SHOCK CARDIOGENO

Caso Clinico

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IABP History

40+ years of experience

1962 Animal studies
Moulopoulos et al, Am Heart J 1962;63:669-675

1968 Clinical description in shock
Kantrowitz et al, JAMA 1968;203:135-140

1973 Hemodynamic effects in shock,
Mortality unchanged
Scheidt et al, NEJM 1973;288:979-984

1980s Selected series in high-risk PTCA

>40 yrs >1 Million patients treated, low
complication rate, Benchmark registry
Ferguson et al, JACC 2001;38:1456-1462

Adapted from H. Thiele
Intra-Aortic Balloon Pump

PROs:
- Well known technology
- Increases coronary perfusion
- Mild increase in cardiac output
- Ease of use
- Cost

CONs:
- Requires a minimum of cardiac function
- Requires a stable rhythm
- Modest unloading
- Negative studies in unselected pts
BCIS-1 Trial

**Design**
- **DESIGN:** Prospective, randomized, control trial
- **OBJECTIVE:** To evaluate all cause long term mortality in patients with LV impairment (EF <30%) and severe CAD receiving elective IABP support during PCI.

301 patients enrolled between December 2005 and January 2009 in 17 clinical sites in the United Kingdom

- 50% No Planned IABP Use (N=151)
- 12% Required Bailout IABP Use (N=18)
- 50% Planned IABP Use (N=150)

**BCIS-1: Inclusion Criteria**

Impaired LV function (EF ≤ 30%) and Extensive Myocardium at Risk

BCIS-1 Jeopardy Score > 8

or...Target vessel supplying occluded vessel which supplies >40% of myocardium

Perera et al, Am Heart J 2009;158:910-916
BCIS-1: Major Outcomes
Bail-out IABP in 18 cases (12%) in control group

Procedural Complications:
- Prolonged hypotension
- VT/VF req. defib
- CPR req. ventilation

BCIS-1: Time-varying Hazard Ratios for Mortality

- 6 months: 0.63 (0.24 to 1.62)
- < 1 year: 0.68 (0.34 to 1.35)
- > 1 year: 0.65 (0.40 to 1.06)
- Overall: 0.66 (0.40 to 0.98)

Perera et al, JAMA 2010; 304(8):867-874
Timing of the Onset of Cardiogenic Shock

Shock developed a median of 6.2 h after MI symptom onset

- Left Main: 1.7 h
- RCA: 3.5 h
- LCx: 3.9 h
- SVG: 10.9 h
- LAD: 11 h

Webb JACC 2000; 36:1084
SHOCK Trial: 12-Month Survival

- Early Revasc: 53% (302), p=0.109
- Medical Stabilization: 44% (302)
- Early Revasc: 50% (301), p=0.027
- Medical Stabilization: 37% (301)
- Early Revasc: 46% (299), p=0.025
- Medical Stabilization: 33% (299)

J. Hochman et al, JAMA 2001
Case

- **History**
  - Female, 74 years old
  - Moderate aorta valve stenosis, normal LVEF

- **Presentation in emergency room**
  - Anginal symptoms and dyspnea on exertion since 1 week
  - Acute coronary syndrome since 4-5 hours with increasing dyspnea and increasing chest pain

- **Physical examination**
  - Cold clammy skin, signs of pulmonary congestion, hypotension (90/50 mmHg), tachycardia (100/min), respiratory distress (frequency 25/min), $O_2$-saturation 95%

→ **cardiogenic shock**
Electrocardiogram
Diagnosis & Initial Treatment

• (Sub)Acute anterior wall infarction with *ongoing ischemia* and *cardiogenic shock*

• Sent to cathlab for Primary percutaneous coronary intervention
Coronary angiogram (RCA)
Coronary angiogram (LCA)
Syntax Score II= 33+
Diagnosis

- Anterior wall infarction with cardiogenic shock
- Persistent myocardial ischemia in severe multivessel disease
- Severe aortic stenosis
- Severe mitral regurgitation (ischemia-mediated?)

