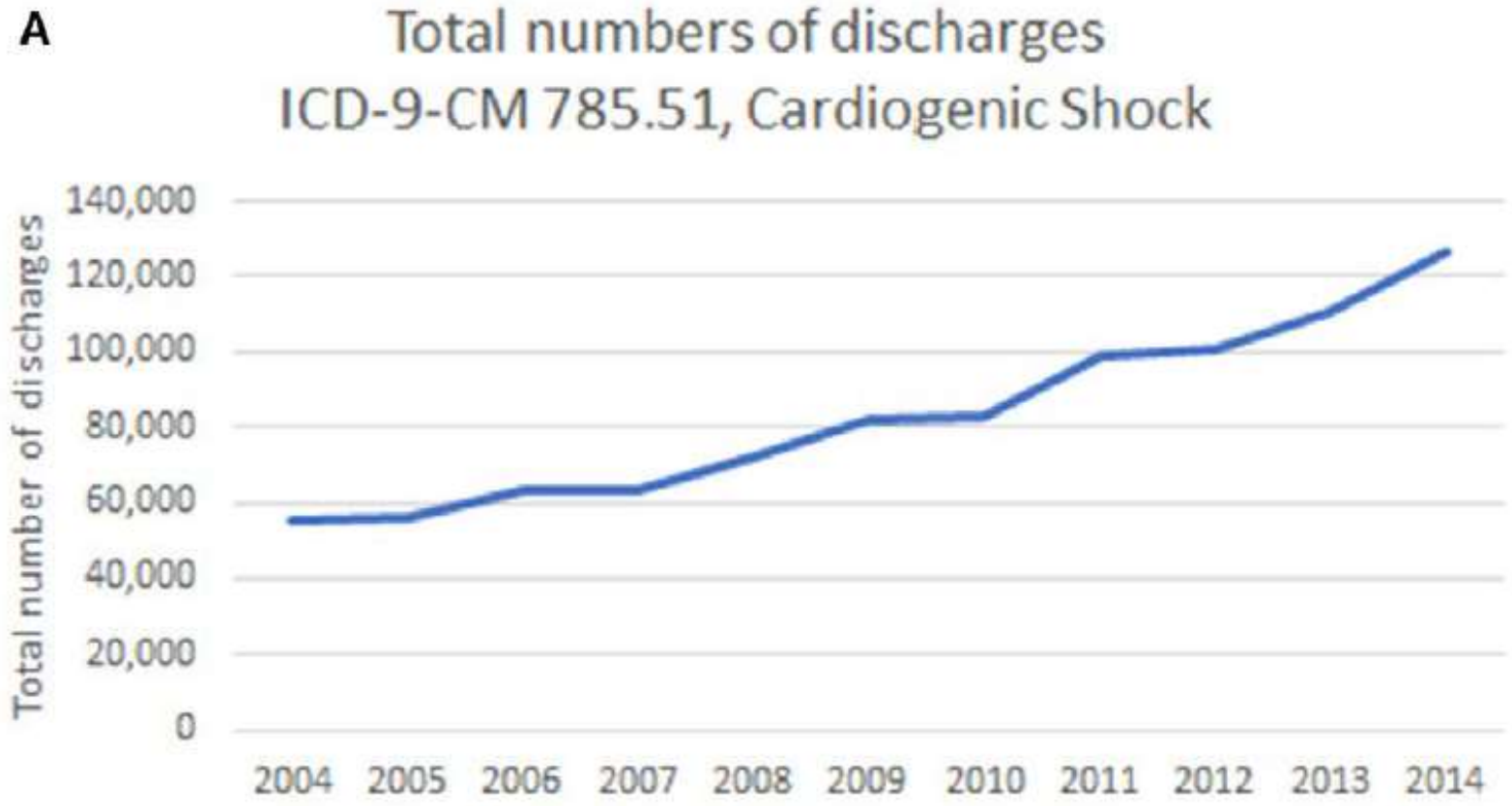
L'ARRESTO CARDIACO EXTRA- E INTRA-OSPEDALIERO E IL PAZIENTE IN SHOCK: IL SUPPORTO MECCANICO DI CIRCOLO IN EMODINAMICA

CARLO TRANI

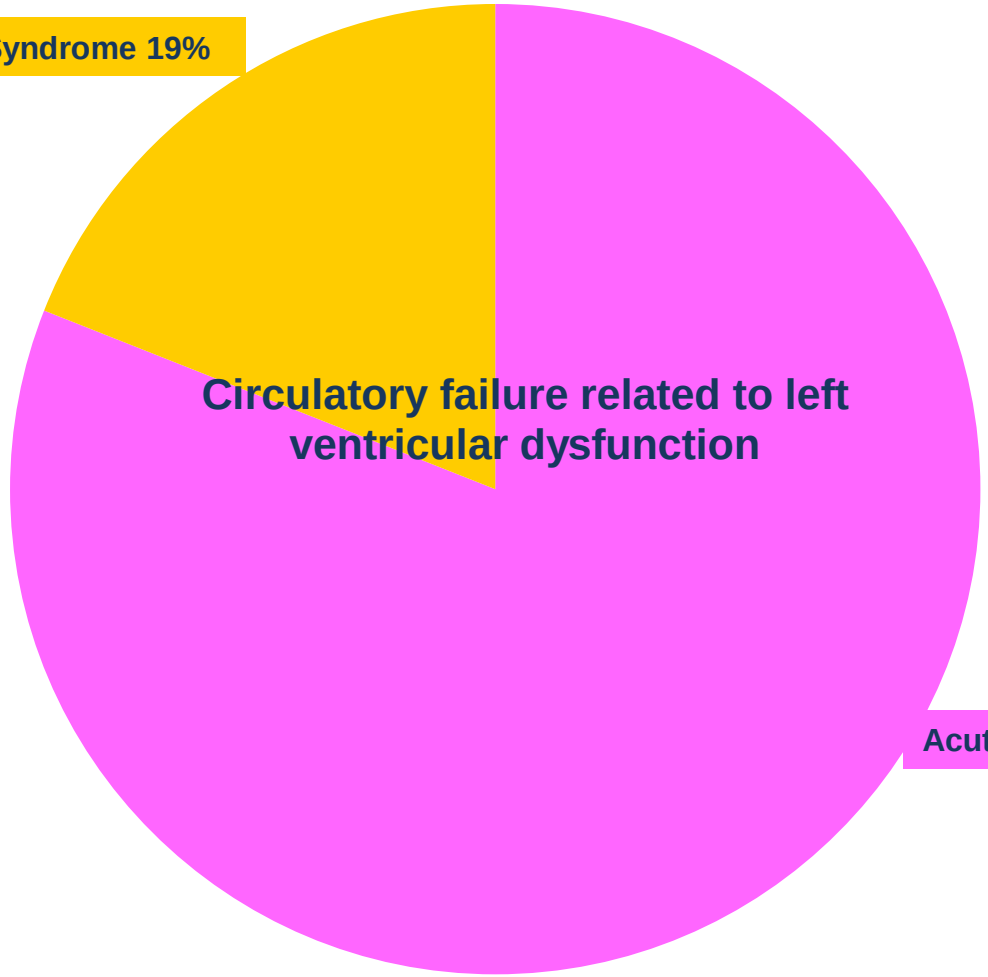
UNIVERSITA' CATTOLICA DEL SACRO CUORE
ROMA

Perché parlare di assistenza Meccanica?



Mandawat et al, *Circ Cardiovasc Interv, 2017*

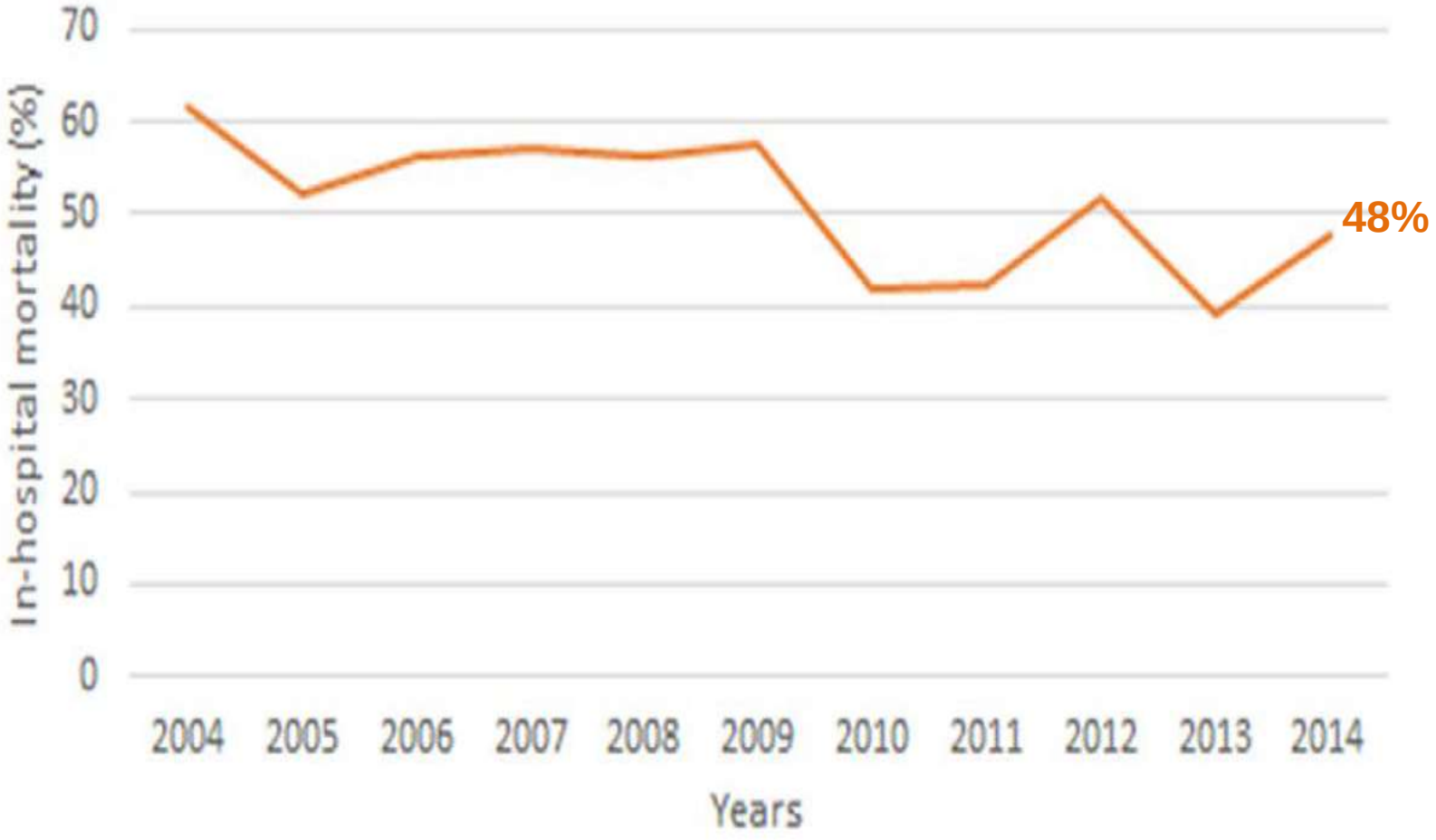
Heterogenous etiology



Szymanski FM Anaesthesiology Intensive Therapy 2014

Perché parlare di assistenza Meccanica?

Data from the Nationwide Inpatient Sample



Mandawat A Circ Cardiovasc Interv. 2017

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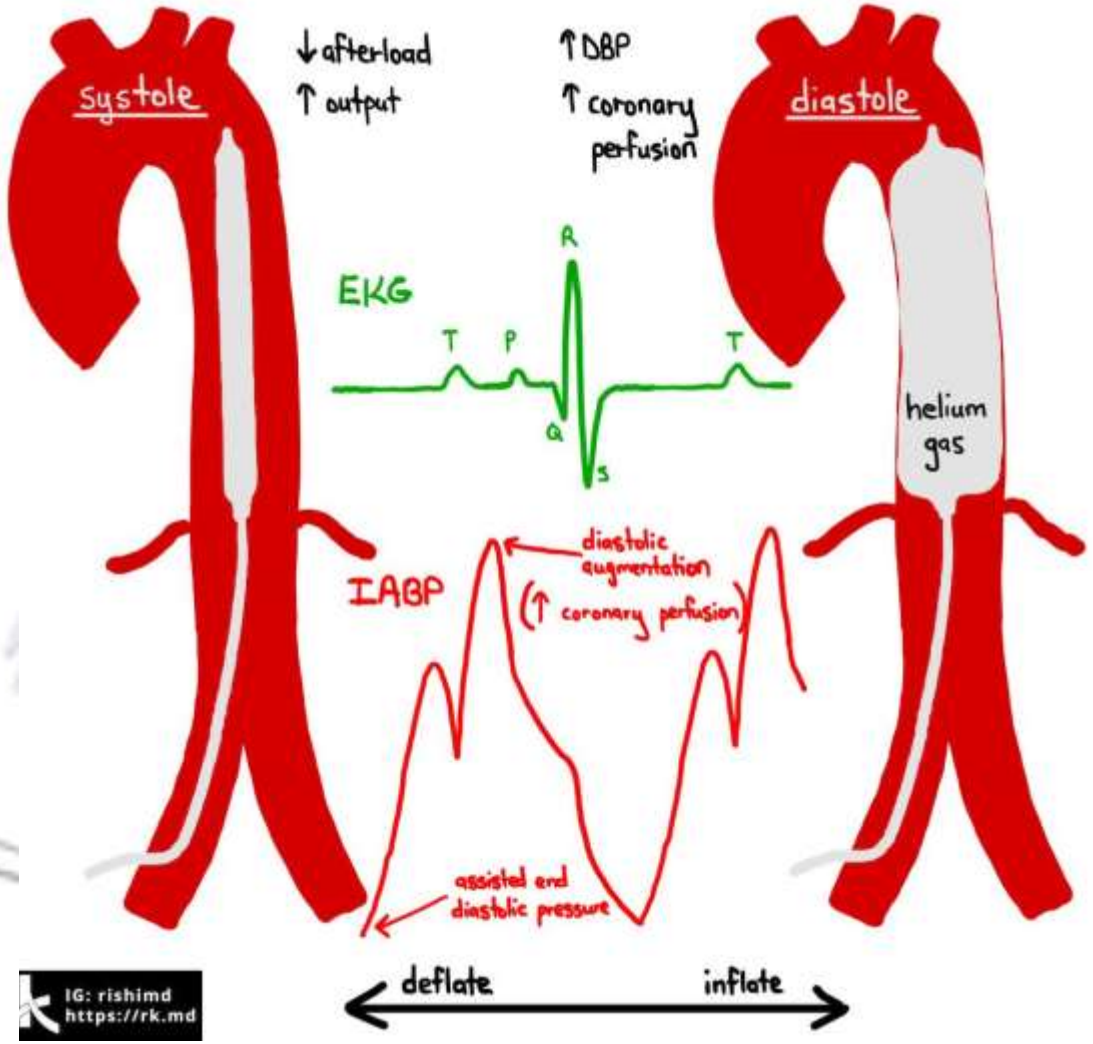
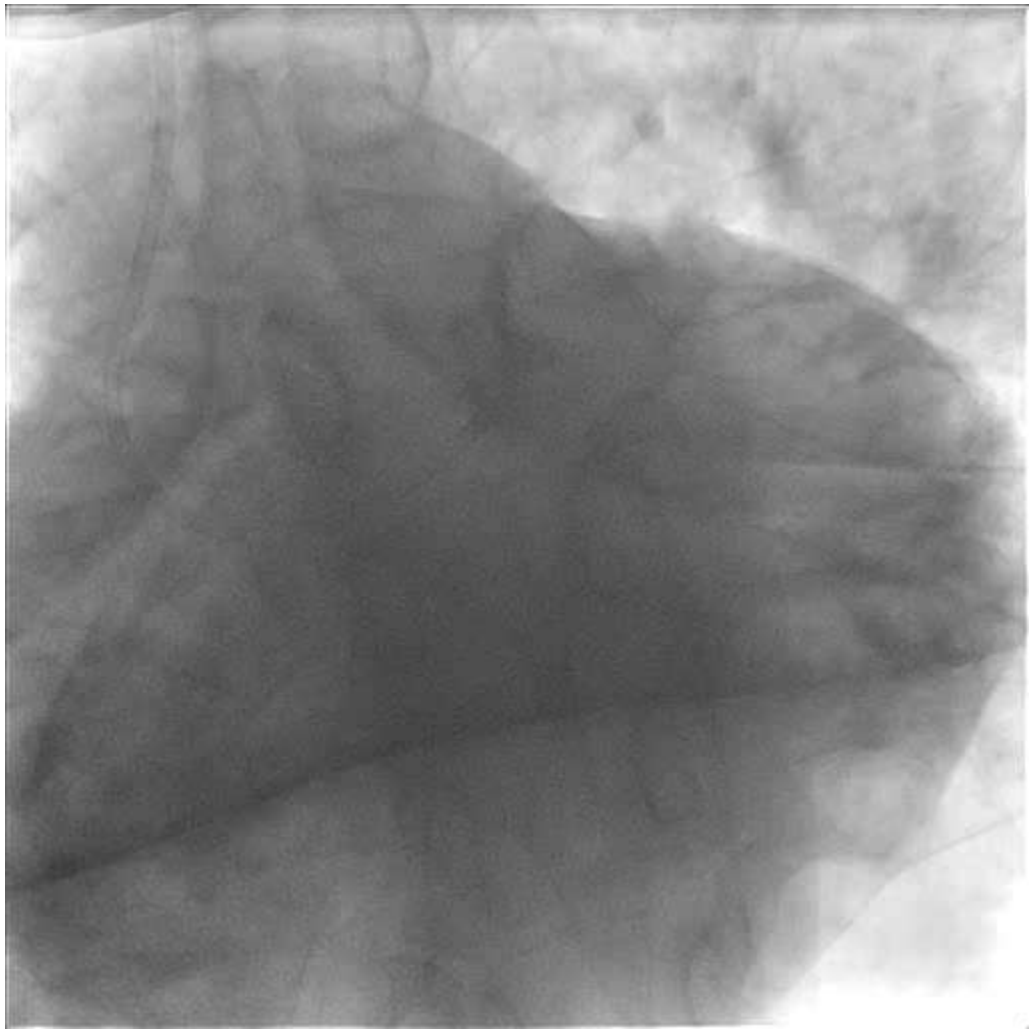
Intra-aortic Balloon Pump



