Percutaneous ventricular cardiac assist device in cardiogenic shock

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Background

- Mortality in patients with cardiogenic shock remains about 50% despite early PCI
- Mechanical support devices might improve prognosis
- Problems: costs, experience needed, evidence

Support devices in cardiogenic shock

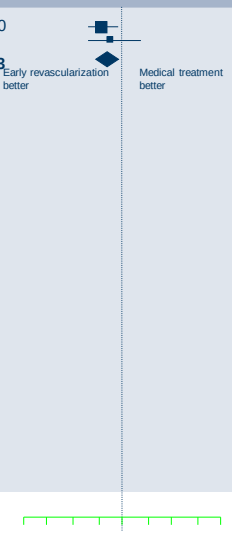
- Which patient ?
- When ?
- Which device ?

Pros and cons of mechanical support devices

- Pro: hemodynamic improvement, initial stabilization
- Con: invasive nature of the devices, complications, costs, lack of outcome data

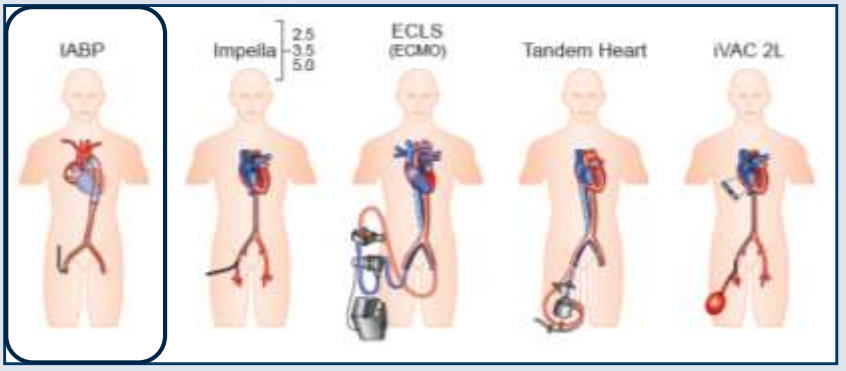
Randomized Trials in Cardiogenic Shock

Trial	Follow-up	n/N	n/N	Relative Risk 95% CI	Relative Risk 95% CI
Revascularization (PCI/CABG)					
SHOCK	1 year	81/152	100/150		0.72 (0.54;0.95)
SMASH	30 days	22/32	18/23		0.87 (0.66;1.29)
Total		**103/184**	**118/173**		**0.82 (0.69;0.97)**



Thiele et al. Eur Heart J 2015;36:1223-1230

Currently Available Percutaneous Devices



Thiele et al. Eur Heart J 2015;36:1223-1230

IABP for cardiogenic shock

History:

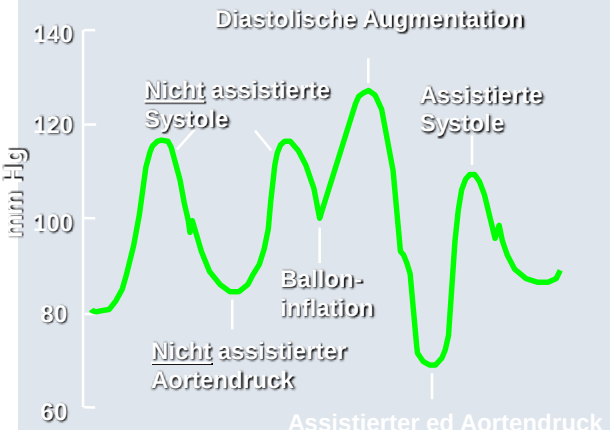
1962 **Animal studies**
Moulopoulos et al, Am Heart J 1962;63:669-675

1968 **First in man experience in shock**
Kantrowitz et al, JAMA 1968;203:135-140

1973 **Postive hemodynamic effects in shock, No mortality benefit**
Scheidt et al, NEJM 1973;288:979-984