- Cardiothoracic surgeon deemed this patient too high risk to undergo open-heart surgery for bypass-grafting and valve replacement

- How to treat?
Interventional Procedure

• Insertion of IABP
  – Augmentation of coronary flow
    (autoregulation exhausted both in infarction area and in remote area of RCA !!)
  – relieve of persistent (ongoing) ischemia
  – LV-unloading
  – Afterload reduction for mitral regurgitation

• Acute percutaneous coronary intervention under adjunctive IABP support
PCI  LM-LAD; LCx  Elective IABP support

Xience 23 mm, 2.75  Xience 33 mm, 3.0

Xience 23 mm, 3.5
Result PCI LAD
In-hospital outcome

- Additional treatment with GPIIb/IIIa inhibitors
- After PCI, inotropic support was needed for 1 day
- IABP therapy was continued for 24 hours
PCI RCA

5 days later
RXB 6 F guide catheter; Guideliner

Xience 23+28 mm, 3.0

Xience 12 mm, 3.5
RCA RESULT

Xience 12 mm, 3.5; Xience 23+28 mm, 3.0
After clinical stabilization, TAVI was performed 2 months later. Edwards Sapien XT n.26 implanted without any complication.
At two year follow-up, patient free from symptoms

No hospital readmissions

Provocative stress test: negative

Echocardiogram: LVEF 53%, no AO paravalvular leak, trivial mitral regurgitation
## Studies of IABP vs No IABP: Mortality

<table>
<thead>
<tr>
<th>Trial</th>
<th>IABP n/N</th>
<th>No IABP n/N</th>
<th>30-day mortality Risk difference</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No reperfusion</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Molouopoulos</td>
<td>24/34</td>
<td>15/15</td>
<td>-0.29 (-0.47 to -0.12)</td>
</tr>
<tr>
<td>Summary Estimate</td>
<td>24/34</td>
<td>15/15</td>
<td></td>
</tr>
<tr>
<td><strong>Thrombolysis</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stromel</td>
<td>28/51</td>
<td>16/13</td>
<td></td>
</tr>
<tr>
<td>Kovack</td>
<td>10/27</td>
<td>13/19</td>
<td></td>
</tr>
<tr>
<td>Bengtson</td>
<td>48/99</td>
<td>58/101</td>
<td></td>
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<tr>
<td>Waksman</td>
<td>11/20</td>
<td>17/21</td>
<td></td>
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<tr>
<td>GUSTO-1</td>
<td>30/62</td>
<td>146/248</td>
<td>-0.18 (-0.20 to -0.16)</td>
</tr>
<tr>
<td>SHOCK registry</td>
<td>220/439</td>
<td>300/417</td>
<td></td>
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<tr>
<td>NRMI-2 TT</td>
<td>1068/2180</td>
<td>2346/3501</td>
<td></td>
</tr>
<tr>
<td>Summary Estimate</td>
<td>1415/2878</td>
<td>2890/4320</td>
<td></td>
</tr>
<tr>
<td><strong>Primary PCI</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NRMI-2 PCI</td>
<td>956/2035</td>
<td>401/956</td>
<td>0.06 (0.03 to 0.10)</td>
</tr>
<tr>
<td>AMC CS</td>
<td>93/199</td>
<td>26/93</td>
<td></td>
</tr>
<tr>
<td>Summary Estimate</td>
<td>1049/2234</td>
<td>427/1048</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>2488/5146</td>
<td>3332/5283</td>
<td>-0.11 (-0.13 to -0.09)</td>
</tr>
</tbody>
</table>

The limitations of evidence-based medicine...

