Assistance circulatoire pour choc cardiogénique

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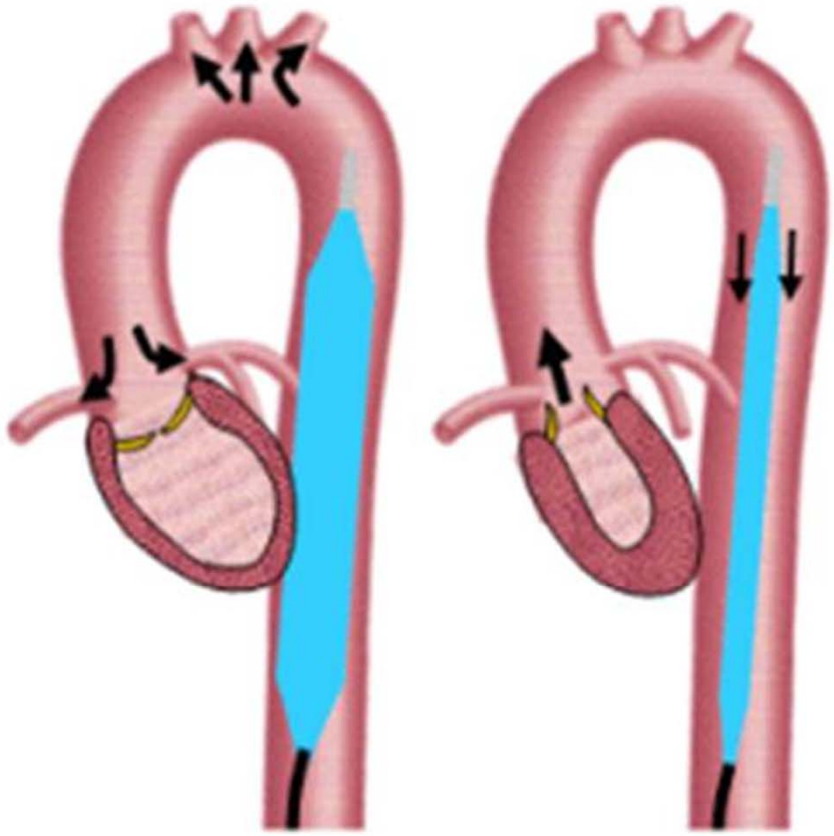
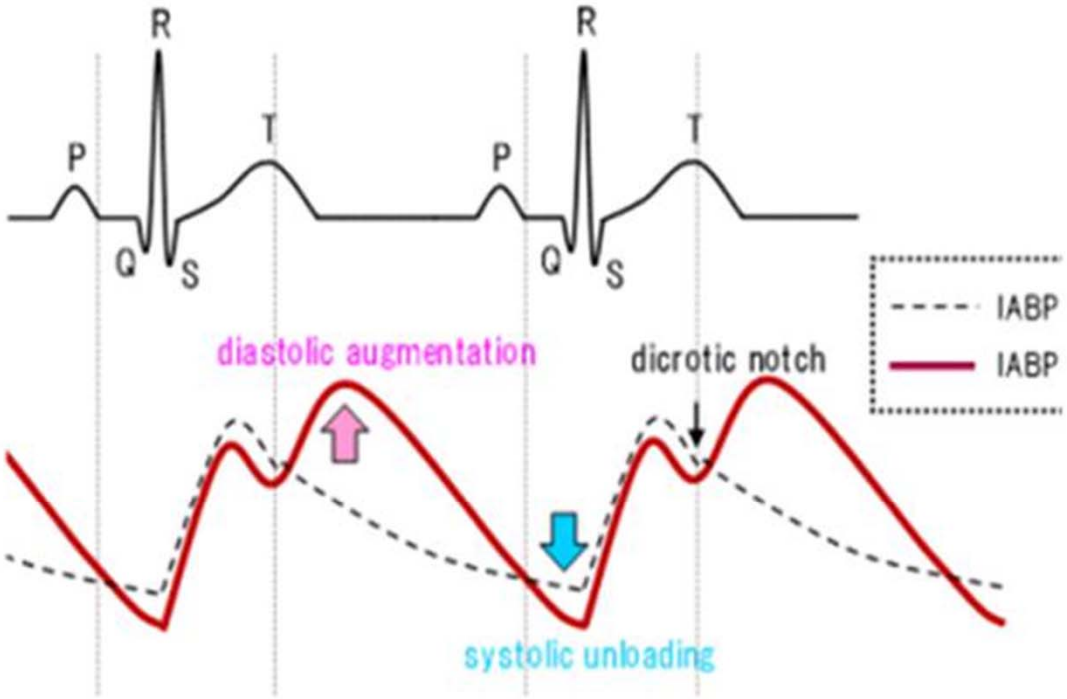
Conflict of interest

- Principal Investigator: HEROICS trial
  - HVHF after complicated heart surgery
  - NCT01077349
  - Sponsored by GAMBRO
- Principal Investigator: EOLIA trial
  - VV ECMO in ARDS
  - NCT01470703
  - Sponsored MAQUET, Getinge Group
- Received honoraria from MAQUET, Getinge Group

Intra-Aortic Balloon Pump





Intraaortic Balloon Support for Myocardial Infarction with Cardiogenic Shock

Holger Thiele, M.D., Uwe Zeymer, M.D., Franz-Josef Neumann, M.D.,

N Engl J Med 2012.

METHODS

In this randomized, prospective, open-label, multicenter trial, we randomly assigned 600 patients with cardiogenic shock complicating acute myocardial infarction to intraaortic balloon counterpulsation (IABP group, 301 patients) or no intraaortic balloon counterpulsation (control group, 299 patients). All patients were expected to undergo early revascularization (by means of percutaneous coronary intervention or bypass surgery) and to receive the best available medical therapy. The primary efficacy end point was 30-day all-cause mortality. Safety assessments included major bleeding, peripheral ischemic complications, sepsis, and stroke.

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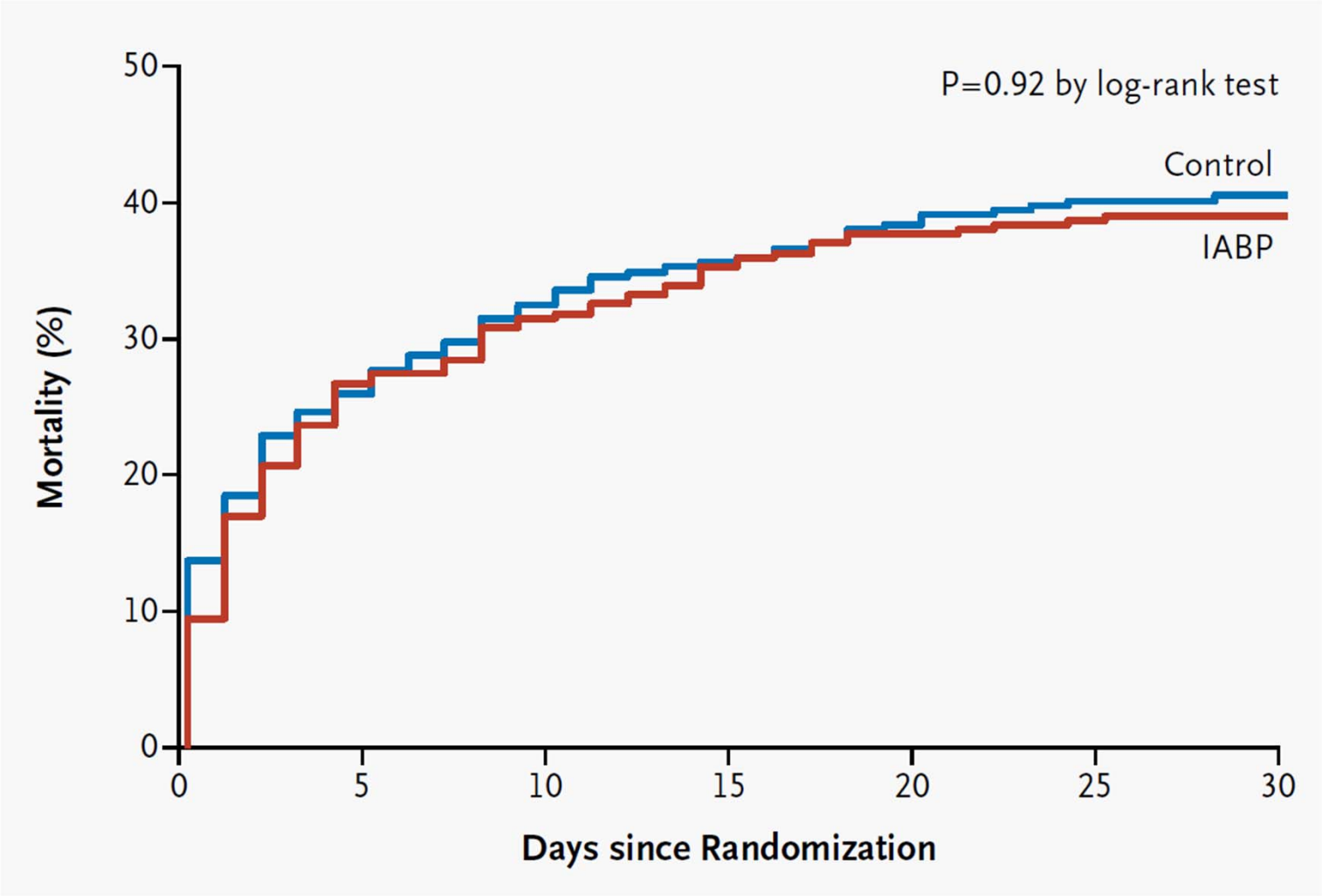

Intraaortic Balloon Support for Myocardial Infarction with Cardiogenic Shock

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Table 3. Clinical Outcomes.

Outcome	IABP (N = 300)	Control (N = 298)	P Value	Relative Risk with IABP (95% CI)
	number (percent)			
Primary end point: all-cause mortality at 30 days	119 (39.7)	123 (41.3)	0.69	0.96 (0.79–1.17)
Reinfarction in hospital	9 (3.0)	4 (1.3)	0.16	2.24 (0.70–7.18)
Stent thrombosis in hospital	4 (1.3)	3 (1.0)	0.71	1.32 (0.30–5.87)
Stroke in hospital	2 (0.7)	5 (1.7)	0.28	0.40 (0.08–2.03)
Ischemic	2 (0.7)	4 (1.3)	0.45	0.49 (0.09–2.71)
Hemorrhagic	0	1 (0.3)	0.50	—
Peripheral ischemic complications requiring intervention in hospital	13 (4.3)	10 (3.4)	0.53	1.29 (0.58–2.90)
Bleeding in hospital*				
Life-threatening or severe	10 (3.3)	13 (4.4)	0.51	0.76 (0.34–1.72)
Moderate	52 (17.3)	49 (16.4)	0.77	1.05 (0.74–1.50)
Sepsis in hospital	47 (15.7)	61 (20.5)	0.15	0.77 (0.54–1.08)

ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation

European Heart Journal (2012) **33**, 2569–2619

2010

IABP insertion is recommended in patients with haemodynamic instability (particularly those in cardiogenic shock and with mechanical complications). | I | C

2012

Intra-aortic balloon pumping may be considered. | IIb | B

ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure 2012

European Heart Journal (2012) **33**, 1787–1847

LV assist devices may be considered for circulatory support in patients in refractory shock.

IIb	C

Therapeutic Strategy: For Whom?

- “Medical” cardiogenic shock
  - AMI, end-stage DCM, myocarditis, drug overdose, Tako-Tsubo…
  - Refractory to conventional treatments
    - Including IABP?
  - Before evolution towards end-stage multiple organ failure
- Cardiac arrest
- Post cardiotomy
  - Failure to wean from CPB

Therapeutic Strategy:
When to initiate mechanical assistance?

- Parameters to evaluate:
  - Etiology/Time course of the disease
  - Treatments administered
  - Clinical status, in particular neurological status:
    - Is it futile to insert a device?
- Other clinical signs associated with rapid deterioration of cardiac function:
  - Nausea, abdominal pain, Alteration of consciousness
  - Tachycardia, rhythm disturbances
  - Ionic disturbances, Acidosis
  - **Hepatic / Renal failure**
- Doppler-Echocardiography +++
  - LVEF <20%
  - Signs of low cardiac output, Ao VTI <8cm

Outcomes and long-term quality-of-life of patients supported by extracorporeal membrane oxygenation for refractory cardiogenic shock*

Alain Combes, MD, PhD; Pascal Leprince, MD, PhD; Charles-Edouard Luyt, MD, PhD; Nicolas Bonnet, MD; Jean-Louis Trouillet, MD; Philippe Léger, MD; Alain Pavie, MD; Jean Chastre, MD

Crit Care Med 2008 Vol. 36, No. 5

Factor	OR (95% CI)	*P*
Female sex	3.89 (1.06–14.22)	0.04
Myocarditis	0.13 (0.02–0.78)	0.03
ECMO under CPR	20.68 (1.09–392.03)	0.04
Prothrombin activity < 50%	3.93 (1.11–13.85)	0.03
24 h urine output < 500 mL	6.52 (1.87–22.74)	0.003

Independent predictors of ICU death

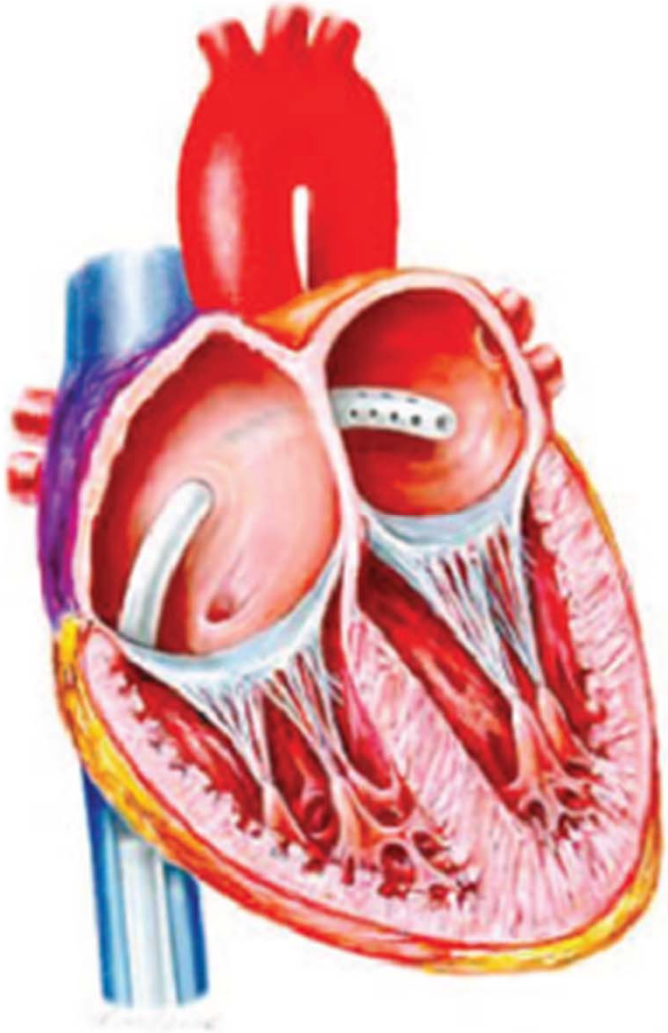
The classical indications of mechanical assistance…