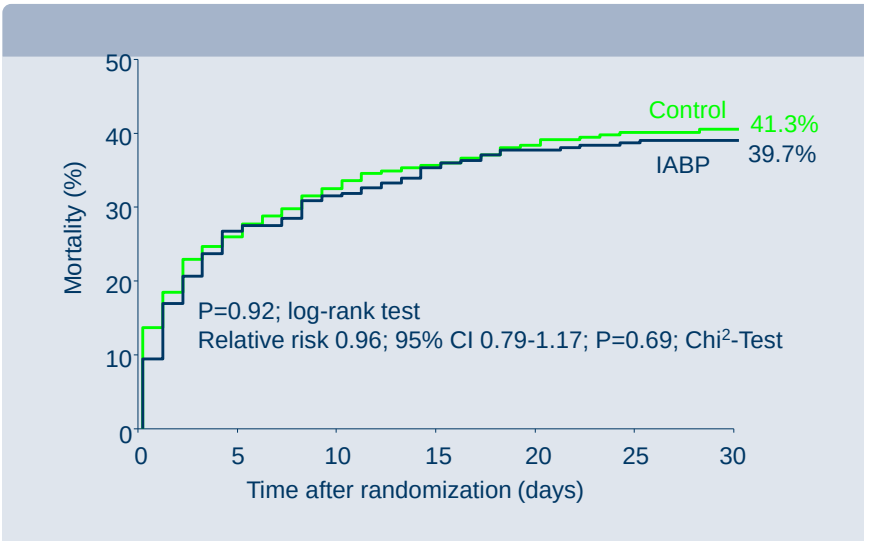
> 40 years **> 1 Mill. Patients, low complication rate Benchmark Registry**
Ferguson et al, JACC 2001;38:1456-1462

IABP – Mode of action



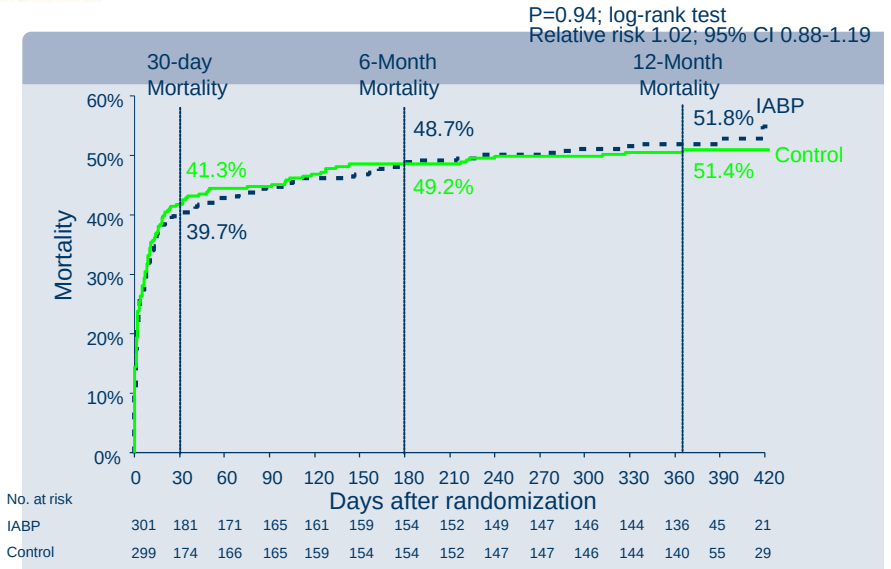
Improvement of coronary perfusion
After load reduction
Reduction of O_2-consumption ↓

Primary Study Endpoint (30-Day Mortality)



