ECMO FOR SEPTIC SHOCK

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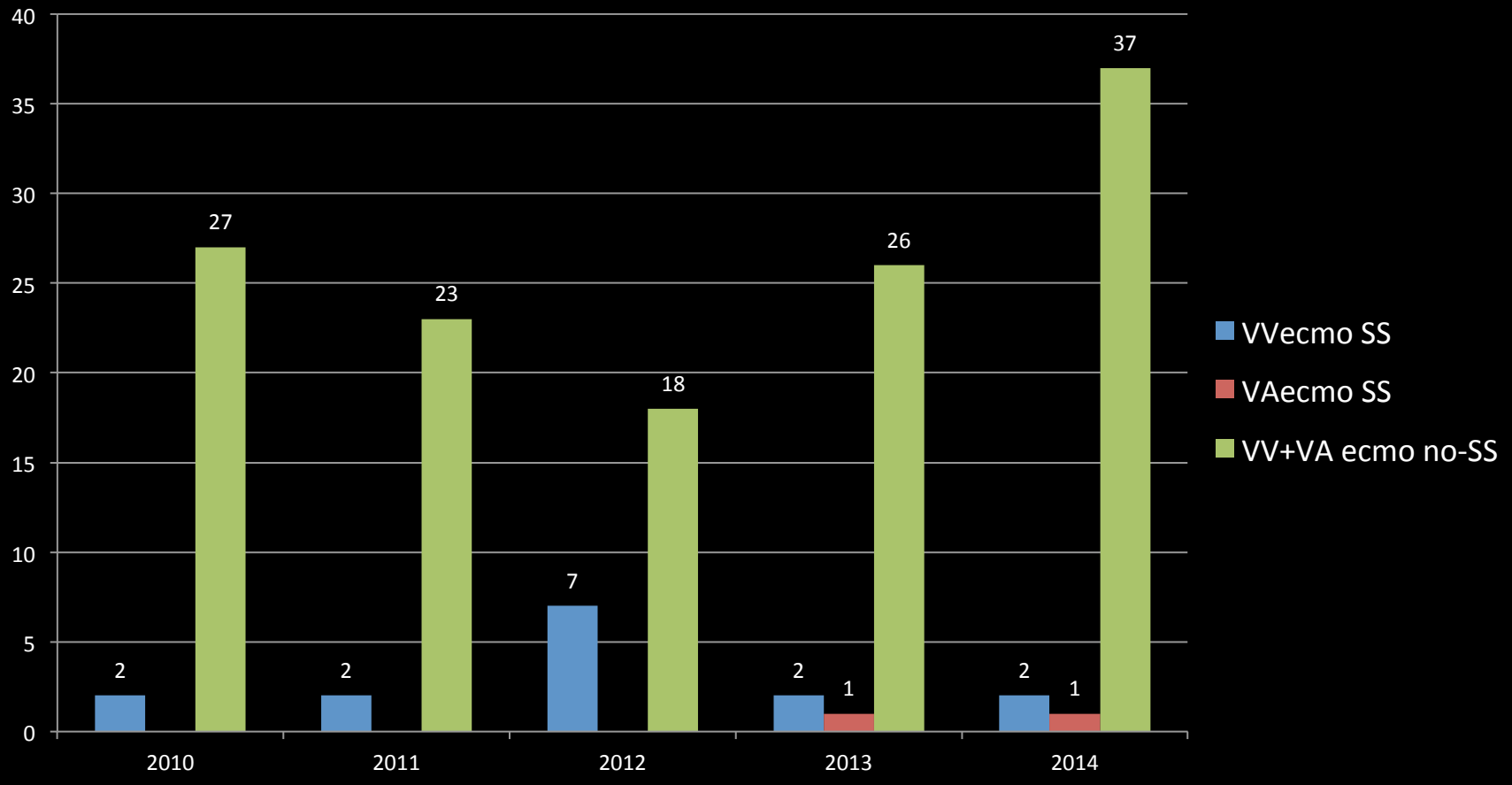
ECMO FOR SEPTIC SHOCK???

What do I know?

…I don’t know a damn!

