%

• TIMI and frequency of prior MI ≡ between groups

### Table 2. Factors Associated With Time to Any Sustained Ventricular Tachycardia/Ventricular Fibrillation After Multivariable Adjustment

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Hazard Ratio</th>
<th>95% Confidence Interval</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systolic BP (per 20 mm Hg)*</td>
<td>0.76</td>
<td>0.64–0.89</td>
<td>0.0005</td>
</tr>
<tr>
<td>WBC (per 2×10⁹/L)†</td>
<td>1.15</td>
<td>1.06–1.25</td>
<td>0.0012</td>
</tr>
<tr>
<td>Creatinine clearance (per 30 mL/min):‡</td>
<td>0.77</td>
<td>0.64–0.93</td>
<td>0.0062</td>
</tr>
<tr>
<td>Elevated troponin</td>
<td>2.56</td>
<td>1.29–5.01</td>
<td>0.0070</td>
</tr>
<tr>
<td>Killip class higher than I</td>
<td>1.72</td>
<td>1.13–2.61</td>
<td>0.0109</td>
</tr>
<tr>
<td>Weight (per 10 kg ≥90 kg):§</td>
<td>1.26</td>
<td>1.06–1.51</td>
<td>0.0109</td>
</tr>
<tr>
<td>Heart rate (per 20 bpm):¶</td>
<td>1.19</td>
<td>1.03–1.38</td>
<td>0.0183</td>
</tr>
<tr>
<td>History of angina</td>
<td>1.61</td>
<td>1.05–2.47</td>
<td>0.0275</td>
</tr>
</tbody>
</table>

MVA of sustained VT/VF:
• Trop at BL,
• Killip >1
  most predictive
Sustained VT/VF peri-NSTEMI

Piccini J. Circulation 2012;126:41-9

- Prior MI in VF, VF/VT > VT only pts
- 30-d mortality in survivors of VF/VT (77%) >> VF only (48%) >> VT only (16%) pts

<table>
<thead>
<tr>
<th>Table 3. Type of Sustained Ventricular Arrhythmia and 30-Day Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>n</td>
</tr>
<tr>
<td>Prior MI, n (%)</td>
</tr>
<tr>
<td>n</td>
</tr>
<tr>
<td>Left ventricular ejection fraction</td>
</tr>
<tr>
<td>≥0.50, n (%)</td>
</tr>
<tr>
<td>0.30–0.49, n (%)</td>
</tr>
<tr>
<td>&lt;0.30, n (%)</td>
</tr>
<tr>
<td>n</td>
</tr>
<tr>
<td>30-d mortality, n (%)</td>
</tr>
</tbody>
</table>
Sustained VT/VF peri-NSTEMI
Piccini J. Circulation 2012;126:41-9

• ↑ 2-30 day † for survivors of early VF/VT (<48h) compared to non-VT/VF pts (13% vs 2.2%)
• Odds of † remained similar after multiple adjustments including LVEF

Table 4. Early Sustained Ventricular Tachycardia/Ventricular Fibrillation and Risk of Death Between 48 Hours and 30 Days

<table>
<thead>
<tr>
<th></th>
<th>30-Day Mortality OR (95% CI)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unadjusted risk</td>
<td>6.84 (2.87–16.33)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Baseline characteristics, randomized treatment, and medications</td>
<td>6.73 (2.68–16.90)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Plus revascularization</td>
<td>7.63 (2.98–19.56)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Plus LVEF</td>
<td>7.12 (2.76–18.40)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>LVEF ≥50%</td>
<td>3.23 (0.17–17.04)</td>
<td>0.83*</td>
</tr>
<tr>
<td>LVEF 30%–49%</td>
<td>6.73 (1.00–26.84)</td>
<td></td>
</tr>
<tr>
<td>LVEF &lt;30%</td>
<td>7.05 (0.89–41.09)</td>
<td></td>
</tr>
</tbody>
</table>

OR indicates odds ratio; CI, confidence interval; and LVEF, left ventricular ejection fraction.
Sustained VT/VF peri-NSTEMI
Piccini J. Circulation 2012;126:41-9

• 1-y † in VT/VF ≥48h (OR 21) >> VT/VF <48h (OR 7.5) >> non VT/VF pts, before and after multiple adjustments including the LVEF

• Results differed from the FAST-MI study (i.e. STEMI and VF only) which showed no long-term prognostic impact of VF in survivors
Prognostic impact of early VF in STEMI
Demidova M. EHJ-ACC 2012;1(4):302-11

- Most of scientific evidence on the lack of prognostic value of early VF dates from pre-thrombolysis era or before reperfusion T\(^x\) widely accepted.