Perché parlare di assistenza Meccanica?

13' after cath lab arrival



Perché parlare di assistenza Meccanica?

16' after cath lab arrival

Perché parlare di assistenza Meccanica?

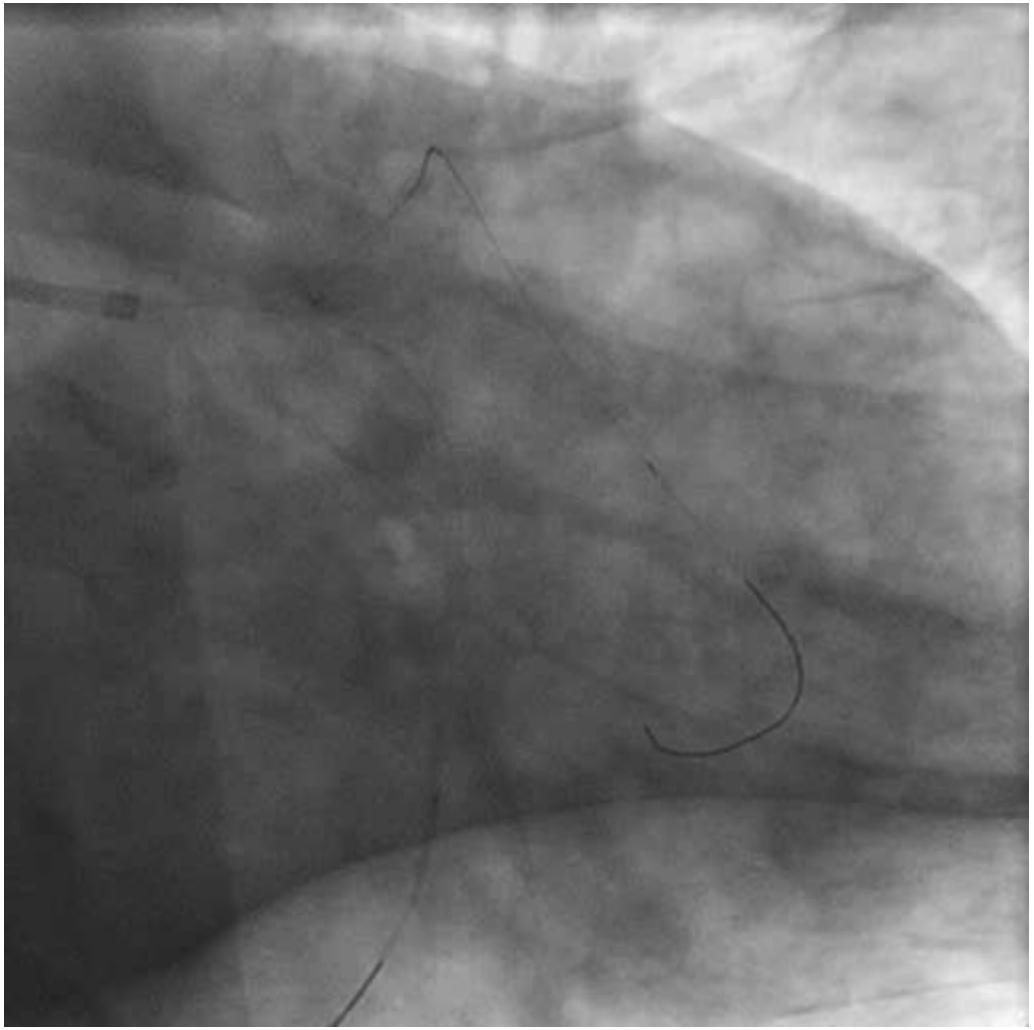
25' after cath lab arrival

Perché parlare di assistenza Meccanica?

30' after cath lab arrival

Perché parlare di assistenza Meccanica?

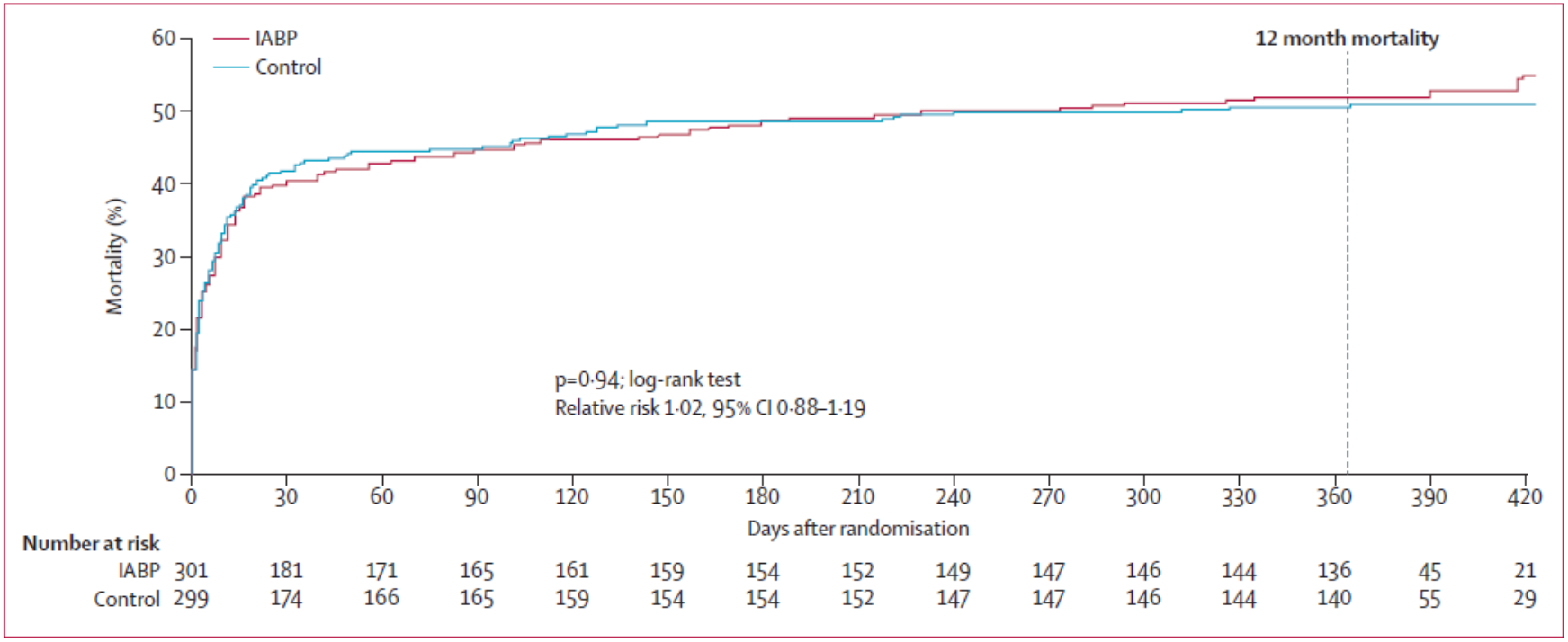
42' after cath lab arrival



Perché parlare di assistenza Meccanica?

Intra-aortic balloon counterpulsation in acute myocardial infarction complicated by cardiogenic shock (IABP-SHOCK II): final 12 month results of a randomised, open-label trial

Holger Thiele, Uwe Zeymer, Franz-Josef Neumann, Miroslaw Ferenc, Hans-Georg Olbrich, Jörg Hausleiter, Antoinette de Waha, Gert Richardt, Marcus Hennersdorf, Klaus Empen, Georg Fuernau, Steffen Desch, Inge Eitel, Rainer Hambrecht, Bernward Lauer, Michael Böhm, Henning Ebelt, Steffen Schneider, Karl Werdan*, Gerhard Schuler*, on behalf of the Intraaortic Balloon Pump in cardiogenic shock II (IABP-SHOCK II) trial investigators†



Perché parlare di assistenza Meccanica?

ESC European Society of Cardiology

European Heart Journal (2018) 00, 1–96
doi:10.1093/eurheartj/ehy394

ESC/EACTS GUIDELINES

2018 ESC/EACTS Guidelines on myocardial revascularization

The Task Force on myocardial revascularization of the European Society of Cardiology (ESC) and European Association for Cardio-Thoracic Surgery (EACTS)

Routine use of IABPs in patients with cardiogenic shock due to ACS is not recommended.[260–262]	III	B

Sistemi di Assistenza Circolatoria (MCS)

Dispositivi disegnati per garantire rapidamente ed efficientemente una perfusione periferica sufficiente a prevenire o far regredire la disfunzione degli organi vitali

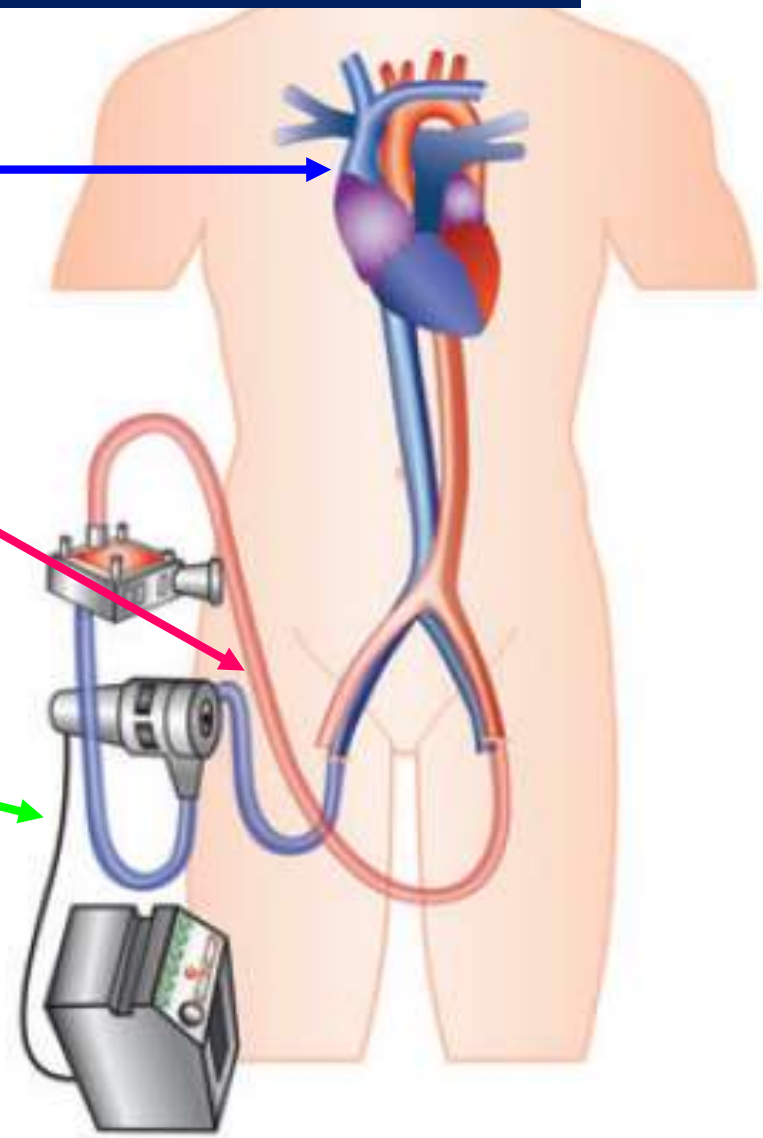
(p)MCS

ECMO (extracorporeal membrane oxigenation)

CANNULA VENOSA (18-21 F) ASPIRA SANGUE NON OSSIGENATO DA ATRIO DESTRO (ACCESSO VENOSO FEMORALE)

UNA CANNULA (18-22 F) ARTERIOSA POMPA IL SANGUE NELL'AORTA DISCENDENTE (ACCESSO FEMORALE)

POMPA CENTRIFUGA a flusso CONTINUO in grado di garantire > 4.5 l/min, mentre l'OSSIGENATORE permette lo scambio di gas