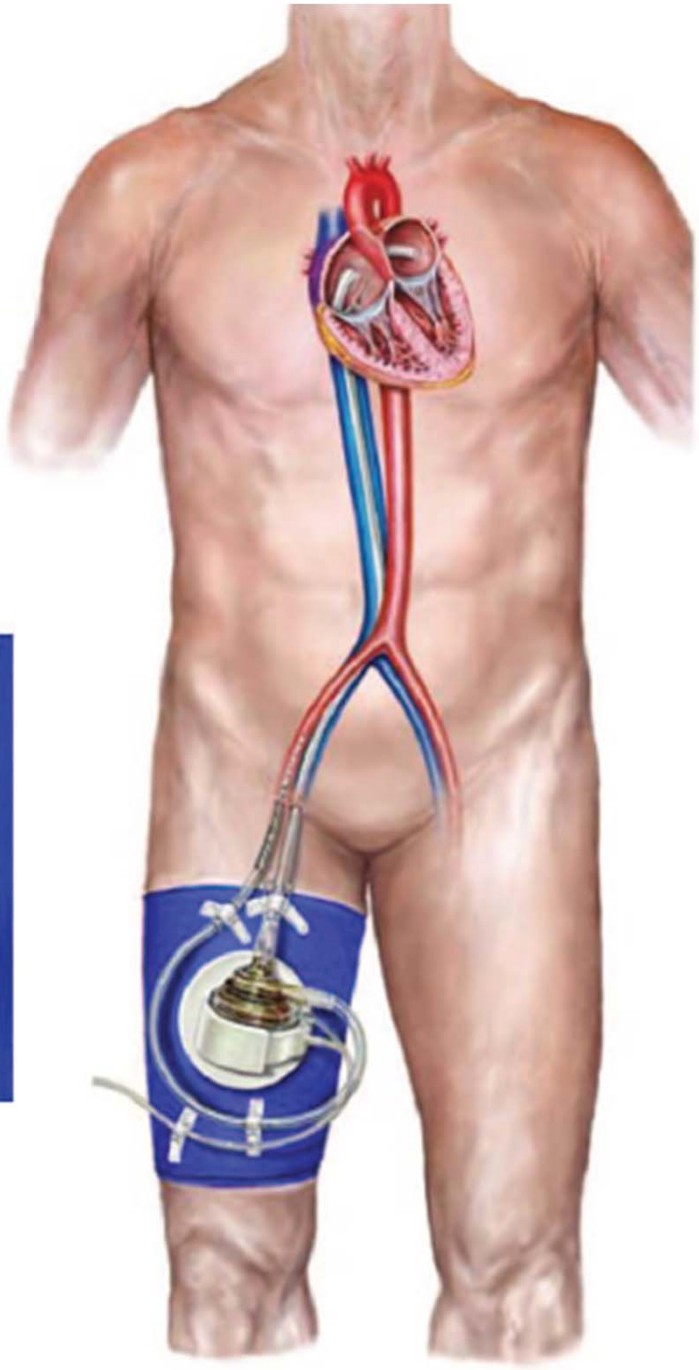
- 4 types of indications:
  - « Bridge to recovery »
  - « Bridge to bridge »
  - « Bridge to transplantation »
  - « Destination therapy »
- But now… In the acute setting…
  - Bridge to whatever seems reasonable
  - Including “withdrawal” after a few days
    - If refractory MOF…

Which mechanical pump?
In the context of acute disease…

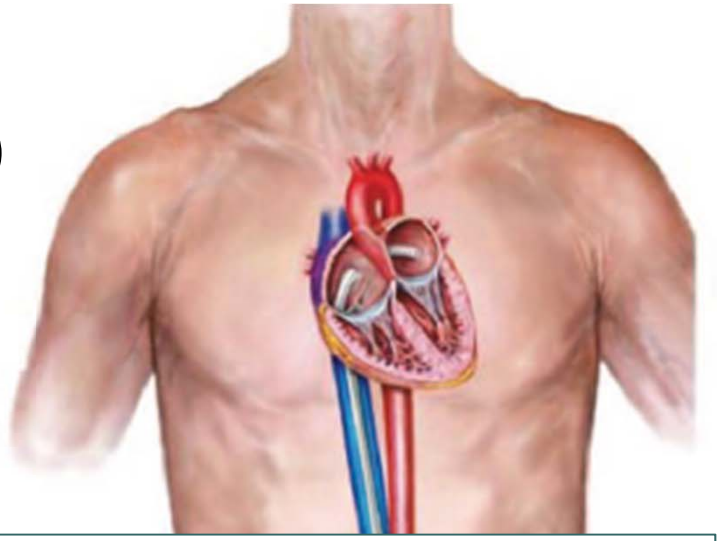
- Centrifugal-flow pumps +/- extracorporeal oxygenation
  - Impella
  - Tandem Heart
  - Levitronix CentriMag
  - **ECMO + + +**

Tandem Heart pVAD

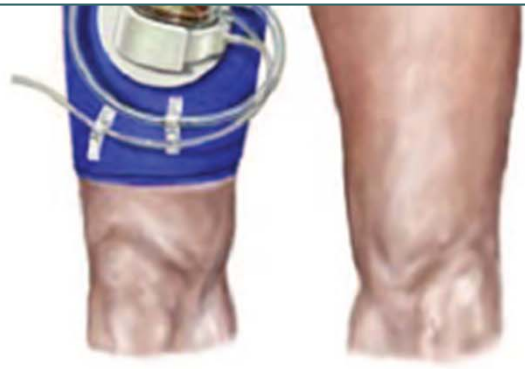




Tandem Heart pVAD



After transseptal puncture a venous inflow cannula is inserted into the left atrium
Oxygenated blood is drawn from there and returned via a centrifugal pump and via an arterial cannula in the femoral artery



A randomized multicenter clinical study to evaluate the safety and efficacy of the TandemHeart percutaneous ventricular assist device versus conventional therapy with intraaortic balloon pumping for treatment of cardiogenic shock

Daniel Burkhoff, MD, PhD,[a] Howard Cohen, MD,[b] Corinna Brunckhorst, MD,[c] and William W. O'Neill, MD,[d] for the TandemHeart Investigators Group[e] *Orangeburg and New York City, NY; Zurich, Switzerland; and Royal Oak, MI*

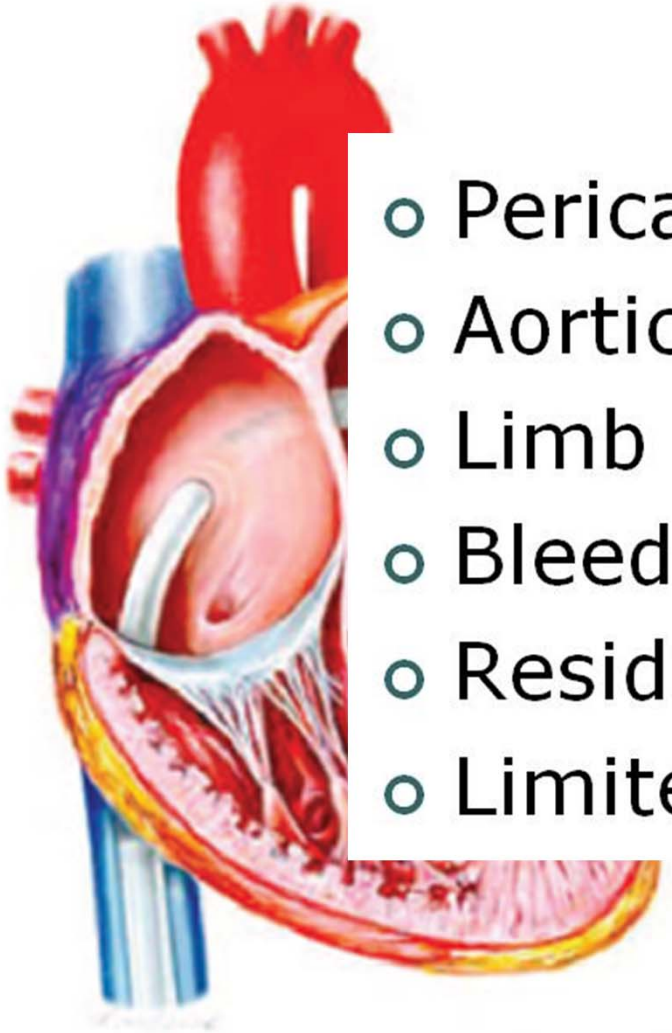
Background and Aim Despite major advances in the treatment of heart failure, cardiogenic shock (CGS) remains associated with substantial mortality. Recent data suggest that the TandemHeart percutaneous ventricular assist device (pVAD) may be useful in the management of CGS. The aim of this prospective randomized study was to test the hypothesis that the TandemHeart (pVAD) provides superior hemodynamic support compared with intraaortic balloon pumping (IABP).

Methods Forty-two patients from 12 centers presenting within 24 hours of developing CGS were included in the study and treated in an initial roll-in phase (n = 9) or randomized to treatment with IABP (n = 14) or TandemHeart pVAD (n = 19). Thirty patients (71%) had persistent CGS despite having an IABP in place at the time of study enrollment.

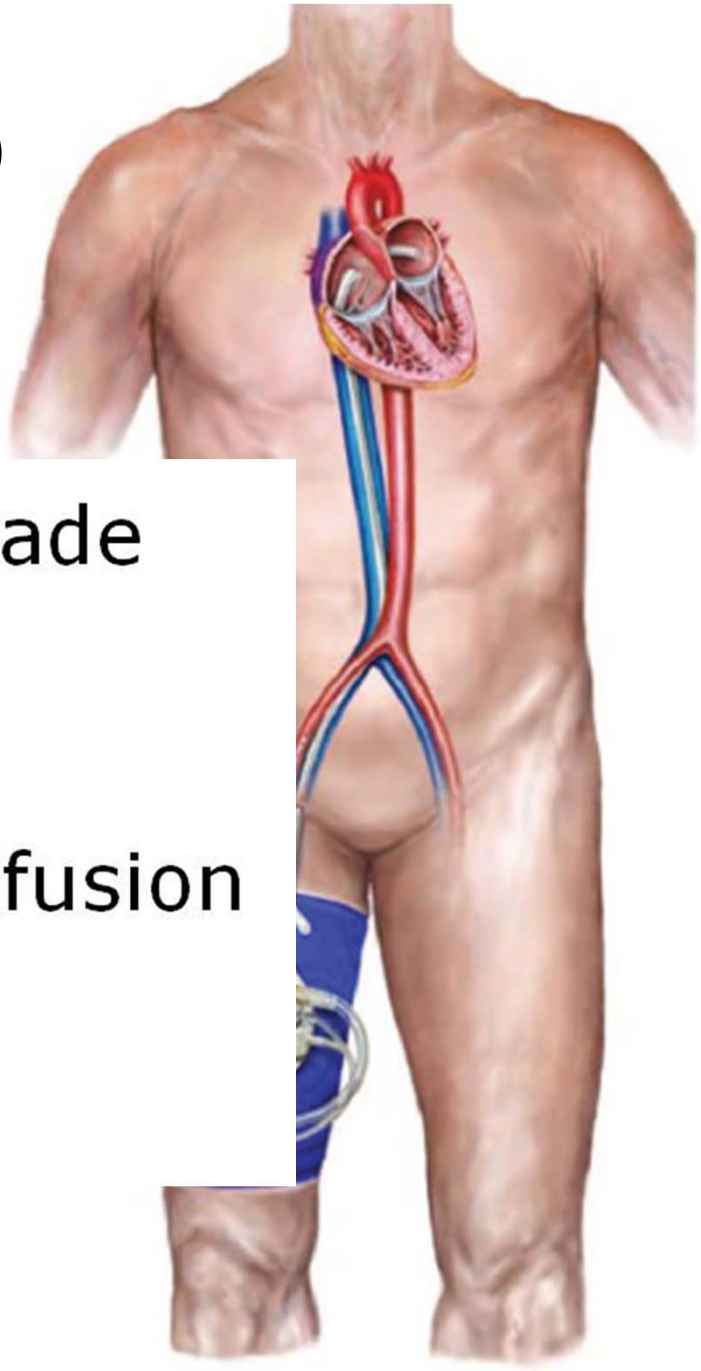
Results Cardiogenic shock was due to myocardial infarction in 70% of the patients and decompensated heart failure in most of the remaining patients. The mean duration of support was 2.5 days. Compared with IABP, the TandemHeart pVAD achieved significantly greater increases in cardiac index and mean arterial blood pressure and significantly greater decreases in pulmonary capillary wedge pressure. Overall 30-day survival and severe adverse events were not significantly different between the 2 groups.

Conclusion In patients presenting within 24 hours of the development of CGS, TandemHeart significantly improves hemodynamic parameters, even in patients failing IABP. Larger-scale studies are required to assess the influence of improved hemodynamics on survival. (Am Heart J 2006;152:469.e1-469.e8.)