Careggi ECMO Center numbers



Mortality	
ECMO SS	44%
ECMO no-SS	48%

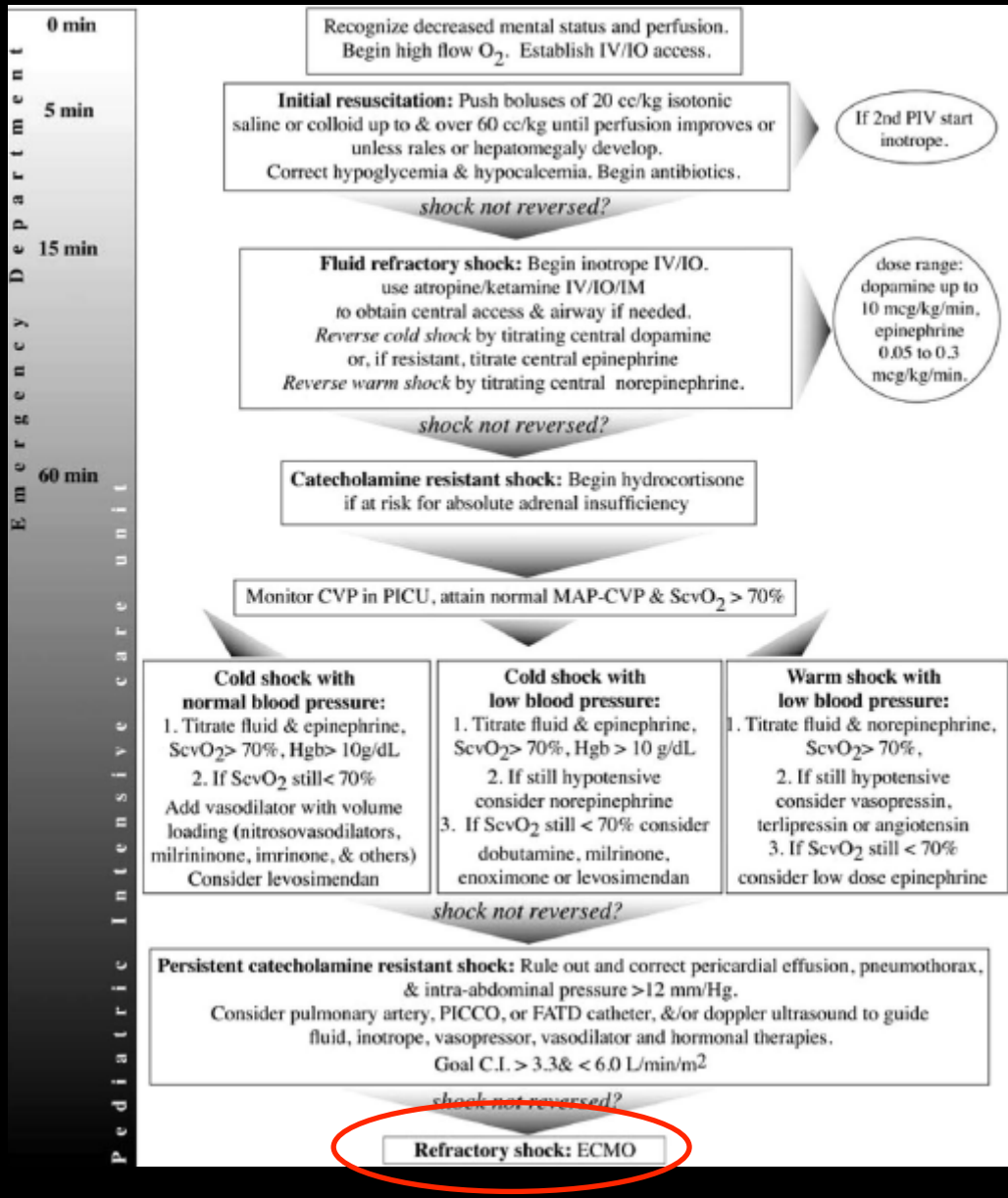
ECMO FOR SEPTIC SHOCK

What do others know?

…not too much!

