# Quelle Assistance pour le Cœur ?

Dr.Jean Beissel
INCCI

# Assistance Circulatoire

## Choc Cardiogenique

## PCI à haut risque

# Le Choc Cardiogenique

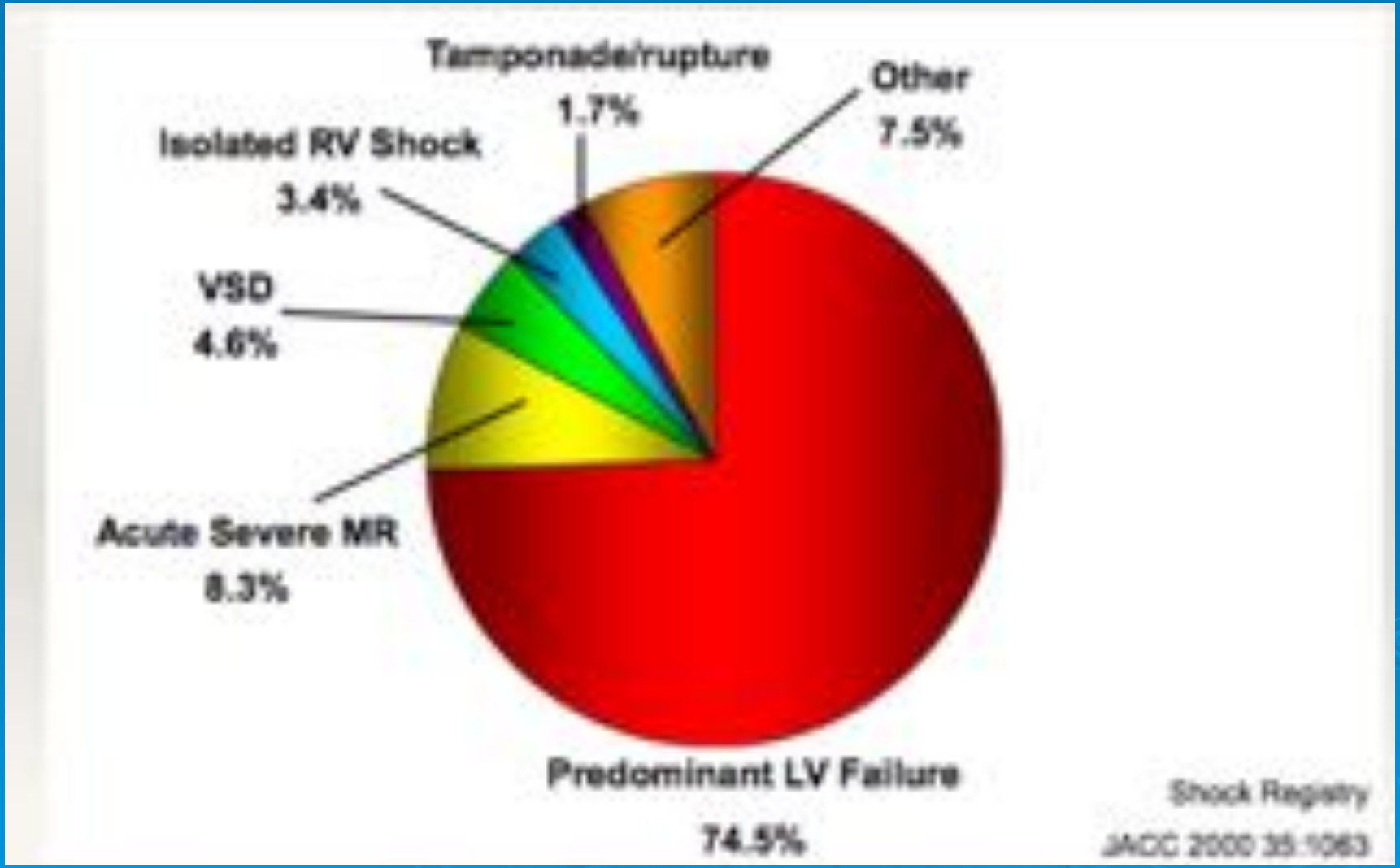
**Le choc cardiogenique est une complication grave de l'infarctus dont la mortalité dépasse à l'heure actuelle toujours les 50% malgré les inotropes et les moyens d'assistance circulatoire**

# Assistance Circulatoire

## Choc cardiogenique

- Etiologies multiples pas toujours secondaires à un SCA
- Cardiomyopathies
- Myocardites
- CP ischemique chronique
- Tr du rythme (Orage rythmique)
- CP valvulaires
- Intoxications
- ARCA

# Etiologies du choc cardiogenique



# CHOC CARDIOGENIQUE

- **Définition** : hypoperfusion tissulaire liée à une défaillance cardiaque après correction de la pré-charge.

  - PAS < 90 mm Hg ou chute de la PAS de 30 mm Hg
  - IC < 2.2 l/min/m2
  - Avec FC > 60 bpm
  - Pcap > 16
  - Diurèse < 0.5ml/kg/min
  - +/- signes de congestion.

ESC guidelines, *Eur Heart J* 2005

# TRAITEMENT

- Repos
- Oxygénothérapie / Support ventilatoire.
- Optimisation de la précharge
- Correction des troubles du rythme
- Inotropes :
  - Dobutamine
  - Inhibiteurs des phosphodiesterases
  - Vasopresseurs
  - Adrénaline si réfractaire
- Diurétiques.
- Etiologique : revascularisation…

# ECHEC

Choc cardiogénique réfractaire

## MORTALITE 75 à 90%

Doll *Ann Thor Surg* 2004

Récupération, traitement étiologique, ou greffe/assistance chronique envisagée.