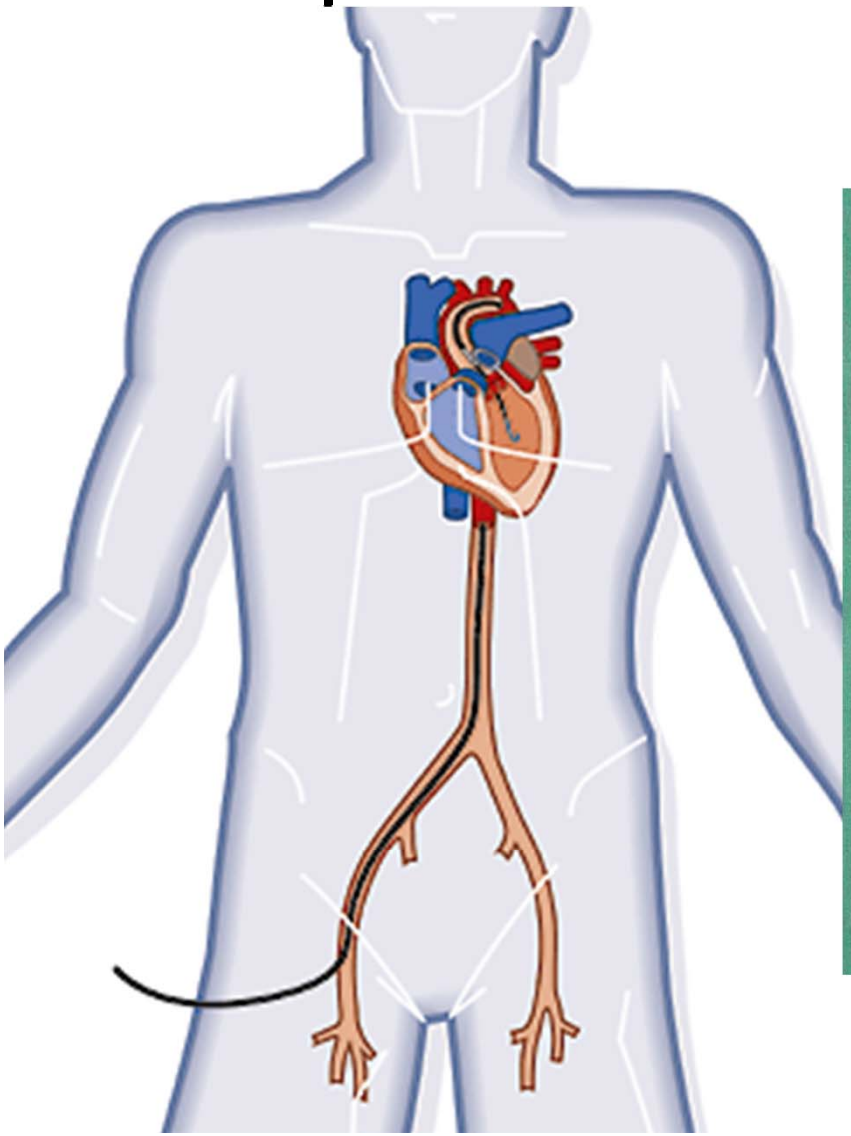
Tandem Heart pVAD

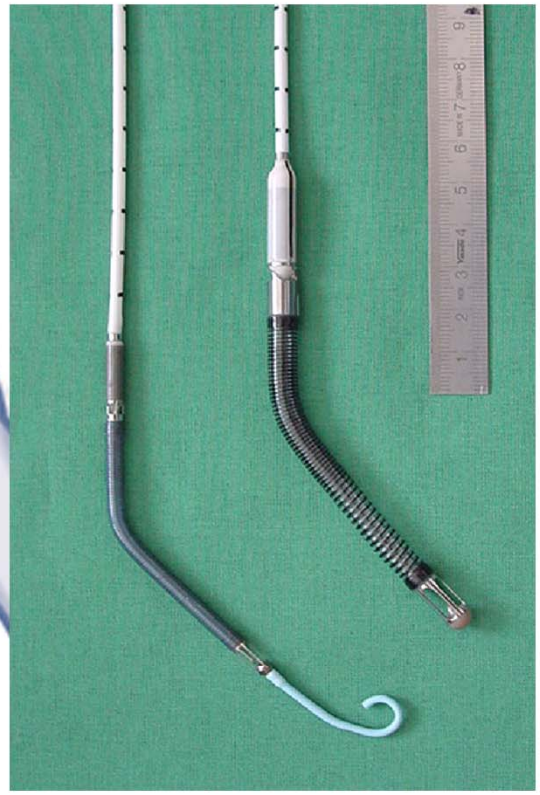


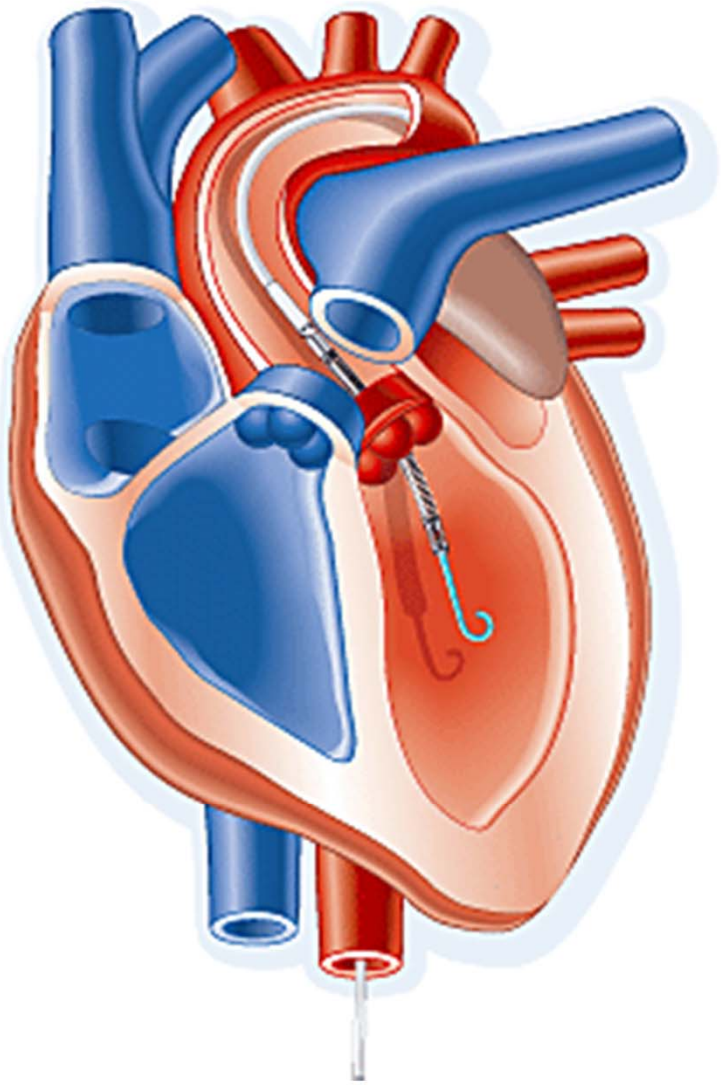
- Pericardial tamponade
- Aortic puncture
- Limb ischemia
- Bleeding and transfusion
- Residual ASD
- Limited flow



Miniature Intraaortic pump: Impella®







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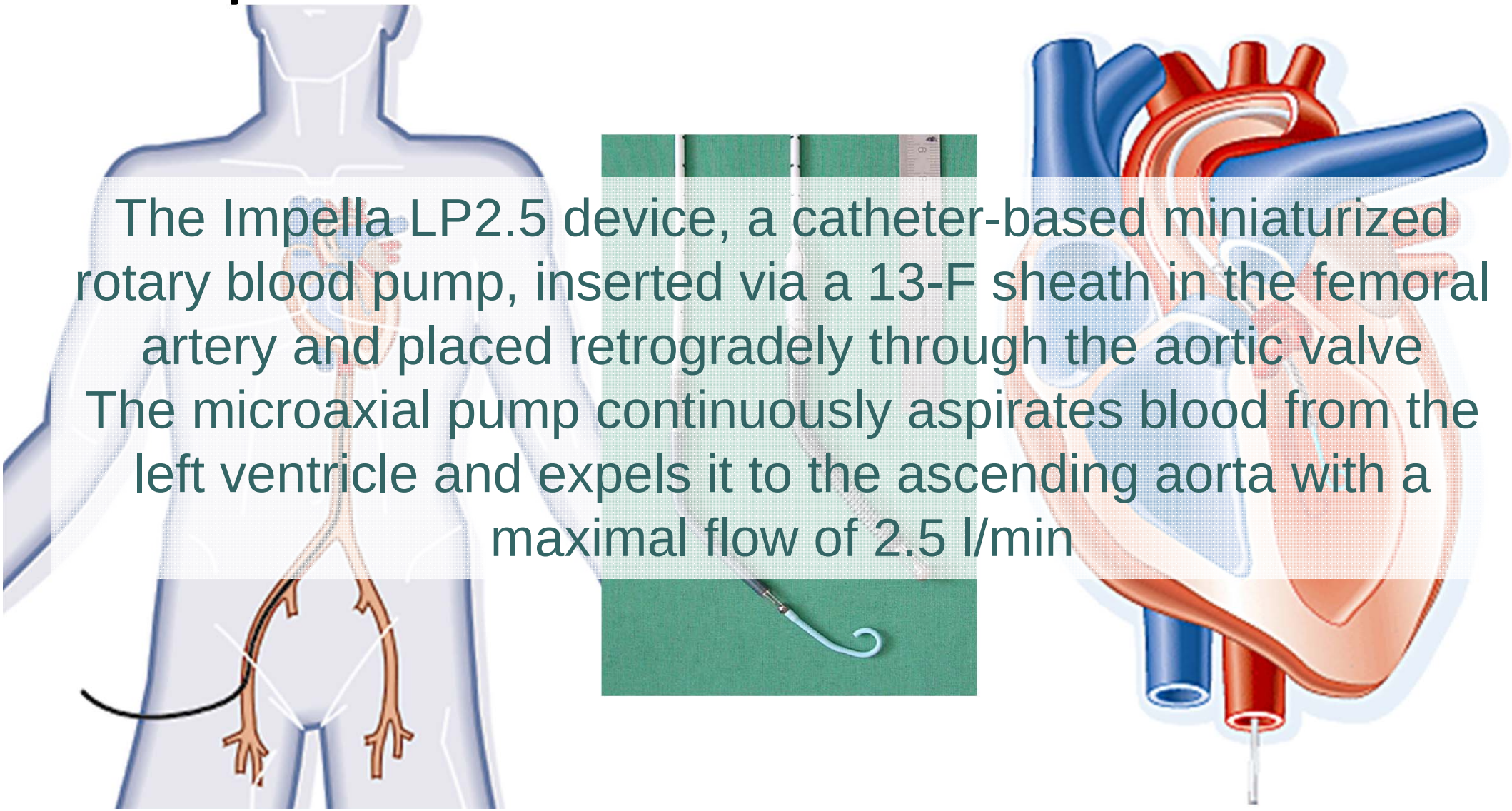
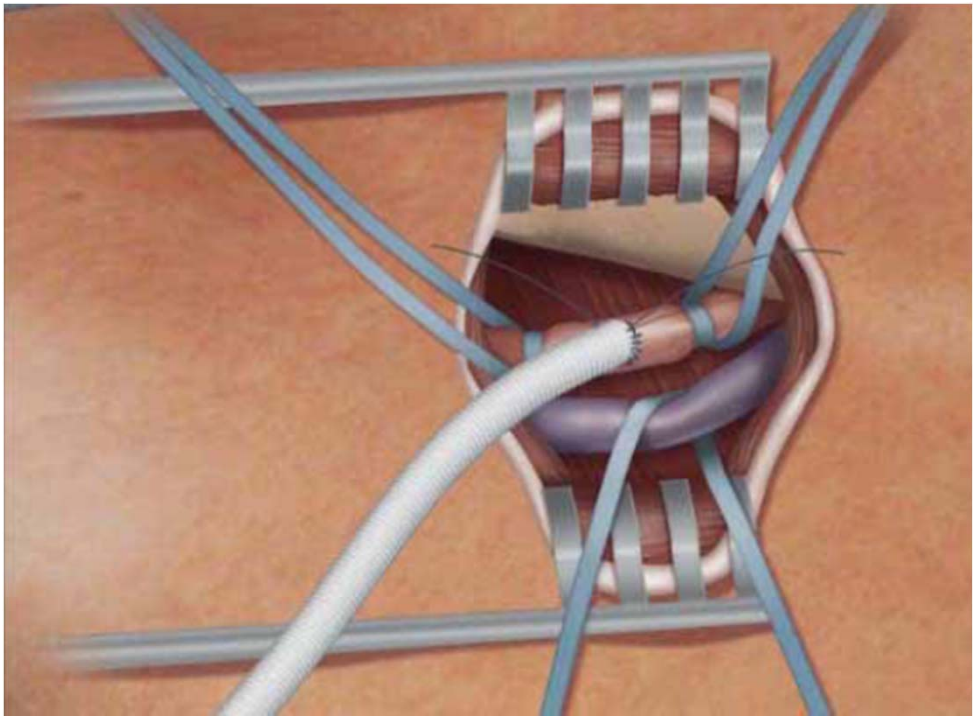
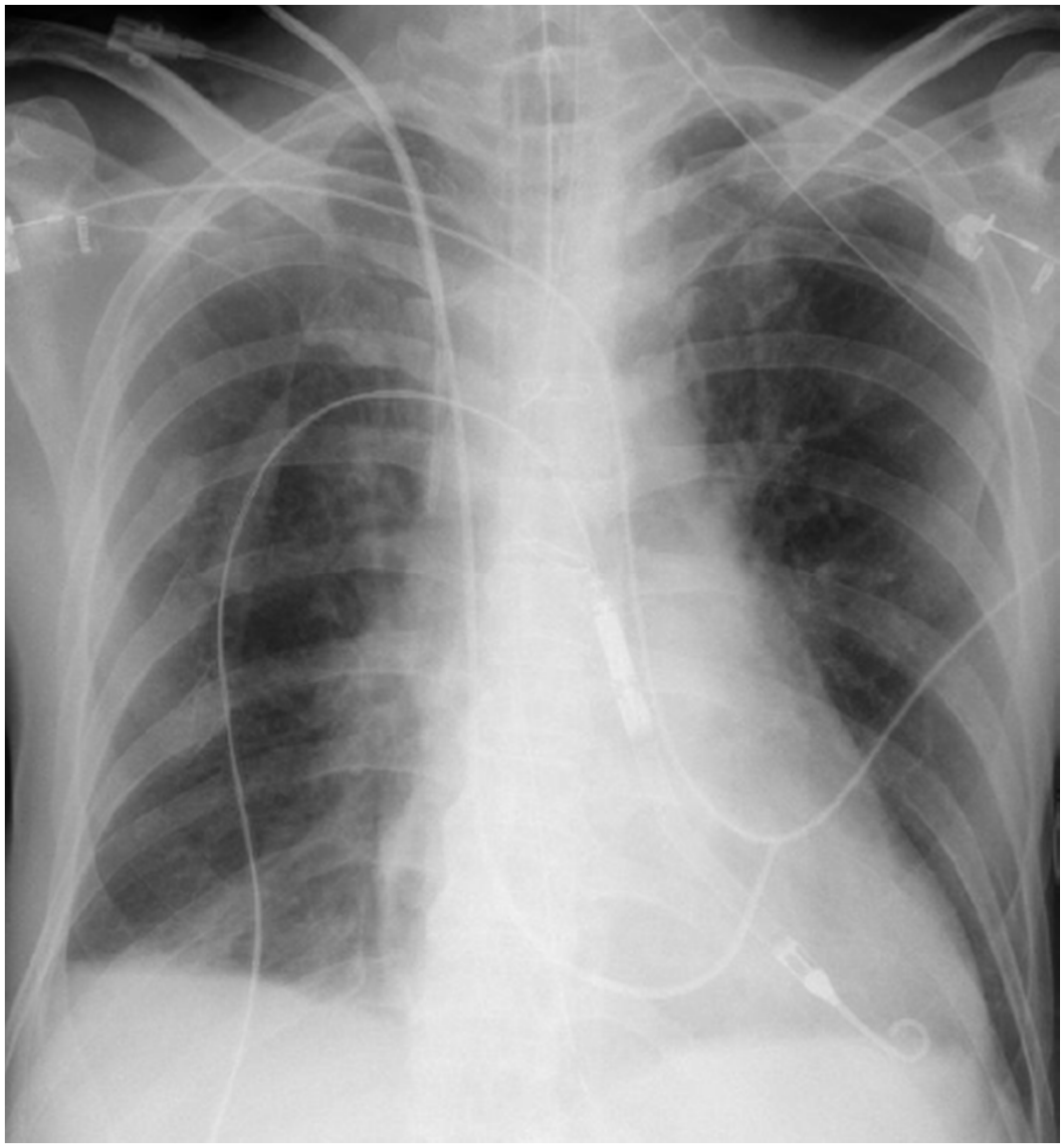


The Impella LP2.5 device, a catheter-based miniaturized rotary blood pump, inserted via a 13-F sheath in the femoral artery and placed retrogradely through the aortic valve
The microaxial pump continuously aspirates blood from the left ventricle and expels it to the ascending aorta with a maximal flow of 2.5 l/min

Impella 5.0





The Impella 2.5 and 5.0 devices for ST-elevation myocardial infarction patients presenting with severe and profound cardiogenic shock: The Academic Medical Center intensive care unit experience*

Annemarie E. Engström, MD; Ricardo Cocchieri, MD; Antoine H. Driessen, MD; Krischan D. Sjauw, MD;

Crit Care Med 2011 Vol. 39, No. 9

Objective: Cardiogenic shock remains an important therapeutic challenge, with high in-hospital mortality rates. Mechanical circulatory support may be beneficial in these patients. Since the efficacy of the intra-aortic balloon pump seems limited, new percutaneously placed mechanical left ventricular support devices, such as the Impella system, have been developed for this purpose. Our current purpose was to describe our experience with the Impella system in patients with ST-elevation myocardial infarction presenting in profound cardiogenic shock, who were admitted to our intensive care unit for mechanical ventilation.

Methods: From January 2004 through August 2010, a total of 34 ST-elevation myocardial infarction patients with profound cardiogenic shock were admitted to our intensive care unit and treated with either the Impella 2.5 or the Impella 5.0 device. Baseline and follow-up characteristics were collected retrospectively.

Measurements and Main Results: Within the study cohort, 25 patients initially received treatment with the Impella 2.5, whereas nine patients received immediate Impella 5.0 support. Eight out of 25 patients in the Impella 2.5 group were upgraded to 5.0 support. After 48 hrs, 14 of 25 patients in the 2.5 group were alive, five of whom had been upgraded. In the 5.0 group, eight out of nine patients were alive. After 30 days, six of 25 patients in the 2.5 group were alive, three of whom had been upgraded. In the 5.0 group, three of nine patients were alive at 30 days.