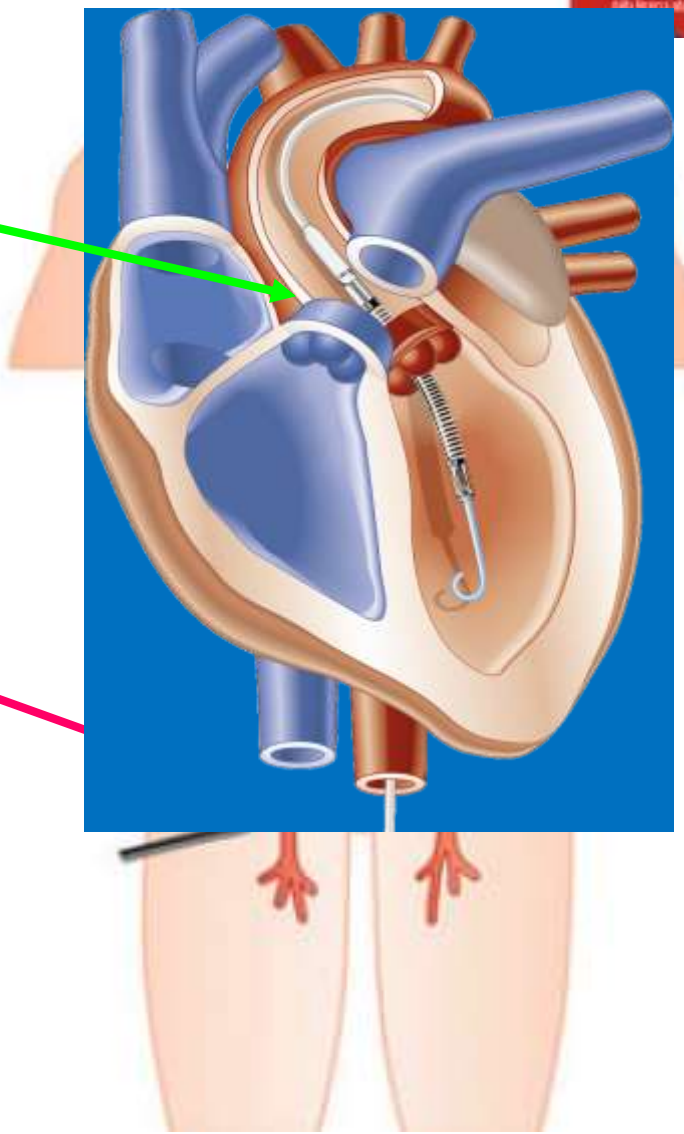


pMCS

Impella

POMPA da 12-13 F POSIZIONATA per via retrograda a cavaliere della valvola aortica ASPIRA SANGUE DAL VENTRICOLO E LO IMMETTE IN AORTA ascendente con flusso continuo garantendo una PORTATA MASSIMA di 2.2-3.9 l/min

UN CATETERE VIENE INTRODODOTTO NELL'ARTERIA FEMORALE ATTRAVERSO UN INTRODUTTORE 13-14 F



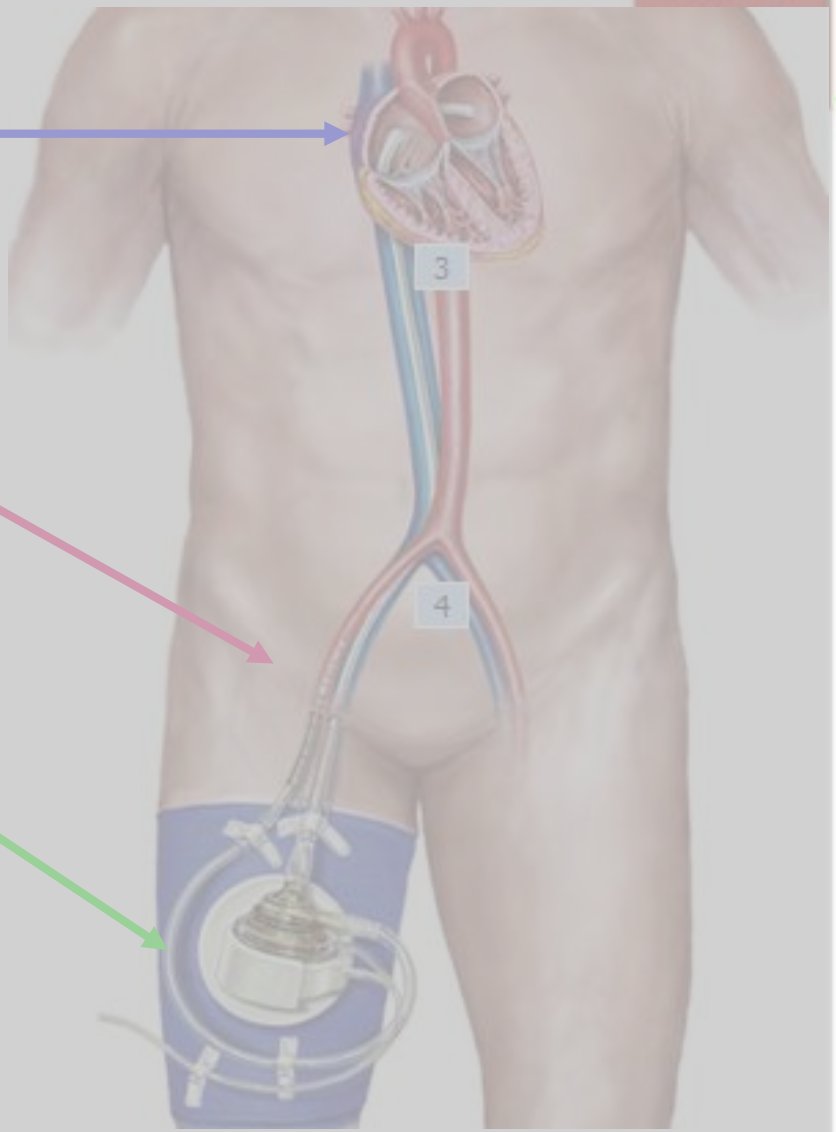
pMCS

TandemHeart

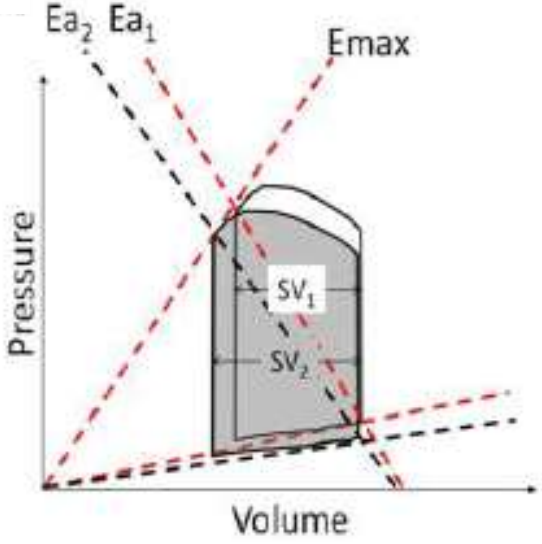
CANNULA VENOSA (21 F) ASPIRA SANGUE OSSIGENATO DA ATRIO SINISTRO (**PUNTURA TRANSETTALE**)

UNA CANNULA DA 9-17 F ARTERIOSA

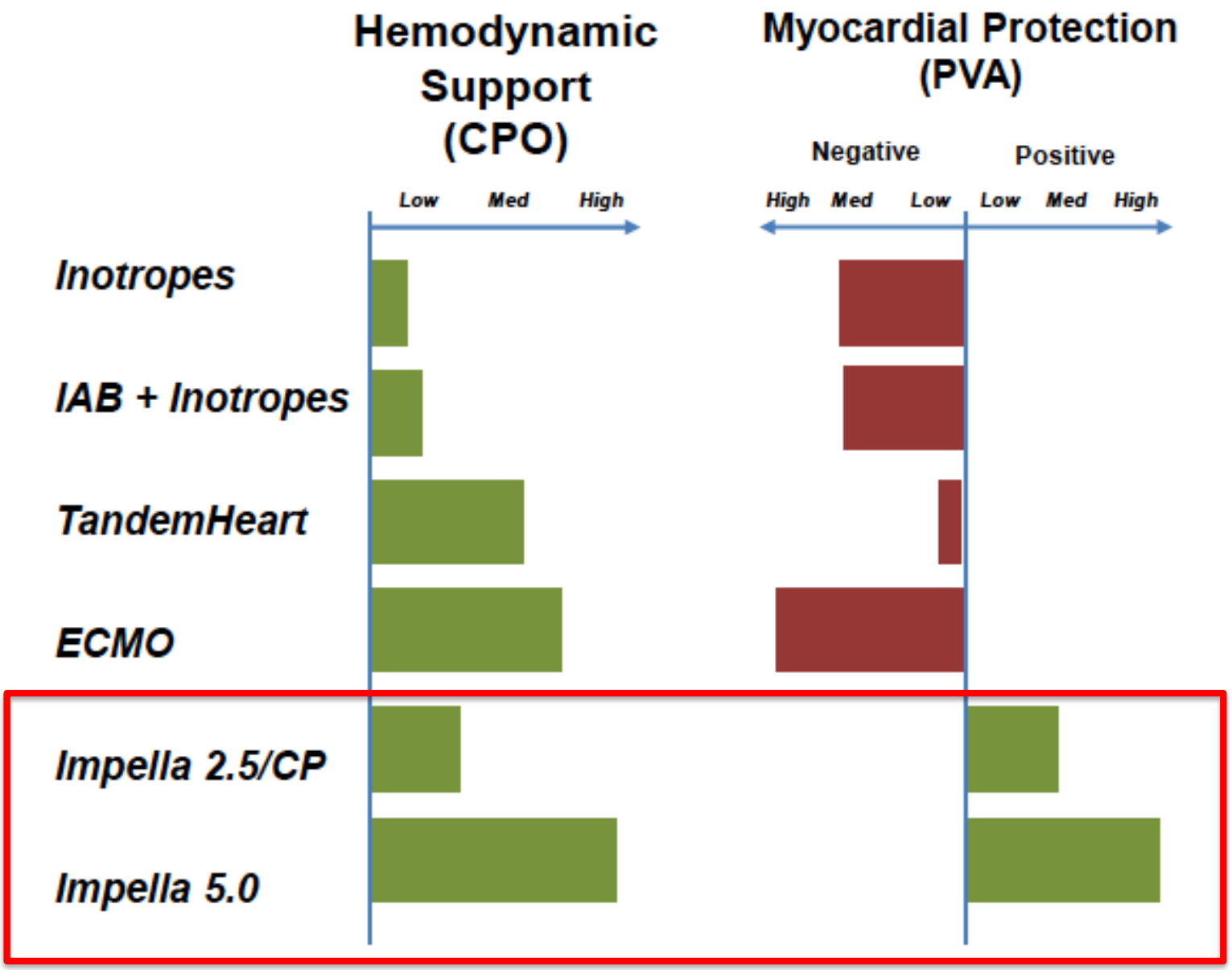
POMPA CENTRIFUGA a flusso CONTINUO in grado di garantire fino a 4 l/min



Effetti emodinamici dei pMCS



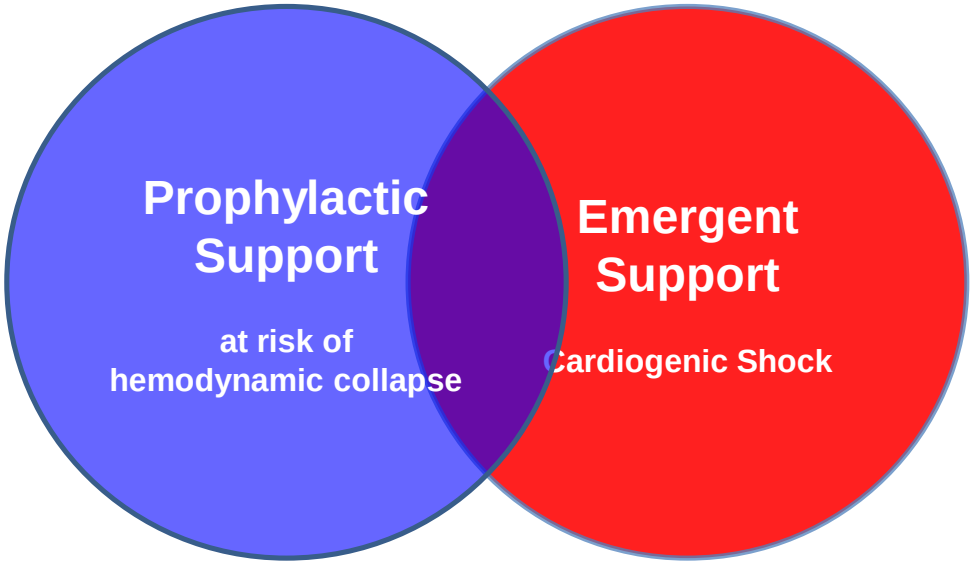
IABP


Hemodynamic Support (CPO)
Low
Med
High
Myocardial Protection (PVA)
Negative
High
Med
Low
Positive
Low
Med
High
Inotropes
IAB + Inotropes
TandemHeart
ECMO
Impella 2.5/CP
Impella 5.0

Clinical Settings and Hemodynamic Support

Prophylactic Setting

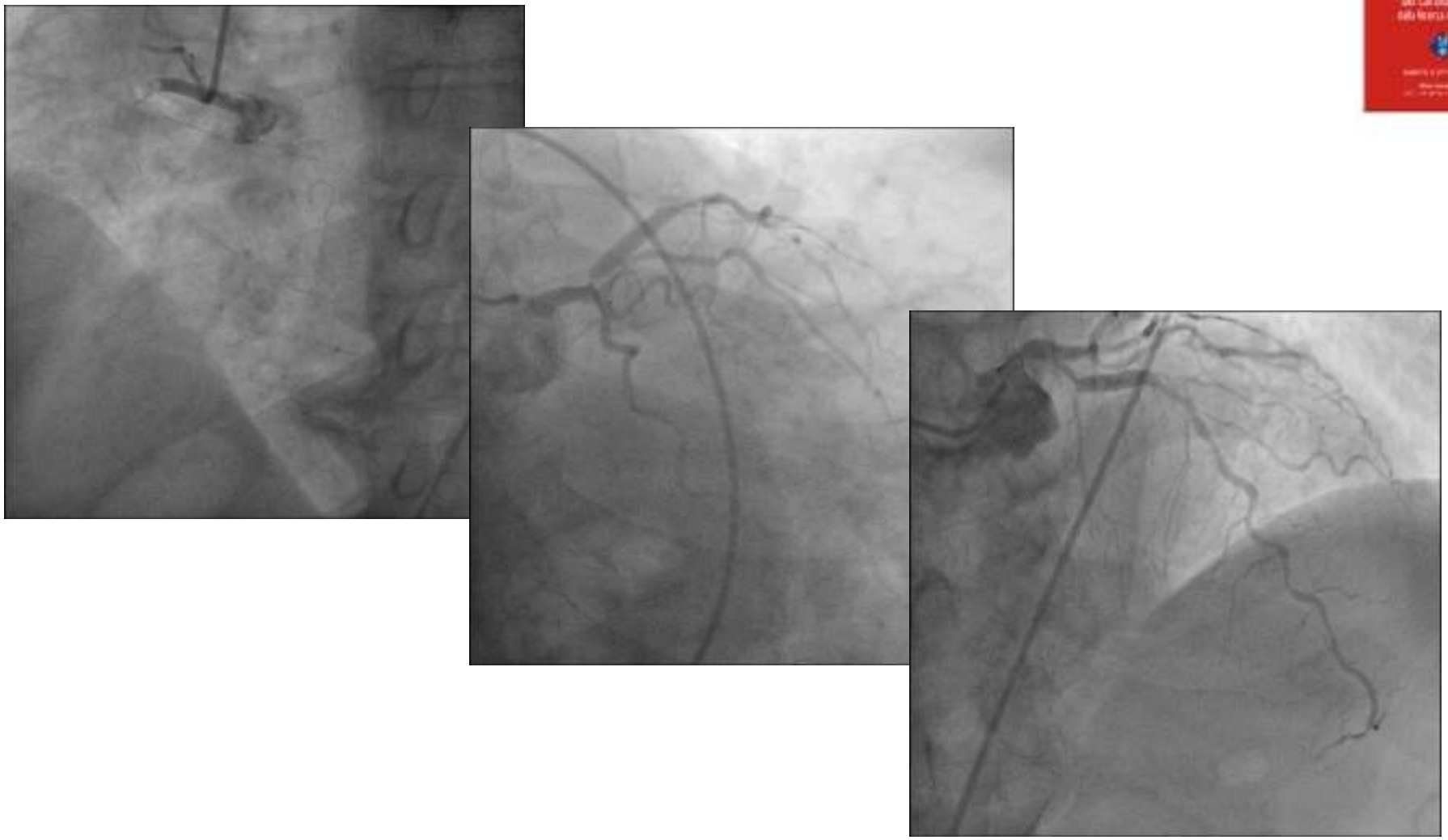
- Maintain BP and CO during procedure to maximize CBF to other myocardial regions and blood flow to the body