- 1’718 pts (66y, 70% male) with STEMI:
  - 7% with unstable VT/VF <48h of STEMI (including 3.1% resuscitated out-hospital)**
  - 60% before PCI, 21% during reperfusion, 18% after PCI
  - 96% of VT/VF occurred within 1day of STEMI

- Independent predictors of VT/VF:
  - Current smoking (OR 2.8)
  - Digitalis at admission (OR 4.7)
  - Bblock Tx (OR 2.5*)
  - Left main (OR 3.1)
Prognostic impact of early VF in STEMI
Demidova M. EHJ-ACC 2012;1(4):302-11

• 1’663 pts alive >48h after STEMI:
  – † rate in the VT/VF group = 12.9% (13/101 pts)
    • 92% (12/13) of † occurred during hospitalization
  – † rate in the non VT/VF group = 5.6% (87/1’562 pts)
    • 28% (24/87) deaths occurred during hospitalization

• In-hospital † in the VT/VF group (Δ non *):
  – 11% for VT/VF occurring before PCI
  – 9% for VT/VF during reperfusion
  – 18% for VT/VF occurring after PCI
Prognostic impact of early VF in STEMI  
Demidova M. EHJ-ACC 2012;1(4):302-11

• No difference in † at 1y in pts w/o VT/VF discharged alive from the hospital after exclusion of early †:
  – 1.1% in VT/VF vs 4.1% in no VT/VF group
  – † mostly due to early in-hospital † (unrelated to VT/VF in those alive at 48h post STEMI, i.e. exclusion of resuscitated pts), then parallel curves

Patients alive 48h post MI : difference is mostly due to in-hospital †
Prognostic impact of early VF in STEMI
Demidova M. EHJ-ACC 2012;1(4):302-11

• Pts discharged alive from the hospital after exclusion of in-hospital †:
  – None of the pts who received an ICD for I prevention (n=18) received adequate ICD Tx thereafter
  – ICD was beneficial only in pts who developed spontaneous VT/VF after discharged (= II prevention)

Patients discharged alive from the hospital= no significant difference thereafter
Conclusions
Demidova M. EHJ-ACC 2012;1(4):302-11

- 96% of sustained VT/VF occurred within 24h of admission, which is in contrast with earlier studies before revx or during thrombolysis era reporting higher numbers up to 48h

- Prior MI and left main occlusion are predictive of VT/VF but not inferior localization (>< Mehta JACC 2004, JAMA 2009)

- †† in pts Tx with B-blockers: interpreted as an indicator of underlying CV disease rather than a risk in itself.

- Higher in-hospital † for VT/VF occurring before, during and after revx but no long term prognostic value for those discharged alive

- No clear benefit of ICD in primary prevention for those with VT/VF discharged alive from the hospital
REPERFUSION VF DURING AMI
NO PROGNOSTIC IMPACT
Predictors of reperfusion VF in STEMI

(Demodova MM. AJC 2015;115:417-22)

• VF during reperfusion (rVF) analyzed together with peri-AMI VF

• Data on predictive value of dynamic ECG changes are lacking: Method:
  – ECGs with complete RBBB/LBBB excluded from the analysis of repolarization
  – Comparision of max ST elevation in a single lead and sum of ST deviation (elevation + depression) in all 12 leads

• 3’274 pts with STEMI (67yo) ⇒ PCI between 2007-2012:
  – 71 (1.9%) with rVF (admission ECG N/A in 16) ⇒ 55 pts = rVF group
  – 614 consecutive pts in 2007 (admission ECG N/A in 102) ⇒ 512 pts = ctrl group
Predictors of reperfusion VF in STEMI
(Demodova MM. AJC 2015;115:417-22)

- 100% of rVF pts had total acute coronary occlusion
- Only left main disease and sum of ST elevation >1500 μV associated with rVF at MVA:
  - Indicative of more intensive and larger area involved in reperfusion VF
  - Inferior MI not significant in MVA!