Conclusions: In ST-elevation myocardial infarction patients with severe and profound cardiogenic shock, our initial experience suggests improved survival in patients who received immediate Impella 5.0 treatment, as well as in patients who were upgraded from 2.5 to 5.0 support, when compared to patients who received only Impella 2.5 support. (Crit Care Med 2011; 39: 2072–2079)

KEY WORDS: cardiogenic shock; intensive care medicine; mechanical circulatory support

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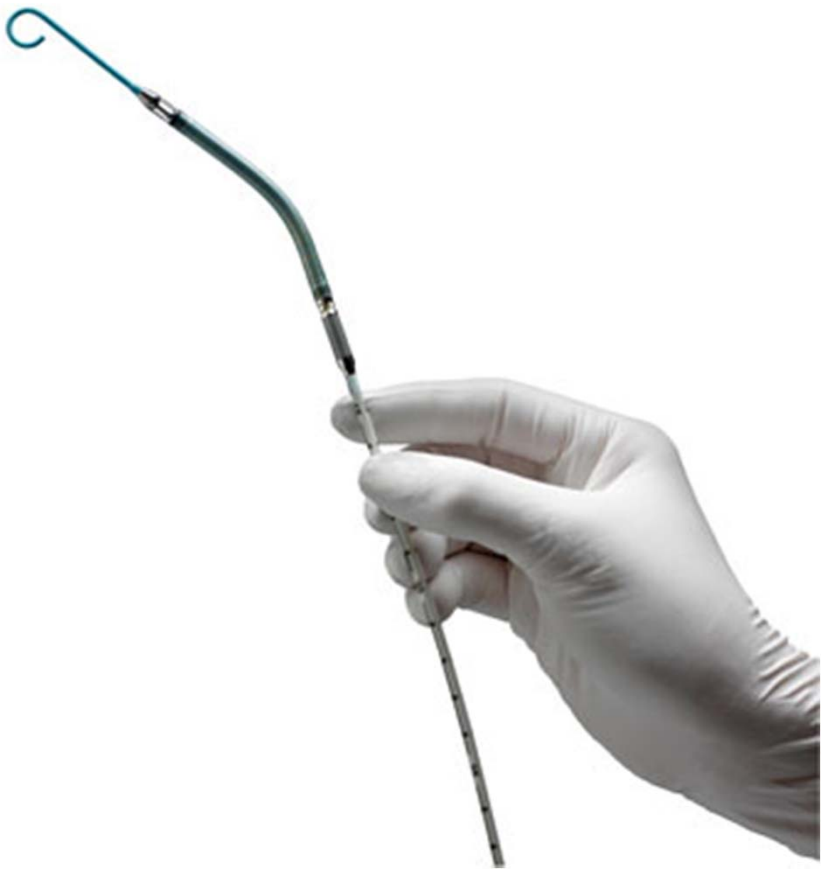
Impella cVAD



- Looks like the Impella 2.5
- But with a maximum blood flow of 4 L/min
- Like the Impella 2.5, the Impella cVAD is percutaneously implanted via a 9 Fr catheter into the LV,
- Powered by the same console
- CE Mark in Europe
- Intended for use for up to 5 d

Percutaneous left ventricular assist devices vs. intra-aortic balloon pump counterpulsation for treatment of cardiogenic shock: a meta-analysis of controlled trials

Jin M. Cheng, Corstiaan A. den Uil*, Sanne E. Hoeks, Martin van der Ent, Lucia S.D. Jewbali, Ron T. van Domburg, and Patrick W. Serruys

European Heart Journal (2009) **30**, 2102–2108
doi:10.1093/eurheartj/ehp292

Methods and results

Two independent investigators searched Medline, Embase, and Cochrane Central Register of Controlled Trials for all controlled trials using percutaneous LVAD in patients with cardiogenic shock, where after data were extracted using standardized forms. Weighted mean differences (MDs) were calculated for cardiac index (CI), mean arterial pressure (MAP), and pulmonary capillary wedge pressure (PCWP). Relative risks (RRs) were calculated for 30-day mortality, leg ischaemia, bleeding, and sepsis. In main analysis, trials were combined using inverse-variance random effects approach. Two trials evaluated the TandemHeart and a recent trial used the Impella device. After device implantation, percutaneous LVAD patients had higher CI (MD 0.35 L/min/m^2, 95% CI 0.09–0.61), higher MAP (MD 12.8 mmHg, 95% CI 3.6–22.0), and lower PCWP (MD −5.3 mm Hg, 95% CI −9.4 to −1.2) compared with IABP patients. Similar 30-day mortality (RR 1.06, 95% CI 0.68–1.66) was observed using percutaneous LVAD compared with IABP. No significant difference was observed in incidence of leg ischaemia (RR 2.59, 95% CI 0.75–8.97) in percutaneous LVAD patients compared with IABP patients. Bleeding (RR 2.35, 95% CI 1.40–3.93) was significantly more observed in TandemHeart patients compared with patients treated with IABP.

Conclusion

Although percutaneous LVAD provides superior haemodynamic support in patients with cardiogenic shock compared with IABP, the use of these more powerful devices did not improve early survival. These results do not yet support percutaneous LVAD as first-choice approach in the mechanical management of cardiogenic shock.

VA-ECMO is now the first line device…

In the context of acute refractory cardiac failure

Extracorporeal Membrane Oxygenation: ECMO/ECLS

- ECMO = ExtraCorporeal Membrane Oxygenation:
  - Centrifugal Pump + Oxygenator: Heart-Lung support
- Peripheral vascular access:
  - Femoral site (cannulas), Seldinger technique, limited cut-down
- Advantages
  - Easy and rapid implantation if peripheral ECMO
    - No sterno/cardiotomy, local anesthesia, Emergency situations
  - Provides high and stable output flow
  - Simultaneous cardiac and pulmonary assistance: ECMO
  - Bridge to: Recovery, Bridge, Transplantation, Withdrawal
  - “Low cost” (2 - 40 times cheaper / other devices)

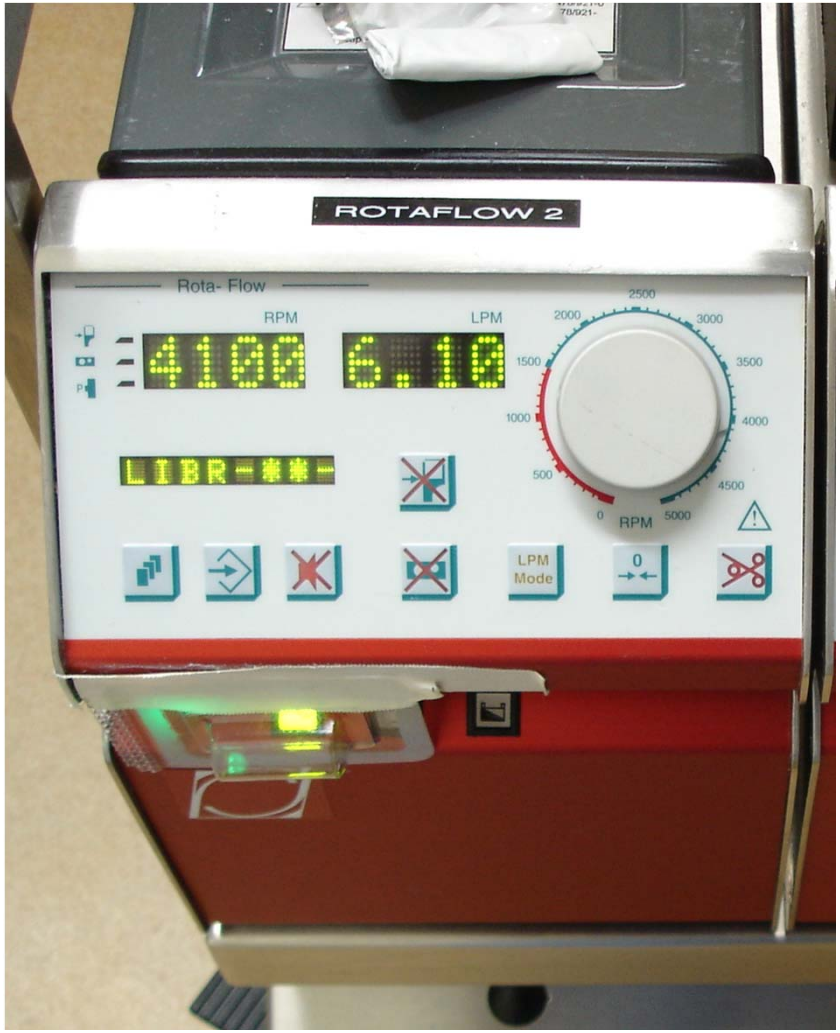
The ECMO circuit: *Centrifugal pump*

- Electrical
- Centrifugal pump
  - 0->4000 RPM
- Can deliver flows up to 8 L/min
- Very reliable
  - Up to 21 days

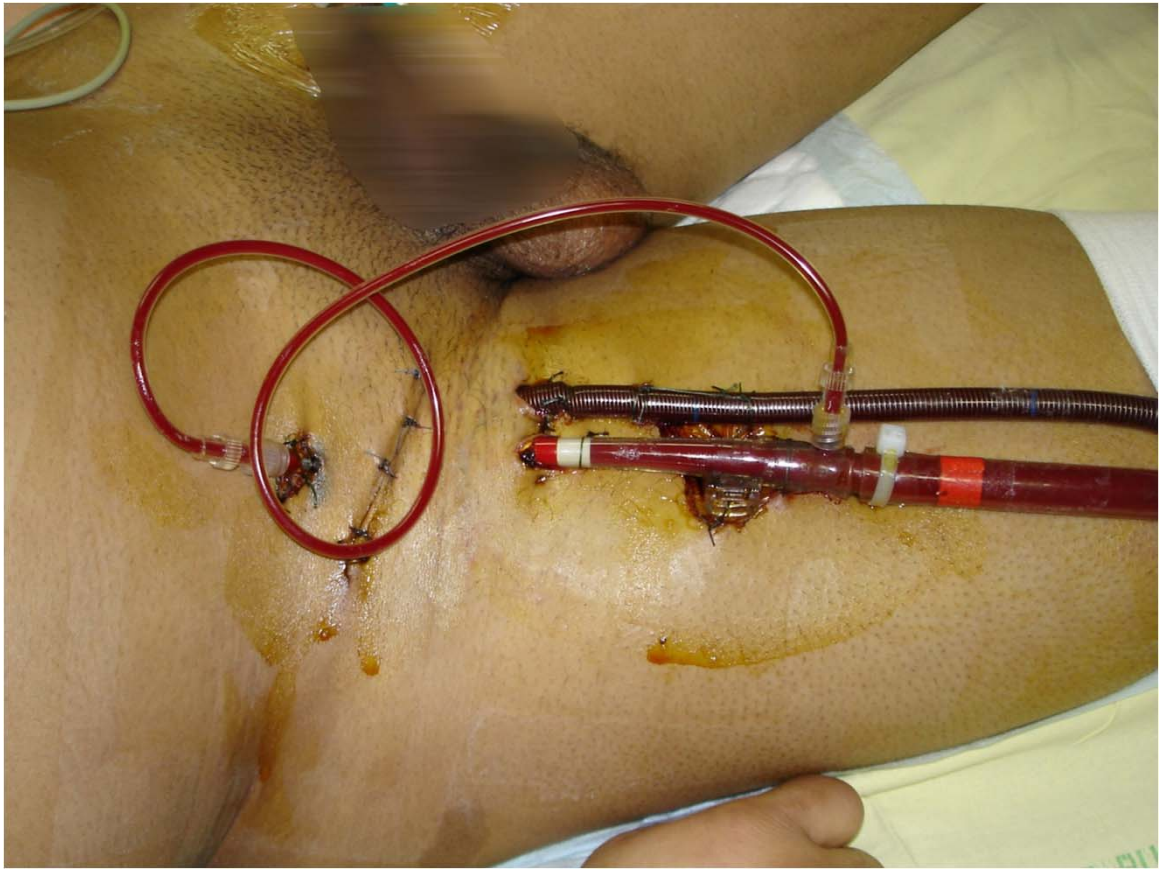
The ECMO circuit: *Membrane Oxygenator*

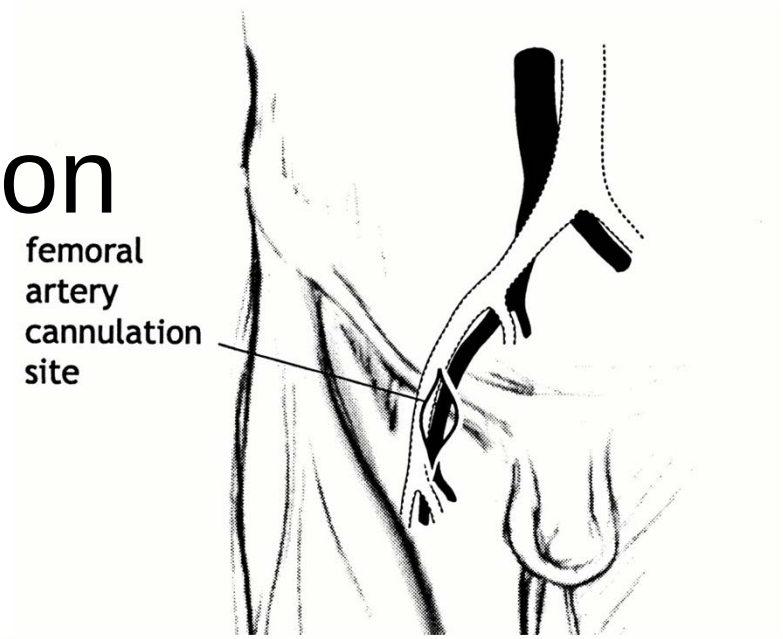
- Hollow fiber membrane oxygenator
- Polymethylpentene
- Heparin-coated
- High performance
  - CO2 elimination
  - Blood oxygenation
  - Low pressure drop
- Long duration 15-21 d

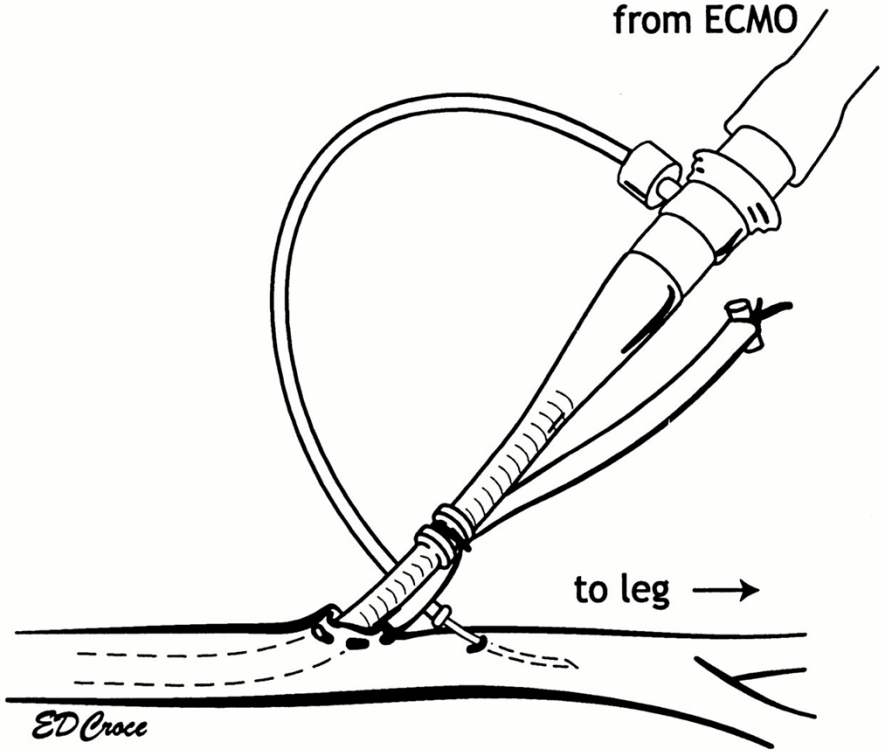
The ECMO circuit:
Central Unit Controller



