



# **IX Congresso** **Novas Fronteiras** **em Medicina** **Cardiovascular**



CENTRO HOSPITALAR  
LISBOA NORTE, EPE



## **Novas Fronteiras em Cuidados Intensivos Cardiovasculares**

### ***Challenges in cardiogenic shock***

**Doroteia Silva, MD**

Intensive Care Unit – Santa Maria University Hospital

HF Clinic – Beatriz Ângelo Hospital

Faculty of Medicine, Lisbon Academic Medical Center

## *Challenges in cardiogenic shock*

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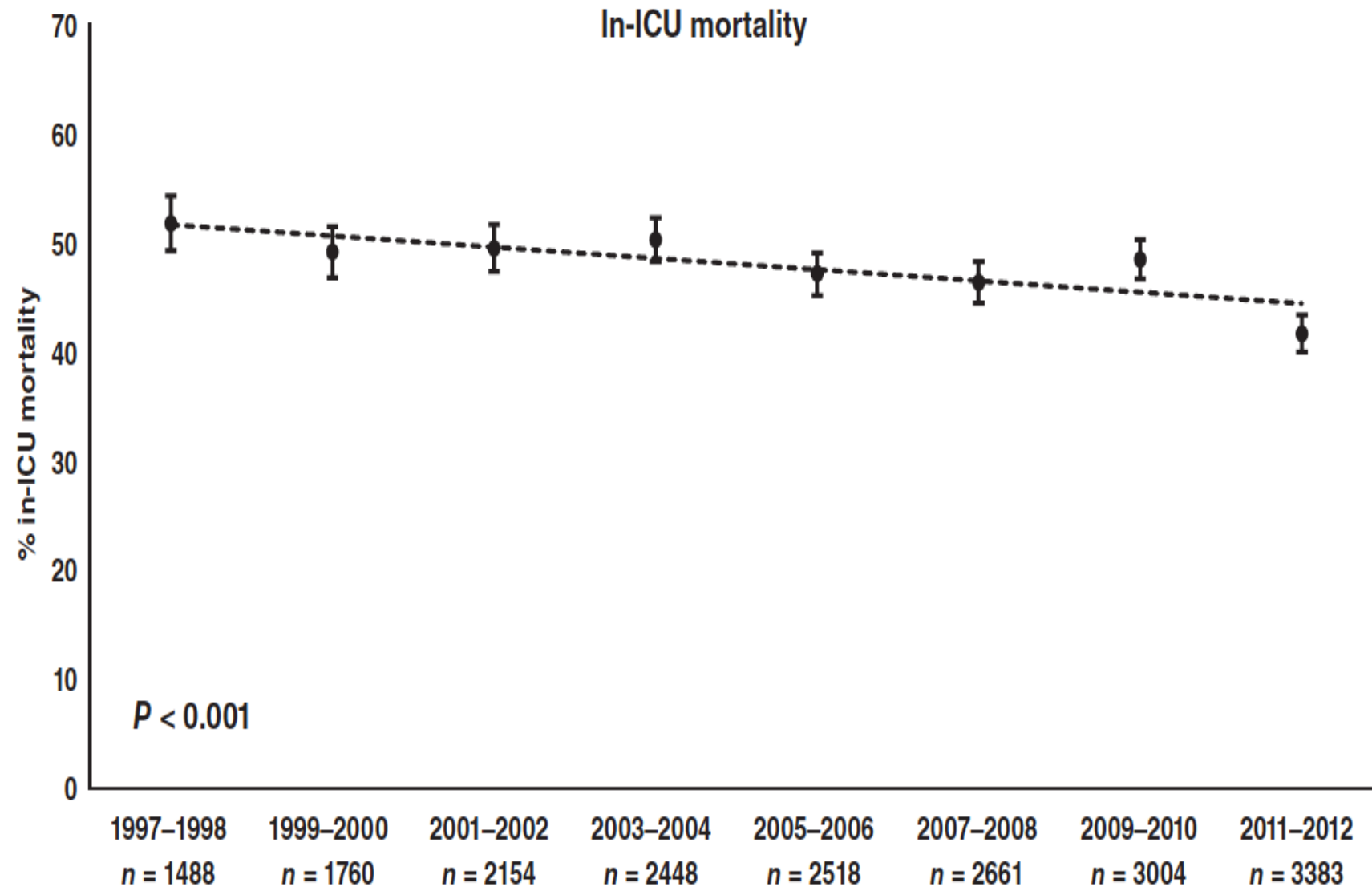
*Cardiogenic shock (CS) = Challenge*

=

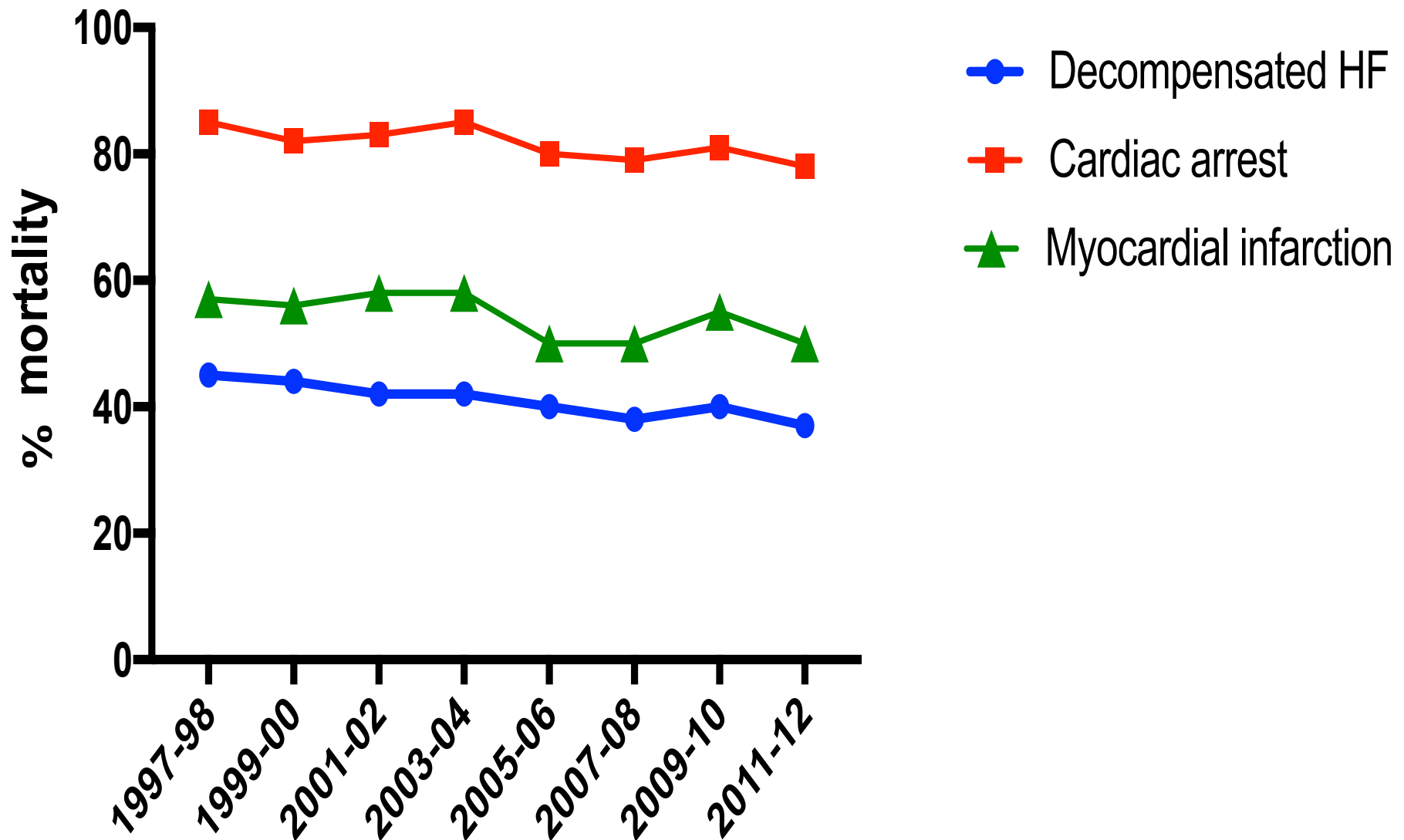
**poor prognosis**



# *Trends in ICU mortality in cardiogenic shock patients*



# *Mortality trends according to etiology*



# *Challenges in cardiogenic shock*

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- ▶ **Diagnosis**
- ▶ **Treatment**
- ▶ **Management of patient complexity**



# *Challenges in cardiogenic shock*

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- ▶ **Diagnosis**
- ▶ Treatment
- ▶ Management of patient complexity