<table>
<thead>
<tr>
<th>Clinical factors associated with VF during reperfusion</th>
<th>Univariate analysis</th>
<th>Multivariate analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Characteristics at admission</td>
<td>OR</td>
<td>95% CI</td>
</tr>
<tr>
<td>Previous MI</td>
<td>1.93</td>
<td>1.04-3.58</td>
</tr>
<tr>
<td>QRS duration at historical ECG</td>
<td>1.02</td>
<td>1.003-1.04</td>
</tr>
<tr>
<td>K⁺ at admission</td>
<td>0.40</td>
<td>0.22-0.73</td>
</tr>
<tr>
<td>VF before PCI</td>
<td>4.15</td>
<td>1.95-8.81</td>
</tr>
<tr>
<td>Medications:</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Aspirin</td>
<td>1.88</td>
<td>1.09-3.22</td>
</tr>
<tr>
<td>B-blockers</td>
<td>1.86</td>
<td>1.09-3.19</td>
</tr>
<tr>
<td>Symptom-to-balloon time &lt;360 min</td>
<td>2.19</td>
<td>1.08-4.42</td>
</tr>
<tr>
<td>Left main stenosis</td>
<td>4.47</td>
<td>1.19-18.80</td>
</tr>
<tr>
<td>Inferior MI</td>
<td>1.89</td>
<td>1.09-3.29</td>
</tr>
<tr>
<td>ST max &gt;300 μV</td>
<td>4.87</td>
<td>2.34-10.16</td>
</tr>
<tr>
<td>Sum ST &gt;1500 μV</td>
<td>6.44</td>
<td>2.86-14.53</td>
</tr>
</tbody>
</table>

CI = confidence interval; MI = myocardial infarction; OR = odds ratio; ST max = maximal ST-segment in the lead with the most prominent elevation; Sum ST = sum of ST-segment deviations in all leads.
Reperfusion VF during STEMI does not increase in-hospital †. (Demodova MM. AJC 2015;115:417-22)

- In-hospital † in rVF 18% vs 3.3% in the no-VF group:
  - Age
  - HF at admission VF
  - before reperfusion
  - Left main disease
  - But NOT rVF

were independently associated with in-hospital †

<table>
<thead>
<tr>
<th>Characteristics at admission</th>
<th>Univariate analysis</th>
<th>Multivariate analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR</td>
<td>95% CI</td>
</tr>
<tr>
<td>Age</td>
<td>1.08</td>
<td>1.04-1.12</td>
</tr>
<tr>
<td>Previous MI</td>
<td>1.60</td>
<td>1.01-2.54</td>
</tr>
<tr>
<td>HF &gt; Killip1</td>
<td>3.21</td>
<td>1.30-7.91</td>
</tr>
<tr>
<td>VF before reperfusion</td>
<td>9.03</td>
<td>4.07-20.04</td>
</tr>
<tr>
<td>VF at reperfusion</td>
<td>4.87</td>
<td>2.39-9.96</td>
</tr>
<tr>
<td>Left main stenosis</td>
<td>4.97</td>
<td>3.07-8.03</td>
</tr>
<tr>
<td>Multivessel coronary disease</td>
<td>1.60</td>
<td>1.10-2.54</td>
</tr>
</tbody>
</table>
ARRHYTHMIA PREVALENCE POST AMI (>10 days)
PROGNOSTIC IMPACT
Arrhythmia prevalence following an AMI.

CARISMA study. Circulation 2010;121:1258-64

- 297 pts, 64±11y, LEVF 31±7%, implanted with an ILR (Reveal, Medtronic) 11±5 days post AMI, 2y FU

- 46% of arrhythmias:
  - but 86% asymptomatic
  - 10% high-grade AVB
  - 28% AF
  - 13% ns VT
  - 3% VT
  - 2.7% VF