**Discuter l'ASSISTANCE CIRCULATOIRE**

# Indications for percutaneous ventricular support

- High risk PCI
  - High risk anatomy (left main, last vessel…)
  - Severe LV dysfunction (EF < 30%)
- Cardiogenic shock
  - Acute MI
- Bridge to LVAD/heart transplant

Background

# IABP in Cardiogenic Shock

IABP SHOCK II

History:

1962 Animal studies

Moulopoulos et al. Am Heart J 1962;63:669-675

1968 First clinical description in shock

Kantrowitz et al. JAMA 1968;203:135-140

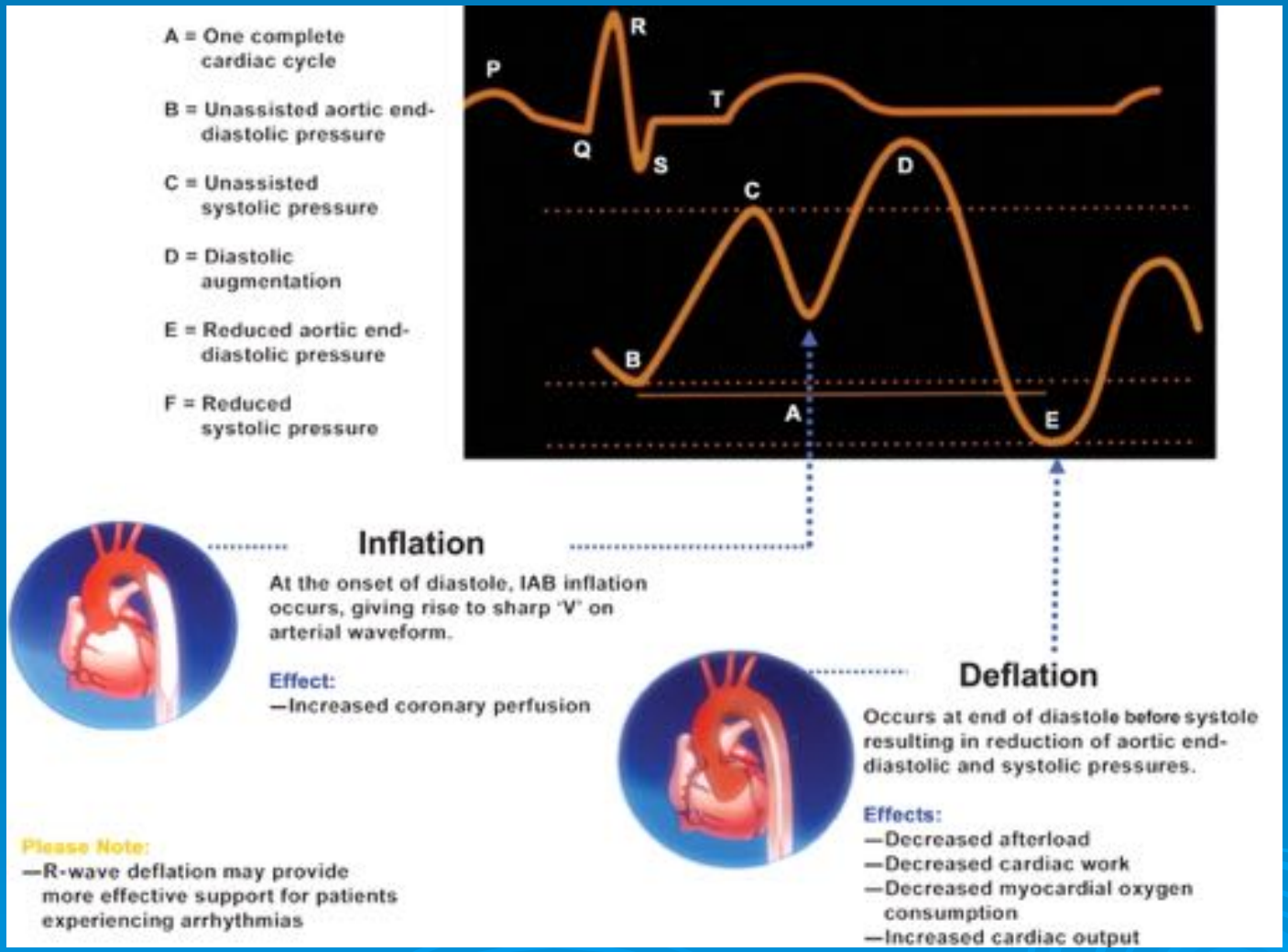
1973 Hemodynamic effects in shock, Mortality unchanged

Scheidt et al. NEJM 1973;288:979-984

> 40 years > 1 Million patients treated, low complication rate, Benchmark registry