# *Challenges in cardiogenic shock - diagnosis*

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- ▶ **Early identification of patient with cardiogenic shock (CS)**
  - ▶ at hospital presentation
  - ▶ developing in patients in-hospital



- ▶ Difficult clinical applicability of the classic CS definition
- ▶ Different CS hemodynamics profiles (same condition)



# Challenges in cardiogenic shock – Classic definition

- Cardiogenic shock (CS) is defined as organ hypoperfusion secondary to impaired cardiac output, combining **systolic blood pressure < 90 mmHg for > 30 minutes** or the **need for vasopressors to maintain systolic blood pressure > 90 mmHg**; pulmonary congestion or increased left ventricular pressures; and organ malperfusion signs. *SHOCK trial*

## EFICA study – Symptoms on Admission

|                                  | All patients<br>(n=581) | Cardiogenic shock |               | p <sup>a</sup>    |
|----------------------------------|-------------------------|-------------------|---------------|-------------------|
|                                  |                         | Yes<br>(n=166)    | No<br>(n=415) |                   |
| <i>Symptoms on admission (%)</i> |                         |                   |               |                   |
| Cardiogenic shock                | 29                      | 100               | 0             | <0.0001           |
| Pulmonary oedema                 | 82                      | 60                | 91            | <0.0001           |
| Peripheral oedema                | 27                      | 20                | 30            | 0.02              |
| Angina                           | 14                      | 17                | 13            | 0.29              |
| Hepatomegaly                     | 20                      | 24                | 18            | 0.09              |
| Syncope                          | 4                       | 9                 | 2             | 0.0002            |
| Arrhythmia                       | 23                      | 26                | 21            | 0.17              |
| Stroke                           | 1                       | 1                 | 1             | 1.00              |
| <b>SBP mmHg</b>                  | <b>126</b>              | <b>93</b>         | <b>139</b>    | <b>&lt;0.0001</b> |
| <b>DBP mmHg</b>                  | <b>71</b>               | <b>54</b>         | <b>77</b>     | <b>&lt;0.0001</b> |

# Potential hemodynamic presentations of cardiogenic shock

|                        |      | Volume Status                                                                |                                                                      |
|------------------------|------|------------------------------------------------------------------------------|----------------------------------------------------------------------|
|                        |      | Wet                                                                          | Dry                                                                  |
| Peripheral Circulation | Cold | Classic Cardiogenic Shock<br>(↓CI; ↑SVRI; ↑PCWP)                             | Euvolemic Cardiogenic Shock<br>(↓CI; ↑SVRI; ↔PCWP)                   |
|                        | Warm | Vasodilatory Cardiogenic Shock<br>or<br>Mixed Shock<br>(↓CI; ↓/↔SVRI; ↑PCWP) | Vasodilatory Shock<br>(not Cardiogenic Shock)<br>(↑CI; ↓SVRI; ↓PCWP) |

2/3  
patients

33% pts with  
MI-associated  
CS

# *Challenges in cardiogenic shock - diagnosis*

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- ▶ Better clinical profiling of CS
- ▶ Define optimal hemodynamic monitoring
  - ▶ Echo parameters?
- ▶ Prediction of patients at high risk of cardiogenic shock
  - ▶ New scores



# *Challenges in cardiogenic shock*

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- ▶ **Diagnosis**
- ▶ **Treatment**
- ▶ **Management of patient complexity**



# *Challenges in cardiogenic shock - Time*

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**Hemodynamic  
problem**

**Hemometabolic  
problem**

**Recovery**

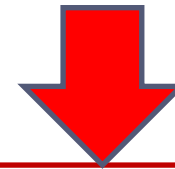
*Time  
in Cardiogenic Shock*

**Death**

**Therapy:** hemodynamic  
support

**Therapy:** multiorgan  
support

## CARDIOGENIC SHOCK (CS)



Causes of CS

Organ dysfunction

Immediate actions

ECG → ACS?  
+/- troponin

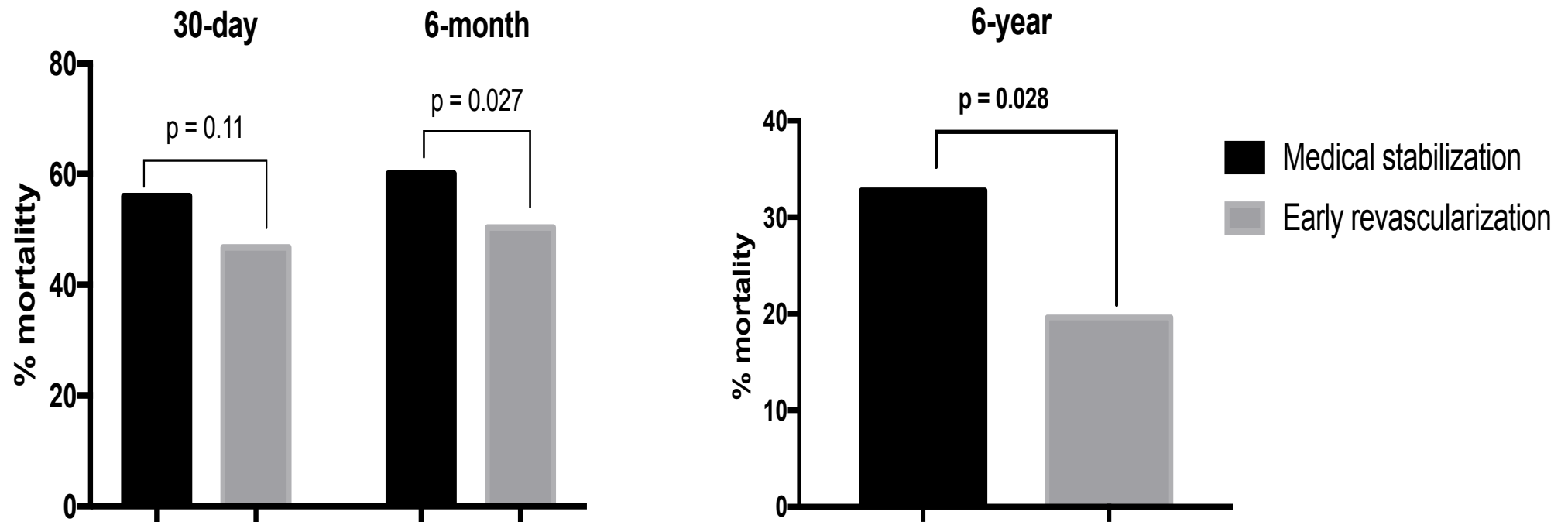
→ Cath lab

# *Timely opening of the culprit artery is key*

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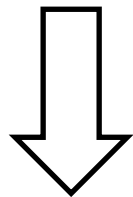
■ n = 302