Emergent Setting

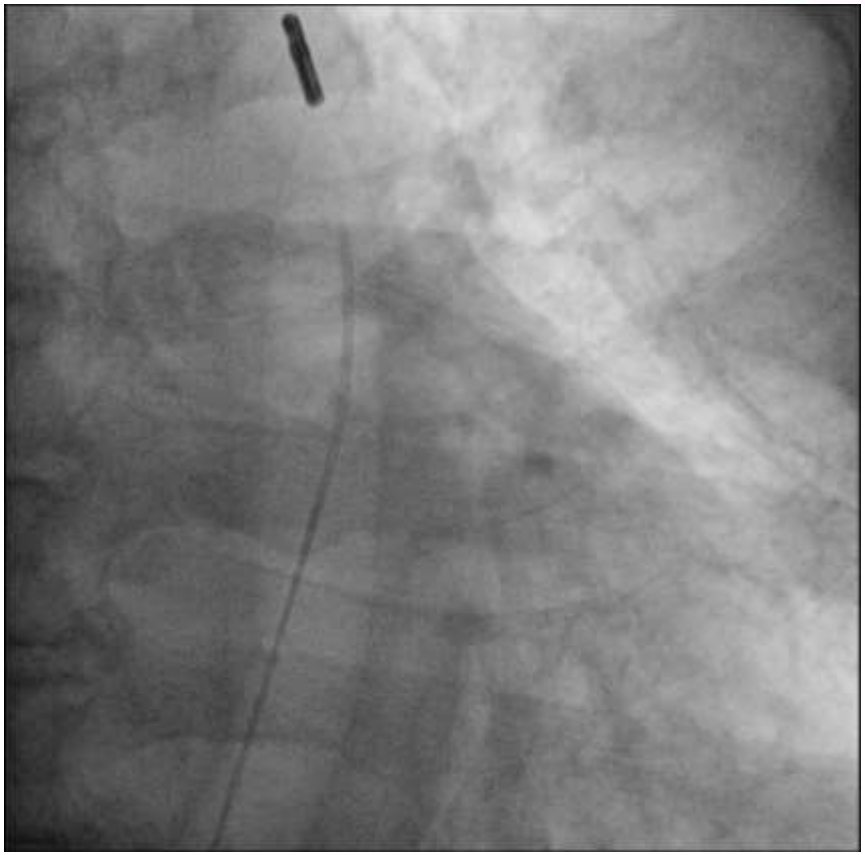
- Normalize CO, BP, Cardiac Power Output (CPO= MAP x CO)
- Decrease PCWP
- Decrease myocardial work and oxygen consumption while optimizing myocardial perfusion
- *Minimize myocardial damage and optimize recovery*

pMCS nello shock cardiogeno

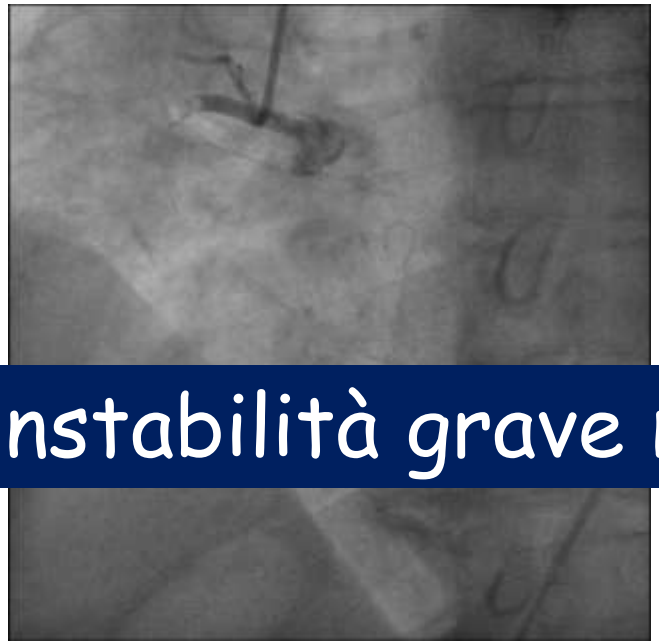


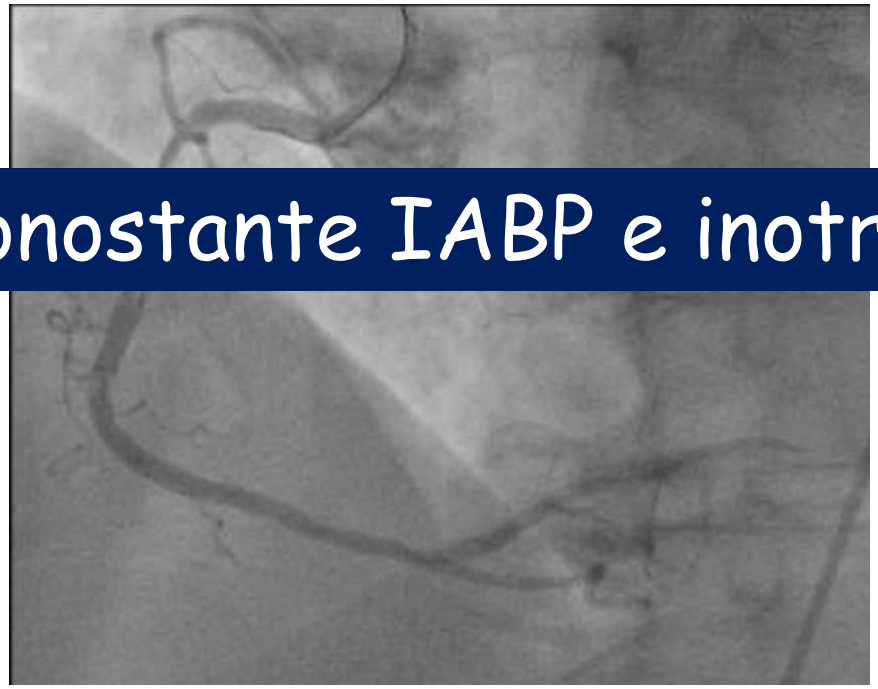
STEMI complicato da SHOCK

pMCS nello shock cardiogeno



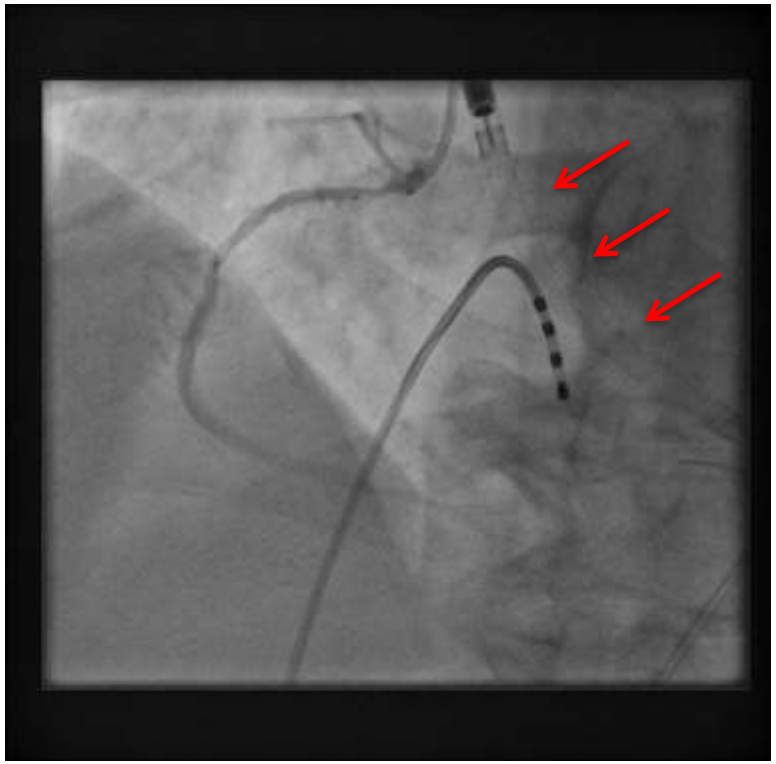
pMCS nello shock cardiogeno





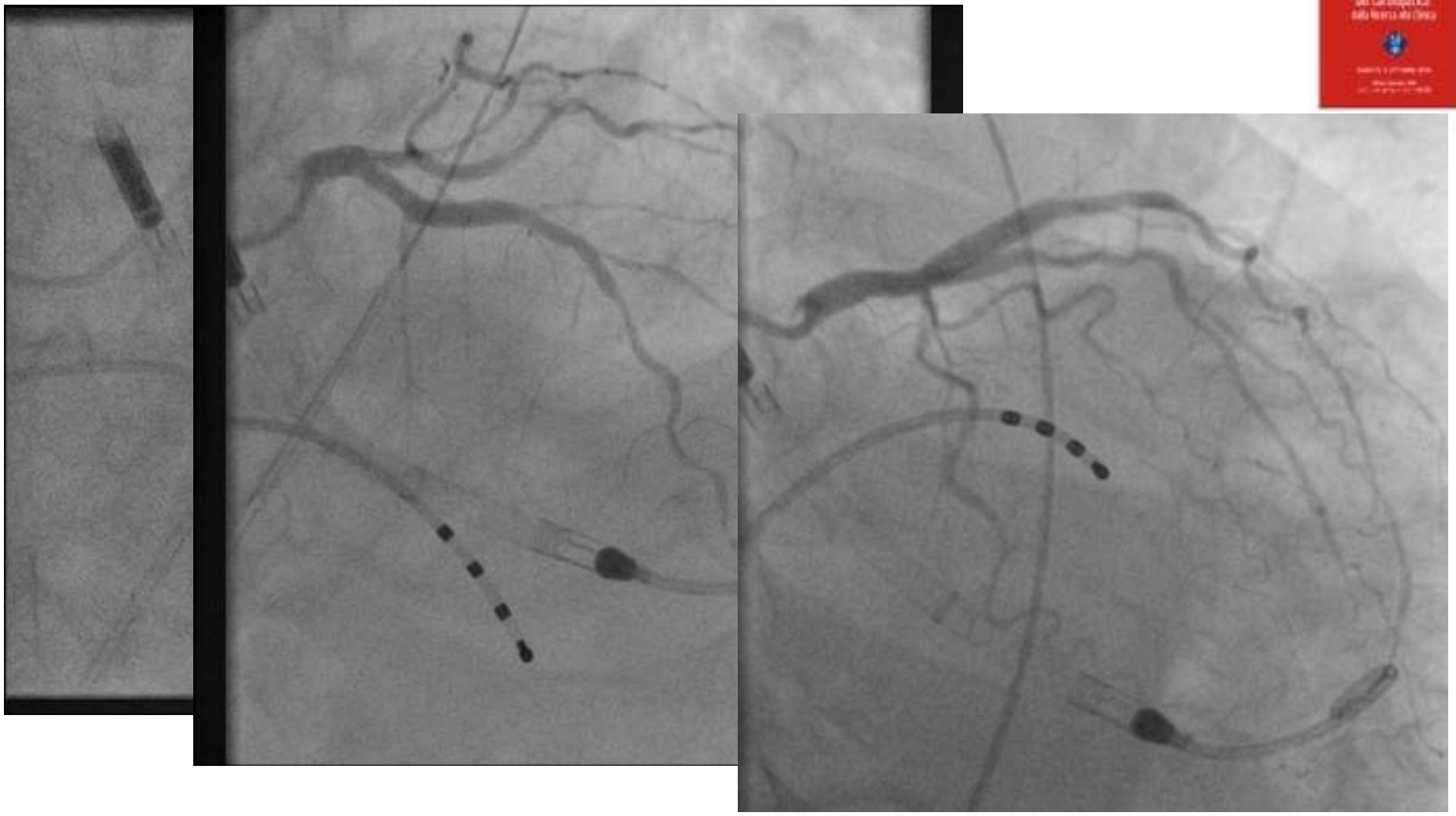
instabilità grave nonostante IABP e inotropi

pMCS nello shock cardiogeno



Impella in STEMI complicato da SHOCK

pMCS nello shock cardiogeno



Impella in STEMI complicato da SHOCK

Mechanical assistance according to guidelines

ESC European Society of Cardiology

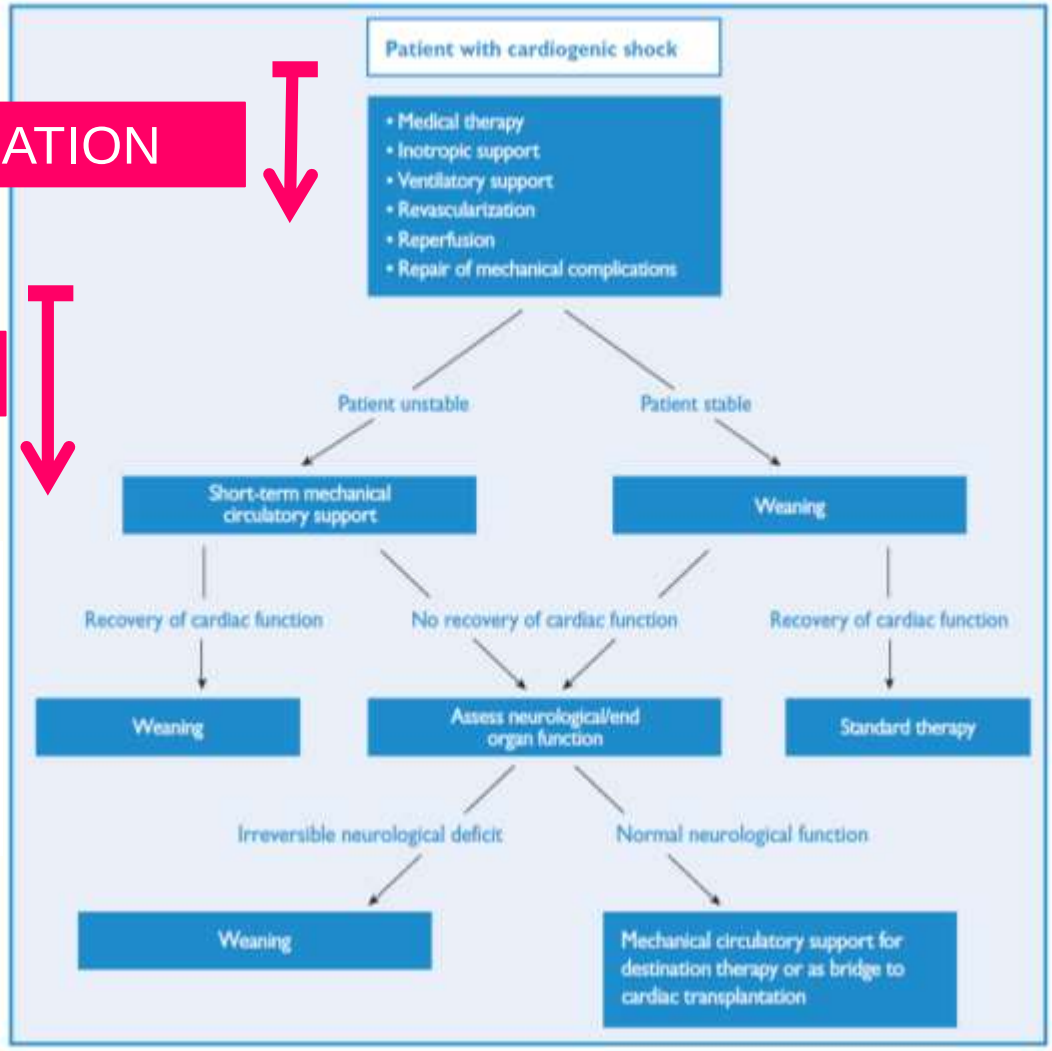
European Heart Journal (2018) 00, 1–96
doi:10.1093/eurheartj/ehy394