Ferguson et al. JACC 2001;38:1456-1462

# One complete cardiac cycle and the corresponding waveform of the IABP during inflation and deflation.




**Krishna M , and Zacharowski K Contin Educ Anaesth Crit Care Pain 2009;9:24-28**

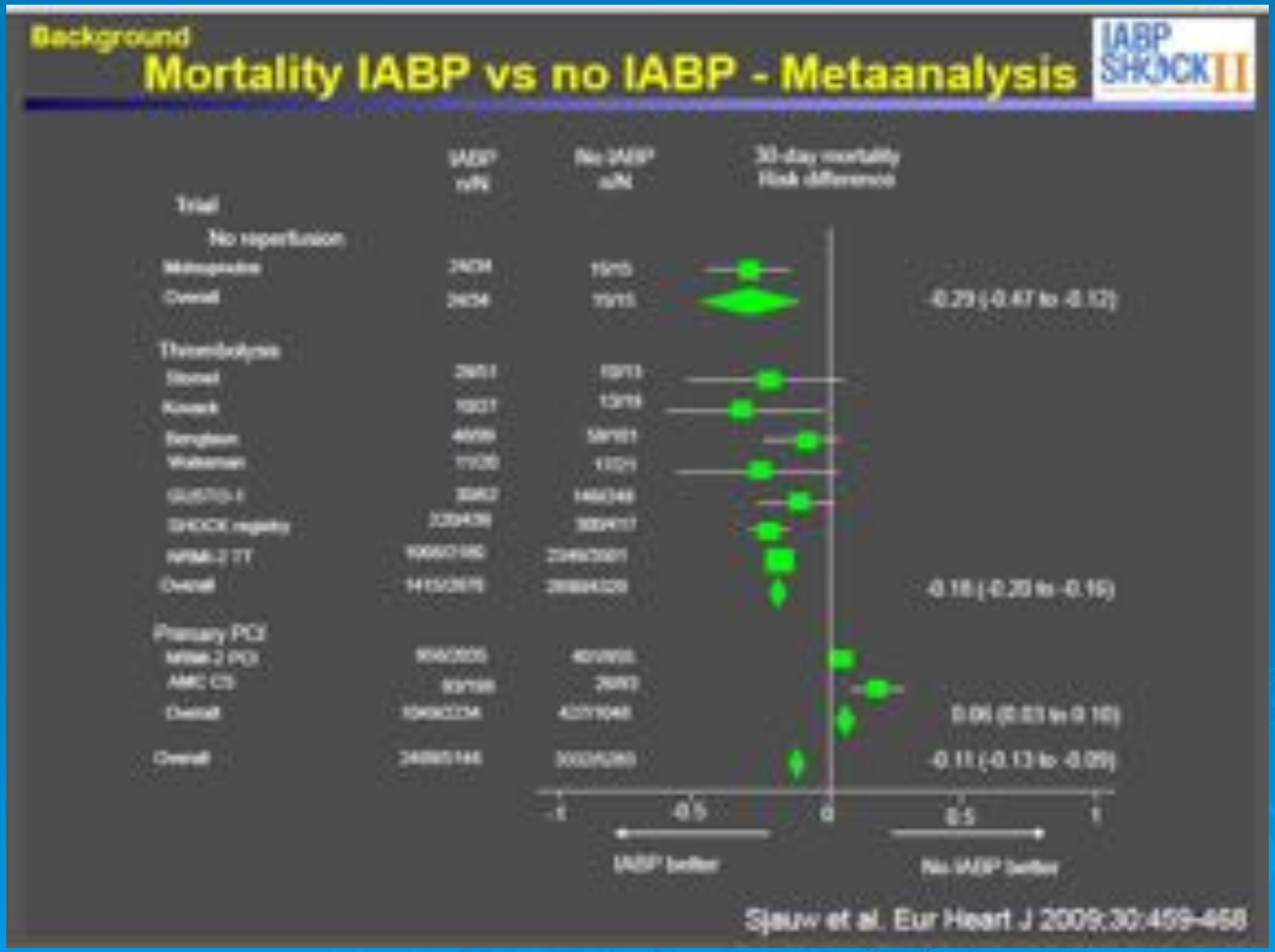


Continuing Education in Anaesthesia, Critical Care & Pain

Background

# Mortality IABP vs no IABP - Metaanalysis

IABP SHOCK II




Sjauw et al. Eur Heart J 2009;30:459-468

# Randomized comparison of intraaortic balloon counterpulsation versus optimal medical therapy in addition to early revascularization in acute myocardial infarction complicated by cardiogenic shock

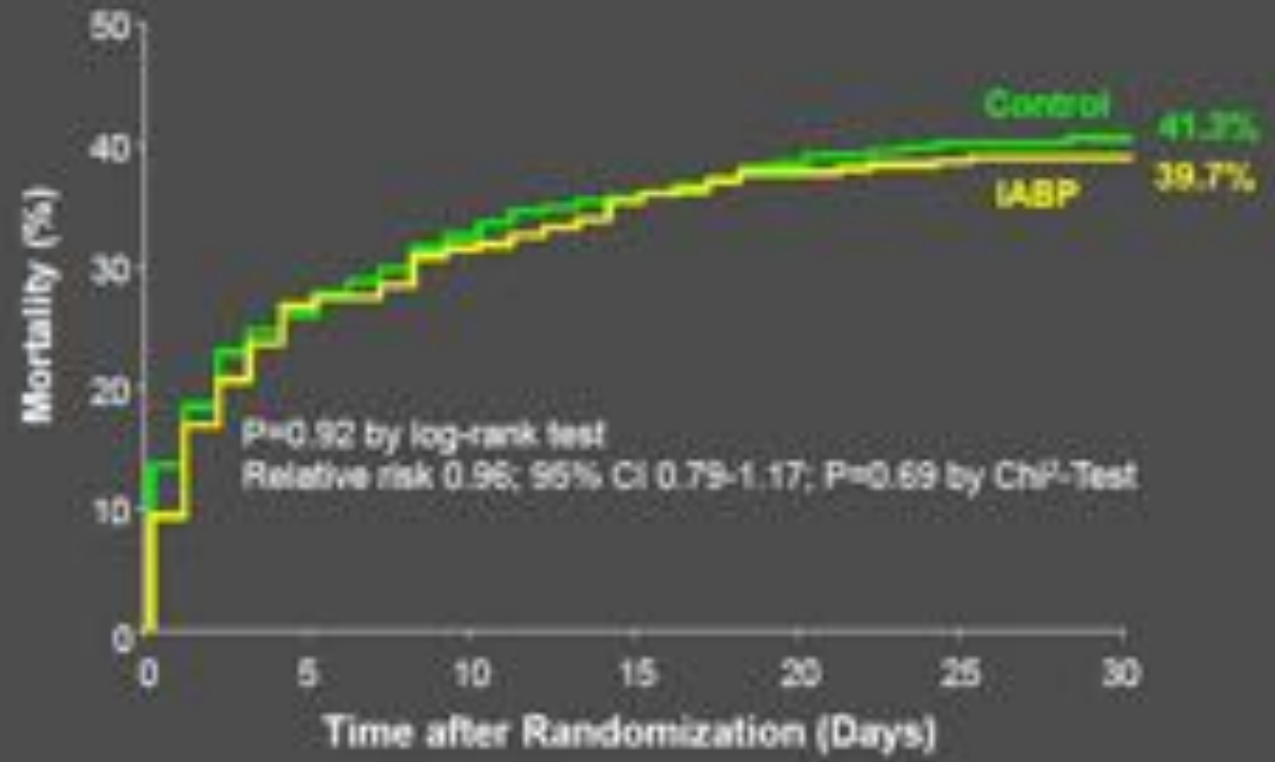
Holger Thiele, MD
Uwe Zeymer, MD; Franz-Josef Neumann, MD; Miroslaw Ferenc, MD; Hans-Georg Olbrich, MD; Jörg Hausleiter, MD; Gert Richardt, MD; Marcus Hennersdorf, MD; Klaus Empen, MD; Georg Fuernau, MD; Steffen Desch, MD; Ingo Eitel, MD; Rainer Hambrecht, MD; Jörg Fuhrmann, MD; Michael Böhm, MD; Henning Ebelt, MD; Steffen Schneider, PhD; Gerhard Schuler, MD; Karl Werdan, MD
on behalf of the IABP-SHOCK II Trial Investigators