Definite recommendation in **pediatric** and **newborn** Septic Shock

American College of Critical Care Medicine Clinical Guidelines for Hemodynamic Support of Neonates and Children with Septic Shock



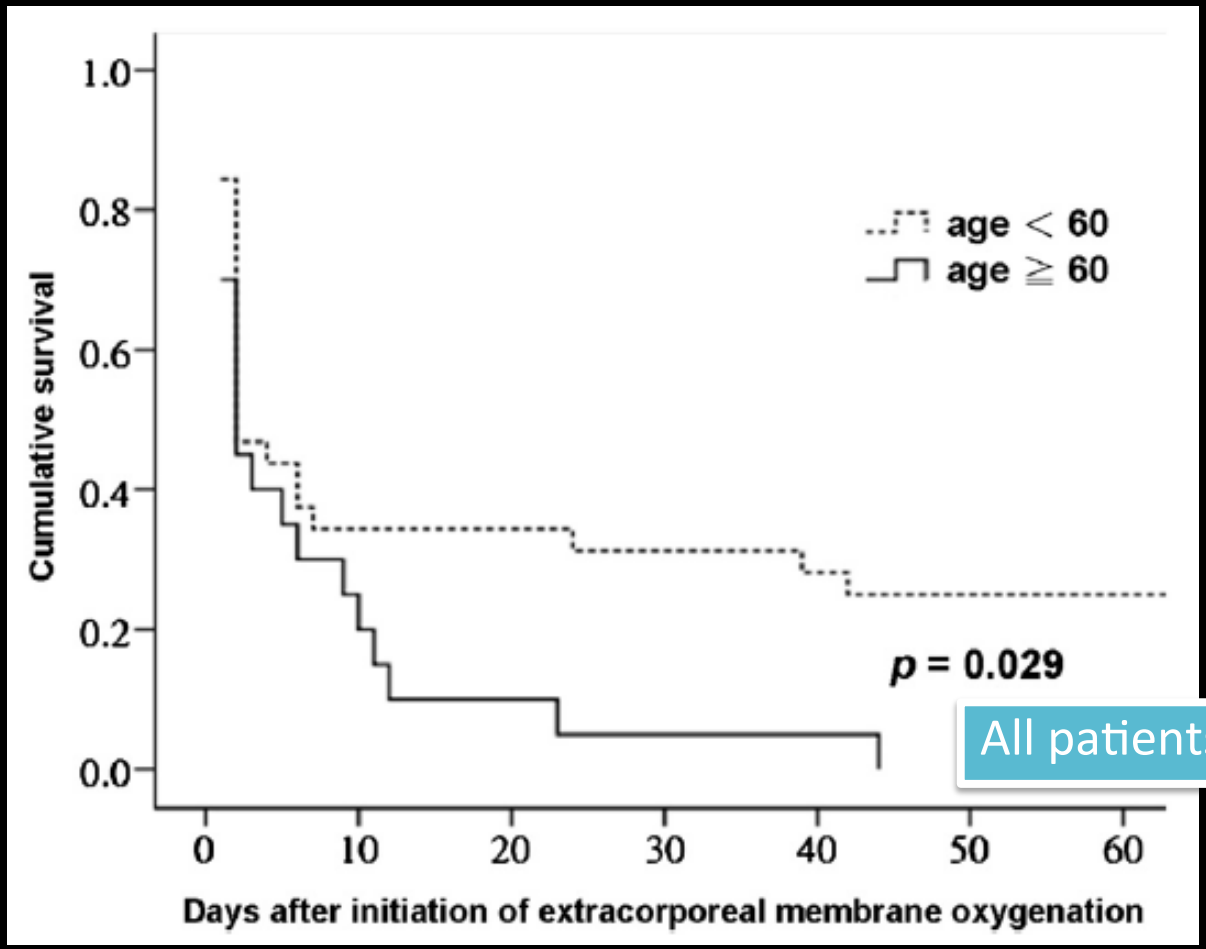
Brierley J. Crit Care Med 2009; 37:666–688

Mortality in PSS is related to the number of organ dysfunction not to age.