REVASCULARIZATION

MECHANICAL SUPPORT

2018 ESC/EACTS Guidelines
revascularization
Society of Cardiology (ESC) and European
Cardio-Thoracic Surgery (EACTS)

In selected patients with ACS and cardiogenic shock, short-term mechanical circulatory support may be considered, depending on patient age, comorbidities, neurological function, and the prospects for long-term survival and predicted quality of life.	IIb	C



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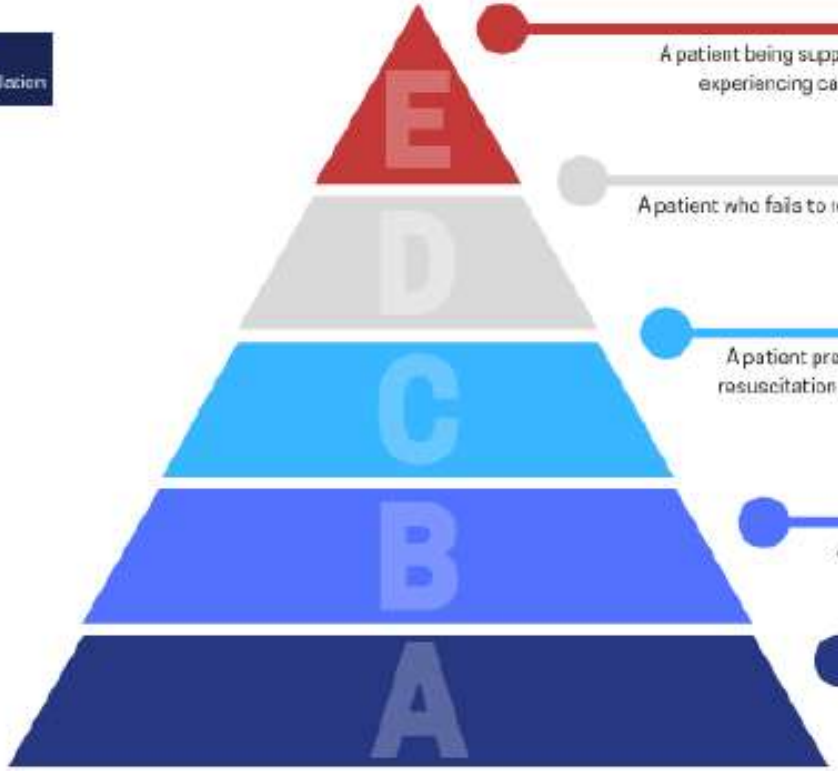
SCAI
Society for Cardiovascular Angiography & Interventions

SCAI Stages of Cardiogenic Shock

Adapted from the SCAI Clinical Expert Consensus Statement on the Classification of Cardiogenic Shock
Endorsed by ACC, AHA, SCCM, and STS

Arrest (A) Modifier:
CPR, including defibrillation



EXTREMIS
A patient being supported by multiple interventions who may be experiencing cardiac arrest with ongoing CPR and/or ECMO.

DETERIORATING
A patient who fails to respond to initial interventions. Similar to stage C and getting worse.

CLASSIC
A patient presenting with hypoperfusion requiring intervention beyond volume resuscitation (inotrope, pressor, or mechanical support including ECMO). These patients typically present with relative hypotension.

BEGINNING
A patient who has clinical evidence of relative hypotension or tachycardia without hypoperfusion.

AT RISK
A patient with risk factors for cardiogenic shock who is not currently experiencing signs or symptoms. For example, large acute myocardial infarction, prior infarction, acute and/or acute on chronic heart failure.

Baran DA, Grines CL, Bailey S, et al. SCAI clinical expert consensus statement on the classification of cardiogenic shock. Catheter Cardiovasc Interv. 2019;1–9. https://doi.org/10.1002/ccd.28329
For more information, please visit: www.scai.org/shockdefinition

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SCAI SHOCK STAGE	PHYSICAL EXAM	BIOCHEMICAL MARKERS	HEMODYNAMICS
A	Normal JVP Lung sounds clear Strong distal pulses Normal mentation	Normal renal function Normal lactic acid	Normotensive (SBP>100 or normal for pt.) If hemodynamics done: • Cardiac index >2.5 • CVP <10 • PA Sat >65%
B	Elevated JVP Rales in lung fields Strong distal pulses Normal mentation	Normal lactate Minimal renal function impairment Elevated BNP	SBP <90 OR MAP <60 OR >30mmHg drop Pulse >100 If hemodynamics done: • Cardiac Index >2.2 • PA Sat >65%
C	Ashen, mottled, dusky Volume overload Extensive Rales Killip class 3 or 4 BiPap or mechanical ventilation Acute alteration in mental status	Lactate >2 Creatinine doubling OR >50% drop in GFR Increased LFTs Elevated BNP Urine Output <30mL/h	Drugs/device used to maintain BP above stage B values • Cardiac Index <2.2 • PCWP >15 • RAP/PCWP >0.8 • PAPI <1.85 • Cardiac Power Output <0.6
D	Any of stage C	Any of stage C AND deteriorating	Any of stage C AND Requiring multiple pressors OR addition of mechanical circulatory support devices to maintain perfusion
E	Near pulselessness Cardiac collapse Mechanical ventilation Defibrillator used	Lactate >6 pH <7.2	No SBP without resuscitation PEA or Refractory VT/VF Hypotension despite maximal support

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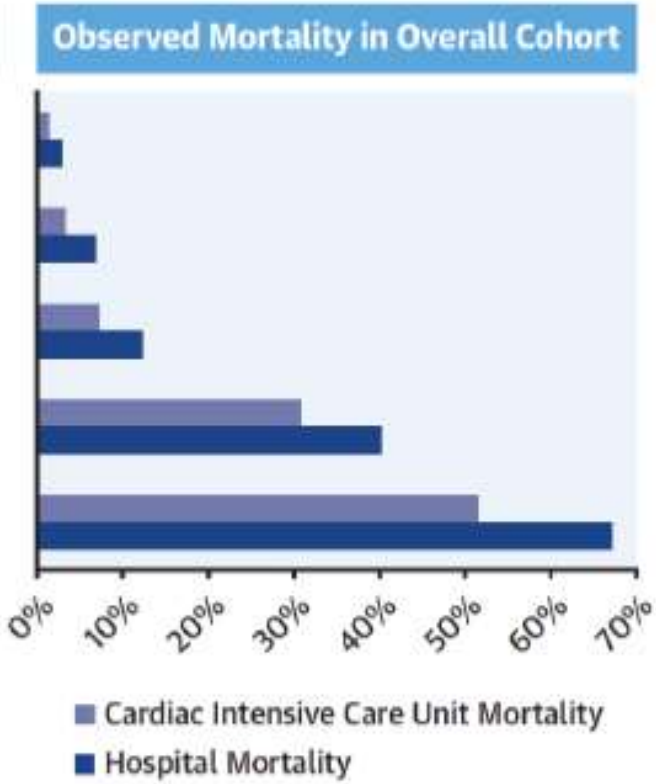
CENTRAL ILLUSTRATION **Definitions of Society for Cardiovascular Angiography and Intervention Shock Stages A Through E, With Associated Cardiac Intensive Care Unit and Hospital Mortality in Each Society for Cardiovascular Angiography and Intervention Shock Stage**

Cardiogenic Shock Stage	Study Definition
Stage A ("At risk")	Neither hypotension/tachycardia nor hypoperfusion
Stage B ("Beginning")	Hypotension/tachycardia WITHOUT hypoperfusion
Stage C ("Classic")	Hypoperfusion WITHOUT deterioration
Stage D ("Deteriorating)"	Hypoperfusion WITH deterioration NOT refractory shock
Stage E ("Extremis")	Hypoperfusion WITH deterioration AND refractory shock



Jentzer, J.C. et al. J Am Coll Cardiol. 2019;■(■):■-■.

Cardiac intensive care unit and hospital mortality increased as a function of higher Society for Cardiovascular Angiography and Intervention shock stage.

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Journal of the American College of Cardiology
Volume 69, Issue 3, 24 January 2017, Pages 278-287
ELSEVIER

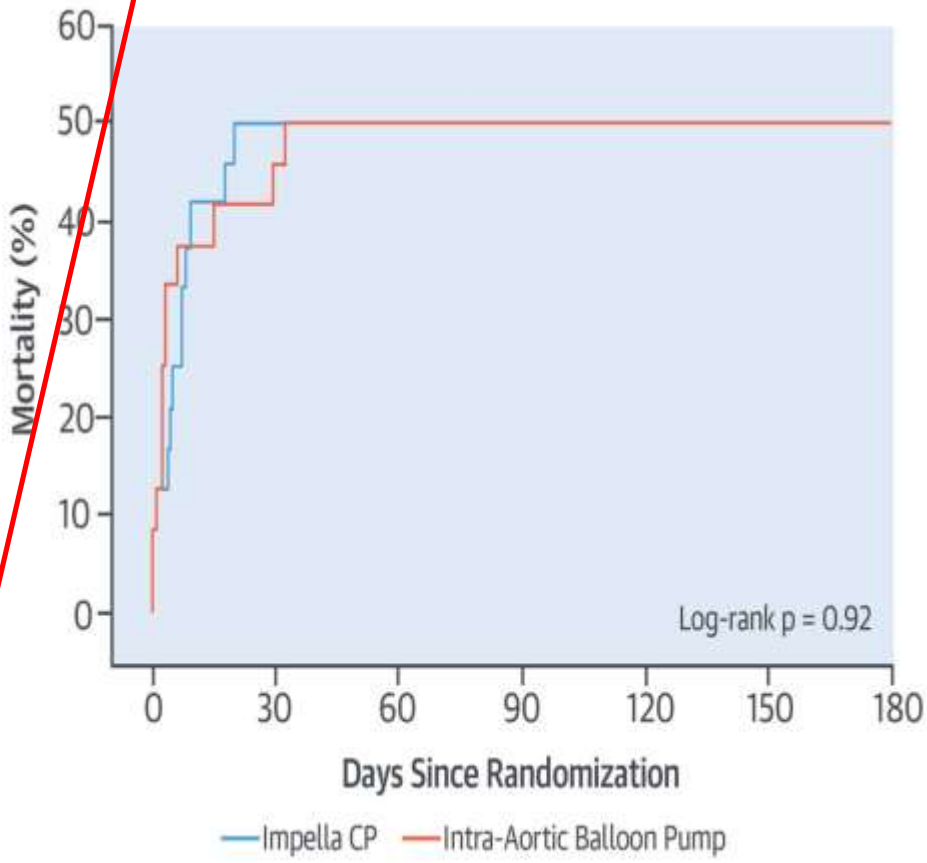
Original Investigation

Percutaneous Mechanical Circulatory Support Versus Intra-Aortic Balloon Pump in Cardiogenic Shock After Acute Myocardial Infarction

48% time to ROSC > 20 min

IMPRESS trial

	pMCS (n = 24)	IABP (n = 24)
Age, yrs	58 ± 9	59 ± 11
Male	18/24 (75)	20/24 (83)
Body mass index, kg/m^2	25 (23-26)	26 (25-27)
Cardiovascular risk factors		
Current smoking	11/18 (61)	6/19 (32)
Hypertension	4/20 (20)	6/21 (29)
Hypercholesterolemia	4/20 (20)	5/21 (24)
Diabetes mellitus	2/22 (9)	3/23 (13)
Prior myocardial infarction	1/22 (5)	1/23 (4)
Prior stroke	0/22 (0)	1/23 (4)
Known peripheral arterial disease	2/23 (9)	0/23 (0)
Prior PCI or CABG	1/22 (5)	0/23 (0)
Hemodynamic variables before randomization		
Heart rate, beats/min	81 ± 21	83 ± 28
Mean arterial pressure, mm Hg	66 ± 15	66 ± 15
Systolic blood pressure, mm Hg	81 ± 17	84 ± 19
Diastolic blood pressure, mm Hg	58 ± 22	57 ± 13
Medical therapy before randomization		
Catecholamines or inotropes	24/24 (100)	22/24 (92)
Mechanical ventilation	24/24 (100)	24/24 (100)
Cardiac arrest before randomization	24/24 (100)	20/24 (83)
Witnessed arrest	22/24 (92)	17/20 (85)
First rhythm VT/VF	22/24 (92)	17/20 (85)
Time till return of spontaneous circulation, min	21 (15-46)	27 (15-52)
Traumatic injuries at admission	5/24 (21)	2/24 (8)
Blood values on admission*		
Lactate, mmol/l	7.5 ± 3.2	8.9 ± 6.6