University of Leipzig – Heart Center

Results

# Primary Study Endpoint (30-Day Mortality)

IABP SHOCK II



# ECMO

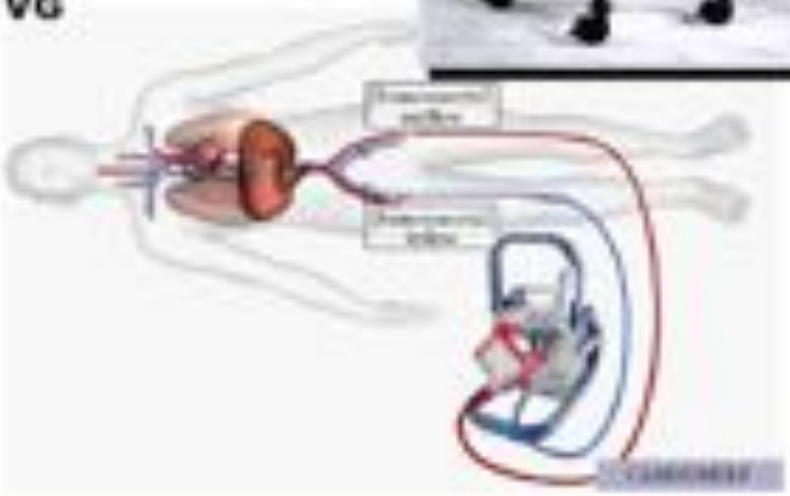
L'ECMO est flexible  veino veineuse ou veino arterielle.
Elle donne 4,5 -5 l/min Le patient doit être bien rempli pour « nourrir » le Cathéter veineux.
.
Le cathéter veineux est placé dans la VCI près de l'oreillette Le sang veineux est oxygéné et reconduit vers l'Aorte descendante  en court-circuitant le cœur et les poumons ce qui entraine une élévation de la post-charge  au niveau du VG.
L'augmentation de la post-charge au niveau du VG a pour effet d'aggraver la défaillance VG  en aggravant le risque d'OAP et d'augmenter la consommation en O2 très défavorable pour ces cœurs déjà ischémiques.

Parfois on peut traiter la surcharge du VG en ponctionnant le septum interauriculaire pour décharger le cœur gauche et la circulation

# Extra - Corporeal Membrane Oxygenation

- Pompe centrifuge. Flux actif
- 4 - 4,5L /min
- Oxygénation associée
- Double abord vasculaire avec veine 18-31F et art 15-22F
- 15 min insertion

- Risques: ↗ PTDVG
  thrombose VG



# Cardiohelp

# Problems with ECMO

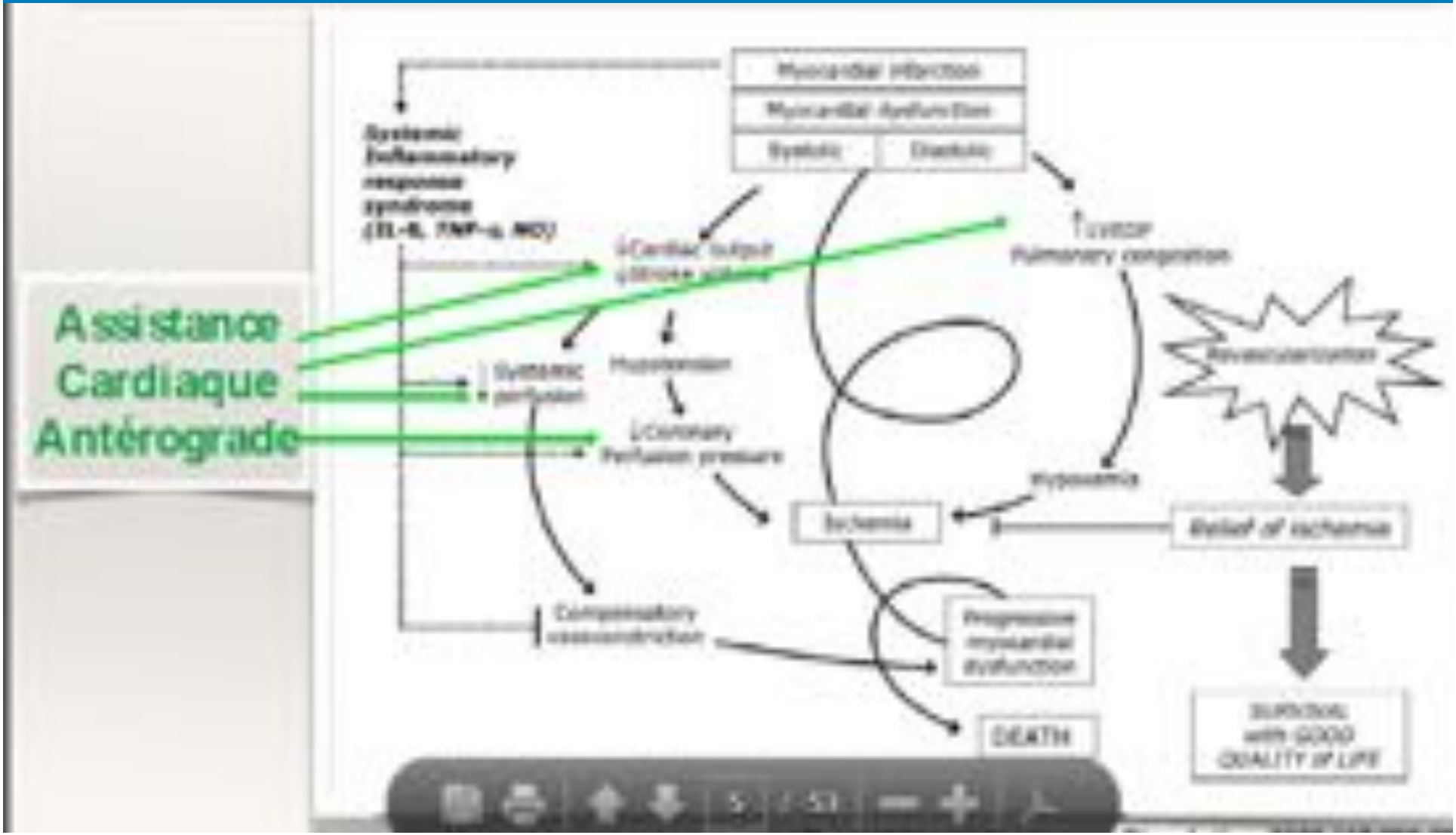
- Small series of patients from high volume LVAD centers (A. Combes, Paris)
- No LV unloading
- Increased LV afterload
- More personnel (cardiac surgeon, perfusionist) and more difficult to organize rapidly in acute setting
- More pronounced systemic inflammatory response