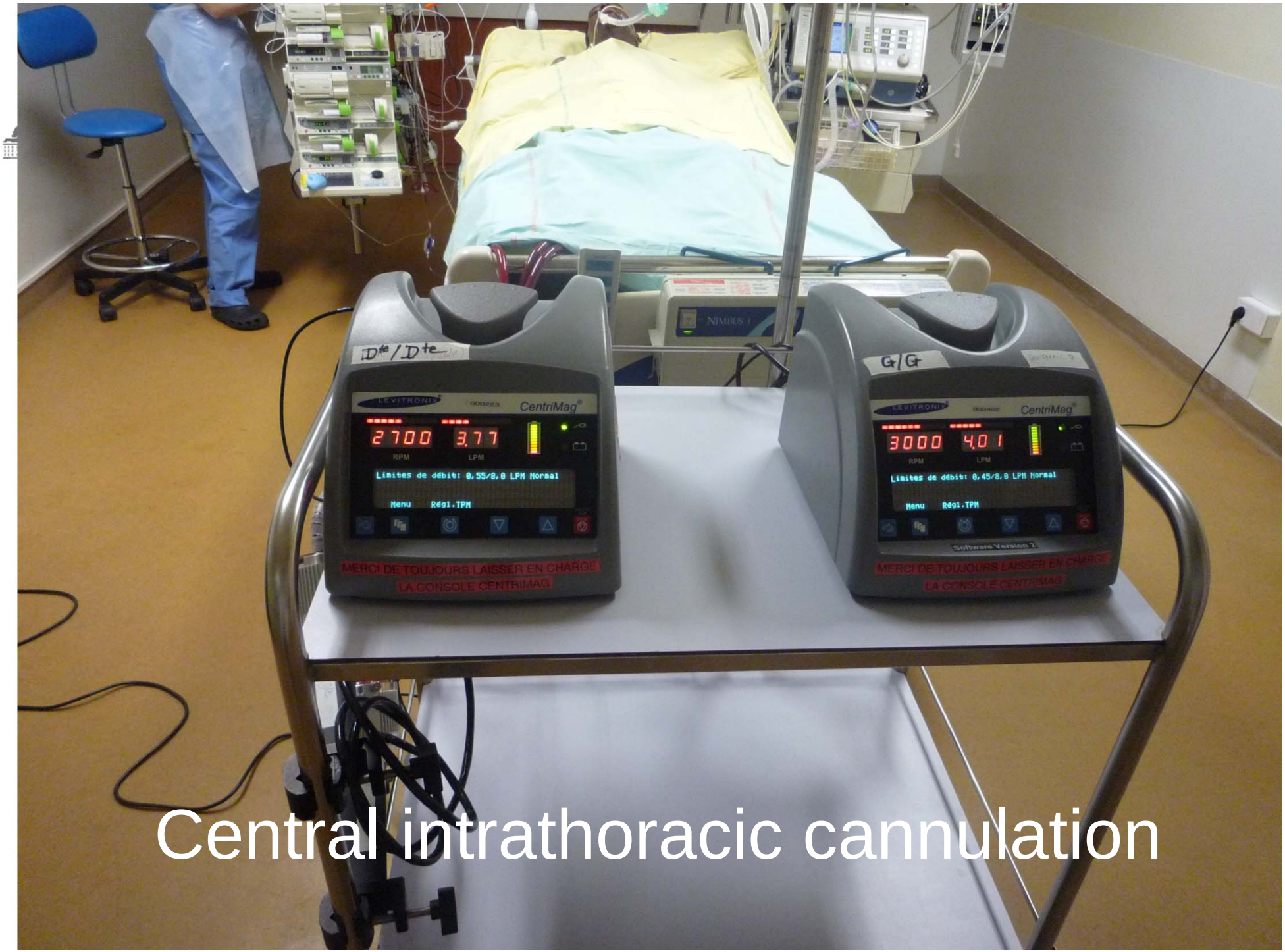
Peripheral cannulation








Central intrathoracic cannulation

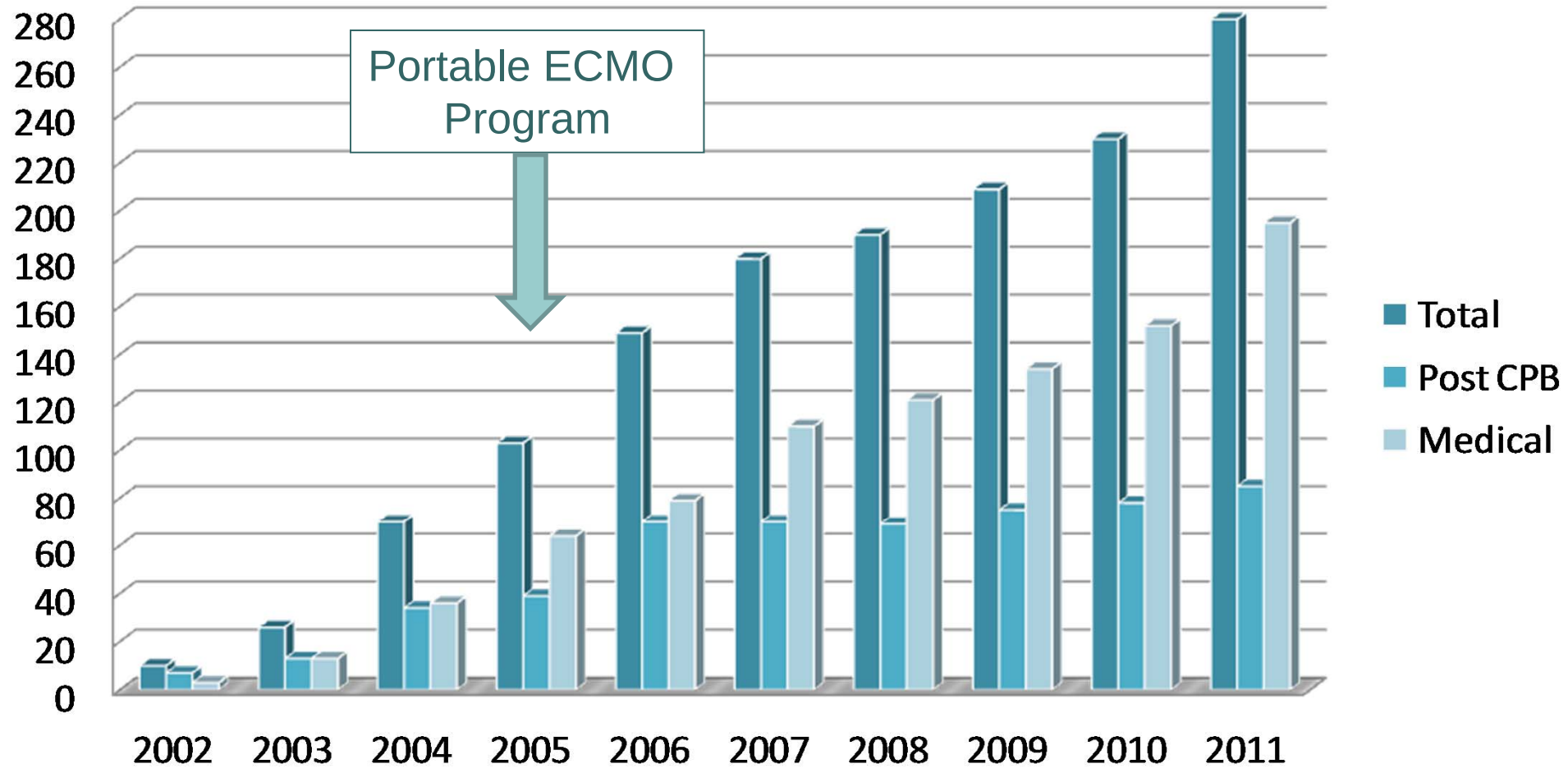


Central intrathoracic cannulation

Results of ECMO…

In the context of acute refractory cardiac failure

ECMO program at La Pitié, Paris



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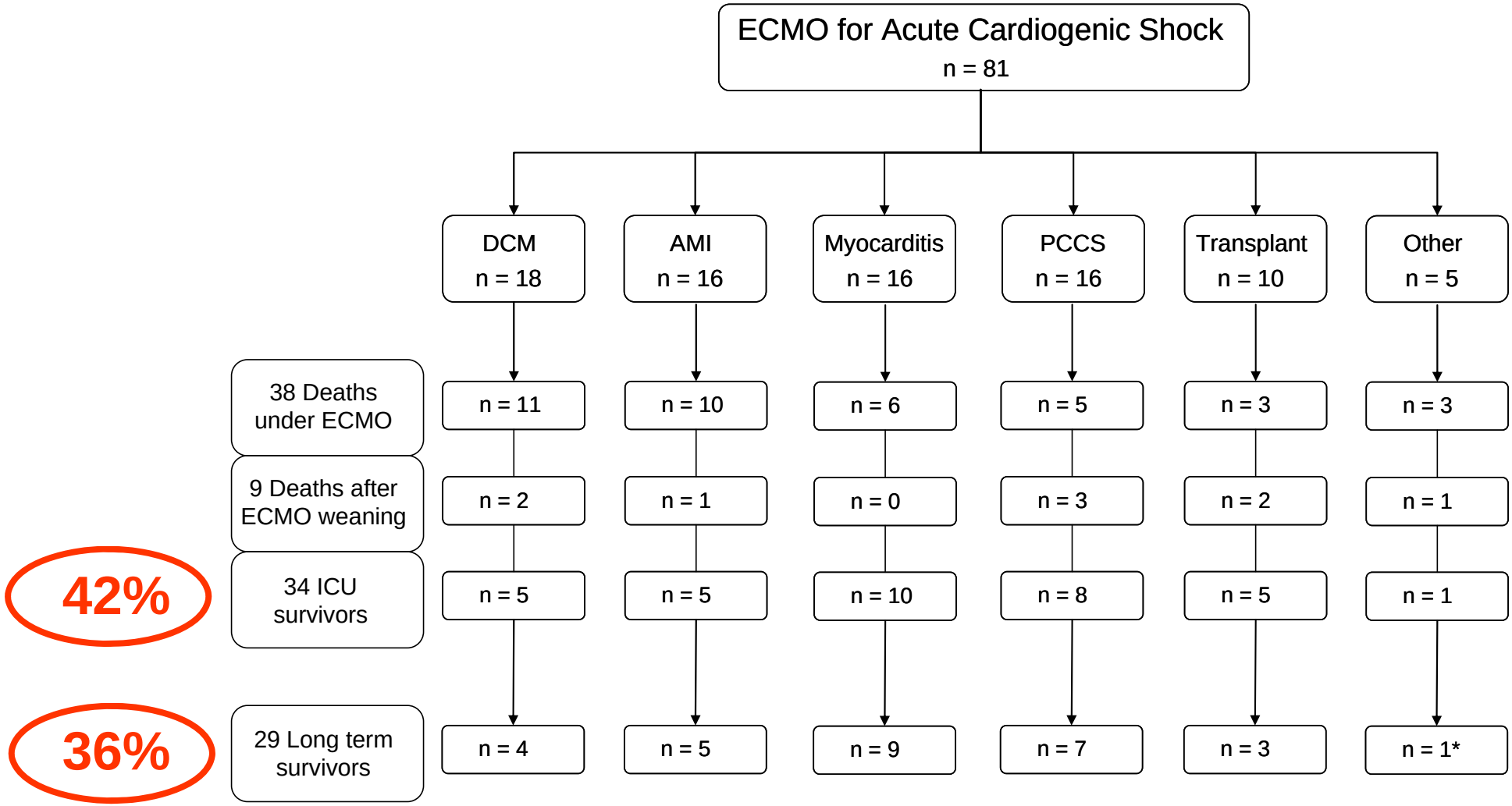
Crit Care Med 2008 Vol. 36, No. 5



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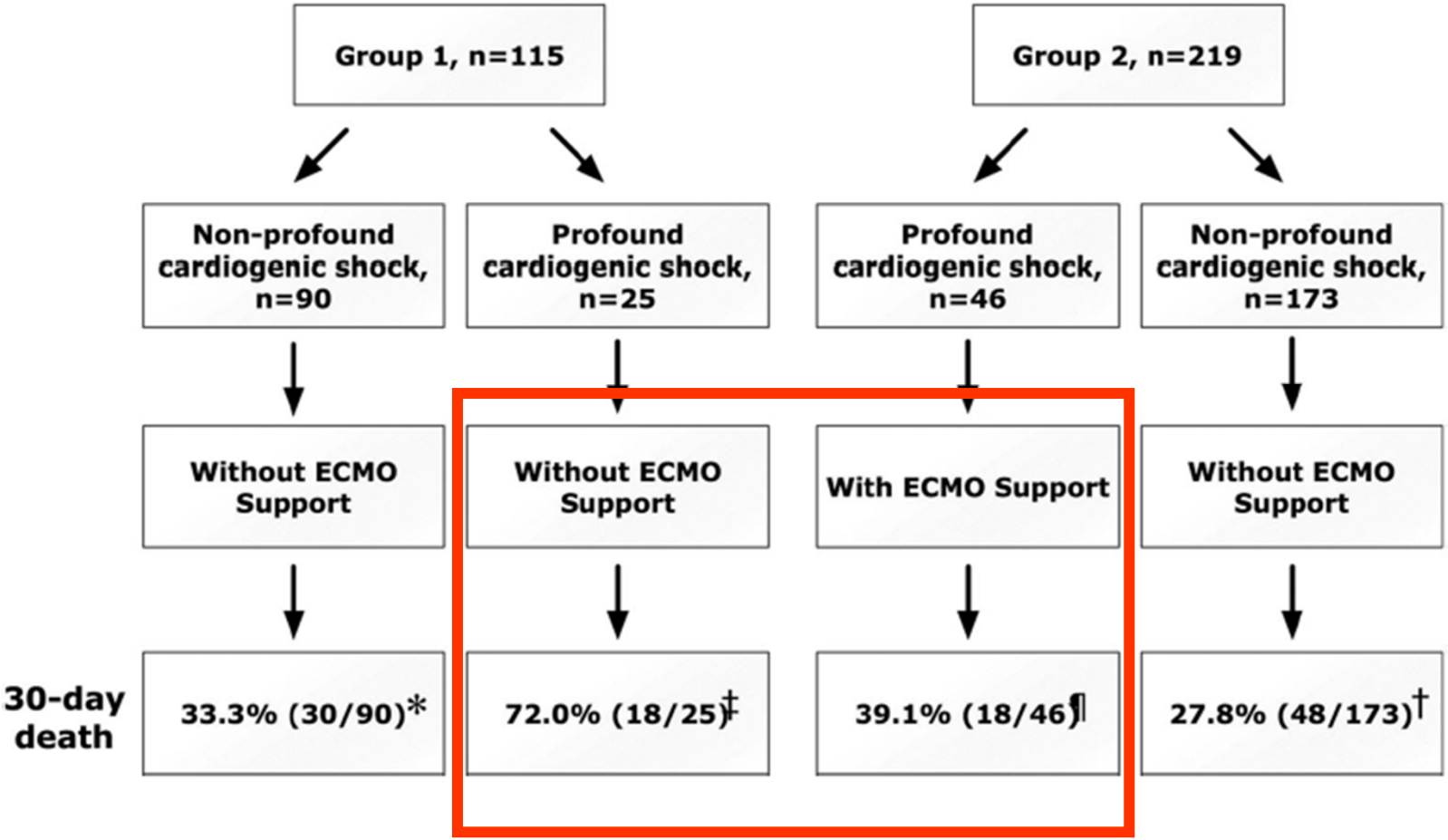
Independent predictors of ICU death

Early extracorporeal membrane oxygenator-assisted primary percutaneous coronary intervention improved 30-day clinical outcomes in patients with ST-segment elevation myocardial infarction complicated with profound cardiogenic shock

Jiunn-Jye Sheu, MD; Tzu-Hsien Tsai, MD; Fan-Yen Lee, MD; Hsiu-Yu Fang, MD; Cheuk-Kwan Sun, MD, PhD; Steve Leu, PhD; Cheng-Hsu Yang, MD; Shyh-Ming Chen, MD; Chi-Ling Hang, MD; Yuan-Kai Hsieh, MD; Chien-Jen Chen, MD; Chiung-Jen Wu, MD; Hon-Kan Yip, MD

Crit Care Med 2010; 38:1810–1817



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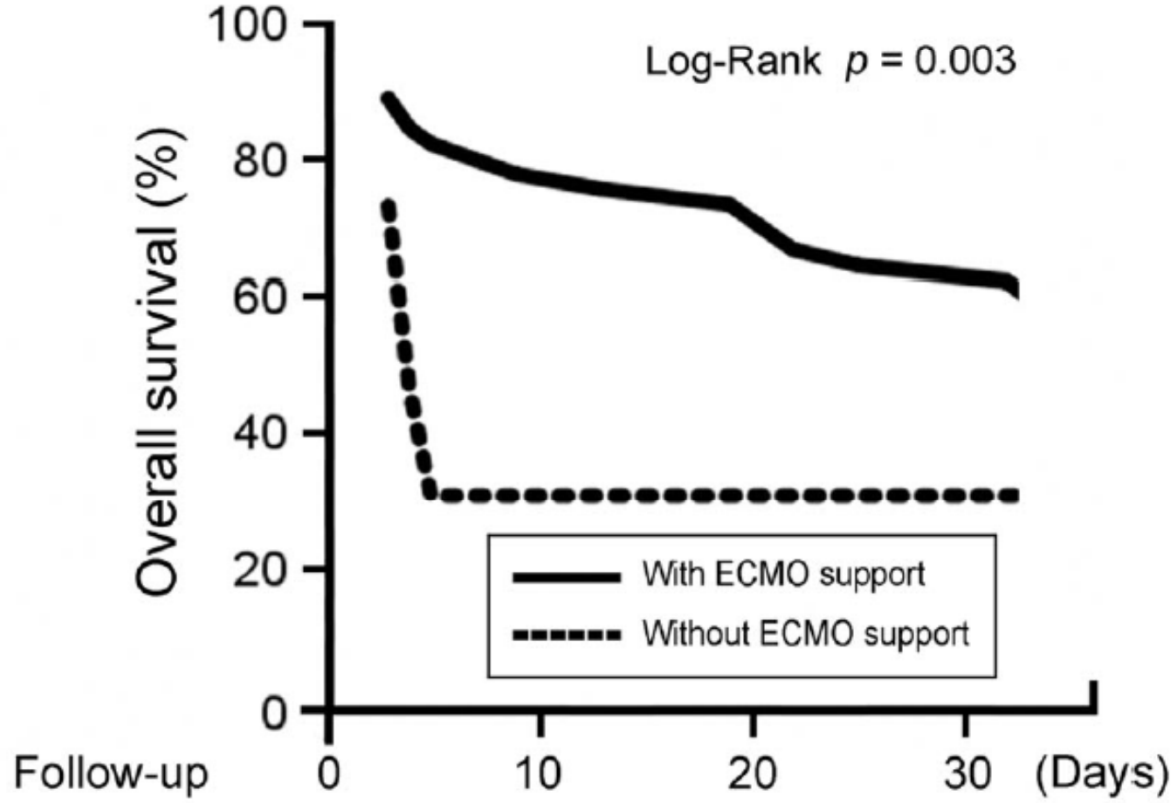
Crit Care Med 2010; 38:1810–1817