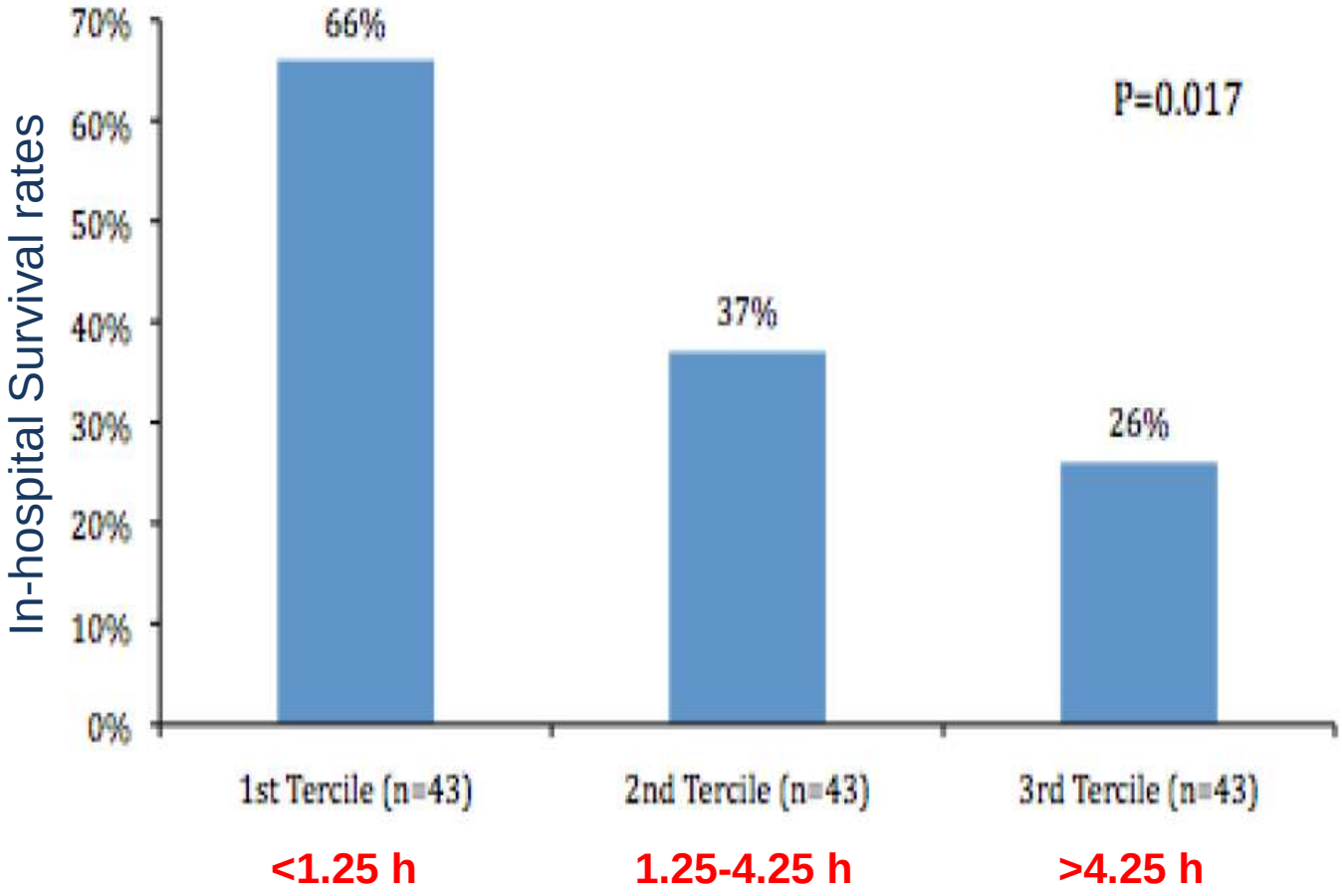


In Shock Trial II Lactate 4.1 mmol/l

Thiele H et al JACC 2017

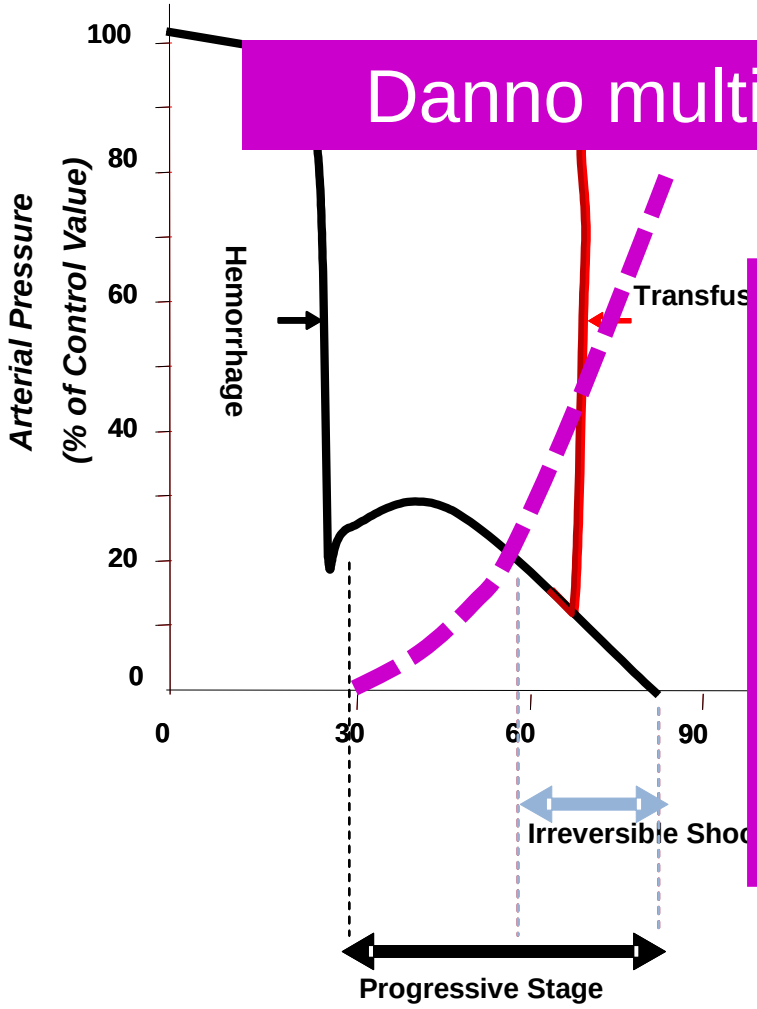
Time “shock to support”

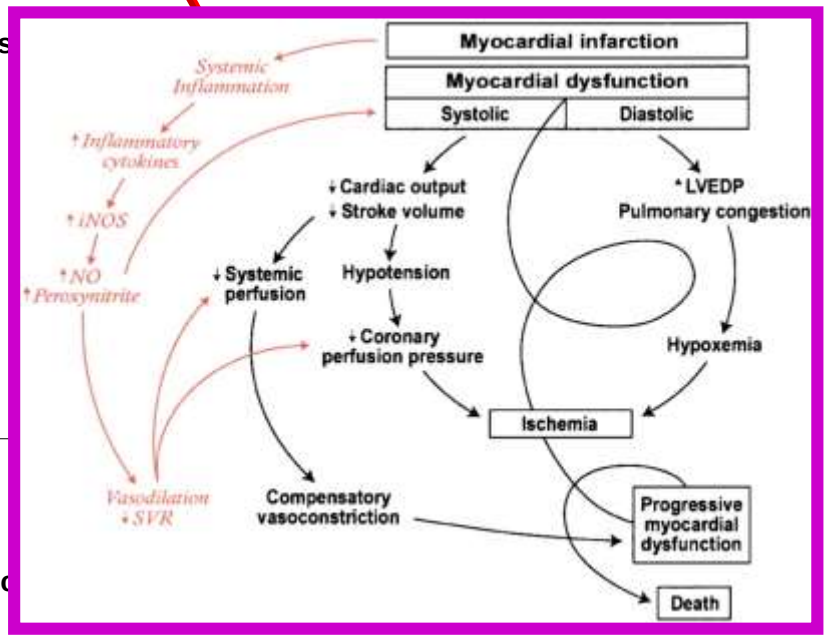
Impella c-VAD registry



Basir MB The American Journal of Cardiology 2017

Danno multiorgano (MOSF)



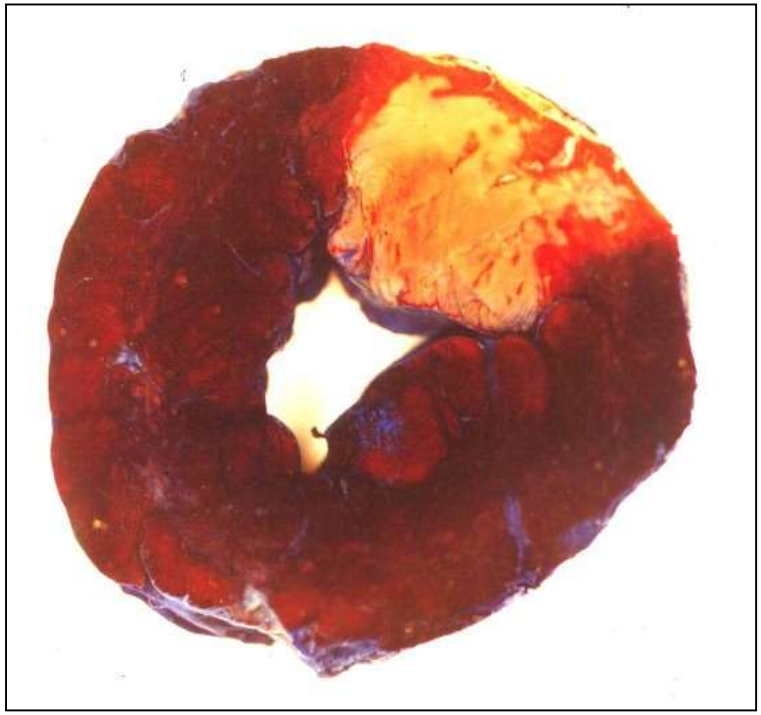


Shock Cardiogeno

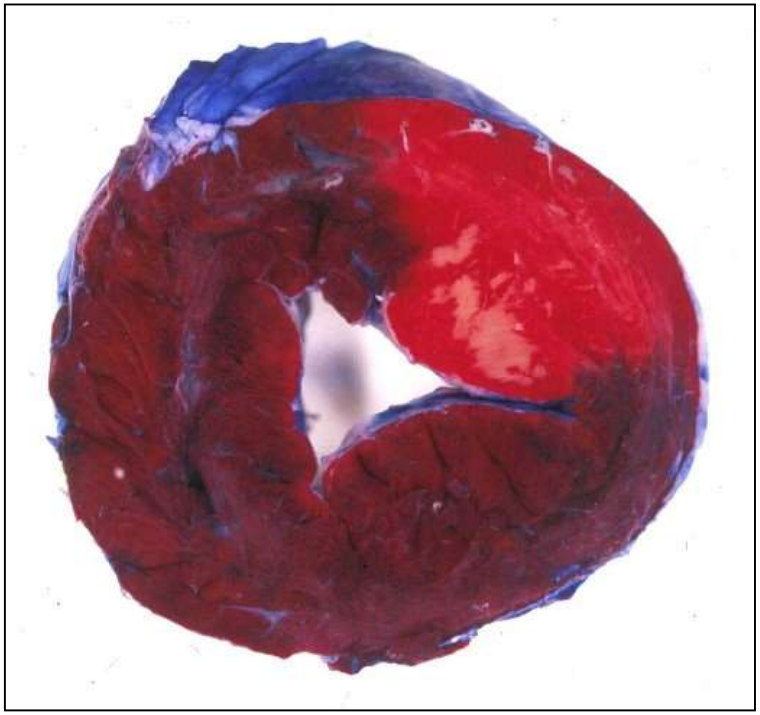
Guyton & Hall – In Medical Physiology 1996

Issues in shock treatment timing

LAD occlusion in Animal model



Control



With Impella Unloading

Meyns et al., J Am Coll Cardiol 2003

Impella timing in AMI shock

Insights from US Impella experience in post-AMI shock

694 patients
reported in USpella Registry
(2006-2008)