Amines


Assistance cardiaque
Antérograde

Assistance circu
rétrograde

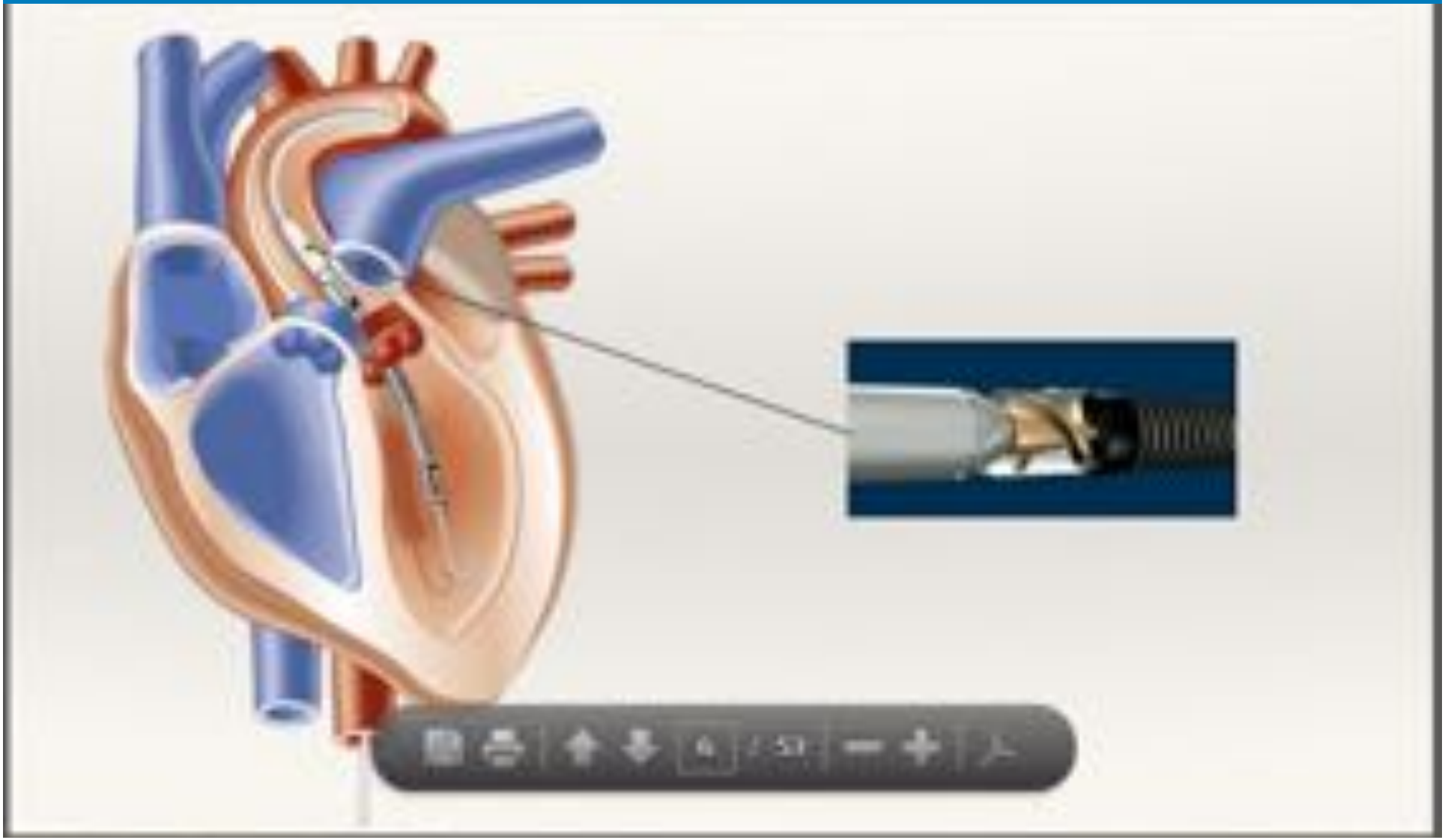
# Assistance Anterograde



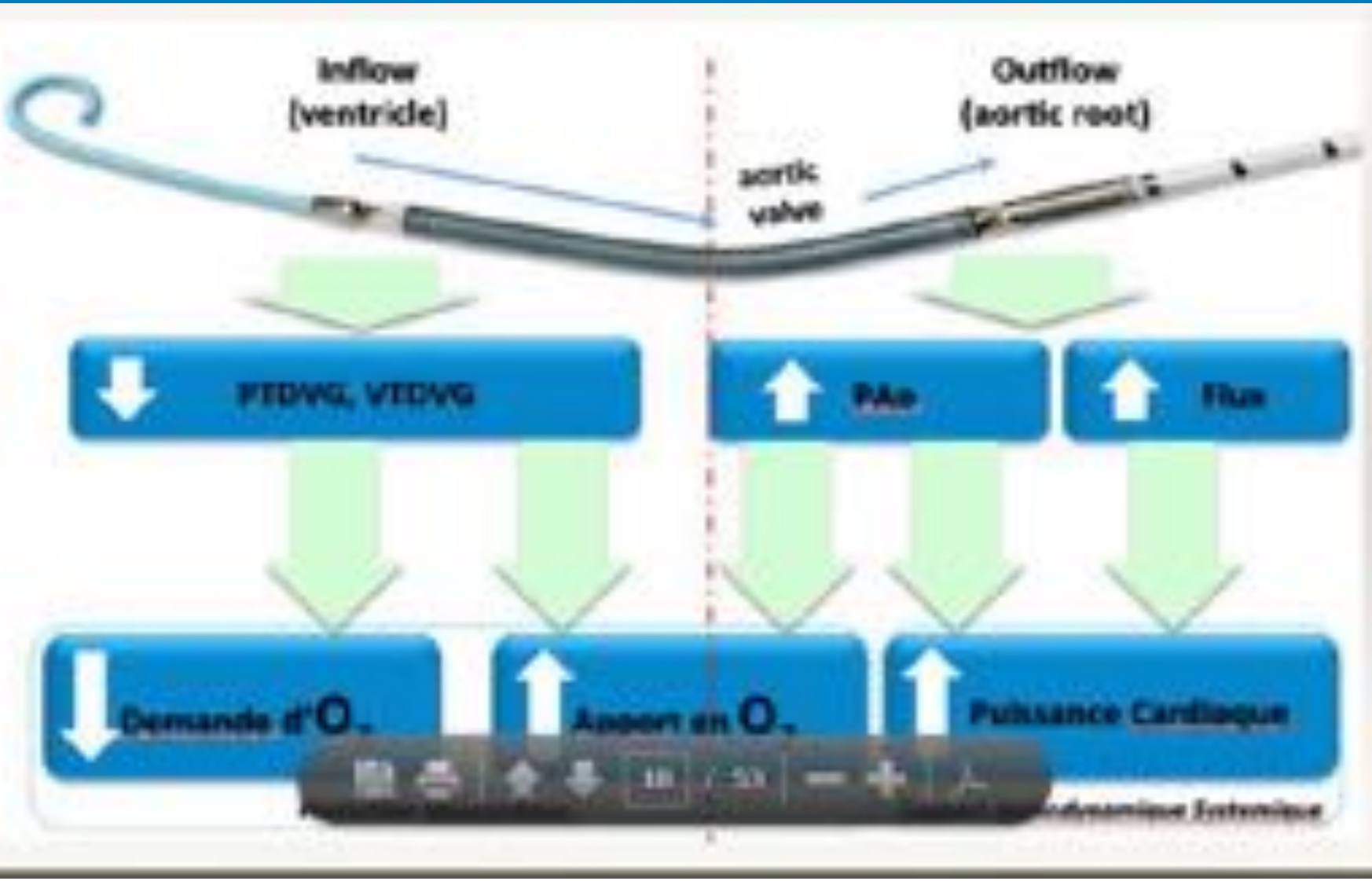
# Impella: LV-aortic axial flow pump

- Miniaturized 12-13F pump
- Single Femoral access
- Placement with 0.018" wire
- Actively unloads the LV
- Forward Flow up to 4.0L/min
- Low anticoagulation

# IMPELLA



# Impella Principe d'Action



# Impella Percutaneous Circulatory Support System

*Key Design Differences*

| | Impella® 2.5 | Impella CP™ |
|---|---|---|
| **Flow Rate (L/min, max)** | 2.5 | Up to 4.0 |
| **Catheter Size** | 9 Fr | 9 Fr |
| **Pump Size** | 12 Fr | 14 Fr |
| **Insertion Method** | Percutaneous via 13 Fr Introducer Sheath | Percutaneous via 14 Fr Introducer Sheath |
| **Guidewire** | 0.018" Silicone Wire | 0.018" PTFE Wire |
| **Placement Measurement** | Fluid-filled Pressure Lumen | Fluid-filled Pressure Lumen |
| **Cannula Geometry** | Curved, Pigtail | Curved, Pigtail |

# Impella Physiopathologie

| Etudes Impella | Augmente Le Débit Cardiaque | Apports en O2 Augmentés (Flux coronaire) | Demande en O2 diminuée (Décharge VG) |
|---|---|---|---|
| Burzotta et al., J Cardiovasc Med. 2008 | ✓ | | |
| Sauren et al., Artif Organs. 2007 | | ✓ | ✓ |