Variables	Without ECMO (n = 25)	With ECMO (n = 46)	*p*
Age, yrs	67.2 ± 11.1	65.1 ± 10.6	.436
Infarction location by ECG			.002
Anterior wall infarction	44.0% (11)	80.4% (37)	
No anterior wall infarction	56.0% (14)	19.6% (9)	
Peak CPK level, IU/L	7051 ± 6482	8867 ± 7888	.316
Angiographic finding of obstructive disease			
Left main trunk	12.0% (3)	28.3% (13)	.117
Left anterior descending artery	80.0% (20)	87.0% (40)	.439
Left circumflex artery	56.0% (14)	60.9% (28)	.690
Right coronary artery	84.0% (21)	65.2% (30)	.093
Multiple vessel disease	76.0% (19)	82.6% (38)	.504
Systolic blood pressure, mm Hg[a]	69.5 ± 6.1	70.3 ± 5.8	.786
Intra-aortic balloon pump support	100% (25)	100% (46)	1.0
ECMO support	0% (0)	100% (46)	<.0001
Mechanical ventilator support	76.0% (19)	84.8% (39)	.361
Final TIMI-3 flow	56.0% (14)	80.4% (37)	.029

Early extracorporeal membrane oxygenator-assisted primary percutaneous coronary intervention improved 30-day clinical outcomes in patients with ST-segment elevation myocardial infarction complicated with profound cardiogenic shock

Jiunn-Jye Sheu, MD; Tzu-Hsien Tsai, MD; Fan-Yen Lee, MD; Hsiu-Yu Fang, MD; Cheuk-Kwan Sun, MD, PhD; Steve Leu, PhD; Cheng-Hsu Yang, MD; Shyh-Ming Chen, MD; Chi-Ling Hang, MD; Yuan-Kai Hsieh, MD; Chien-Jen Chen, MD; Chiung-Jen Wu, MD; Hon-Kan Yip, MD

Crit Care Med 2010; 38:1810–1817



At risk (n)	With ECMO	46	32	31	28
	Without ECMO	25	7	7	7

ECMO vs. BiVAD?

Paracorporeal pulsatile biventricular assist device versus extracorporal membrane oxygenation–extracorporal life support in adult fulminant myocarditis

Olivier N. Pages, MD,[a] Stéphane Aubert, MD,[a] Alain Combes, MD, PhD,[b] Charles E. Luyt, MD,[b] Alain Pavie, MD, PhD,[a] Philippe Léger, MD,[c] Iradj Gandjbakhch, MD, PhD,[a] and Pascal Leprince, MD, PhD[a]

J Thorac Cardiovasc Surg 2009;137:194-7

Difference of effectivness in Fulminant Myocarditis?

	BIVAD	ECMO
	n=5	n=6
✓ *Age*	32 ±2	40 ±4
✓ **LVEF *(%)***	**33 ±8**	**18 ±4**
✓ *Creat(micromoL/L)*	183 ±65	127 ±27
✓ **T Bili *(micromoL/L)***	**14 ±3**	**37 ±11**
✓ ***Apache II*:**	**11 ±9**	**24 ±18**

P = ns

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J Thorac Cardiovasc Surg 2009;137:194-7

RESULTS

	BIVAD	ECMO
Output *(L/min)*	**5,4** ±0,7	**4,8** ±0,4
Duration *(days)*	**21** ±5	**13** ±4
Death	**20% (4/5)**	**16,6% (5/6)**
PRBC:	**22 ±5**	**7 ±4** ***(p=0,03)***

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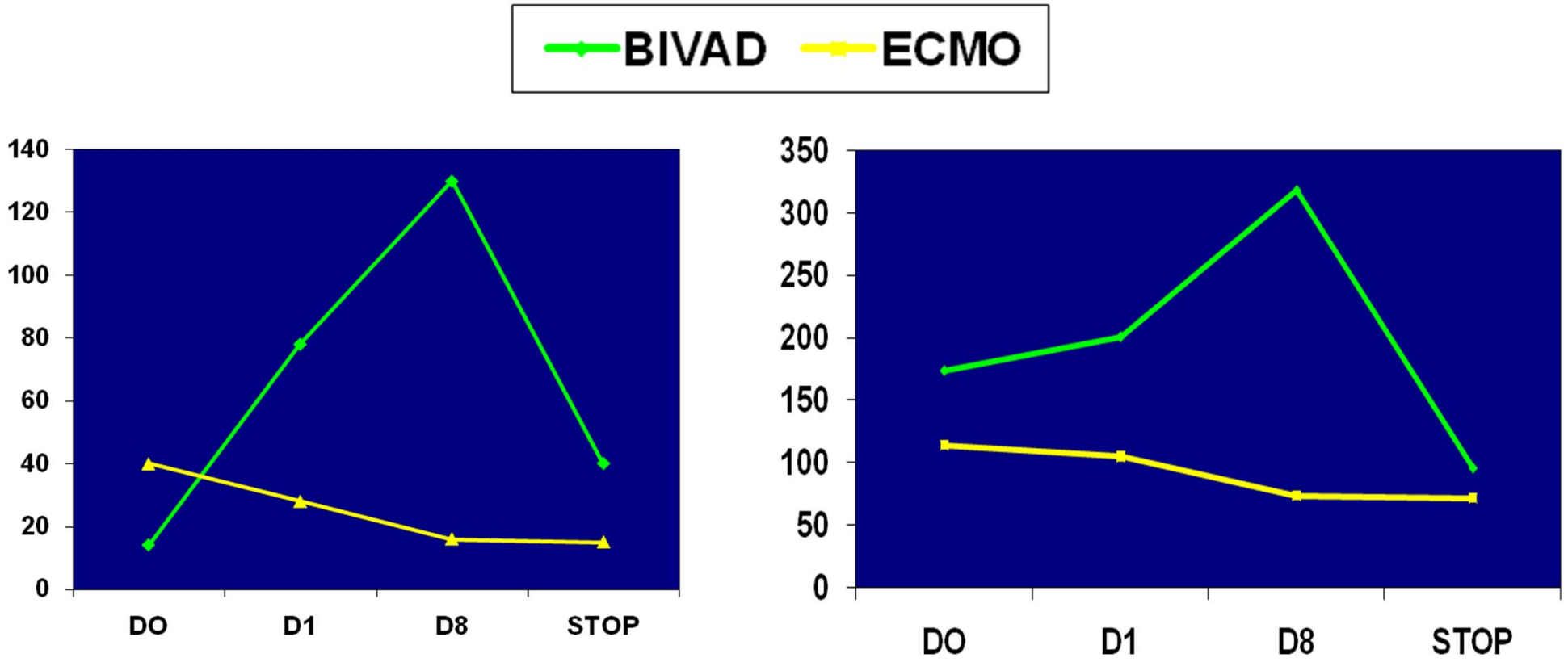

T bilirubin μmol/dl

Creatinine μmol/dl

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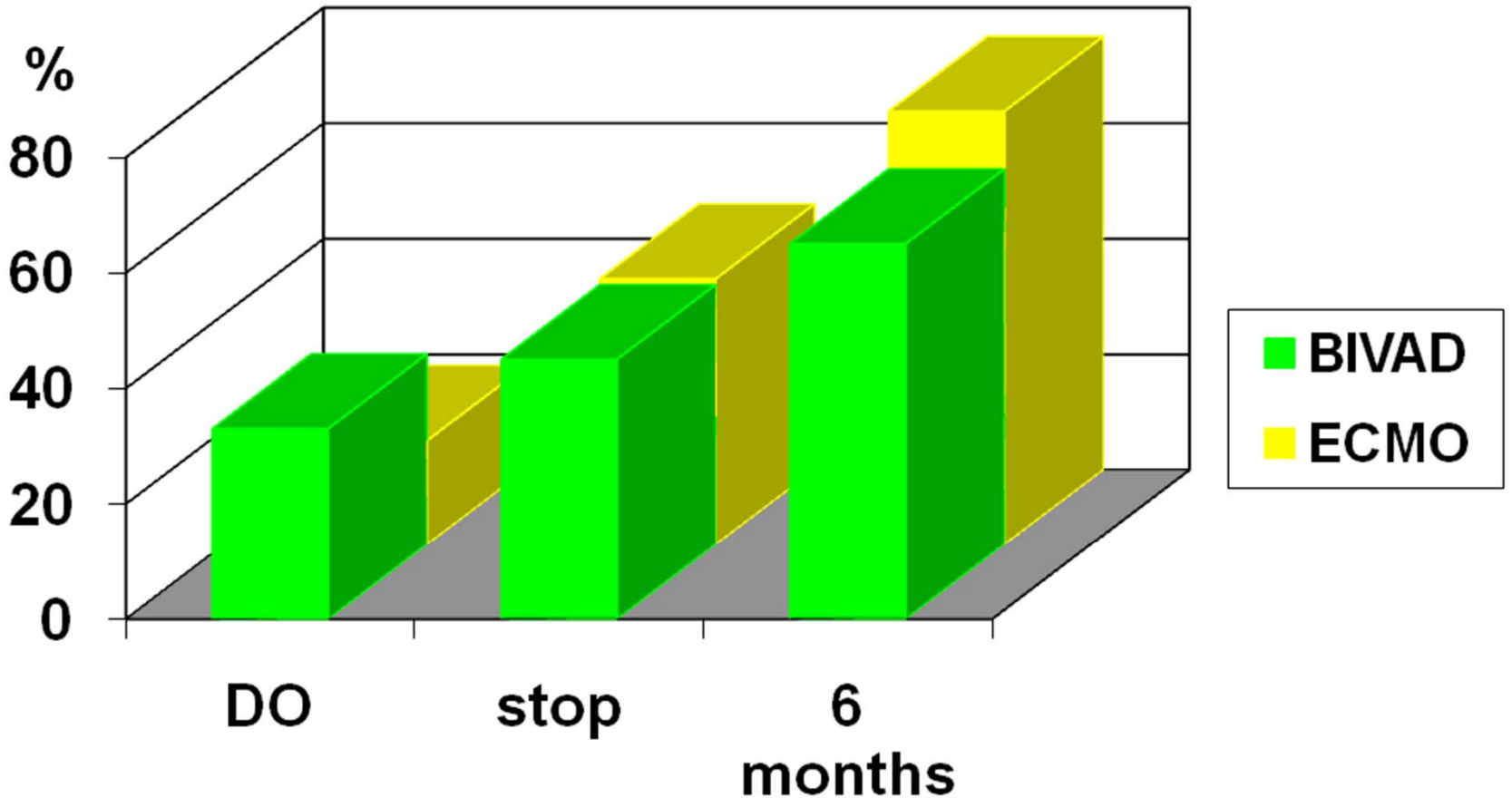

ECMO for fulminant myocarditis

Outcomes, long-term quality of life, and psychologic assessment of fulminant myocarditis patients rescued by mechanical circulatory support

Mariana Mirabel, MD; Charles-Edouard Luyt, MD, PhD; Pascal Leprince, MD, PhD; Jean-Louis Trouillet, MD; Philippe Léger, MD; Alain Pavie, MD; Jean Chastre, MD; Alain Combes, MD, PhD

Crit Care Med 2011 Vol. 39, No. 5

- 2003 - 2009
- 41 patients refractory cardiogenic shock due to fulminant myocarditis
  - Mean age 38±12 years
  - 66%, women
- Mechanical assistance
  - Thoratec BiVAD (n=6) or
  - ECMO (n=35)

Outcomes, long-term quality of life, and psychologic assessment of fulminant myocarditis patients rescued by mechanical circulatory support

Mariana Mirabel, MD; Charles-Edouard Luyt, MD, PhD; Pascal Leprince, MD, PhD;
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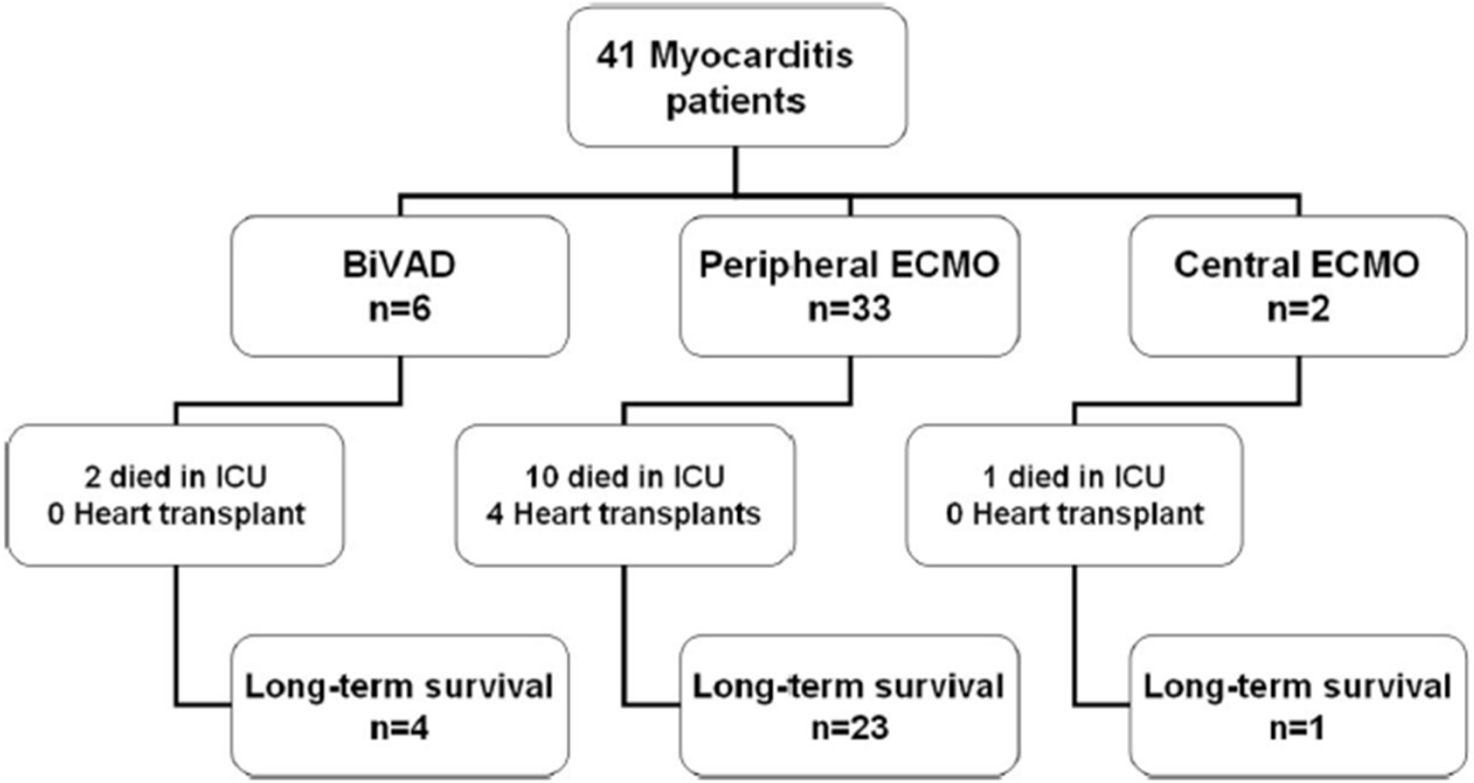
Crit Care Med 2011 Vol. 39, No. 5



Long term survival: 68%, 4 (10%) patients had heart transplantation
Independent predictors of ICU death determined at admission:
SAPS II >56 (OR, 10.23) and troponin Ic >12 g/L (OR, 7.49)