Thiele, Zeymer et al. NEJM 2012;367:1287-1296

Mortality 12-Month Follow-up



Thiele. Zeymer et al. Lancet 2013;382:1638-1645

ESC Revascularization Guidelines 2014

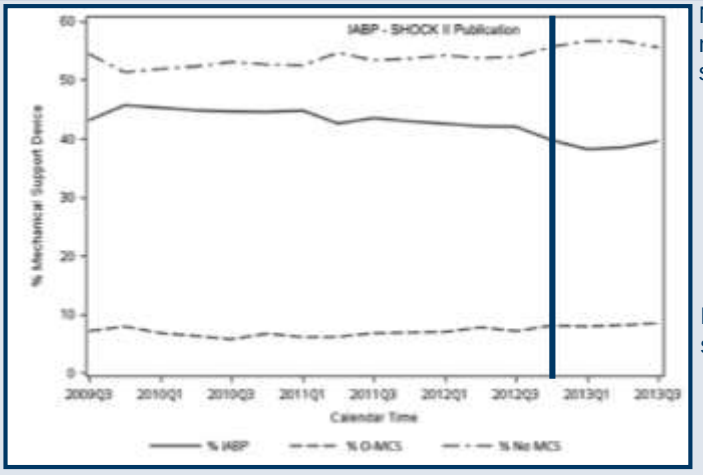
IABP in cardiogenic shock

Class IC → IIb B → III

Windecker et al. Eur Heart J. 2014;35:2541-2619

IABP + Other Devices Use in the US

Cath PCI US Registry: 76474 patients with PCI and cardiogenic shock



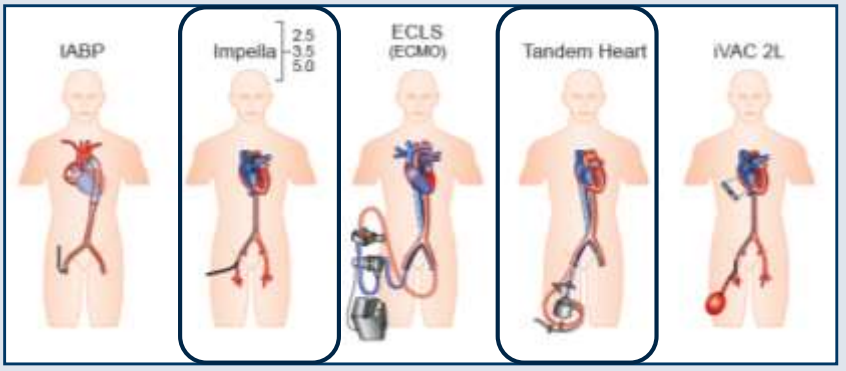
No mechanical support

IABP

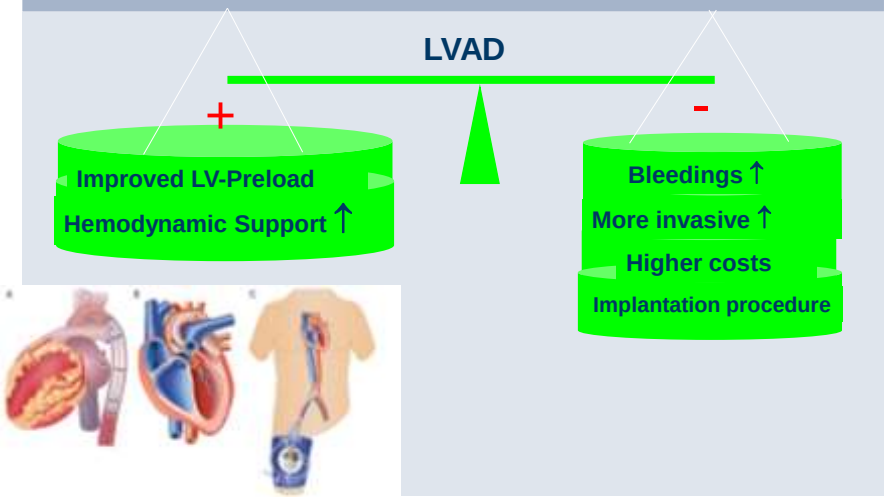
Mechanical support

Sandhu et al. Circulation 2015;132:1243-1251

Currently Available Percutaneous Devices



LVAD vs IABP?



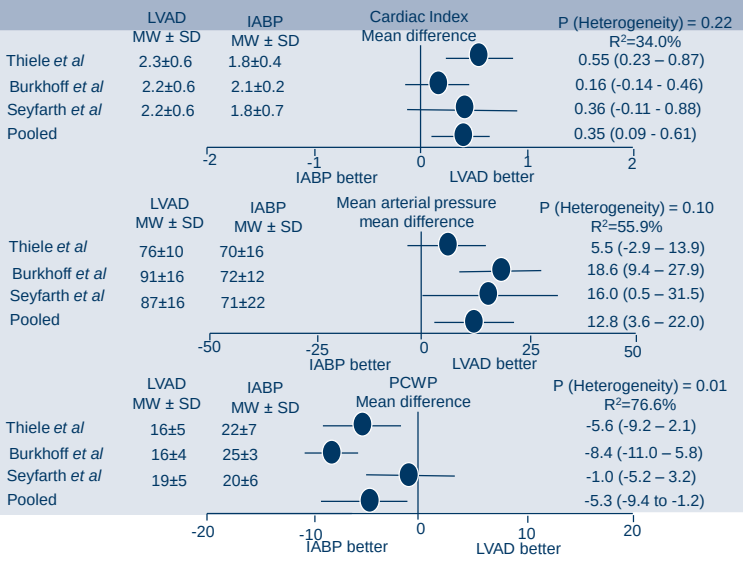
Currently Available Percutaneous Devices