| Valgimigli et al., Cath Cardiovasc Interv. 2005 | ✓ | | ✓ |
| Meyns et al., Thorac Cardiov Surg. 2003 | ✓ | | ✓ |
| Meyns et al., J Am Coll Cardio. 2003 | | | ✓ |
| Remmelink et al., Cath Cardiov Interv. 2007 | | ✓ | |
| Reesink et al., CHEST 2004 | ✓ | | ✓ |
| Dixon et al., J Am Coll Card Interv. 2009 | ✓ | | |
| Seyfarth et al., J Am Coll Card | | | |

# Danish Cardiogenic Shock Trial (DanShock)

- In 2012 a more powerful Impella has been introduced that is able to deliver 3.5l/min (approximately 75% of a normal cardiac output).
- The hypothesis of the current study is to reduce mortality and morbidity of patients with cardiogenic shock using the Impella cVAD.
- The study will be carried out as a randomized multicenter study where eligible patients will be randomized to receive conventional circulatory support or support with the Impella device and inotropic support if needed.
- A total of 360 patients are planned to be enrolled, and the primary endpoint will be death.

# Danish (DanShock) Trial

Acute MI (STEMI < 36 h)

Shock

Inclusion criteria

PCI (CABG)

Randomization (N=360)

- Lactate .2.5mmol/l
- Hemodynamics SBP < 100 mmhg or vasopressors
- LV-EF <35%

**Primary Endpoint: Total Mortality**

IABP pre PCI (n=180)