Characteristic	ECMO alone (N = 1358)	
	Prevalence	Mortality
Age		
<1 year	661 (48.7 %)	344 (52.0 %)
1-4 years	319 (23.5 %)	130 (40.8 %)
5-9 years	126 (9.3 %)	57 (45.2 %)
10-18 years	252 (18.6 %)	118 (46.8 %)
Organ dysfunction		
1	241 (17.8 %)	122 (50.6 %)
2	646 (47.6 %)	264 (40.9 %)
3	309 (22.8 %)	163 (52.8 %)
4	117 (8.6 %)	72 (61.5 %)
5+	45 (3.3 %)	28 (62.2 %)

Ruth A. Critical Care (2015) 19:397

ECMO and age in adult Septic Shock

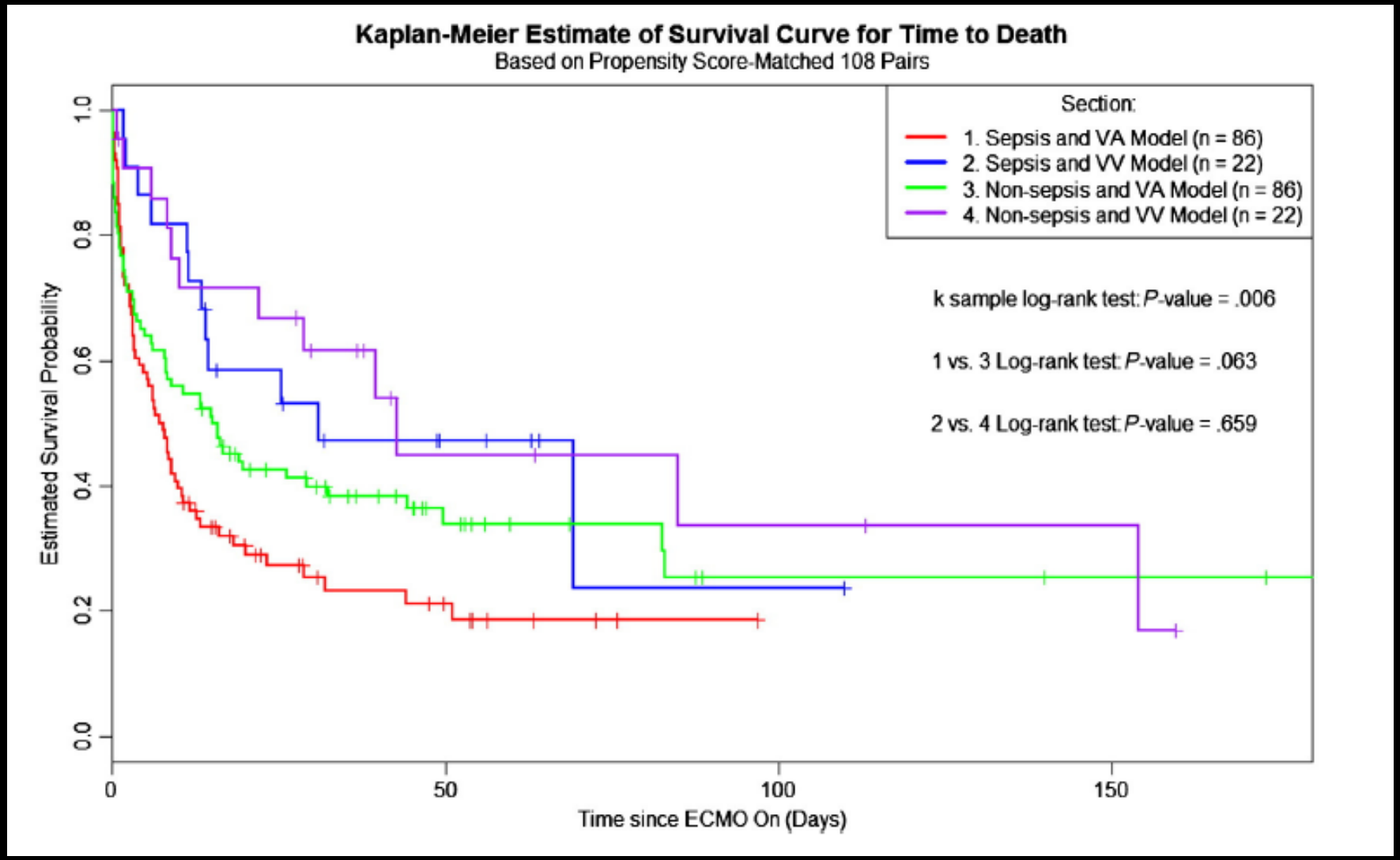


All patients aged > 60 y (n20) died

Huang CT. J Thorac Cardiovasc Surg 2013;146:1041-6

Low survival for patients with SS and V-A ECMO

Taiwan 2001-2009



Cheng A. Journal of Critical Care (2013) 28, 532

Venoarterial Extracorporeal Membrane Oxygenation Support for Refractory Cardiovascular Dysfunction During Severe Bacterial Septic Shock*