Technical Parameters

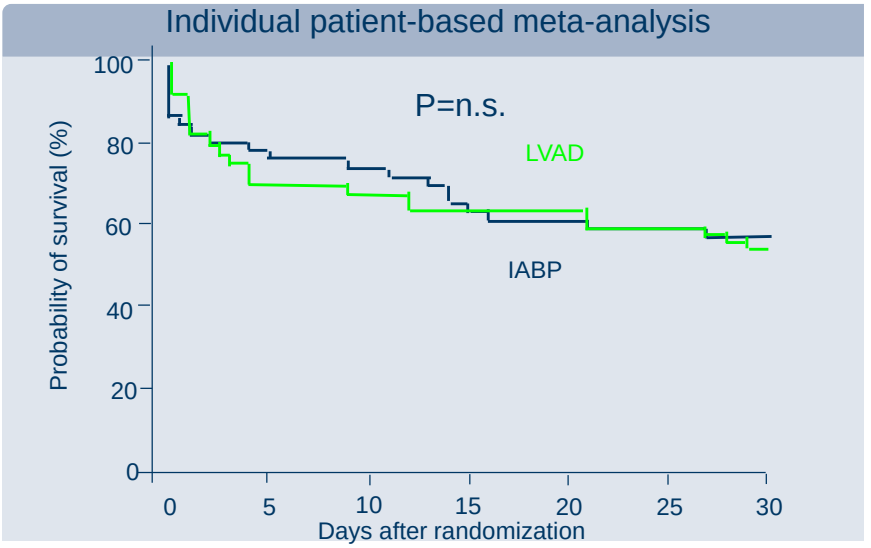
	IVAC 3L®	TandemHeart™	Impella® 5.0	Impella® 2.5	Impella® CP	ECLS (multiple systems)
Catheter size (F)	11 (expandable)	—	9	9	9	
Cannula size (F)	17	21 venous 12–19 arterial	21	12		17–21 venous 16–19 arterial
Flow (L/min)	Max 2.8	Max. 4.0	Max. 5.0	Max. 2.5	3.7–4.0	Max. 7.0
Pump speed (rpm)	Pulsatile, 40 mL/beat	Max. 7500	Max. 33 000	Max. 51 000	Max. 51 000	Max. 5000
Insertion/ Placement	Percutaneous (femoral artery)	Percutaneous (femoral artery + vein for left atrium)	Peripheral surgical (femoral artery)	Percutaneous (femoral artery)	Percutaneous (femoral artery)	Percutaneous (femoral artery + vein)
LV unloading	+	++	++	+	+	–
Anticoagulation	+	+	+	+	+	+
Recommended duration of use	~21 days	~14 days	10 days	10 days	10 days	~7 days
CE-certification	+	+	+	+	+	+
FDA	–	+	+	+	+	+
Relative costs	++	+++++	++++	+++	++++	+(+)

LVAD or IABP?

Hemodynamics

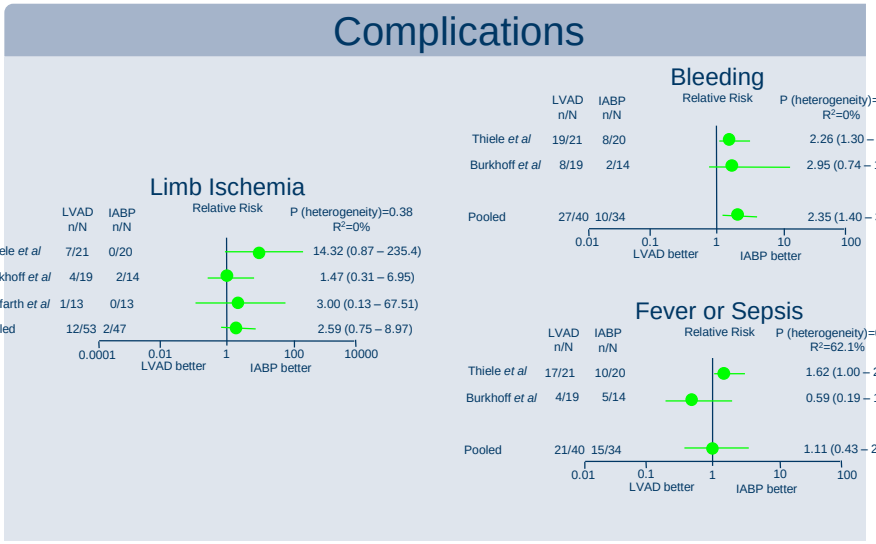


LVAD or IABP - Mortality



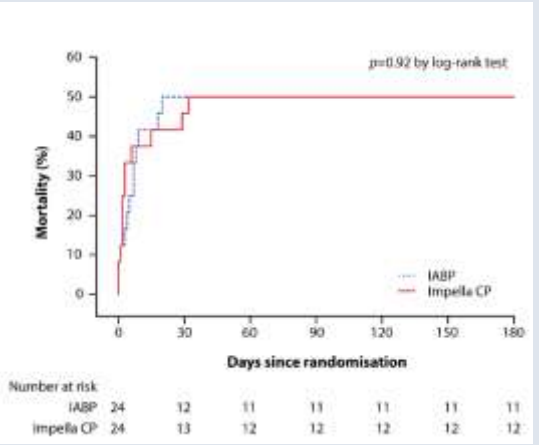
Thiele et al. Eur Heart J 2010;31:1828–1835

LVAD oder IABP?