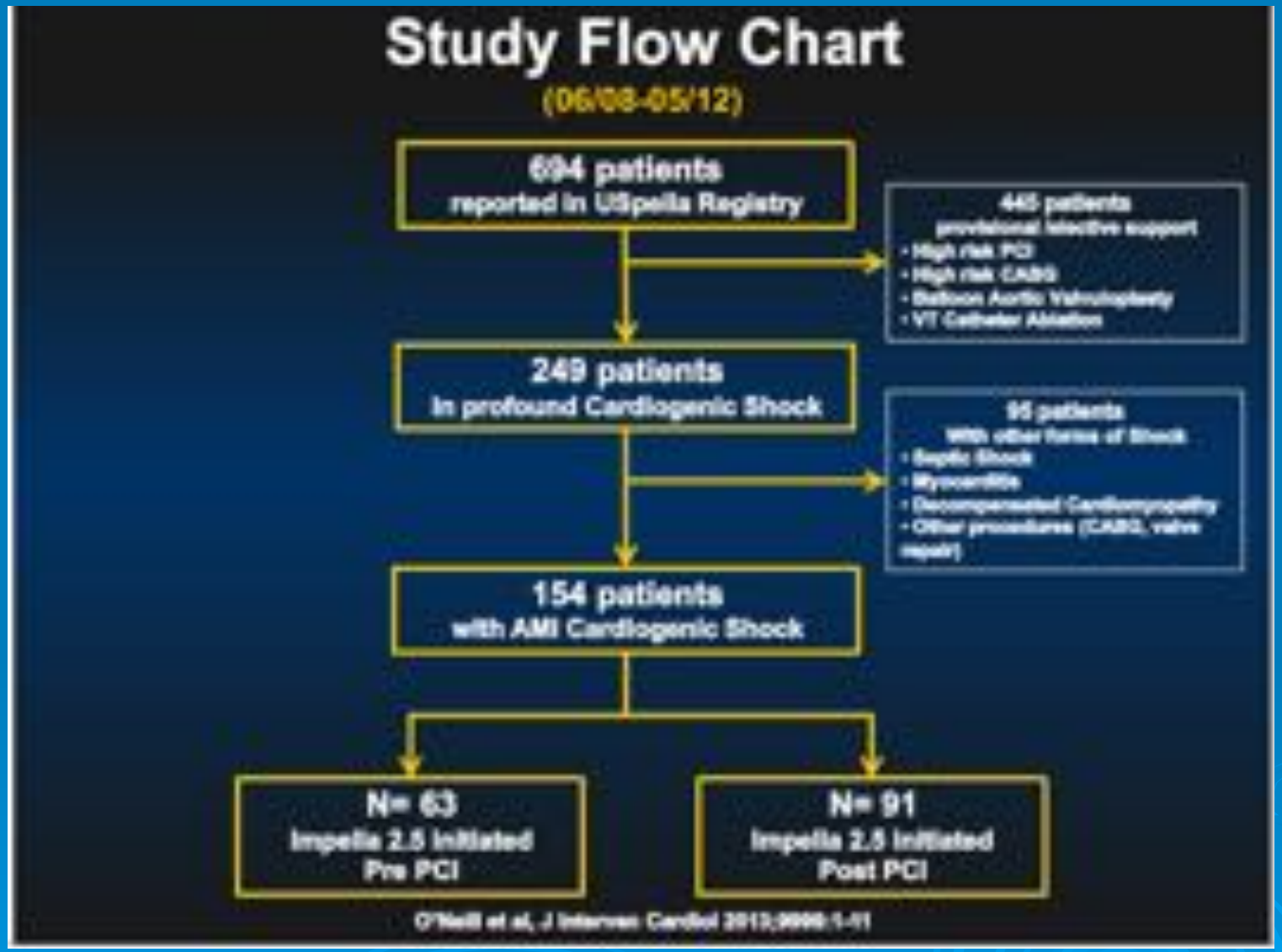
Impella cVAD pre PCI (n=180)

# The Current Use of Impella 2.5 in Acute Myocardial Infarction Complicated by Cardiogenic Shock: Results from the USpella Registry

William W. O'Neill, MD[1]; Theodore Schreiber, MD[2]; David H. W. Wohns, MD[3]; Charanjit Rihal, MD[4]; Srihari S. Naidu, MD[5]; Andrew B. Civitello, MD[6]; Simon R. Dixon, MBChB[7]; Joseph M. Massaro, PhD[8]; Brijeshwar Maini, MD[7]; E. Magnus Ohman, MD[9]

From the [1]Henry Ford Hospital, Detroit, MI, USA; [2]Detroit Medical Center, Detroit, MI, USA; [3]Spectrum Health, Grand Rapids, MI, USA; [4]Mayo Clinic, Rochester, MN, USA; [5]Winthrop University Hospital, Mineola, NY, USA; [6]Texas Heart Institute, Houston, TX, USA; [7]Beaumont Hospital, Royal Oak, MI, USA; [8]Harvard Research Institute, Boston, MA, USA; [9]Pinnacle Health Medical Center, Wormleysburg, PA, USA; [9]Duke University Medical Center, Durham, NC, USA.

O'Neill et al. J Interven Cardiol 2013;[illegible]:1-11


Study Flow Chart
(06/08-05/12)
694 patients
reported in USpella Registry
445 patients
• High risk PCI
• High risk CABG
• Balloon Aortic Valvuloplasty
• VT Catheter Ablation
249 patients
In profound Cardiogenic Shock
95 patients
• Septic Shock
• Myocarditis
• Decompensated Cardiomyopathy
• Other procedures (CABG, valve repair)
154 patients
with AMI Cardiogenic Shock
N= 63
Impella 2.5 Initiated
Pre PCI
N= 91
Impella 2.5 Initiated
Post PCI

# USpella Cardiogenic Shock

Hemodynamics All Patients

N = 154 (mean ± SD or %)

| | Pre-support | On Support | P-Vaue |
|---|---|---|---|
| SBP, mmHg | 85.4±25.6 (143) | 126.7±31.4 (144) | <0.0001 |
| DBP, mmHG | 50.8±18.6 (143) | 78.7±21.1 (143) | <0.0001 |
| MAP, mmHg | 62.7±19.2 (143) | 94.4±23.1 (143) | <0.0001 |
| PCWP, mmHg | 31.9±11.0 (25) | 19.2± 9.7 (25) | <0.0001 |
| Cardiac Output, L/min | 3.4±1.3 (23) | 5.3± 1.7 (23) | <0.0001 |
| Cardiac index, L/min/m$^2$ | 1.9±0.7 (23) | 2.7± 0.7 (23) | <0.0001 |
| Cardiac power output, W | 0.48± 0.17 (23) | 1.06± 0.48 (23) | <0.0001 |