Nicolas Bréchot, MD, PhD[1]; Charles-Edouard Luyt, MD, PhD[1]; Matthieu Schmidt, MD[1];

Crit Care Med 2013; 41:1616–1626

Paris 2008-2011

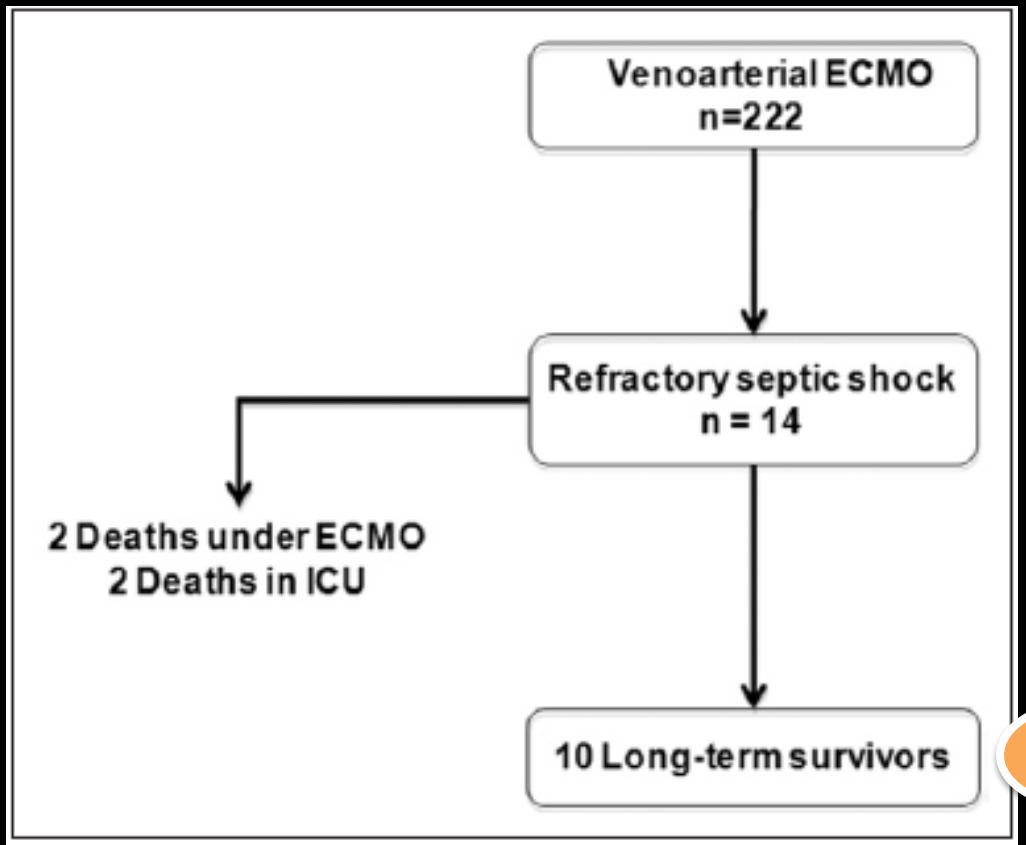


Figure 1. Outcomes of the 14 patients with refractory myocardial dysfunction during septic shock who received extracorporeal membrane oxygenation (ECMO) support.

