The Twin Cities, Post VF/VT Early Cardiac Cath Lab access protocol. 2-years report

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State wide initiative: Out of the hospital cardiac arrest and direct access to Cardiac Cath Lab.

A Minnesota Resuscitation Consortium

Participants:

All major EMS in the Twin Cities and all major PCI centers

Program started: 2012
Initial Rhythm
VF/VT witnessed/unwitnessed

ROSC: YES
Get an ECG

STEMI

Follow STEMI protocol

No STEMI

Exclusion Criteria:
Age > 75 years < 18 years
DNR/DNI
Obvious Trauma
Known Terminal Disease
Hemorrhage (any cause)

No

Transport to participating hospital

Call in to the ED and announce:
“Resuscitated VF Cardiac Arrest Protocol en route”

Yes

Follow current agency protocol

Participating hospitals:
All metro PCI centers.
Initiative goals

• Primary: All patients with **Resuscitated** OOHCA presenting with VF arrest should be transferred to a PCI center and will gain access to the CCL within two hours from hospital arrival with emphasis on early access.

• Secondary: Patients with ongoing CPR and **refractory witnessed VF/VT** (unsuccessful defibrillation after 15 minutes of ACLS on the field) will be transferred directly to the Cardiac Cath Lab with PCI capabilities given the high likelihood of high grade proximal coronary occlusion.

• Data collection prospectively for the next 4 years
Data Collection for Catheterization Lab Initiative as part of QA/QI Monitoring

- Standard CARES data
- Troponin at 24 hours post arrest
- In hospital hypothermia times:
  1. Time to target temperature
  2. Duration at target therapy
- CCL times
  1. 911 call to CCL door
  2. ED door to balloon if angioplasty
- CCL data (including entire catheterization report)
  1. Number of vessels affected
  2. Stents placed # and location
- Neurological evaluation report at discharge (implement a standard evaluation of this patients with a neurological assessment at discharge with clear documentation of functional evaluation)
  1. CPC
  2. MRS
- At least one left ventricular function ejection fraction evaluation before hospital discharge or at least 3 days after the arrest.
- Was pt readmitted within 6 months of discharge, and why?
Where is the evidence?


Objectives. To assess if early reperfusion of an occluded left anterior descending (LAD) artery after ischemic cardiac arrest will improve 24-hour survival and neurological outcome.
Experimental paper

Early coronary revascularization improves 24 h survival and neurological function after ischemic cardiac arrest. A randomized animal study

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ABSTRACT

Background: Survival after out-of-hospital cardiac arrest (OHCA) remains poor. Acute coronary obstruction is a major cause of OHCA. We hypothesize that early coronary reperfusion will improve 24 h survival and neurological outcomes.

Methods: Total occlusion of the mid LAD was induced by balloon inflation in 27 pigs. After 5 min, VF was induced and left untreated for 8 min. If return of spontaneous circulation (ROSC) was achieved within 15 min (21/27 animals) of cardiopulmonary resuscitation (CPR), animals were randomized to a total of either 45 min (group A) or 4 h (group B) of LAD occlusion. Animals without ROSC after 15 min of CPR were classified as refractory VF (group C). In those pigs, CPR was continued up to 45 min of total LAD occlusion at which point reperfusion was achieved. CPR was continued until ROSC or another 10 min of CPR had been performed. Primary endpoints for groups A and B were 24-h survival and cerebral performance category (CPC). Primary endpoint for group C was ROSC before or after reperfusion.

Results: Early compared to late reperfusion improved survival (10/11 versus 4/10, p = 0.02), mean CPC (1.4 ± 0.7 versus 2.5 ± 0.6, p = 0.017), LVEF (43 ± 13 versus 32 ± 9%, p = 0.01), troponin I (37 ± 28 versus 99 ± 12, p = 0.005) and CK-MB (11 ± 4 versus 20.1 ± 5, p = 0.031) at 24 h after ROSC. ROSC was achieved in 4/6 animals only after reperfusion in group C.