Umbrellas protect from rain — randomized studies not useful

There are no randomized, controlled studies on the efficacy of parachutes

adapted from H. Thiele
SEMPER FI study

Survival in Extensive Myocardial Infarction with PERsistent Ischemia Following IABP

Recently started, randomized prospective trial with primary endpoint mortality at 30 days and 6 months in patients with large myocardial infarction, successful epicardial reperfusion, but persistent (ongoing) ischemia as reflected by < 50% resolution of ST-elevations
CRISP-AMI: 30-day mortality


All patients (N=329)
“large” infarction (N=146) $(\sum ST\text{-elevation} \geq 15 \text{ mmHg})$
persistent ischemia (N=36) $(ST \text{ resolution} \leq 50\%)$
CONCLUSIONS

In CRISP-AMI and SHOCK 2, benefit of IABP was obscured by including too many patients in whom no effect could be expected anyway and by inadequate statistical methods.

IABP is particularly useful and potentially life-saving in patients with large myocardial infarction and adequate pPCI but insufficient myocardial reflow (persistent ischemia, pain, ST-elevation), whether or not accompanied by (pre-) shock.
Shock Registry
Main Indications For Support
(N=352 patients at 24 centers)

- Elective PCI†, 29%
- High Risk PCI (66%)
- Urgent PCI‡, 37%
- AMI Shock, 20%
- Other Forms of Shock, 14%

Others includes Myocarditis with shock, Post-cardiotomy shock, septic shock, toxic shock, post partum cardiomyopathy, other cardiomyopathies with shock

† Elective = Stable angina or silent ischemia
‡ Urgent = Unstable angina or Non ST elevation Myocardial Infarction
High Risk Patients

- Complex Left Main
- Last remaining vessel, Complex 3 vessel disease
- Poor LV function – LVEF <30-35%
- Cardiogenic shock
- Uncompensated Congestive Heart Failure*
- Renal Failure?
- Acute anterior MI for myocardial salvage?

Patient specific decisions to assure basic principles
In-hospital Mortality
USIK 1995, USIC 2000, FAST-MI France National Registry

Death at 30 days (%)

1995: 70 (62-77)
2000: 63 (56-70)
2005: 51 (44-59)

Shock: 8.7 (7.5-10.0)
No Shock: 4.2 (3.4-5.1)

1995: 3.6 (3.0-4.4)

Aissaoui et al. Eur Heart J 2012; 33:2535–2543
Causes of Cardiogenic Shock

- Predominant LV Failure: 74.5%
- Acute Severe MR: 8.3%
- VSD: 4.6%
- Isolated RV Shock: 3.4%
- Tamponade/rupture: 1.7%
- Other: 7.5%

Sanborn T. et al, JACC. 2000
IABP SHOCK-2

Design

**DESIGN:** Prospective, multicenter, randomized, open-label controlled trial comparing IABP vs. medical therapy.

**OBJECTIVE:** To compare the efficacy and safety of the IABP vs. early medical therapy on the background of early revascularization by PCI or CABG.

790 patients enrolled between June 2009 and March 2012 in 37 clinical sites in Germany

190 patients excluded

600 patients randomized

Medical Therapy

Clinical follow-up at 30 days in 99.7% (N=298)

IABP

Clinical follow-up at 30 days in 99.7% (N=300)

Thiele H. et al, NEJM 2012
IABP SHOCK II: 1 year Mortality

30-day mortality:
- IABP: 41.3%
- Control: 39.7%

6-month mortality:
- IABP: 48.7%
- Control: 49.2%

12-month mortality:
- IABP: 51.8%
- Control: 51.4%

Logrank p = 0.94
RR 1.02
95% CI 0.88-1.19

Days after randomization

No. at risk
- IABP: 301, 181, 171, 165, 161, 159, 154, 152, 149, 147, 146, 144, 136, 45, 21
- Control: 299, 174, 166, 165, 159, 154, 152, 147, 147, 146, 144, 140, 55, 29