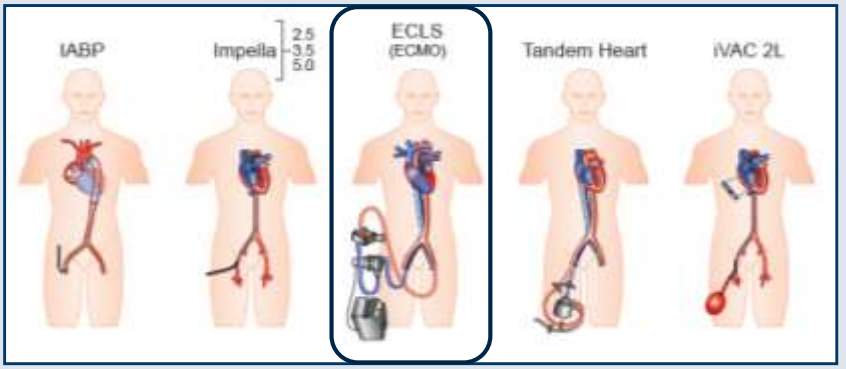
Cheng et al. Eur Heart J 2009;30:2102-2108

IMPELLA VERSUS IABP – The randomized IMPRESS trial



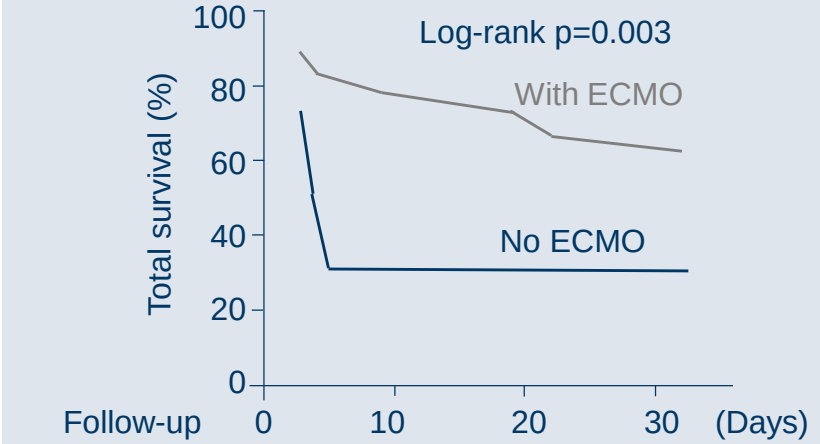
Henriques et al, J Am Coll Cardiol 2017; 69: 280-287

Currently Available Percutaneous Devices



ECMO - Evidence

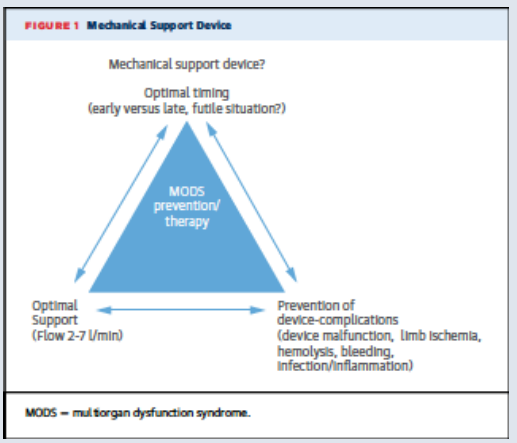
Historical control without ECMO; 1993 – 2002 versus ECMO; 2002 – 2009 retrospective analysis



At risk (n)	ECMO	46	32	31	28
	No ECMO	25	7		

Sheu et al. Crit Care Med 2010;38:1810-1817

Problems with ventricular assist devices in cardiogenic shock



Zeymer and Thiele J Am Coll Cardiol 2017; 69: 288-90

Summary

- Routine IABP in cardiogenic shock not useful
- Maybe used in patients with mechanical complications (VSD, mitral insufficiency)
- IMPELLA provides hemodynamic support, survival benefit needs to be shown
- ECMO useful in patients after CPR to be able to perform PCI

Conclusion

- Which patient:
- Young patient hemodynamic unstable after successful revascularization
- When:
- after PCI, only in patients with ongoing CPR before revascularization
- Which device:
- IABP only for mechanical complications. Impella low output after PCI, ECMO: CPR, pulmonary problems