# PROTECT II

## *Prospective Multicenter Randomized Trial Comparing IMPELLA to IABP in High Risk PCI: 90 Day Results*

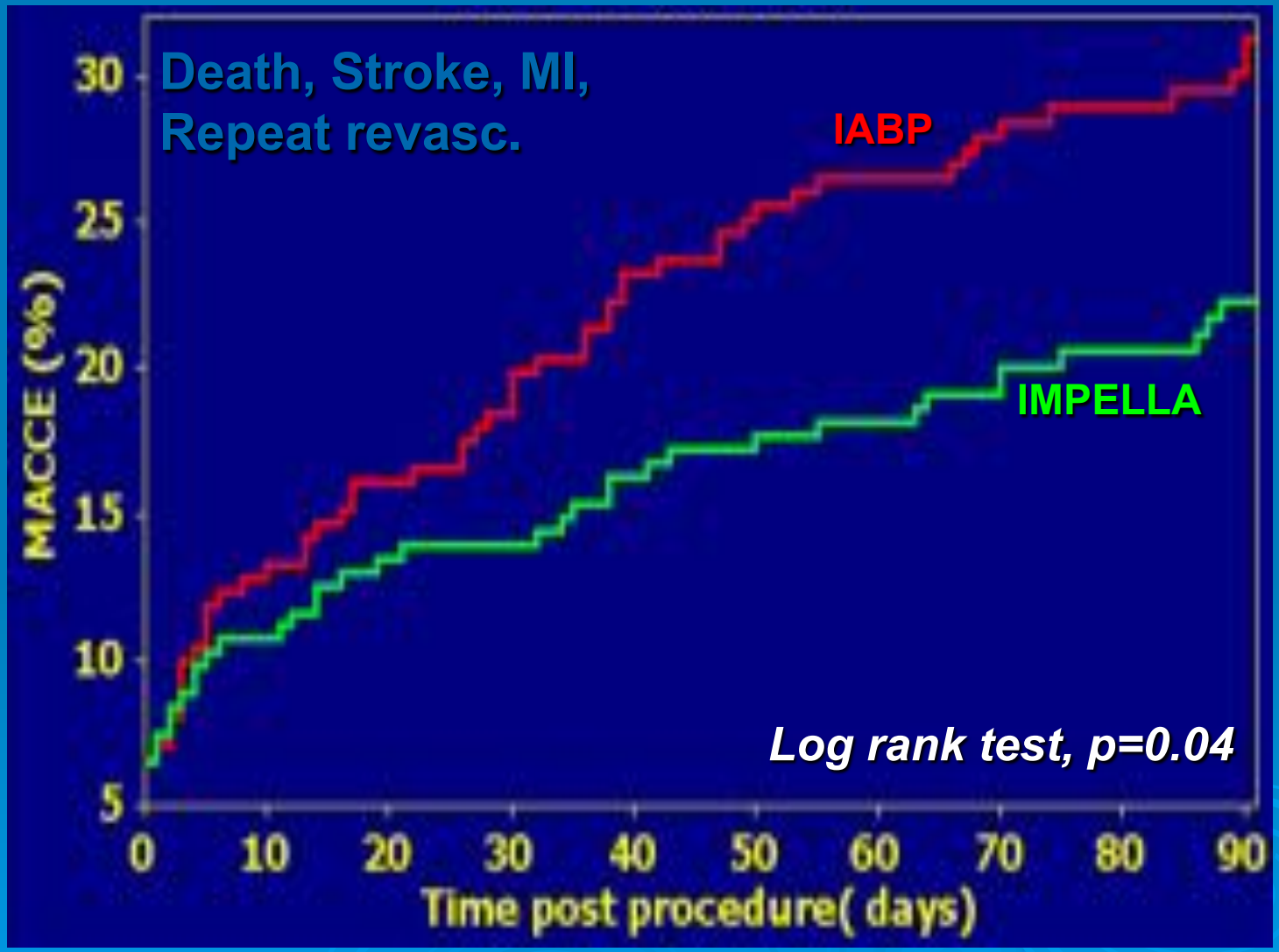
**William O'Neill, Neal Kleiman, Jose Henriques, Simon Dixon, Joseph Massaro, Ioana Ghiu, Brijeshwar Maini, Suresh Mulukutla, Vladimir Dzavik, James Revenaugh, Hadley Wilson, Karim Benali, Magnus Ohman**

***On behalf of all PROTECT II Investigators***

SCAI 2011

# PROTECT II MACCE**

## Per Protocol Population, N=426




***Using x8ULN threshold for biomarkers or Q-wave for Peri-procedural MI (Stone et al Circulation 2001;104:642-647) and 2xULN threshold for biomarkers for Spontaneous MI (Universal MI definition)*

# Impella or ECMO in Refractory Cardiogenic Shock?

- Absence of randomized data compared to routine care for both devices
- No randomized comparison between ECMO and Impella
- Advantages of Impella:
  - 2.5 and CP: percutaneous insertion, smaller sheaths
  - Left ventricular unloading

# American Guidelines for Impella

- 2011 ACCF/AHA/SCAI Guideline for Percutaneous Coronary Intervention. *JACC 2011*
  - High risk patients: Class IIb
  - PCI and Cardiogenic Shock: Class I
- 2013 ACCF/AHA Guideline for the Management of ST-Elevation Myocardial Infarction. *Circulation 2012*
  - STEMI and Cardiogenic Shock: Class IIb
  - STEMI and urgent CABG: Class IIa
- Use of Mechanical Circulatory Support: American Heart Association. *Circulation 2012*
  - Acutely decompensated heart failure patients: Class IIa
- 2013 International Society for Heart and Lung Transplantation Guidelines for Mechanical Circulatory Support. *The Journal of Heart and Lung Transplantation, 2013*
  - Temporary mechanical support for patients with multi-organ failure: Class I
- 2013 ACCF/AHA Guideline for the Management of Heart Failure, *Journal of American College of Cardiology 2013*
  - "Bridge to Recovery" or "Bridge to Decision" for patients with acute, profound hemodynamic compromise: Class IIa

# Conclusion: INCCI algorithm for shock?