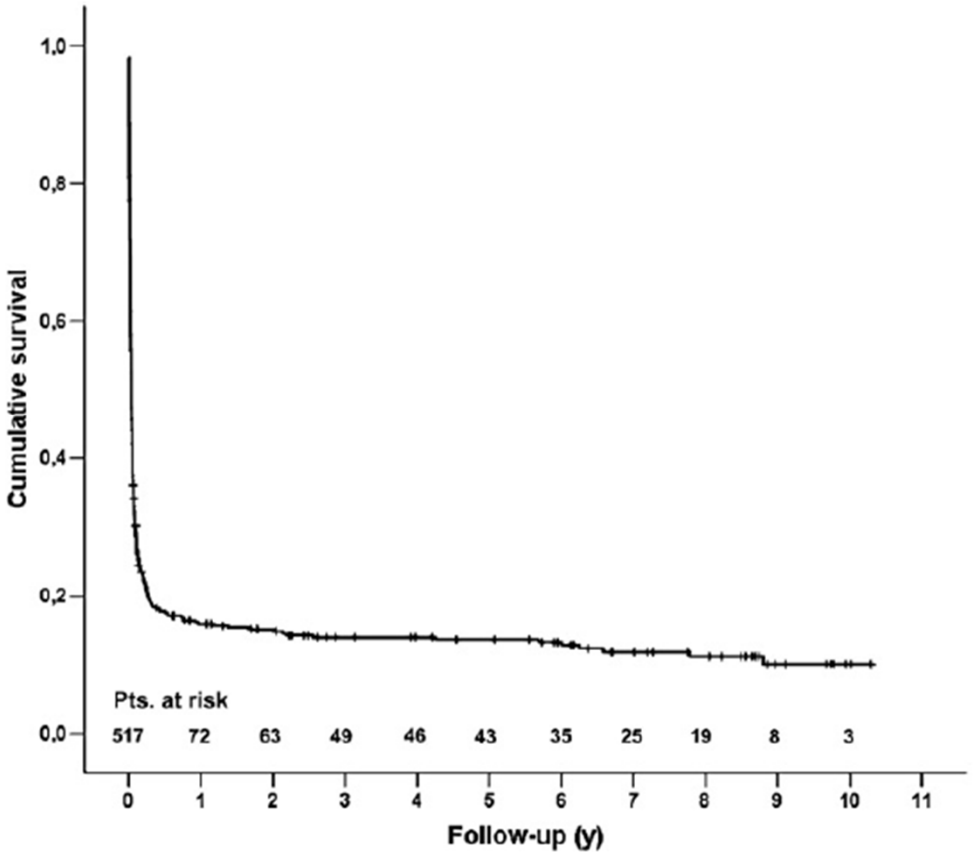
ECMO after complicated cardiac surgery

Early and late outcomes of 517 consecutive adult patients treated with extracorporeal membrane oxygenation for refractory postcardiotomy cardiogenic shock

Ardawan Julian Rastan, MD, PhD, Andreas Dege, MD, Matthias Mohr, MD, Nicolas Doll, MD, PhD, Volkmar Falk, MD, PhD, Thomas Walther, MD, PhD, and Friedrich Wilhelm Mohr, MD, PhD

J Thorac Cardiovasc Surg 2010;139:302-311

- 517 adult patients
  - CABG (37.4%)
  - Isolated valve surgery (14.3%)
  - CABG plus valve surgery (16.8%)
  - Organ transplantation (6.5%)
  - Other combinations (25.0%)
- Thoracic (61%) vs. Extrathoracic (39%)
- Hospital outcomes
  - 63% weaned, 24% discharged alive
- Predictors of hospital death
  - Age>70, diabetes, PreOp renal failure
  - Obesity, Euroscore >20%, Lactate >4



After heart transplantation

Predictive risk factors for primary graft failure requiring temporary extra-corporeal membrane oxygenation support after cardiac transplantation in adults☆

Cosimo D'Alessandro[a,*], Jean-Louis Golmard[b], Eleodoro Barreda[a], Mojgan Laali[a], Ralouka Makris[c], Charles-Edouard Luyt[d], Pascal Leprince[a], Alain Pavie[a]

European Journal of Cardio-thoracic Surgery 40 (2011) 962–970

Objective: Primary graft failure (PGF) is a major risk factor for death after heart transplantation. We investigated the predictive risk factors for severe PGF that require extra-corporeal membrane oxygenation (ECMO) circulatory support after cardiac transplantation. **Methods:** Between January 2003 and December 2008, 402 adult patients underwent isolated cardiac transplantation at our institution. PGF was defined as the need for ECMO support in the immediate postoperative period. Thirty-three recipient and 37 donor variables were analyzed for the risk of PGF occurrence. **Results:** PGF occurred in 91 (23%) patients. Predictive risk factors for PGF occurrence were, in the recipient, being aged >60 years (odds ratio (OR) 2.11, $p = 0.01$) and preoperative mechanical circulatory support (MCS) (OR 2.65, $p = 0.01$); in the donor, they were mean norepinephrine dose (OR 2.02, $p < 0.01$), trauma as the cause of death (OR 2.45, $p < 0.01$), left-ventricle ejection fraction (LVEF) <55% (OR 2.72, $p = 0.02$), and the ischemic time (OR 1.01, $p < 0.01$). Weaning and discharge rates after ECMO support for PGF were, respectively, 60% (55/91 patients) and 46% (42/91 patients). The absence of PGF was correlated with improved long-term survival: 78% at 1 year and 71% at 5 years without PGF versus 39% at 1 year and 34% at 5 years with PGF ($p < 0.01$). Surviving patients treated with ECMO for PGF have similar conditional 1-year survival rates as non-PGF patients: 93% at 3 years and 91% at 5 years without PGF versus 93% at 3 years and 84% at 5 years with PGF ($p = 0.46$, NS). **Conclusions:** Occurrence of PGF is a multifactorial event that depends on both donor and recipient profiles. ECMO support is a reliable treatment for severe PGF; furthermore, surviving patients treated with ECMO have the same 1-year conditional survival rates as patients not having suffered a PGF.

ECMO after cardiac arrest

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

Yih-Sharng Chen*, Jou-Wei Lin*, Hsi-Yu Yu, Wen-Je Ko, Jih-Shu in Jerng, Wei-Tien Chang, Wen-Jone Chen, Shu-Chien Huang, Nai-Hsin Chi, Chih-Hsien Wang, Li-Chin Chen, Pi-Ru Tsai, Sheoi-Shen Wang, Juey-Jen Hwang, Fang-Yue Lin

Lancet 2008; 372: 554-61

- 3-year prospective observational study
- ECMO for 59 patients
  - Aged 18–75 years
  - With *witnessed in-hospital cardiac arrest* of cardiac origin
  - Undergoing CPR of more than 10 min
- Compared with patients
  - Receiving conventional CPR
- Matching process based
  - On a propensity-score

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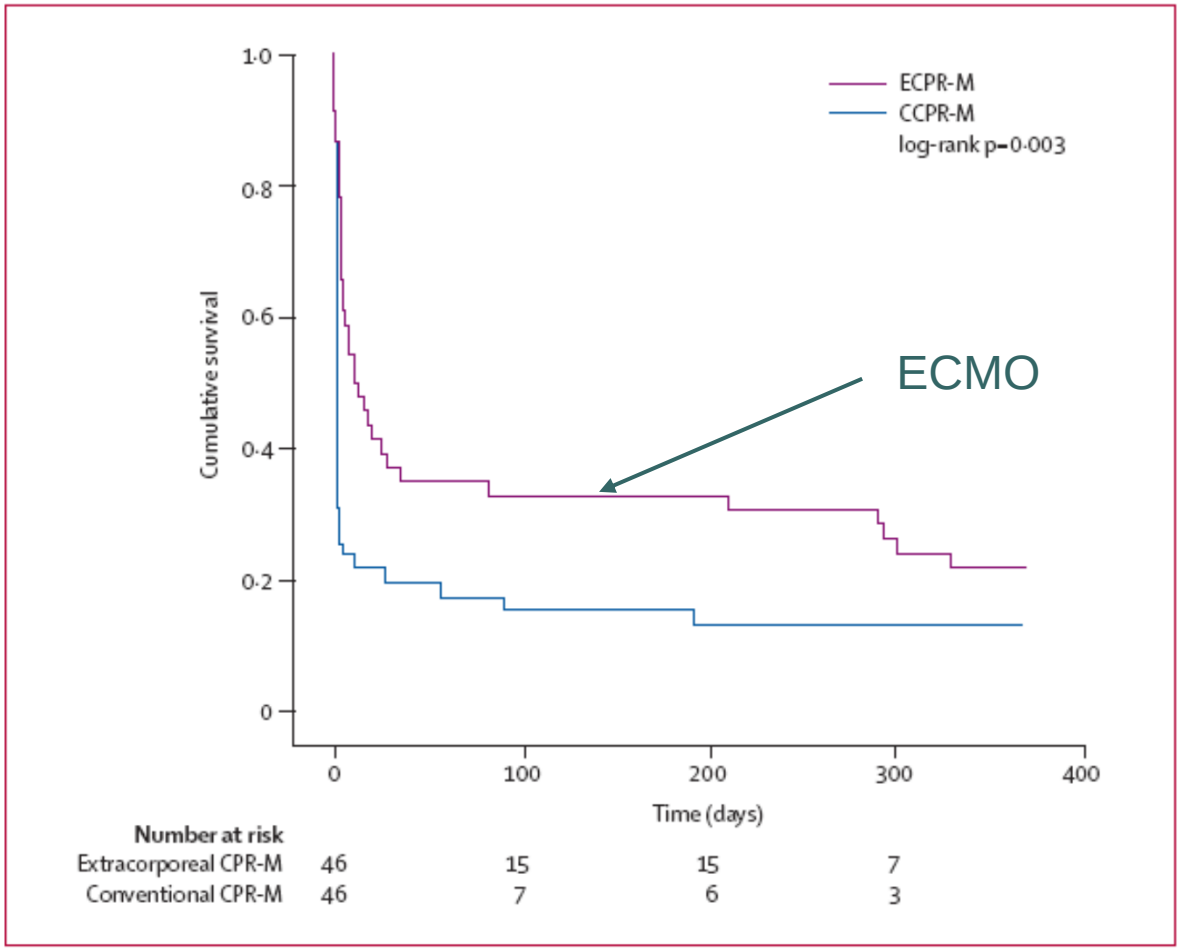

Figure 3: Kaplan-Meier plot of the survival curves in the extracorporeal CPR-M and conventional CPR-M groups for 1 year

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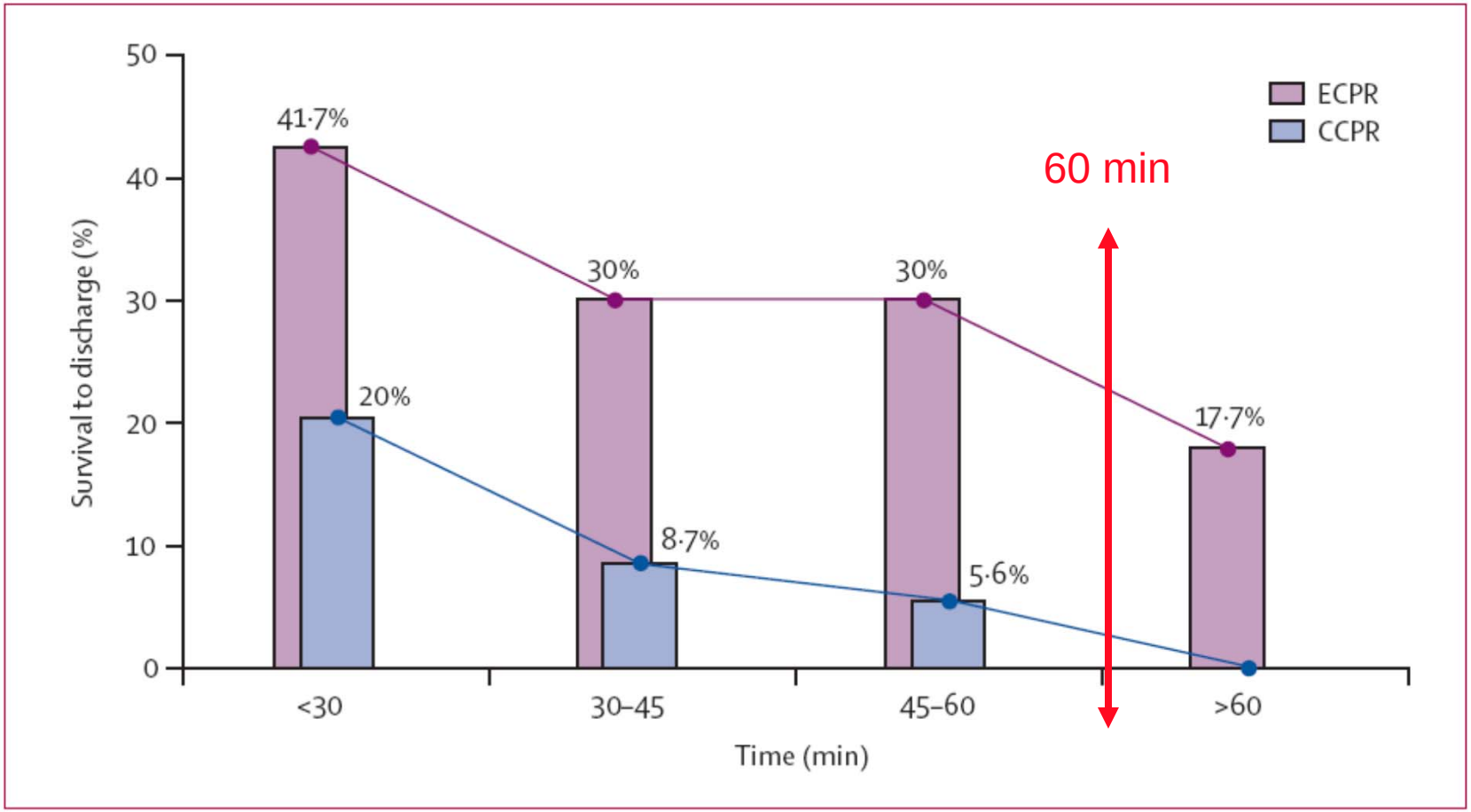


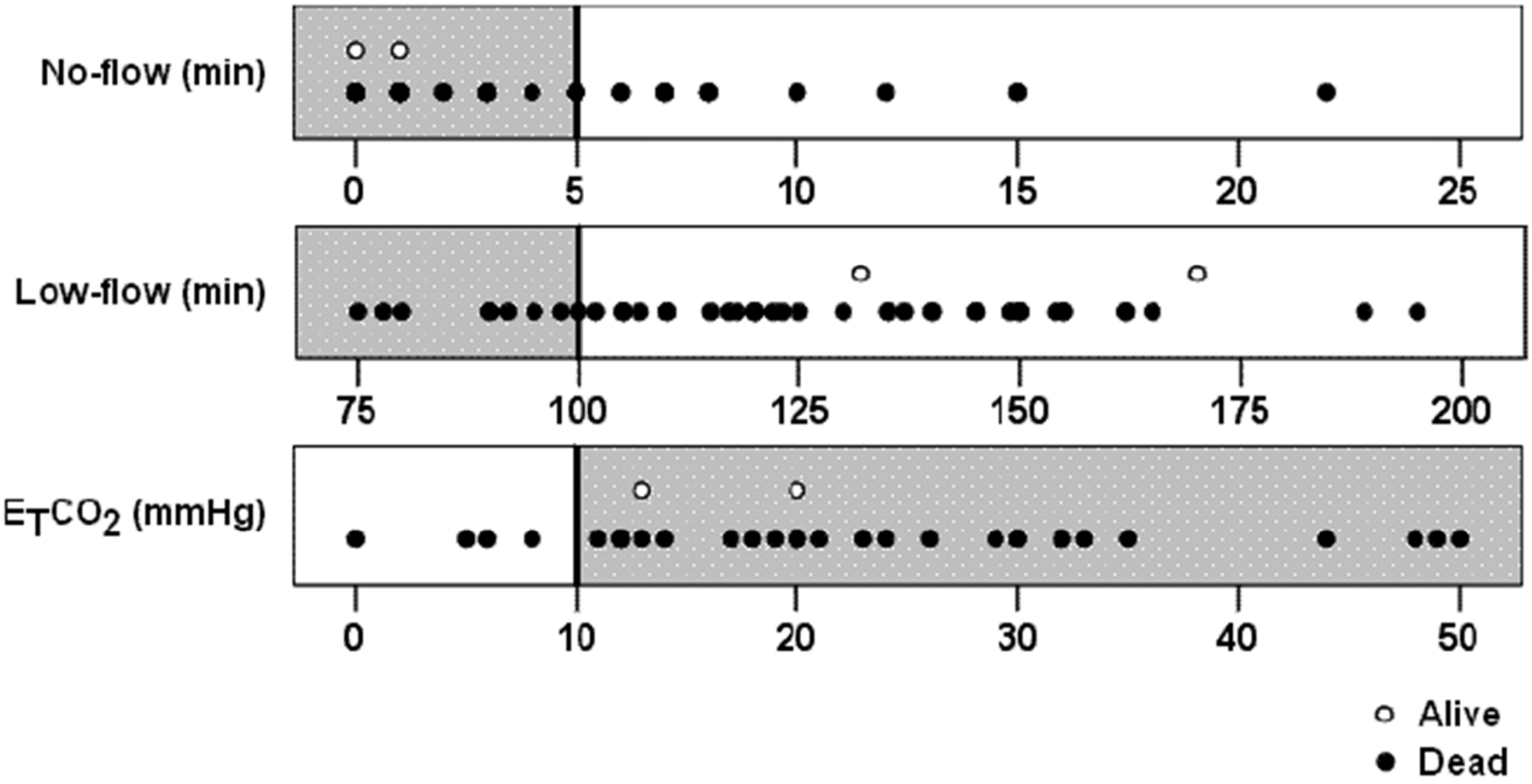
Figure 1: **Relation between CPR duration and the survival rate to discharge**
ECPR=extracorporeal CPR. CCPR=conventional CPR.