Table 1. Incidence of Cardiac Arrhythmias Recorded by the ICM

<table>
<thead>
<tr>
<th>Arrhythmia</th>
<th>Patients, n (Incidence, %)</th>
<th>Events, n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sinus bradycardia (≤30 bpm, ≥8 beats)</td>
<td>20 (6.7)</td>
<td>111</td>
</tr>
<tr>
<td>Sinus arrest (≥5 s)</td>
<td>16 (5.4)</td>
<td>23</td>
</tr>
<tr>
<td>New-onset AF (≥125 bpm, ≥16 beats)</td>
<td>82 (27.6)</td>
<td>538</td>
</tr>
<tr>
<td>High-degree AV block (second to third degree; ≤30 bpm, ≥8 beats)</td>
<td>29 (9.8)</td>
<td>124</td>
</tr>
<tr>
<td>Nonsustained VT (≥125 bpm, ≥16 beats, &lt;30 s)</td>
<td>39 (13.1)</td>
<td>64</td>
</tr>
<tr>
<td>Sustained VT (≥125 bpm, ≥30 s)</td>
<td>9 (3.0)</td>
<td>20</td>
</tr>
<tr>
<td>VF (≥125 bpm, ≥16 beats)</td>
<td>8 (2.7)</td>
<td>19</td>
</tr>
<tr>
<td>Any arrhythmia</td>
<td>137 (46.1)</td>
<td>885</td>
</tr>
</tbody>
</table>
CARISMA. Long-term monitoring of arrhythmias in reduced EF post MI. Thomsen et al. Circ 2010:121:1258-64

- 17% of bradyarrhythmias over 2y
- % night >> day time
  (OSAS not sought !!)

- 29% tachyarrhythmias
- % night = % day time
- Predominantly AF
CARISMA. Long-term monitoring of arrhythmias in reduced EF post MI. Thomsen et al. Circ 2010:121:1258-64

- **time-dependent MVA $\Rightarrow$ high-degree AVB most powerful predictor of cardiac † (HR 6.75), but no proof that its Tx reduced †

- Sustained and nsVT : borderline association (underpowered ?)
CHRONIC TOTAL OCCLUSION OF CORONARY ARTERY (CTO)
PROGNOSTIC IMPACT
VACTO-study. Impact of CTO on ICD treatment
Nombela-Franco L. CircAE 2012;5:147-54

• CTO occurs in 20-50% of pts referred to lab

• Post-MI, CTO is associated with:
  – further LVEF deterioration
  – Increased long-term †

• 162 pts, 62±9 yo, 29±9%, 44% with CTO:
  – CTO pts (71): ↑ 3-vx disease, Q-wave in 30%, RCA in 52%, LAD in 23%,
  – dyskinesia in 6%, hypokinesia or normal fct in 58% supplied by the CTO

VACTO-study. Impact of CTO on ICD treatment
Nombela-Franco L. CircAE 2012;5:147-54

- Similar VTA CL between groups

### Table 2. Cumulative Event Rates for Appropriate ICD Therapy

<table>
<thead>
<tr>
<th>Primary Prevention, % (95% CI)</th>
<th>Global (n=161)</th>
<th>No CTO (n=90)</th>
<th>CTO (n=71)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 y</td>
<td>13 (8-19)</td>
<td>7 (2-13)</td>
<td>21 (11-31)</td>
<td>0.01</td>
</tr>
<tr>
<td>2 y</td>
<td>16 (10-22)</td>
<td>9 (3-15)</td>
<td>26 (14-38)</td>
<td>0.01</td>
</tr>
<tr>
<td>3 y</td>
<td>23 (15-31)</td>
<td>15 (6-24)</td>
<td>33 (19-47)</td>
<td>0.01</td>
</tr>
</tbody>
</table>

**MVA:**
- Age (HR 1.5/5y)
- CTO (HR 3.5)

Only predictors of ICD Tx

**Figure 2.** Kaplan-Meier survival curves for freedom from first appropriate device therapy in CTO and non-CTO populations. CTO indicates chronic total coronary occlusion; ICD, implantable cardioverter-defibrillator.
VACTO-study. Impact of CTO on †
Nombela-Franco L. CircAE 2012;5:147-54

- 2-y cumulative †:
  - 15% in CTO
  - 4% w/o CTO

MVA:
- Age (HR 1.5/5y)
- CTO (HR 5.6)
- NYHA≥III (4.7)
- Absence of Bblockers (6.3)

Only predictors of †
VACTO-study. Conclusions
Nombela-Franco L. CircAE 2012;5:147-54

• CTO has a negative impact on VTA incidence and †
• Suggests that revx of CTO might improve the outcomes:
  – Need for a RCT showing that revx CTO have an improved outcome (VTA,†) vs non-revx CTO