249 patients
In profound Cardiogenic Shock

154 patients
with AMI Cardiogenic Shock

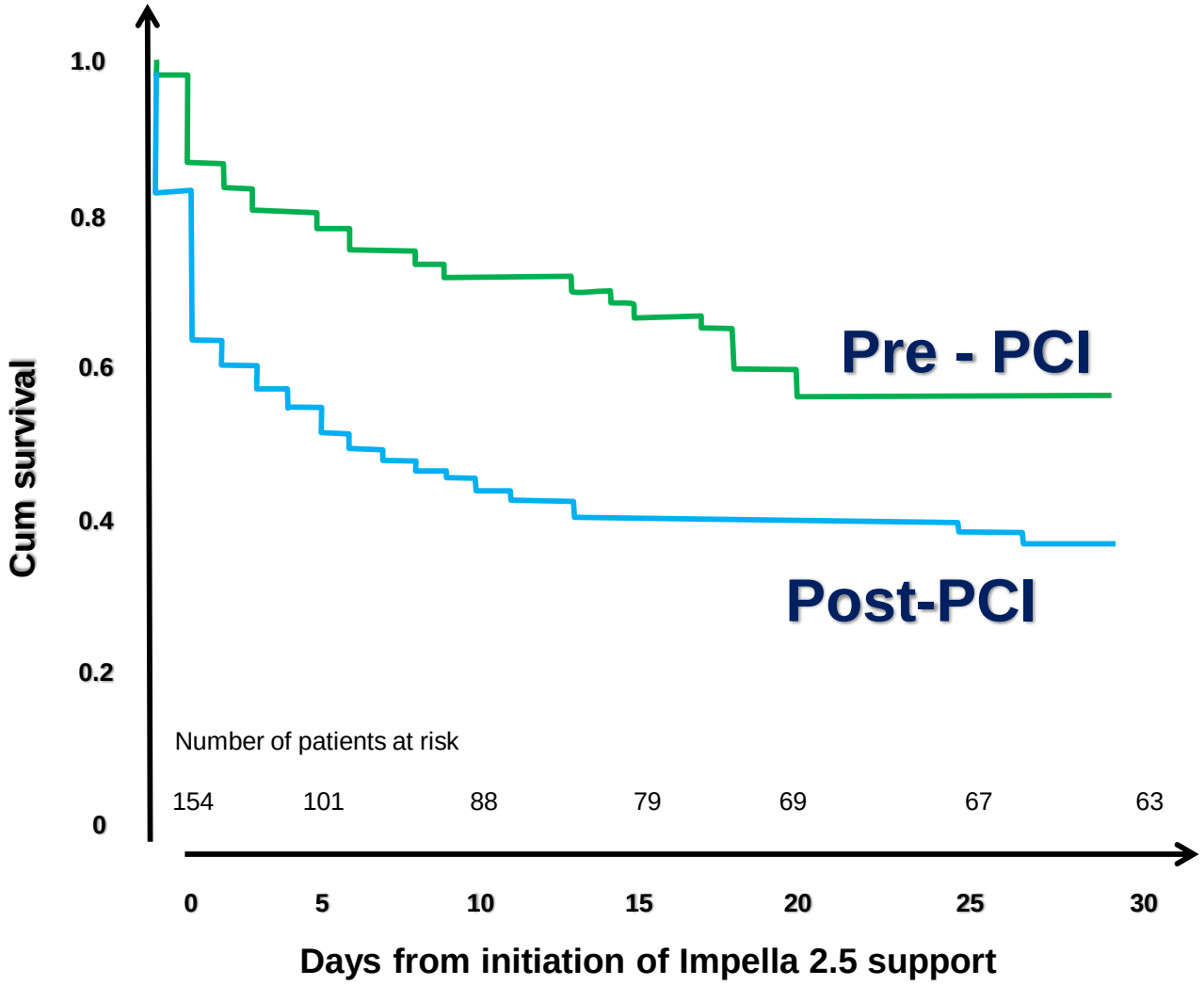
N= 63
Impella 2.5 initiated
Pre-PCI

N= 91
Impella 2.5 initiated
Post-PCI

O'Neill et al, J Interven Cardiol 2014

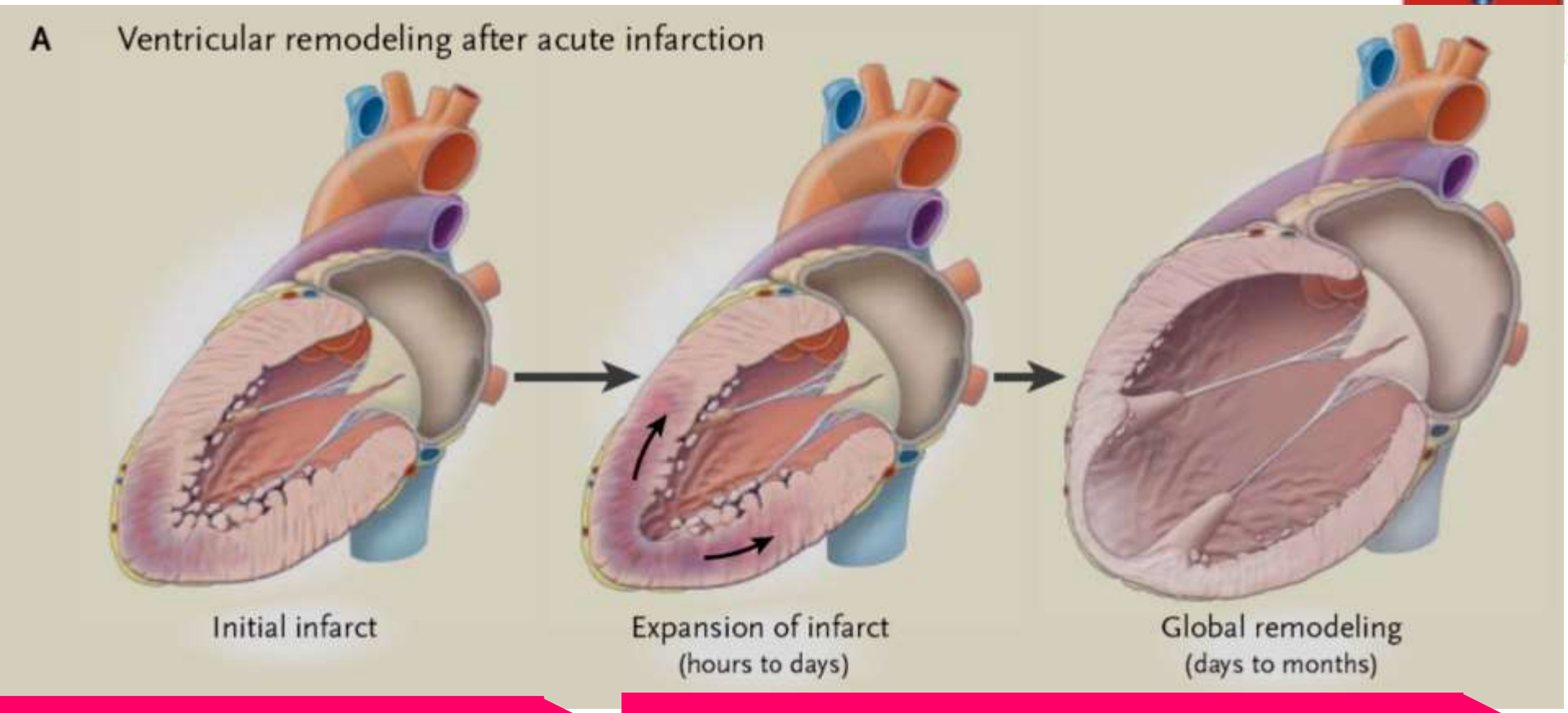
Impella timing in AMI shock

Insights from US Impella experience in post-AMI shock



O'Neill et al, J Interven Cardiol 2014

Is it time for a paradigm shift?

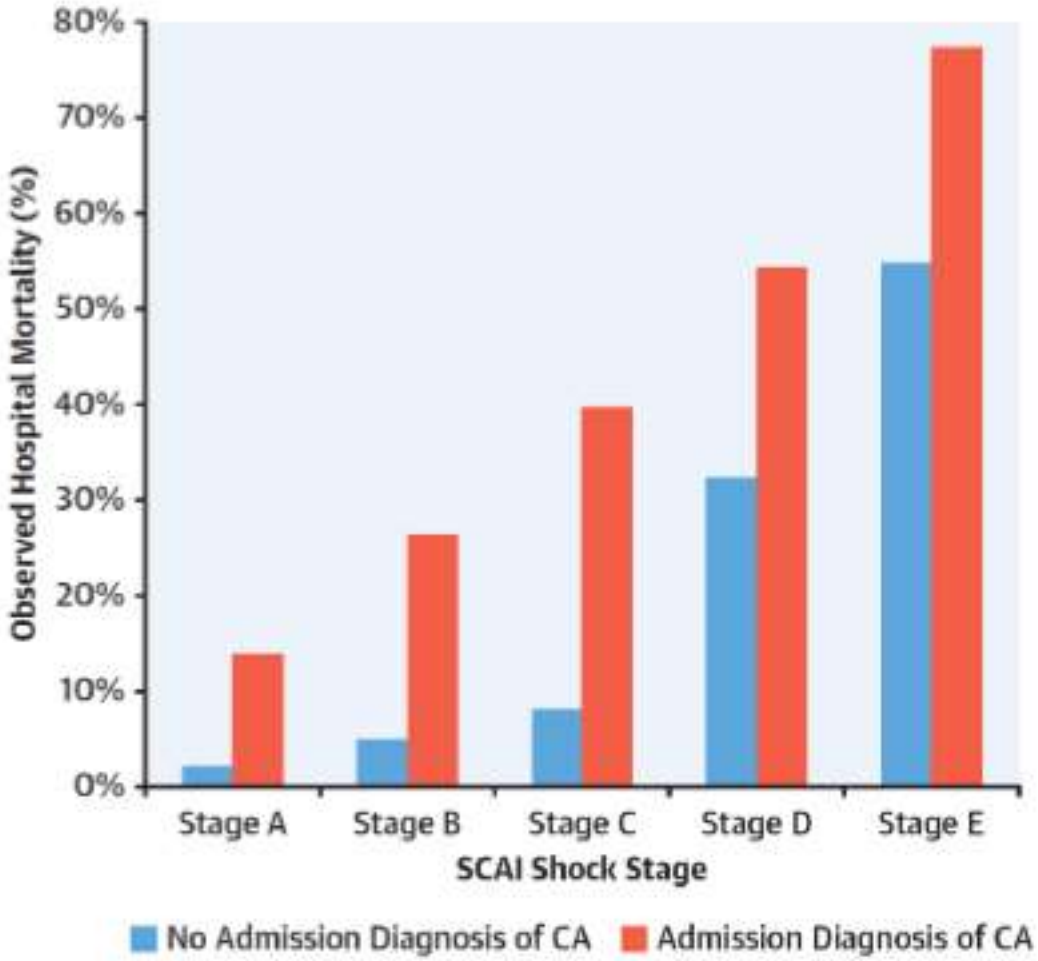


REVASCULARIZATION

MECHANICAL SUPPORT

New England Journal of Medicine: 2003; 348:2007-18

FIGURE 2 Hospital Mortality as a Function of SCAI Shock Stage Among Patients With and Without an Admission Diagnosis of CA



Hospital mortality was higher among patients with an admission diagnosis of cardiac arrest (CA) in each Society for Cardiovascular Angiography and Intervention (SCAI) shock stage (all $p < 0.001$).

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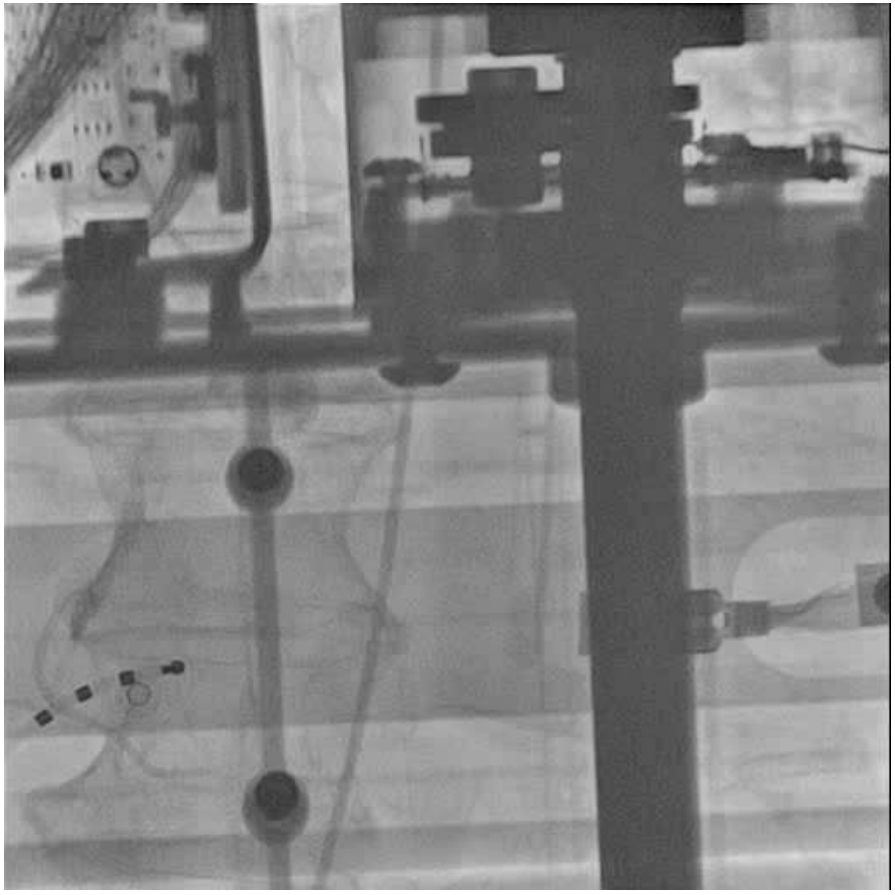

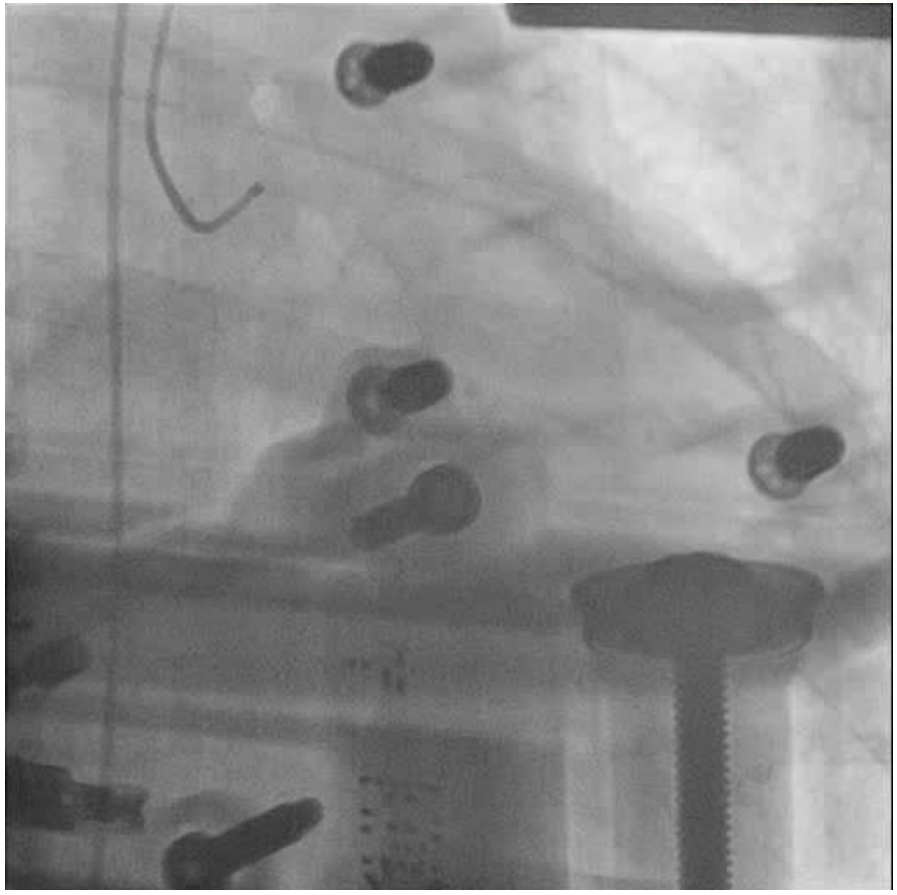

ECMO in STEMI con arresto cardiaco refrattario

ECMO in STEMI con arresto cardiaco refrattario

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ECMO in STEMI con arresto cardiaco refrattario

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Cardiopulmonary resuscitation with assisted extracorporeal life-support versus conventional cardiopulmonary resuscitation in adults with in-hospital cardiac arrest: an observational study and propensity analysis

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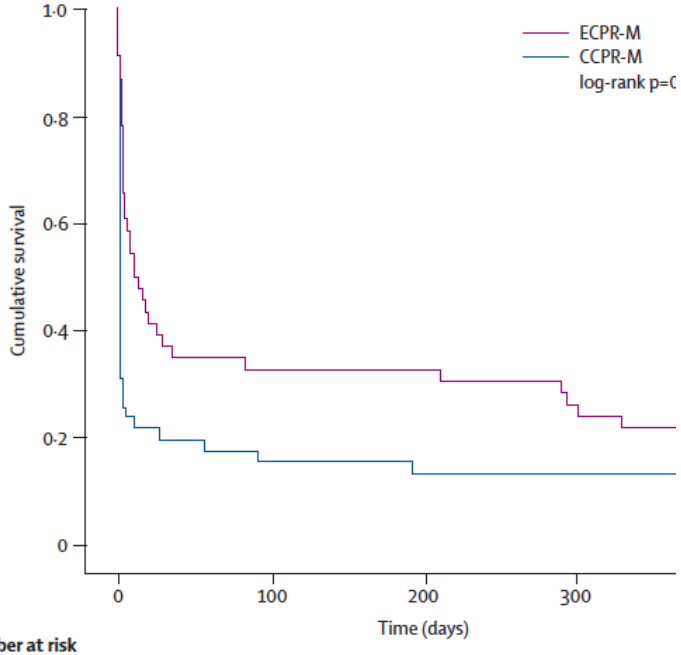
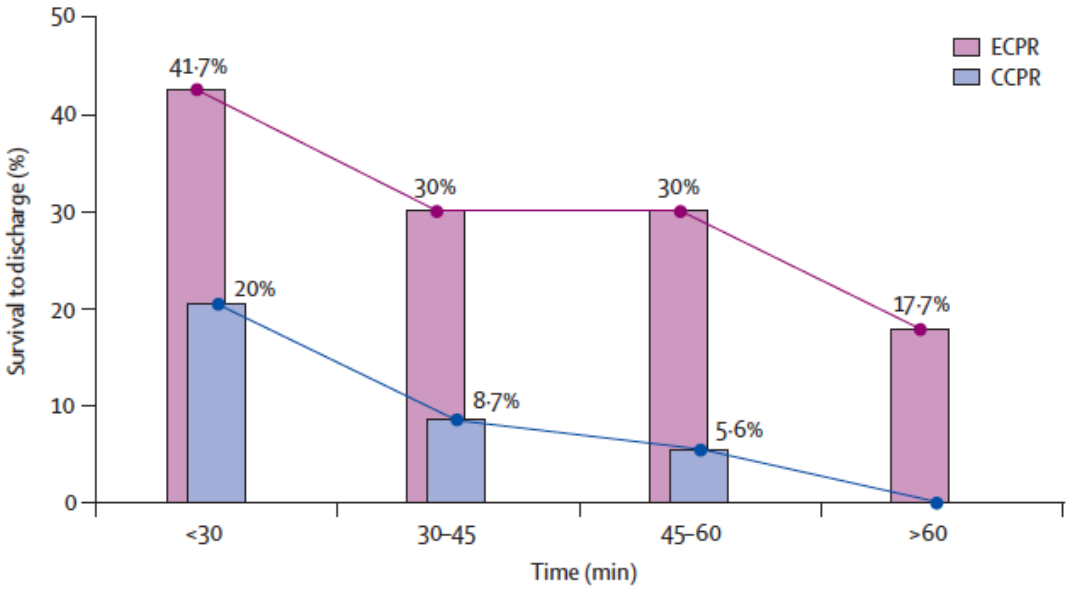
***Lancet* 2008; 372: 554–61**



Number at risk				
Extracorporeal CPR-M	46	15	15	7
Conventional CPR-M	46	7	6	3



1. SCOPO

Il Codice Viola è una Linea Guida Interna che verrà utilizzata per il trattamento dello shock cardiogeno refrattario e dell' arresto cardiaco refrattario.