Extracorporeal life support following out-of-hospital refractory cardiac arrest

Morgan Le Guen[1], Armelle Nicolas-Robin[1], Serge Carreira[1], Mathieu Raux[1], Pascal Leprince[2], Bruno Riou[3*], Olivier Langeron[1]

CRITICAL CARE

Critical Care 2011, **15**:R29



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CRITICAL CARE

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Abstract

Introduction: Extracorporeal life support (ECLS) has recently shown encouraging results in the resuscitation of in-hospital (IH) refractory cardiac arrest. We assessed the use of ECLS following out-of-hospital (OH) refractory cardiac arrest.

Methods: We evaluated 51 consecutive patients who experienced witnessed OH refractory cardiac arrest and received automated chest compression and ECLS upon arrival in the hospital. Patients with preexisting severe hypothermia who experienced IH cardiac arrest were excluded. A femorofemoral ECLS was set up on admission to the hospital by a mobile cardiothoracic surgical team.

Results: Fifty-one patients were included (mean age, 42 ± 15 years). The median delays from cardiac arrest to cardiopulmonary resuscitation and ECLS were, respectively, 3 minutes (25th to 75th interquartile range, 1 to 7) and 120 minutes (25th to 75th interquartile range, 102-149). Initial rhythm was ventricular fibrillation in 32 patients (63%), asystole in 15 patients (29%) patients and pulseless rhythm in 4 patients (8%). ECLS failed in 9 patients (18%). Only two patients (4%) (95% confidence interval, 1% to 13%) were alive at day 28 with a favourable neurological outcome. There was a significant correlation ($r = 0.36$, $P = 0.01$) between blood lactate and delay between cardiac arrest and onset of ECLS, but not with arterial pH or blood potassium level. Deaths were the consequence of multiorgan failure ($n = 43$; 47%), brain death ($n = 10$; 20%) and refractory hemorrhagic shock ($n = 7$; 14%), and most patients ($n = 46$; 90%) died within 48 hours.

Conclusions: This poor outcome suggests that the use of ECLS should be more restricted following OH refractory cardiac arrest.

Extracorporeal life support following out-of-hospital refractory cardiac arrest

Morgan Le Guen[1], Armelle Nicolas-Robin[1], Serge Carreira[1], Mathieu Raux[1], Pascal Leprince[2], Bruno Riou[3*], Olivier Langeron[1]

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This poor outcome suggests that the use of ECLS should be more restricted following OH refractory cardiac arrest

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The Mobile ECMO rescue team at La Pitié

European Heart Journal
doi:10.1093/eurheartj/ehs081

CLINICAL RESEARCH

Emergency circulatory support in refractory cardiogenic shock patients in remote institutions: a pilot study (the cardiac-RESCUE program)

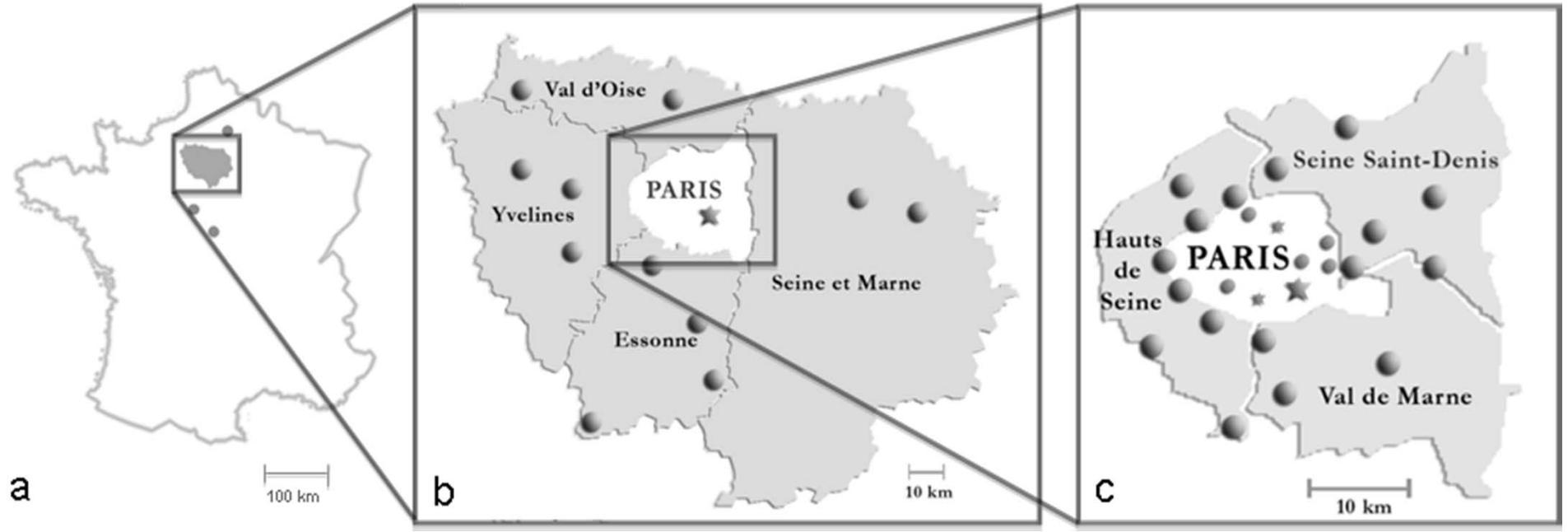
Sylvain Beurtheret[1*†], Pierre Mordant[1†], Xavier Paoletti[2], Eloi Marijon[3,4,5], David S. Celermajer[6], Philippe Léger[1], Alain Pavie[1], Alain Combes[7], and Pascal Leprince[1]

The Mobile ECMO rescue team at La Pitié:

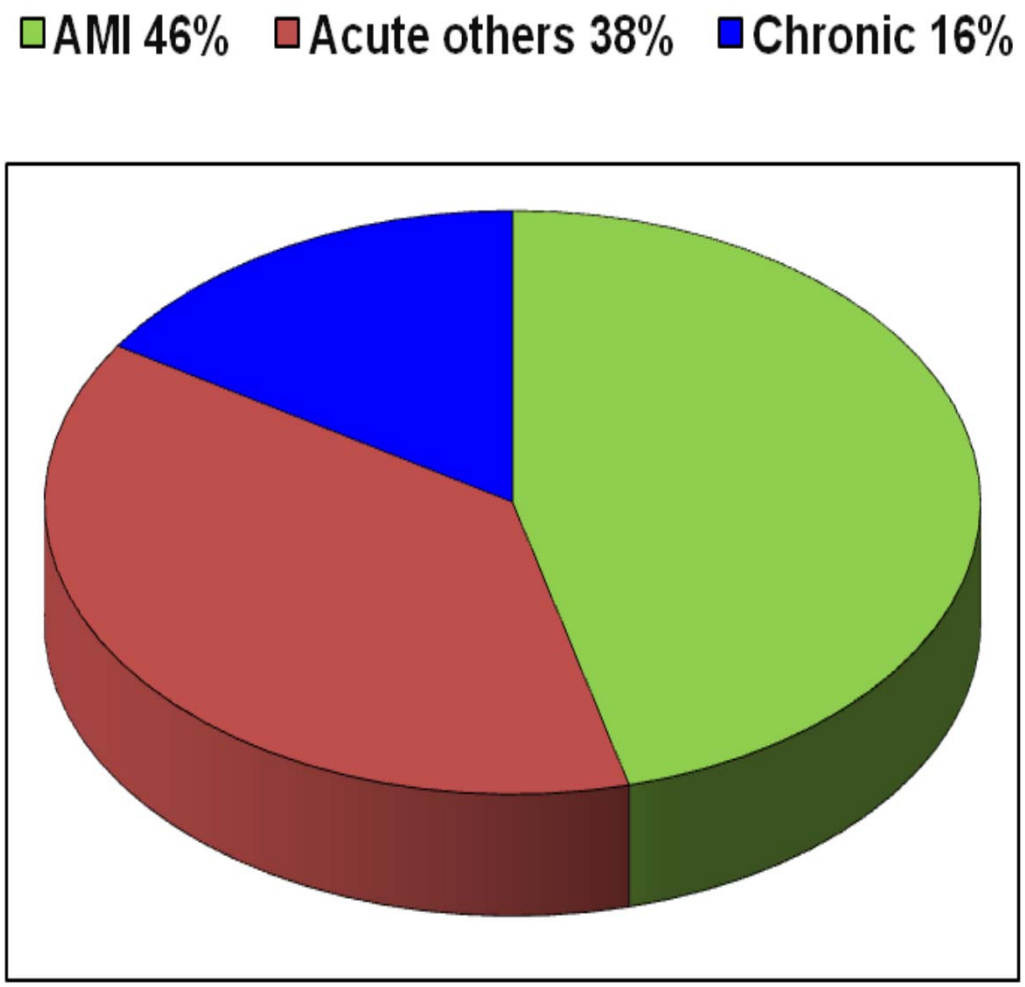
2005-2009 experience for refractory cardiac failure…

The mobile ECMO rescue team

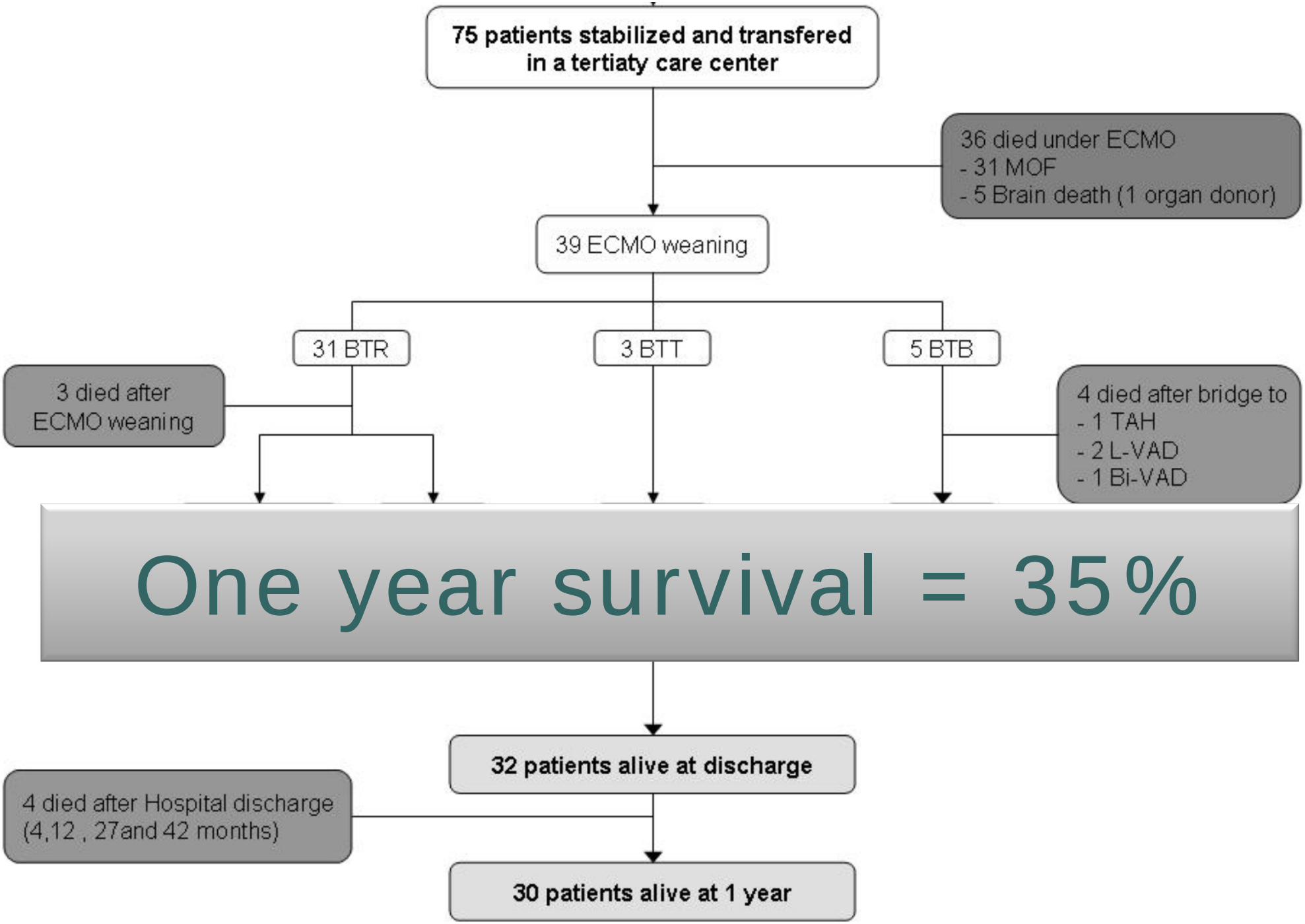
Centres	Patients N (%)	Median distance (range), Km	Median time (range), min
Paris urban agglomeration (7 centres)	25 (29)	4 (4-18)	4 (4-26)
Paris region (26 centres)	54 (62)	13 (4-53)	19 (7-46)
Outside Paris region (4 centres)	8 (9)	88 (87-243)	60 (64-134)
Total (37 centres)	87	17 (4-243)	20 (4-134)



The mobile ECMO rescue team



- 87 patients 2005-2009
  - 57 males, 28 females
  - Mean age: 46.1 [13-76]
- Etiologies
  - AMI 46%
  - Chronic DCM 16%
  - Other Acute HF= 38%
    - Myocarditis 14
    - Intoxication 5
    - Rythmic 4
    - Post-Partum 3
    - Hypoxemia 2
    - Takotsubo 3
    - Anaphylactic 1
    - Septic 1


75 patients stabilized and transfered in a tertiaty care center
36 died under ECMO
- 31 MOF
- 5 Brain death (1 organ donor)
39 ECMO weaning
31 BTR
3 BTT
5 BTB
3 died after ECMO weaning
4 died after bridge to
- 1 TAH
- 2 L-VAD
- 1 Bi-VAD
One year survival = 35%
32 patients alive at discharge
4 died after Hospital discharge (4,12 , 27and 42 months)
30 patients alive at 1 year

Comparison with in-house patients

- In the multivariate analysis
  - Adjusted for the inotrope score
  - Stratified for diagnosis and CPR at ECMO start
- Mortality at hospital discharge in the Cardiac-RESCUE Program group was not statistically different between groups
  - OR 1.48, 95% CI 0.72–3.00, p=0.29

Conclusion

- Early and rapid recognition of refractory cardiogenic shock
  - Acute MI, Myocarditis, Cardiotoxic drugs overdose…
- Emergency transfer to an experienced center
  - **VA-ECMO** is the first line therapy, institution before MOF
  - Mobile Cardiac Assistance Unit for highly unstable patients
  - ECMO as a bridge to… whatever seems reasonable…
- Outcomes: 20-70% of long-term survivors
  - Poor outcomes if MOF at the time of ECMO institution
- Other devices?
  - Less evidence to date

La Pitié: 1612 to 2012…