■ Medical stabilization vs. early angiography and revascularization

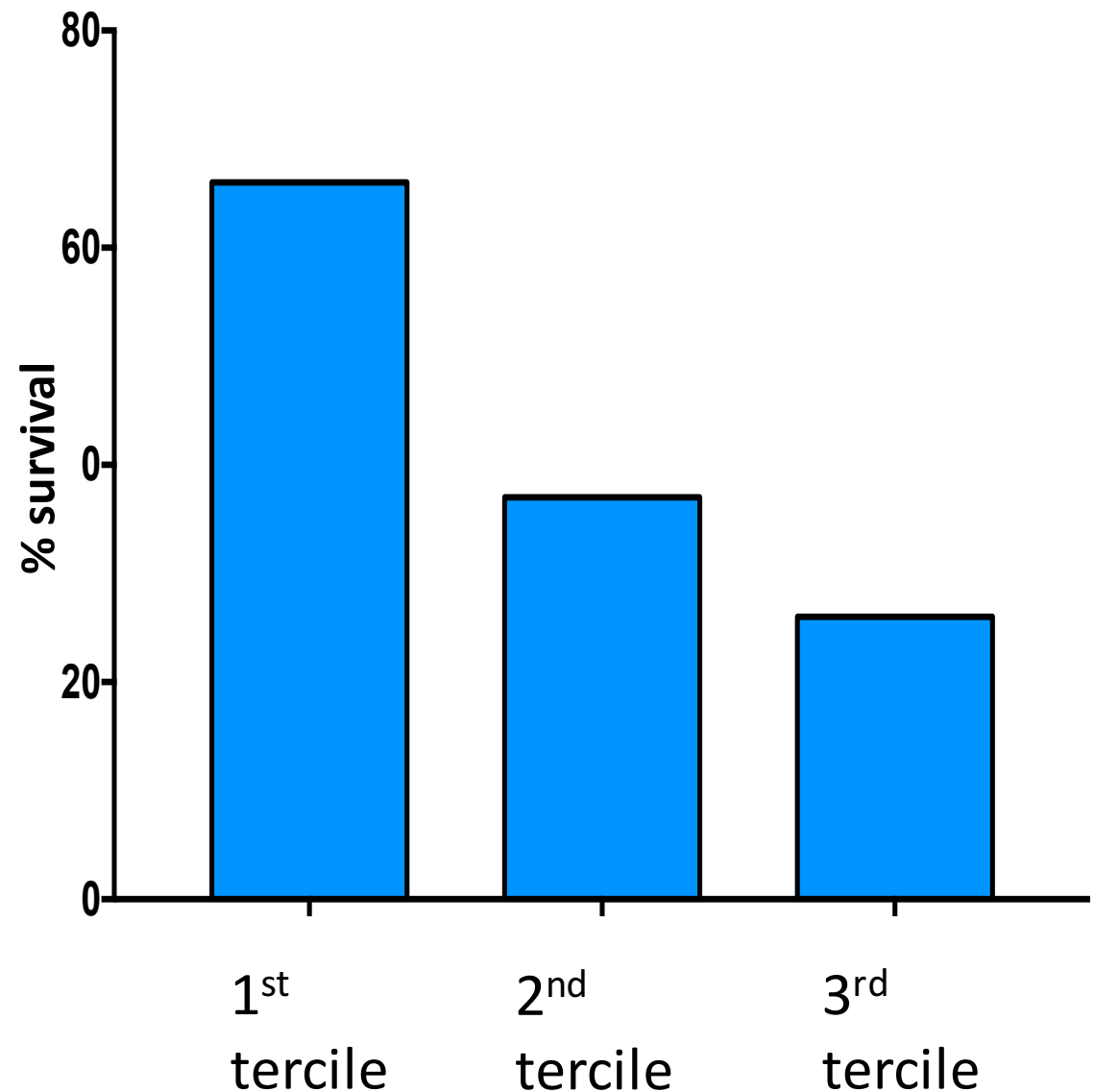


# *The door to percutaneous Mechanical Circulatory Support (MCS) concept*

- 287 patients with AMI
- All received percutaneous MCS
- Time from shock onset until MCS implantation



|                         |               |
|-------------------------|---------------|
| 1 <sup>st</sup> tercile | < 1.25 h      |
| 2 <sup>nd</sup> tercile | 1.25 - 4.25 h |
| 3 <sup>rd</sup> tercile | > 4.25 h      |



## *Challenges in cardiogenic shock - Medical treatment*

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- ▶ Use inotropes as single or in combination?
- ▶ Witch as first line?
- ▶ Timing and appropriate doses of cardiovascular medications?



## *Challenges in cardiogenic shock - treatment*

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- ▶ Which patients will benefit from advanced therapies?
- ▶ Utility of current risk scores (CardSHock, IABP-SHOCK II, SAVE) in various CS cohorts to select patients for MCS or other advanced therapies?
- ▶ Which percutaneous MCS ? ideal timing?



# Challenges in cardiogenic shock - Witch percutaneous MCS ?

**IABP**

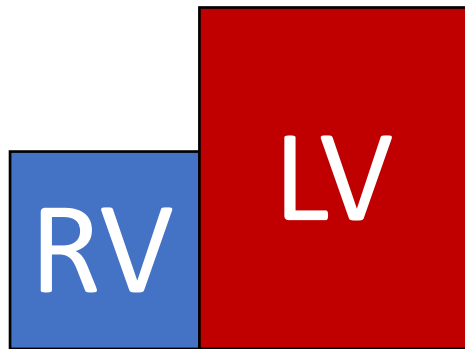
**VA-ECMO**

**Impella**

**Tandem-  
Heart**

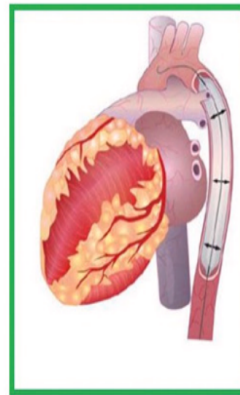
|                                 | IABP      | VA-ECMO         | Impella     | Tandem-Heart |
|---------------------------------|-----------|-----------------|-------------|--------------|
| <b>Catheter / cannula size</b>  | 8 F       | 17-21 V 17-19 A | 12 - 21     | 21 V 12-19 A |
| <b>Flow (L/min)</b>             | 1.5       | 7.0 Max         | 2 - 5.0 Max | 4.0 Max      |
| <b>LV unloading</b>             | +         | -               | ++          | +            |
| <b>Anticoagulation</b>          | +         | +               | +           | +            |
| <b>Rec. duration of support</b> | - 10 days | -7 days         | 10 days     | - 14 days    |
| <b>Relative costs</b>           | +         | ++              | ++++        | +++++        |