2. CAMPO DI APPLICAZIONE

Queste Linee Guida Interne si applicano sia nel Dipartimento Emergenza e Accettazione, sia nel Dipartimento di Scienze Cardiovascolari per il trattamento dello shock cardiogeno refrattario e dell' arresto cardiaco refrattario

Tav. 1 Codici ICD9

CODICE ICD9	DESCRIZIONE
427.5	Arresto cardiaco
785.51	Shock cardiogeno

Si propone quindi di considerare l'ECLS in presenza di un arresto cardiaco refrattario testimoniato da soccorritori addestrati in cui sussistano le seguenti condizioni: Età ≤65 anni, durata della rianimazione (low flow) compresa tra 10 e 60 minuti *ed* $ETCO_2$ ≥ 10 mmHg, assenza di controindicazioni, elencate in tabella 4.2

Shock cardiogeno

Il ricorso alla ECMO V-A periferica è indicato in presenza di patologie cardiopolmonari potenzialmente reversibili, minacciose per la sopravvivenza, e refrattarie alle terapie convenzionali.

Al fine di essere considerato per il supporto ECMO, un paziente deve presentare una indicazione accettata e non deve presentare controindicazioni elencate al punto n.5.2

Indicazione accettate nel programma ECMO V-A periferica

- Shock cardiogeno nel contesto dell'infarto miocardico acuto refrattario alla terapia convenzionale, compresa la contropulsazione aortica se indicata
- Shock cardiogeno post-chirurgia cardiaca (compreso il caso di impossibilità ad uscire dalla CEC con supporti convenzionali)
- Miocardite acuta
- Peggioramento di scompenso cardiaco cronico
- Cardiomiopatie, compresa la Peri-partum
- Shock cardiogeno da storm aritmico
- Overdose di farmaci con profonda depressione cardiaca
- Valvulopatie eccetto l'insufficienza aortica

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LINEE GUIDA INTERNE CODICE VIOLA	Data: 30/10/2015
	Rev.: 0
	LG.001

Indicazioni	Proc DX	Proc Terapeutico	Stetting necessario
STEMI	CGF	PCI	EMOD
NONSTEMI	CGF	PCI CABG	EMOD
MIOCARDITE ACUTA	CGF/BIOPSIA EM	NO	EMOD
CMP STRESS	CG CGF/BIOPSIA EM ?	NO	EMOD
CMP PERIPARTUM		NO	
SPCT		NO	
PEGGIORAMENTO CMD NOTA		NO	
STORM ARITMICO		ABLAZIONE TC	EF

UCSC Cath Lab Experience
2006-2017

IABP: tot 267

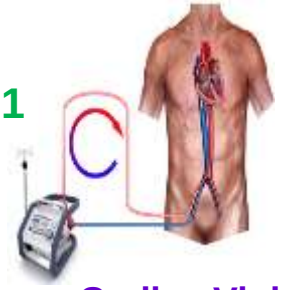
shock 90

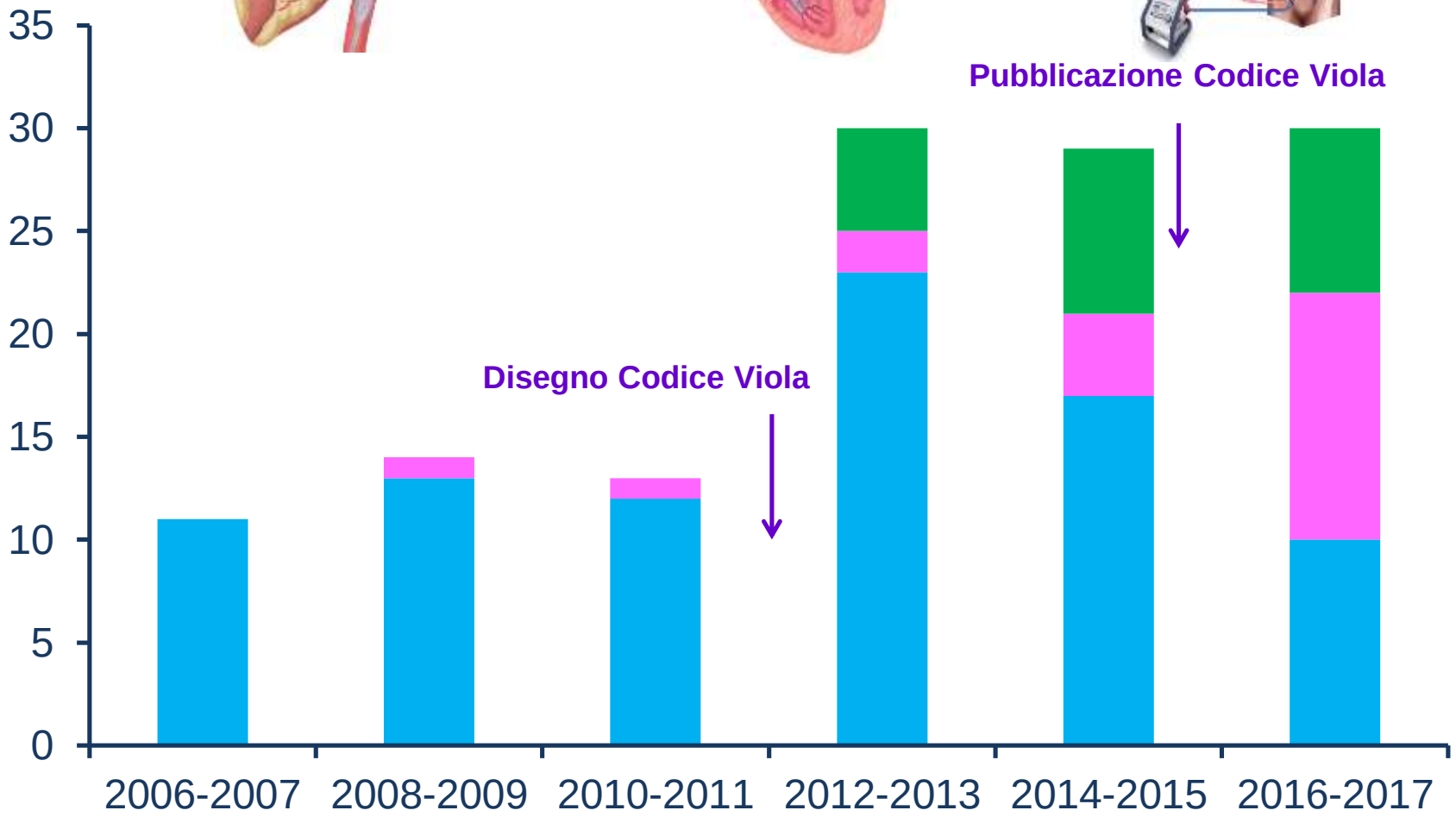
Impella: tot 95

shock 20

ECMO: tot 22

shock 21





G Ital Cardiol 2018;19(6 Suppl 1):5S-13S

Come orientarsi tra contropulsatore, Impella e ossigenazione a membrana extracorporea

Francesco Burzotta, Giulio Russo, Eloisa Basile, Cristina Aurigemma, Antonio Maria Leone, Giampaolo Niccoli, Italo Porto, Piergiorgio Bruno, Massimo Massetti, Filippo Crea, Carlo Trani

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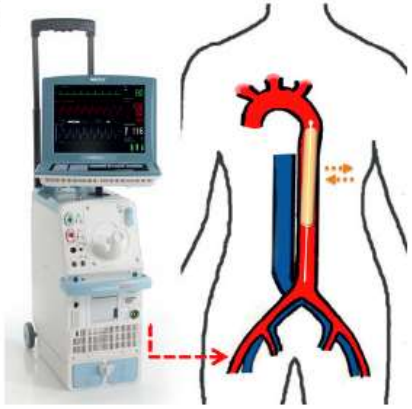
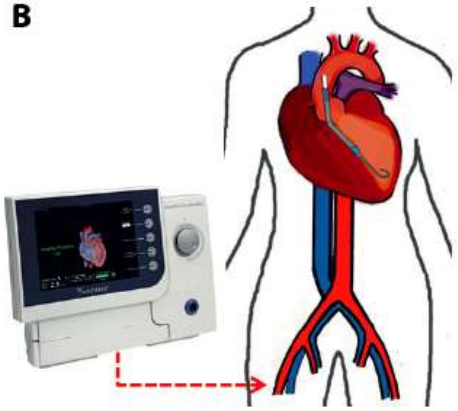
A



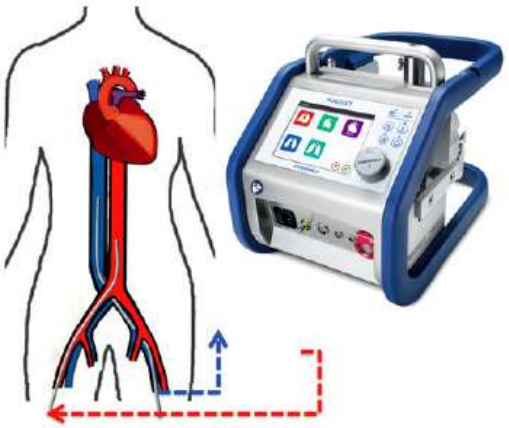
Accesso arterioso	8-9 F
Lavoro cardiaco	–
PA media	↑
Gittata cardiaca	↑
Flusso coronarico	↑
Unloading VSx	↑

B



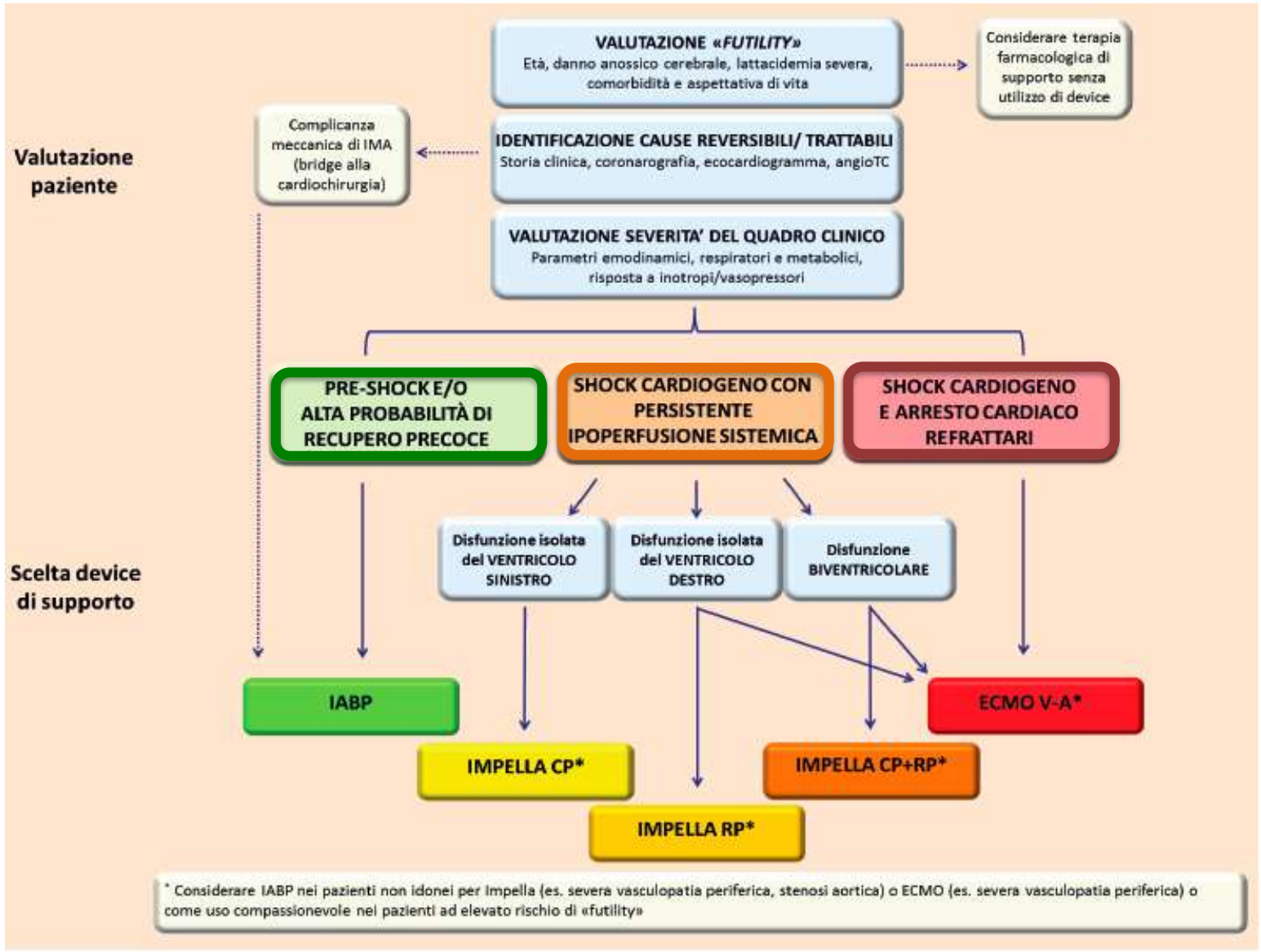
Accesso arterioso	13 F (2.5) – 14 F (CP)
Lavoro cardiaco	↓
PA media	↓
Gittata cardiaca	↑↑
Flusso coronarico	↑↑
Unloading VSx	↑↑

C



Accesso arterioso	15-17 F
Accesso venoso	21-23 F
Lavoro cardiaco	↑
PA media	↑
Gittata cardiaca	↑↑↑
Flusso coronarico	↑↑↑
Unloading VSx	–/↓

SHOCK CARDIOGENO



MY CONCLUSIONS

- pMCS are essential in shock/cardiac arrest although their benefits on prognosis are not yet completely demonstrated
- In patients with **cardiogenic shock** or impending haemodynamic collapse undergoing PCI, pMCS make revascularization safer and more effective. Impella should be considered as first line therapy. Early initiation might result in better heart recovery and outcome shifting the focus from door-to-balloon to door-to-unloading
- In refractory **cardiac arrest**, ECMO support under CPR should be carried out as soon as possible and the revascularization should be postponed after haemodynamic stabilization