Conclusions: Early reperfusion after ischemic cardiac arrest improved 24 h survival rate and neurological function. In animals with refractory VF, reperfusion was necessary to achieve ROSC.
Figure 1. Study Protocol

Group A. Total LAD occlusion of 45 min.
- BLS
  - 3 min
- ACLS
  - up to 12 min
- NO ROSC
- ACLS
- Reperfusion
- STEMI verified with ST elevation on ECG and angiographic proof of loss of distal flow to the LAD

Group B. Total LAD occlusion of 4 hours
- Reperfusion

Group C. Total LAD occlusion of 45 min.
- Reperfusion
Results

• Early compared to late reperfusion improved 24-hour survival (10/11 versus 4/10, \( p = 0.02 \)),
• Mean CPC (1.4±0.7 versus 2.5±0.6, \( p = 0.017 \)),
• LVEF (43±13 versus 32±9%, \( p = 0.01 \)),
• Troponin I (37±28 versus 99±12, \( p = 0.005 \)) and CK-MB (11±4 versus 20.1±5, \( p = 0.031 \)) at 24-hr after ROSC.
• ROSC was achieved in 4/6 animals only after reperfusion in group C.
Conclusions

• Early reperfusion after ischemic cardiac arrest improved 24h survival rate and neurological function.

• In animals with refractory VF from coronary occlusion, reperfusion was necessary to achieve ROSC.
Favourable 5-year postdischarge survival of comatose patients resuscitated from out-of-hospital cardiac arrest, managed with immediate coronary angiogram on admission

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Abstract

Aims: On-admission coronary angiogram (CA) with angioplasty (percutaneous coronary intervention, PCI) may improve survival in patients resuscitated from out-of-hospital cardiac arrest (OHCA), but long-term survival data are scarce. We assessed long-term survival in OHCA patients managed with on-admission CA and PCI if indicated and compared survival rates in patients with/without acute coronary syndrome (ACS).

Methods: Retrospective single-centre study including patients aged ≥18 years resuscitated from an OHCA without noncardiac cause, with sustained return of spontaneous circulation, undergoing on-admission CA with PCI if indicated. ACS was diagnosed angiographically. Survival was recorded at hospital discharge and at 5-year follow up. Survival probability was estimated by Kaplan–Meier survival curves.

Results: A total of 300 comatose patients aged 56 years (IQR 48–67 years) were included, 36% with ST-segment elevation. All had on-admission CA; 31% had ACS. PCI was attempted in 91% of ACS patients and was successful in 93%. Hypothermia was performed in 84%. Survival to discharge was 32.3%. After discharge, 5-year survival was 81.7±5.4%. Survival from admission to 5 years was 26.2±2.8%. ACS patients had better survival to discharge (40.8%) compared with non-ACS patients (28.5%, p=0.047). After discharge, 5-year survival was 92.2±5.4% for patients with ACS and 73.4±8.6% without ACS (hazard ratio, HR, 2.7, 95% CI 0.8–8.9, p=0.1). Survival from admission to 5 years was 37.4±5.2% for ACS patients, 20.7±3.0%, for non-ACS patients (HR 1.5, 95% CI 1.12–2.0, p=0.0067).