# Challenges in cardiogenic shock - Witch percutaneous MCS ?



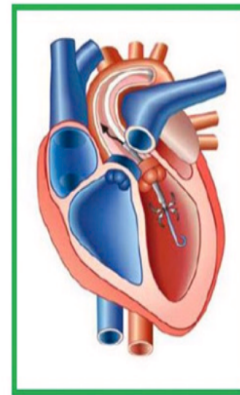
## Continuous Flow Pumps

### Pulsatile

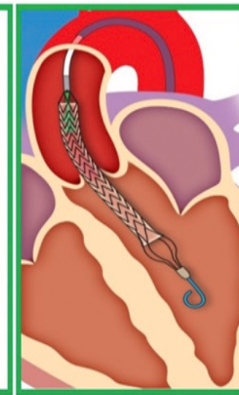


IABP

### Axial-Flow

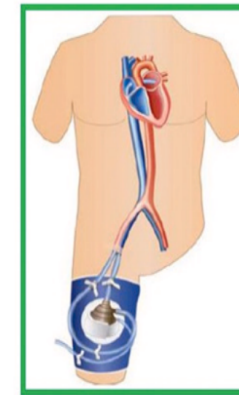


Impella CP

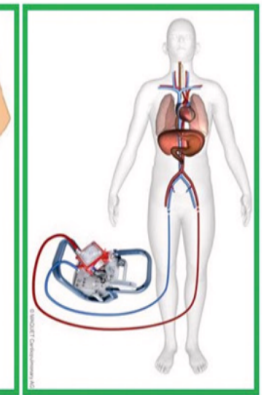


PHP \*

### Centrifugal Flow



TandemHeart



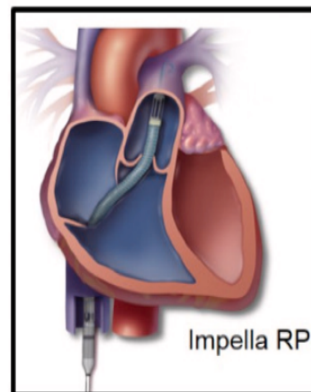
VA-ECMO

## Intracorporeal

## Extracorporeal



### Axial Flow

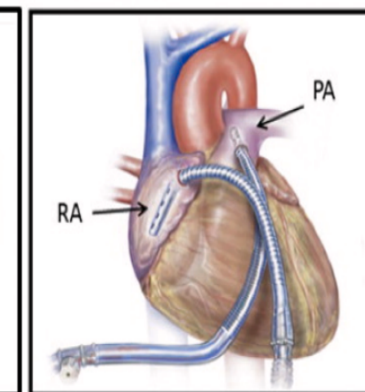


Impella RP

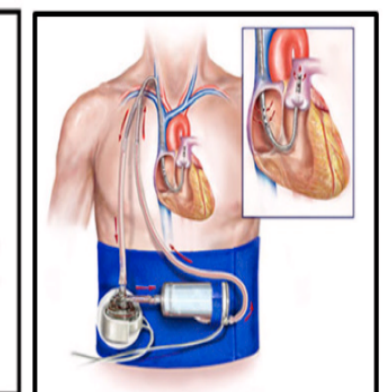
### Centrifugal Flow



VA-ECMO



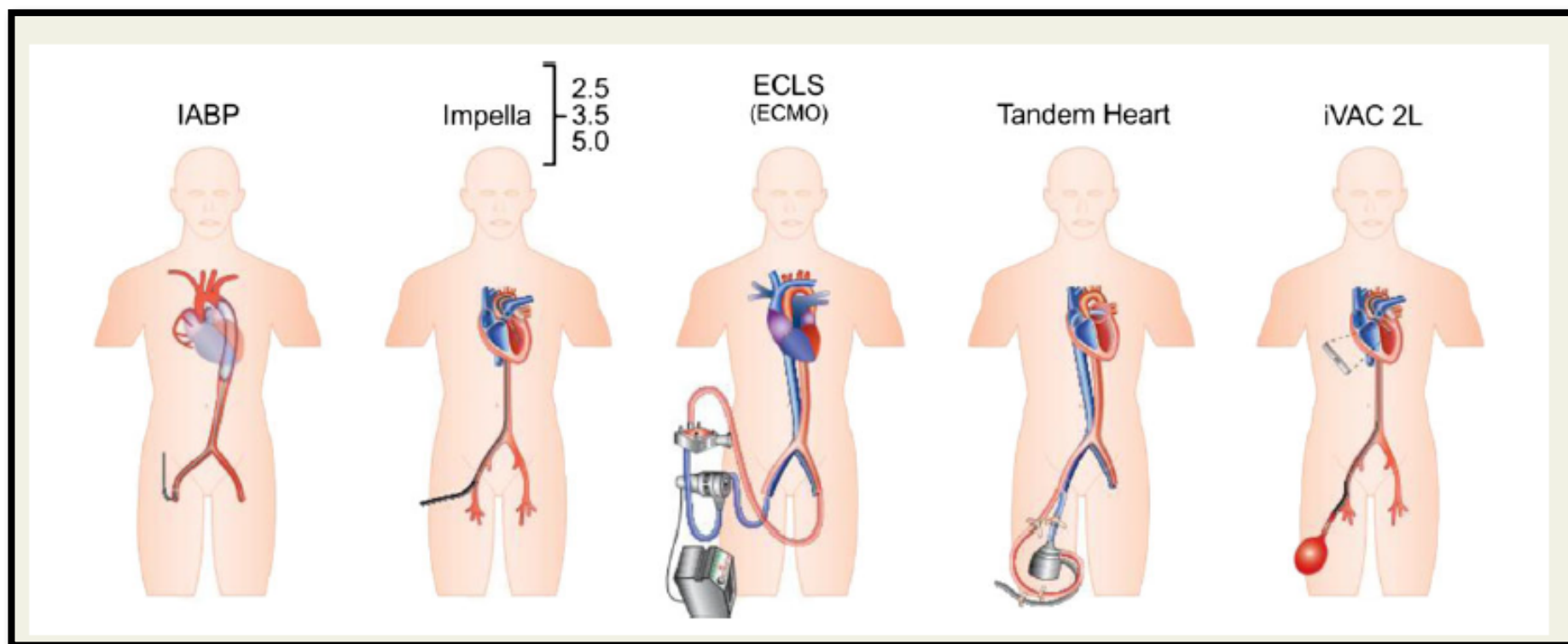
Tandem pRVAD



Protek Oxy-RVAD

# Challenges in cardiogenic shock - Which percutaneous MCS ?

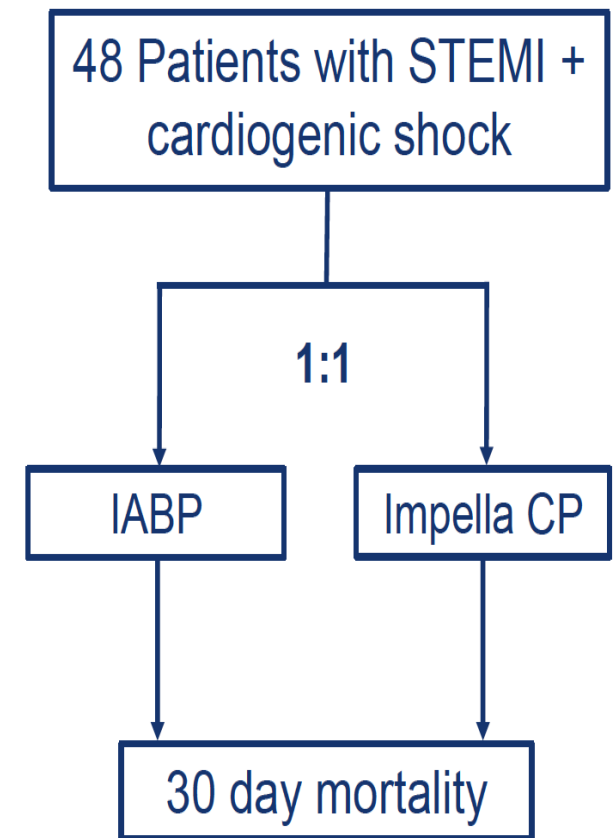
*“Based on current evidence, we do not recommend one mode of short-term circulatory support over another.”*



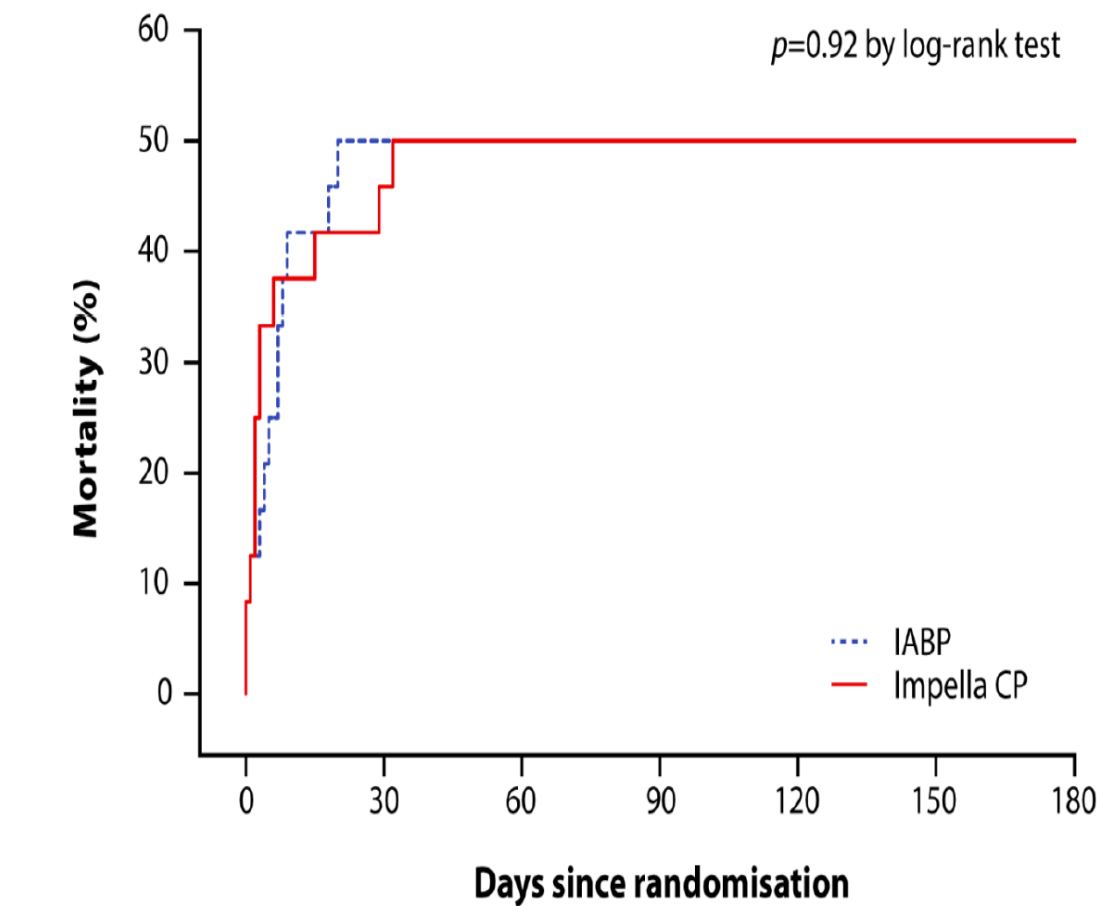
# *IMPRESS trial*

Critically ill mechanically ventilated patients

|                                               | Impella    | IABP      |
|-----------------------------------------------|------------|-----------|
| Systolic blood pressure                       | 81         | 83        |
| Baseline lactate                              | 7.5        | 7.9       |
| Cardiac arrest (%)                            | <b>100</b> | <b>83</b> |
| Arterial pH                                   | 7.14       | 7.17      |
| Device placement before revascularization (%) | 21         | 13        |
| RRT (%)                                       | 33         | 19        |
| Therapeutic hypothermia (%)                   | 79         | 71        |
| Brain anoxia as cause of death (%)            | 23         | 25        |