Thiele et al. Lancet 2013
### IABP SHOCK II: Treatment / Processes of Care

<table>
<thead>
<tr>
<th>Variable</th>
<th>IABP (n=301)</th>
<th>Control (n=299)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary PCI; n/total (%)</td>
<td>287/301 (95.3)</td>
<td>288/299 (96.3)</td>
<td>0.55</td>
</tr>
<tr>
<td>Stent implanted; n/total (%)</td>
<td>273/301 (90.7)</td>
<td>266/299 (89.0)</td>
<td>0.48</td>
</tr>
<tr>
<td>Drug-eluting stent; n/total (%)</td>
<td>126/301 (41.9)</td>
<td>123/299 (41.1)</td>
<td>0.86</td>
</tr>
<tr>
<td>Immediate PCI of non-culprit lesions; n/total (%)</td>
<td>90/301 (29.9)</td>
<td>81/299 (27.1)</td>
<td>0.45</td>
</tr>
<tr>
<td>Immediate bypass surgery; n/total (%)</td>
<td>8/301 (2.7)</td>
<td>10/299 (3.3)</td>
<td>0.62</td>
</tr>
<tr>
<td>Staged bypass surgery; n/total (%)</td>
<td>3/301 (1.0)</td>
<td>4/299 (1.3)</td>
<td>0.72</td>
</tr>
<tr>
<td>Active left ventricular assist device; n/total (%)</td>
<td>11/301 (3.7)</td>
<td>22/299 (7.4)</td>
<td><strong>0.053</strong></td>
</tr>
<tr>
<td>Mild hypothermia; n/total (%)</td>
<td>106/301 (35.2)</td>
<td>120/299 (40.1)</td>
<td>0.21</td>
</tr>
<tr>
<td>Mechanical ventilation; n/total (%)</td>
<td>240/301 (79.7)</td>
<td>252/299 (84.3)</td>
<td>0.15</td>
</tr>
<tr>
<td>Mechanical ventilation duration (days); median (IQR)</td>
<td>3.0 (1.0-8.0)</td>
<td>3.0 (1.0-8.0)</td>
<td>0.44</td>
</tr>
<tr>
<td>ICU treatment (days); median (IQR)</td>
<td>6.0 (3.0-12.0)</td>
<td>6.0 (3.0-13.0)</td>
<td>0.34</td>
</tr>
<tr>
<td>Renal replacement therapy; n/total (%)</td>
<td>62/301 (20.6)</td>
<td>47/299 (15.7)</td>
<td>0.12</td>
</tr>
<tr>
<td>Catecholamines (µg/kg per minute); median (IQR)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dopamine</td>
<td>4.1 (2.9-7.7)</td>
<td>4.2 (3.6-8.3)</td>
<td>0.76</td>
</tr>
<tr>
<td>Norepinephrine</td>
<td>0.3 (0.1-1.2)</td>
<td>0.4 (0.1-1.1)</td>
<td>0.73</td>
</tr>
<tr>
<td>Epinephrine</td>
<td>0.3 (0.1-1.3)</td>
<td>0.3 (0.2-1.4)</td>
<td>0.59</td>
</tr>
<tr>
<td>Dobutamine</td>
<td>10.2 (4.9-20.6)</td>
<td>9.0 (4.8-17.6)</td>
<td>0.25</td>
</tr>
<tr>
<td>Duration of catecholamines (days); median (IQR)</td>
<td>3.0 (1.0-5.0)</td>
<td>3.0 (1.0-6.0)</td>
<td>0.61</td>
</tr>
<tr>
<td>Time - hemodynamic stabilization (days); median (IQR)</td>
<td>3.0 (1.0-5.0)</td>
<td>3.0 (1.0-6.0)</td>
<td>0.50</td>
</tr>
</tbody>
</table>

**Median BP ~90/55 mmHg, HR ~92 bpm**

**IABP placed after PCI in 87% of pts**

**Thiele et al NEJM 2012**

**10% xo to IABP**