Conclusions: OHCA patients undergoing on-admission CA had a very favourable postdischarge survival. Patients with OHCA due to ACS had better survival to discharge at 5-year follow up than patients with OHCA due to other causes.
# Table 2. Characteristics of OHCA patients.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Overall (n=300)</th>
<th>In-hospital survivors (n=97)</th>
<th>Nonsurvivors (n=203)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>OHCA in public place</td>
<td>170 (57)</td>
<td>65 (67)</td>
<td>105 (52)</td>
<td>0.042</td>
</tr>
<tr>
<td>Initial rhythm (n=270)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Ventricular fibrillation</td>
<td>130 (43)</td>
<td>67 (69)</td>
<td>63 (31)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Ventricular tachycardia&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6 (2)</td>
<td>3 (3)</td>
<td>3 (1)</td>
<td>NC</td>
</tr>
<tr>
<td>Asystole</td>
<td>116 (39)</td>
<td>11 (11)</td>
<td>105 (52)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Pulseless electrical activity</td>
<td>18 (6)</td>
<td>7 (7)</td>
<td>11 (5)</td>
<td>0.73</td>
</tr>
<tr>
<td>Duration of no flow (min, n=243)</td>
<td>4 (0–10)</td>
<td>2.5 (0–5)</td>
<td>5 (1–10)</td>
<td>0.0031</td>
</tr>
<tr>
<td>Duration of low flow (min, n=245)</td>
<td>20 (10–30)</td>
<td>10 (6–21)</td>
<td>22 (12–30)</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

Values are median (IQR) or n (%).

<sup>a</sup>One patient had torsade de pointe, one had polymorphic ventricular tachycardia, and four had monomorphic ventricular tachycardia.

NC, not calculated due to the reduced number of patients; OHCA, out-of-hospital cardiac arrest. See text for definition of no flow and low flow.
Table 6. Survival in the overall population and in ACS and non-ACS patients.

<table>
<thead>
<tr>
<th></th>
<th>Overall (n=300)</th>
<th>Patients with ACS (n=93)</th>
<th>Patients without ACS (n=207)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-hospital survival</td>
<td>97 (32)</td>
<td>38 (40.8)</td>
<td>59 (207)</td>
<td>0.047</td>
</tr>
<tr>
<td>Postdischarge survival (%)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>81.7±5.4</td>
<td>92.2±5.4</td>
<td>73.4±8.6</td>
<td>0.1</td>
</tr>
<tr>
<td>Long-term overall survival (%)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>26.2±2.8</td>
<td>37.4±5.2</td>
<td>20.7±3.0</td>
<td>0.0067</td>
</tr>
</tbody>
</table>

Values are n (%) or mean±SD.
ACS, acute coronary syndrome.
<sup>a</sup>Expressed as probability according to Kaplan–Meier survival curve.
**Figure 2.** Probability of long-term overall survival of ACS patients vs. non-ACS patients according to Kaplan–Meier survival analysis.

The probability of long-term overall survival in ACS patients (dashed line) was $37.4 \pm 5.2\%$ and in non-ACS patients (solid line) was $20.7 \pm 3.0\%$ (hazard ratio 1.5, 95% CI 1.12–2.0; $p=0.0067$. ACS, acute coronary syndrome.
The Twin Cities 2-year experience.

2012-2013 data
Cardiac arrest, ages 18-75, survived to ED and admitted to the hospital (n=585)

Non-shockable rhythms (n=195)

Shockable rhythms (n=370)

VF/VT (n=202)

Unknown but received a shock (n=168)

Early access to the CCL (n=313)

No early access to the CCL (n=56)

Outcomes: Survival at hospital discharge and CPC score 1 or 2
Protocol penetration in the Twin Cities:

313/370 (85%) patients got early access to the cath lab after resuscitated VF/VT

Of the patients with early access to the cath lab:

- 235/313 (75%) were discharged alive
- 222/235 (95%) had CPC 1 and 2
- 147/313 (46%) had PCI

Patient that did not get access to the cath lab:

- 24/56 (42%) were discharged alive
- 19/24 (79%) had CPC 1 and 2
Conclusions

• Early access to the cardiac catheterization for resuscitated patients from VF/VT is feasible, can be organized in a large metro area with close communication and collaboration of EMS directors and cath lab directors.

• Expected survival for this population is >75% and >95% are neurologically intact. Long term outcomes are stable Sideris et have shown.

• PCI is expected in about 50% of the patients and a smaller proportion will undergo CABG.

• Patients that do no get access to the cath lab have a poor outcome with expected survival of ~40%.