# *IMPRESS trial*



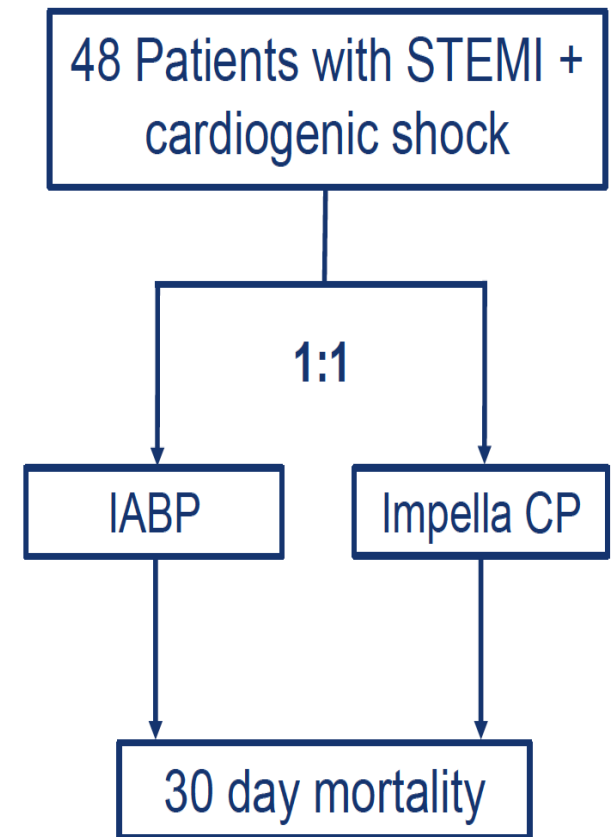
Number at risk

|            |    |    |    |    |    |    |    |
|------------|----|----|----|----|----|----|----|
| IABP       | 24 | 12 | 11 | 11 | 11 | 11 | 11 |
| Impella CP | 24 | 13 | 12 | 12 | 12 | 12 | 12 |

# *IMPRESS trial*

Critically ill mechanically ventilated patients

|                                               | Impella    | IABP      |
|-----------------------------------------------|------------|-----------|
| Systolic blood pressure                       | 81         | 83        |
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| <b>Brain anoxia as cause of death (%)</b>     | <b>23</b>  | <b>25</b> |



ORIGINAL



# The ENCOURAGE mortality risk score and analysis of long-term outcomes after VA-ECMO for acute myocardial infarction with cardiogenic shock

Grégoire Muller<sup>1</sup>, Erwan Flecher<sup>2</sup>, Guillaume Lebreton<sup>2</sup>, Charles-Edouard Luyt<sup>1</sup>, Jean-Louis Trouillet<sup>1</sup>, Nicolas Bréchet<sup>1</sup>, Matthieu Schmidt<sup>1</sup>, Ciro Mastroianni<sup>2</sup>, Jean Chastre<sup>1</sup>, Pascal Leprince<sup>2</sup>, Amedeo Anselmi<sup>3</sup> and Alain Combes<sup>1\*</sup>

138 ECMO-treated AMI patients

**Table 3 Categorical pre-ECMO-institution variables independently associated with in-ICU death comprising the ENCOURAGE score**

| Parameter                             | β Coefficient | OR (95 % CI)      | P value | ENCOURAGE component score |
|---------------------------------------|---------------|-------------------|---------|---------------------------|
| Age >60 years                         | 0.966         | 2.63 (1.01–6.85)  | 0.048   | 5                         |
| Female                                | 1.470         | 4.35 (1.29–14.72) | 0.018   | 7                         |
| Body mass index >25 kg/m <sup>2</sup> | 1.131         | 3.10 (1.21–7.92)  | 0.018   | 6                         |
| Glasgow coma score <6                 | 1.128         | 3.09 (1.19–8.05)  | 0.021   | 6                         |
| Creatinemia >150 μmol/L               | 0.957         | 2.60 (1.05–6.49)  | 0.040   | 5                         |
| Serum lactate                         |               |                   |         |                           |
| <2 mmol/L                             | 0             | 1                 |         | 0                         |
| 2–8 mmol/L                            | 1.551         | 4.71 (1.31–17.01) | 0.020   | 8                         |
| >8 mmol/L                             | 2.165         | 8.71 (1.76–43.10) | 0.004   | 11                        |
| Prothrombin activity <50 %            | 1.029         | 2.80 (1.01–7.77)  | 0.049   | 5                         |

# *Challenges in cardiogenic shock: Witch percutaneous MCS ?*

- Respiratory failure?
  - Profound cardiogenic shock or cardiac arrest?
  - Left ventricular failure
  - Biventricular failure
  - RV failure
  - Centre and operator expertise
  - Availability
  - Cost
- ECMO
  - ECMO
  - Impella vs. ECMO
  - Bi-Pella vs. ECMO
  - RVAD
- } ▪ Site specific

## *Challenges in cardiogenic shock - treatment*

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- ▶ Lack of homogeneous and robust recommendations
- ▶ Evidence recommendations based on just a few randomized and small-sized studies.
- ▶ CS registries of varying sizes, but almost exclusively of ischaemic origin



## *Challenges in cardiogenic shock - treatment ... missing:*

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- ▶ To validate common therapeutics, and cardiocirculatory support
- ▶ To develop novel approaches > targeted therapies:
  - ▶ end-organ support ?
  - ▶ anti-inflammatory therapy ?
  - ▶ temperature management ?



## *Challenges in cardiogenic shock - palliative care*

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- ▶ The timing of palliative care initiation, its assessment, and its management are not well studied in patients with CS.

*We suggest that healthcare providers openly discuss barriers to and benefits of initiating palliative care in patients with CS.*

*Contemporary Management of Cardiogenic Shock. Circulation 2017*



# Suggestions for Global Palliative Care Management in CS

| Management Domains                                                                                                                                                                  | Patient-Focused Supportive Care Recommendations                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Consultation services                                                                                                                                                               | Discuss advanced care decisions, personal goals, emotional/practical/spiritual support, symptom control and care, and illness understanding and trajectory in preparation for supportive care decision making                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Palliative care specialists<br>Cardiology team member trained in coordinating health services (psychologists, chaplains, physicians, and nurses) and providing psychosocial support | Ensure palliative care interventions are parallel with curative treatment care, are holistic, and are tailored to patients' values and preferences<br>Address fears and concerns; maintain open, trusting dialogue<br>Use direct, simple messages and everyday language<br>Provide ongoing services/support for readdressing goals, symptoms, treatment preferences, and self-determination in end-of-life care choices (which may change over time)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Considerations for CS-specific preparedness plan                                                                                                                                    | Prepare for artificial nutrition, hemodialysis, mechanical ventilation, and postdischarge rehabilitation<br>Consider alarm fatigue associated with multiple intravenous drug infusions and hemodynamic monitoring<br>Assess for potential mechanical circulatory support device application <sup>311</sup> : chronic infection and long-term antibiotic use, perioperative morbidity and mortality, stroke or intracranial hemorrhage, recurrent gastrointestinal bleeding, device malfunction/pump failure, financial burden, postoperative complications, and postemergency cardiac surgery                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Preparedness for withdrawal of life-sustaining measures <sup>312</sup>                                                                                                              | Assess and consider each patient's desire<br>Discuss the withdrawal process, what to expect, and how to address distressing factors<br>Ensure the presence of an experienced physician, nurse, and respiratory therapist at the time of extubation<br>Respond quickly if patient experiences distress during the withdrawal process<br>Conduct rounds at the bedside regularly, and ensure emotional and psychological support of patients, families, and healthcare providers<br>Place patients in private rooms whenever possible or maintain privacy with curtains and signage<br>Offer family members a private, quiet, comfortable space, separate from the patient's room, and immediate grief support and referral to community bereavement support services<br>Allow family members to be present at the bedside during withdrawal procedures and to participate in patient care<br>When possible, discontinue paralytic medications to be better able to assess distressing signs before withdrawal of life-sustaining measures<br>Continue opioid medication during withdrawal processes and titrate on the basis of signs or symptoms of distress; if patient was not previously on an opioid, morphine is the medication of choice for pain or dyspnea during withdrawal processes<br>Use sedative medications after effectively treating pain and dyspnea with opioids; combination opioid and sedative medications can be used during withdrawal processes<br>ICU staff should develop protocols for withdrawal of life-sustaining treatments and devices (implantable cardioverter-defibrillator, ventilator, ventricular assist device, inotropic or vasopressor infusions, continuous renal replacement therapies, enteral or parenteral tube feedings, and intravenous fluids)<br>Individualize the pace of withdrawal of life-sustaining measures; use a step-wise approach and ensure that distressing signs and symptoms are managed at each step<br>In MM withdrawal, contribute to team discussions as possible and opt to noninvasive mechanical ventilation |

# *Challenges in cardiogenic shock*

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- ▶ **Diagnosis**
- ▶ **Treatment**
- ▶ **Management of patient complexity**



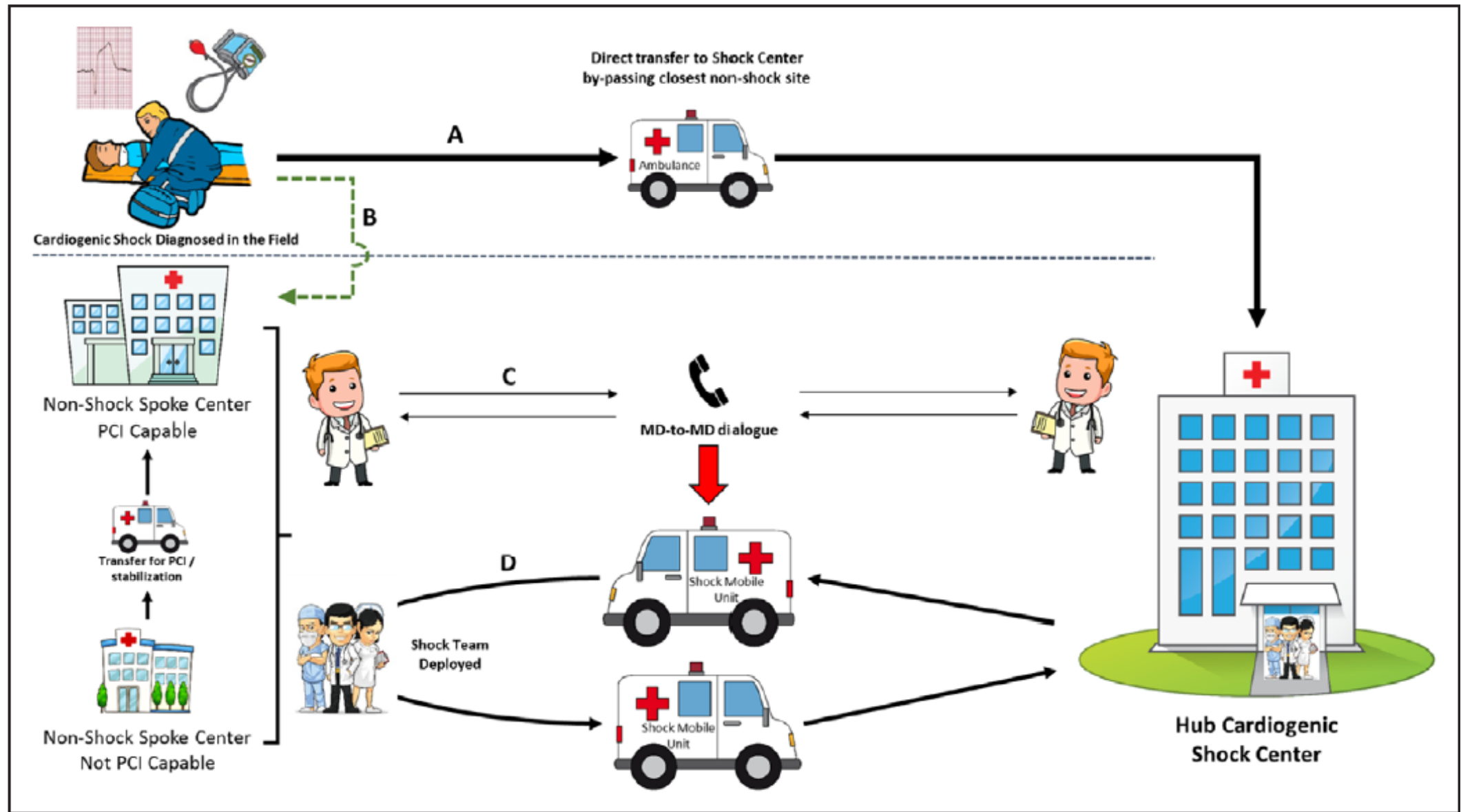
# *Challenges in cardiogenic shock - Management*

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- ▶ Specialized centers – systems of care
- ▶ Multilevel organization: CICU Level 3
- ▶ Multidisciplinary team: *Cardiogenic shock team*



# Proposed regional system of care for cardiogenic shock



## *Challenges in cardiogenic shock - Specialized centers*

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- ▶ ***All CS should be rapidly transferred to a tertiary care center which has a 24/7 service of cardiac catheterization, and a dedicated ICU with availability of short-term mechanical circulatory support***



# *Challenges in cardiogenic shock - Management*

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- ▶ Specialized centers – systems of care
- ▶ Multilevel organization: CICU Level 3
- ▶ Multidisciplinary team: *Cardiogenic shock team*



# Acute Cardiovascular Care Association Position Paper on Intensive Cardiovascular Care Units: An update on their definition, structure, organisation and function

European Heart Journal: Acute Cardiovascular Care  
1–16

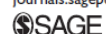
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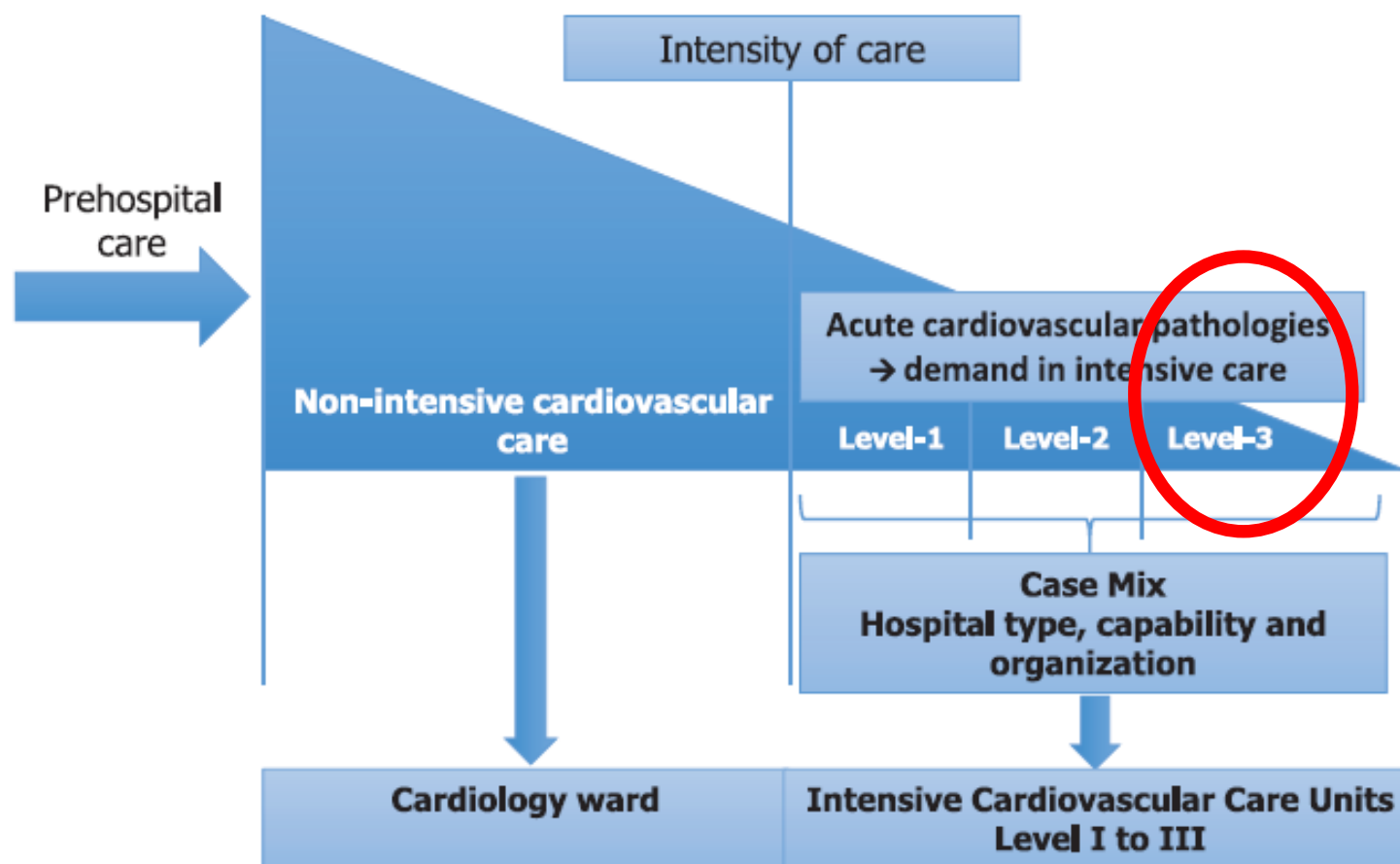
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DOI: 10.1177/2048872617724269

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## Acute Cardiac Care



# **Acute Cardiovascular Care Association Position Paper on Intensive Cardiovascular Care Units: An update on their definition, structure, organisation and function**

European Heart Journal: Acute Cardiovascular Care  
1–16

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## **ACUTE CONDITIONS acting as modifiers**

Acute heart failure with venous congestion as dominant clinical expression

Level 1

Ventricular tachyarrhythmia with no hemodynamic complication

Level 1

Acute heart failure with hypoperfusion as dominant clinical expression

Level 2

Acute renal failure with oliguria

Level 2

Condition (sepsis, right ventricular dysfunction...) requiring IV vasopressor

Level 2

Cardiac arrhythmias with heart failure

Level 2

Cardiogenic shock

Level 3

Cardiac arrest with coma

Level 3

Ventricular tachycardia or fibrillation with electrical storm

Level 3

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European Heart Journal: Acute Cardiovascular Care  
1–16

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**Table 2.** Techniques that contribute to define the level of care for acute cardiovascular conditions

| Techniques that contribute to define level-1 case                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Techniques that contribute to define level-2 case                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Techniques that contribute to define level-3 case                                                                                                                                                                                                                                                                                               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>• Need of continuous observation based on clinical condition</li> <li>• Need of observation because of serious risk of aspiration pneumonia</li> <li>• Need of continuous oxygen therapy because of clinical hypoxaemia</li> <li>• Need for frequent daily respiratory physiotherapy to treat/ prevent respiratory failure</li> <li>• Need of bi-level positive airway pressure or CPAP</li> <li>• Need of chest drain</li> <li>• Need of intravenous rhythm controlling drug(s) to support or control supraventricular arrhythmias</li> </ul> | <ul style="list-style-type: none"> <li>• Need of a central venous access line for monitoring of central venous pressure</li> <li>• Need of an arterial line for monitoring the arterial pressure and/or sampling of arterial blood</li> <li>• Need of central venous access to deliver titrated fluids to treat hypovolaemia, for boluses or continuous infusion of intravenous drugs</li> <li>• Need of single intravenous vasoactive drug to support or control arterial pressure cardiovascular output or organ perfusion</li> <li>• Need of a temporary cardiovascular pacemaker</li> <li>• Need of percutaneous cardiac assist device (IABP, axial pumps...)</li> <li>• Need of pericardiocentesis or myocardial biopsies</li> </ul> | <ul style="list-style-type: none"> <li>• Need of invasive mechanical ventilator support</li> <li>• Need of renal replacement therapy for an acute condition</li> <li>• Need of targeted temperature management</li> <li>• Need of surgically implanted mechanical circulatory support</li> <li>• Need of extracorporeal life support</li> </ul> |

**Table 3.** Suggested monitoring and equipment according to intensive cardiovascular care unit (ICCU)'s level.

| Level I ICCU                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Level II ICCU                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Level III ICCU                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>• At least 2 ECG channels</li> <li>• Non-invasive blood pressure monitor</li> <li>• At least one invasive pressure channel</li> <li>• SpO2 metre</li> <li>• Electronic prescribing and chart access (advisable)</li> <li>• Nurse station to be used for central monitoring at least one ECG lead from each patient as well as relevant haemodynamic and respiratory data should continuously be present on a central screen.</li> <li>• Slave monitors to enable monitoring of patients from different sites of the unit</li> <li>• Working stations for retrospective analysis of index events</li> <li>• Volumetric pump/automatic syringes</li> <li>• CPAP delivery systems to use with face mask</li> <li>• At least one mechanical ventilator for the unit with non-invasive ventilation capacity</li> <li>• Biphasic defibrillators</li> <li>• At least one external pacemaker for the unit</li> <li>• Temporary VVI pacemakers and at least one DDD for the unit advisable</li> <li>• Mobile echocardiography machine</li> <li>• Glucose level measurement kits</li> <li>• If blood chemistry tests cannot come back from the central lab within 5 min: blood clot metre (ACT), blood chemical markers kits, blood gasses and electrolyte analyser, multiparametric blood analyser</li> </ul> | <p>Same as level I ICCU plus</p> <ul style="list-style-type: none"> <li>• Additional ECG channels</li> <li>• Invasive haemodynamic channels</li> <li>• End tidal CO2</li> <li>• Non-invasive cardiovascular output</li> <li>• Non-invasive thermometers</li> <li>• Mechanical ventilators</li> <li>• Mobile echocardiography machine including TEE probe, vascular probe</li> <li>• At least one echography device for ultrasound guidance for central venous access line</li> <li>• Percutaneous circulatory assist devices (IABP; percutaneous axial pump)</li> <li>• X-ray system for fluoroscopy in the unit</li> <li>• Haemodialysis/haemofiltration machine through the nephrology department (advisable)</li> <li>• Hypothermia maintenance devices (advisable)</li> </ul> | <p>Same as level II plus all techniques and equipment that put this unit on par with a general critical care unit including:</p> <ul style="list-style-type: none"> <li>• Specific additional monitoring</li> <li>• Haemodialysis/haemofiltration machine</li> <li>• Mechanical ventilators</li> <li>• And more specifically</li> <li>• ECLS</li> <li>• Hypothermia maintenance devices</li> </ul> |



# Acute Cardiovascular Care Association Position Paper on Intensive Cardiovascular Care Units: An update on their definition, structure, organisation and function

## Level I ICCU

## Level II ICCU

## Level III ICCU

|                      |                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                               |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Hospital             | <ul style="list-style-type: none"> <li>Emergency department; computed tomography scanner; transoesophageal echo; X-ray system for fluoroscopy</li> </ul>                                                                      | <ul style="list-style-type: none"> <li>24/7 coronary interventional cath-lab; hub centre of a STEMI network</li> <li>Idem for level I ICCU plus pacing, cardiovascular resynchronisation therapy; implantable cardioverter-defibrillator programme; ablation therapy; renal support therapy; scanner and CMR</li> </ul> | <ul style="list-style-type: none"> <li>Tertiary or university hospital</li> <li>Idem for level II ICCU plus percutaneous structural heart intervention; endomyocardial biopsy; donor organ and transplantation programme; interventional vascular radiology; comprehensive cardiovascular surgery</li> </ul>  |
| Level of competence  | <ul style="list-style-type: none"> <li>Head: cardiologist</li> <li>Team: cardiologists</li> <li>On site: intensivist consultation 24/7</li> </ul>                                                                             | <ul style="list-style-type: none"> <li>Head: cardiovascular intensivist</li> <li>Team: cardiovascular intensivists</li> <li>On site: intensivist consultation 24/7</li> </ul>                                                                                                                                           | <ul style="list-style-type: none"> <li>Head: cardiovascular intensivist or co-directorship with a general critical care specialist</li> <li>Team: cardiovascular intensivists with additional education in critical care; may include general intensivists with additional education in cardiology</li> </ul> |
| Education programmes | <ul style="list-style-type: none"> <li>Recommended: written exam of the ESC-ACC certification for individuals; should master all the techniques required in level I ICCU</li> <li>Resident or fellow in cardiology</li> </ul> | <ul style="list-style-type: none"> <li>Required: specific national curriculum for acute cardiovascular care or ACCA curriculum for cardiovascular intensivist</li> <li>Residents or fellow in cardiovascular intensive care</li> </ul>                                                                                  | <ul style="list-style-type: none"> <li>Idem level II ICCU plus specific curriculum for general critical care training</li> <li>Resident and fellow in cardiovascular intensive care; critical care</li> </ul>                                                                                                 |

# *Challenges in cardiogenic shock - Management*

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- ▶ Specialized centers – systems of care
- ▶ Multilevel organization: CICU Level 3
- ▶ Multidisciplinary team: ***Cardiogenic shock team***



# Past Shock TEAM

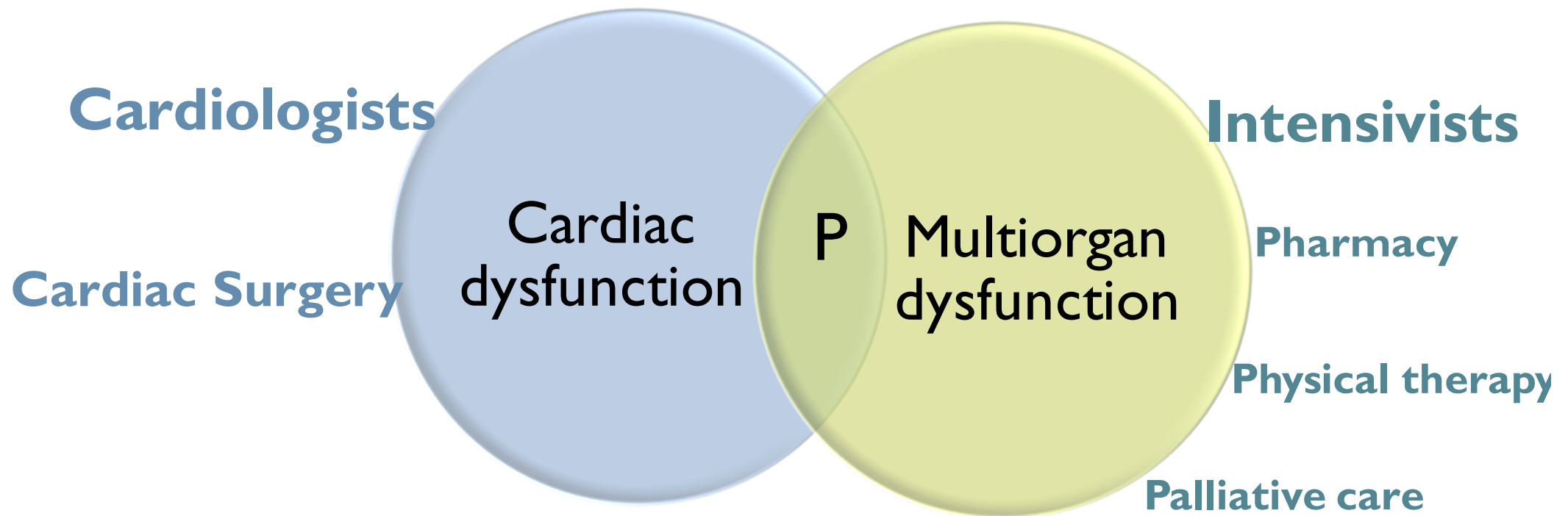
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# *Challenges in cardiogenic shock - Multidisciplinary team*

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Think collective!



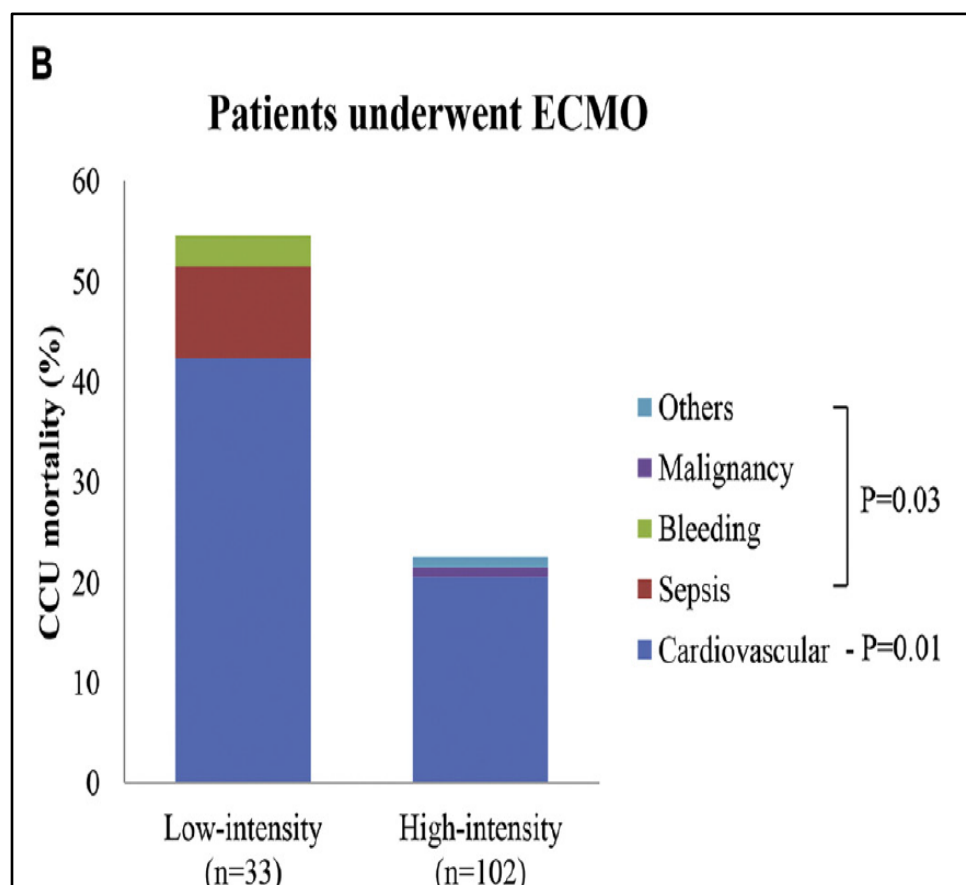
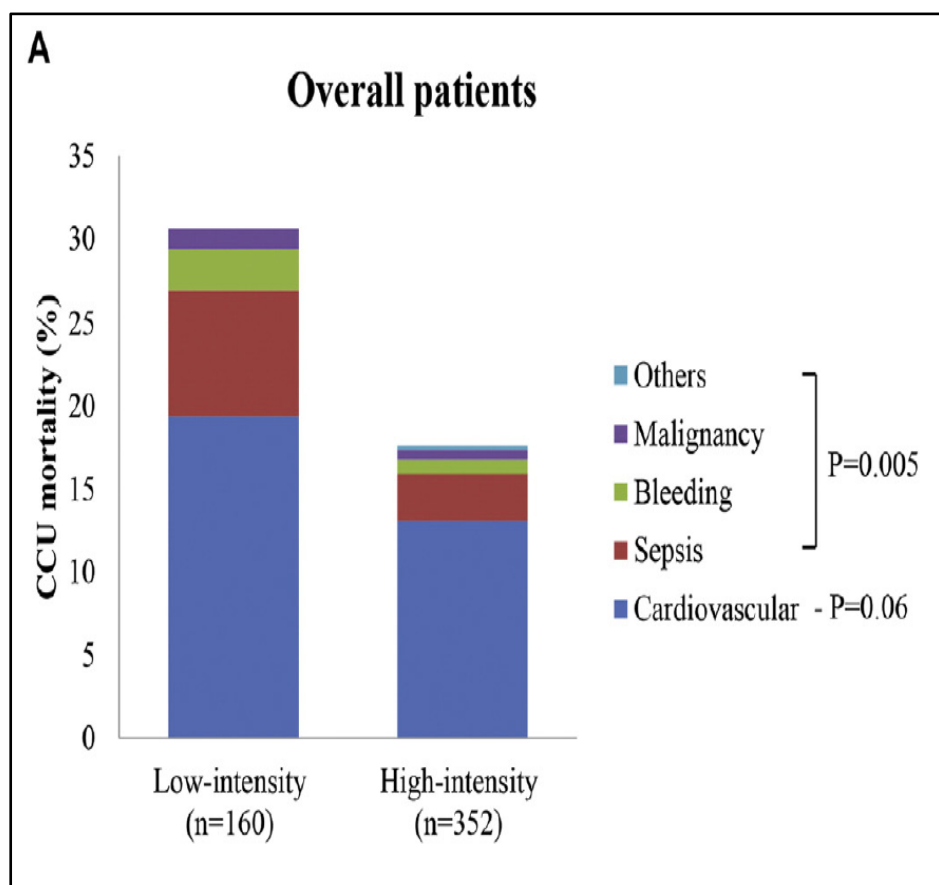
*Collaboration between different specialties with the patient at the centre*

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# Impact of a cardiac intensivist on mortality in patients with cardiogenic shock

Soo Jin Na<sup>a,1</sup>, Taek Kyu Park<sup>b,1</sup>, Ga Yeon Lee<sup>b,1</sup>, Yang Hyun Cho<sup>c,1</sup>, Chi Ryang Chung<sup>a,1</sup>, Kyeongman Jeon<sup>a,d,1</sup>,  
Gee Young Suh<sup>a,d,1</sup>, Joong Hyun Ahn<sup>e,1</sup>, Keumhee C. Carriere<sup>e,f,1</sup>, Young Bin Song<sup>b,1</sup>, Jin-Oh Choi<sup>b,1</sup>,  
Joo-Yong Hahn<sup>b,1</sup>, Seung-Hyuk Choi<sup>b,1</sup>, Hyeon-Cheol Gwon<sup>b,1</sup>, Jeong Hoon Yang<sup>a,b,\*,1</sup>





## The (R)Evolution of the CICU

Better for the Patient, Better for Education

Valentin Fuster, MD, PhD, MACC



- ▶ “In conclusion, this **new cardiac surgical-medical intensive care unit**, which I have deemed as **Stage IV** in this revolution of intensive care, is best for the patient, because the complex disease states are assessed and treated by experts from various cardiovascular specialists, and the whole assembly of the cardiovascular personnel **holistically treat the patient in a team-based environment**”

# *Challenges in cardiogenic shock*

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- ▶ *Cardiogenic shock* : still a challenge!
- ▶ It is of the utmost importance to update and improve our knowledge of CS in real life.
- ▶ There is an acute need of new evidence: new RCT and large contemporary registries.