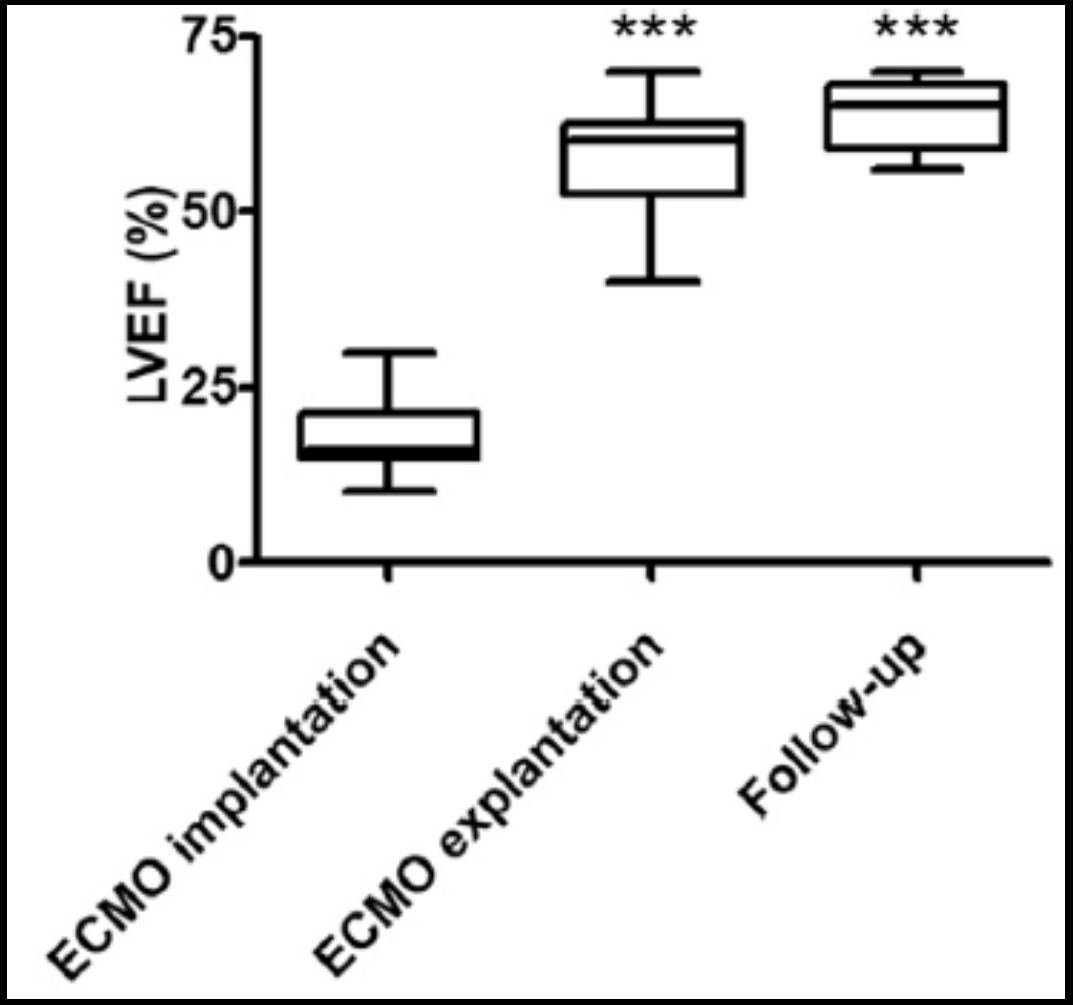
Bréchot N. Crit Care Med 2013; 41:1616–1626

Pneumonia as the principal cause of Septic Shock

Patient	Age	Sex	Immunodeficiency	Infection	Temperature at Admission (°C)
1	33	M	None	CA pneumonia	38.4
2	62	M	None	CA pneumonia	37.7
3	31	F	Chemotherapy for Ewing sarcoma	Acute cholecystitis	38.5
4	33	F	None	Aspiration pneumonia	33.5
5	48	F	HIV infection	CA pneumonia	39.7
6	66	M	Hepatic transplantation	Peritonitis after liver transplant	35.8
7	59	M	None	CA pneumonia	38.6
8	52	M	None	CA pneumonia	40.1
9	28	F	Corticosteroids for inflammatory bowel disease	CA pneumonia	38.2
10	35	M	None	Aspiration pneumonia	38.9
11	28	F	None	Aspiration pneumonia	36
12	52	F	Consolidation chemotherapy for acute myeloid leukemia	Nosocomial pneumonia	39.5
13	57	F	Methotrexate and tumor necrosis factor inhibitors for ankylosing spondylitis	Pharyngitis	40
14	48	M	None	CA pneumonia	39.5

Bréchot N. Crit Care Med 2013; 41:1616–1626

Septic Shock with depressed contractility!



Cardovascular response to sepsis

- Peripheral vasodilatation
- Intrinsic myocardial dysfunction, masked by the concomitant elevation in cardiac index
- Abnormal increase in left ventricular end-diastolic diameter in survivors

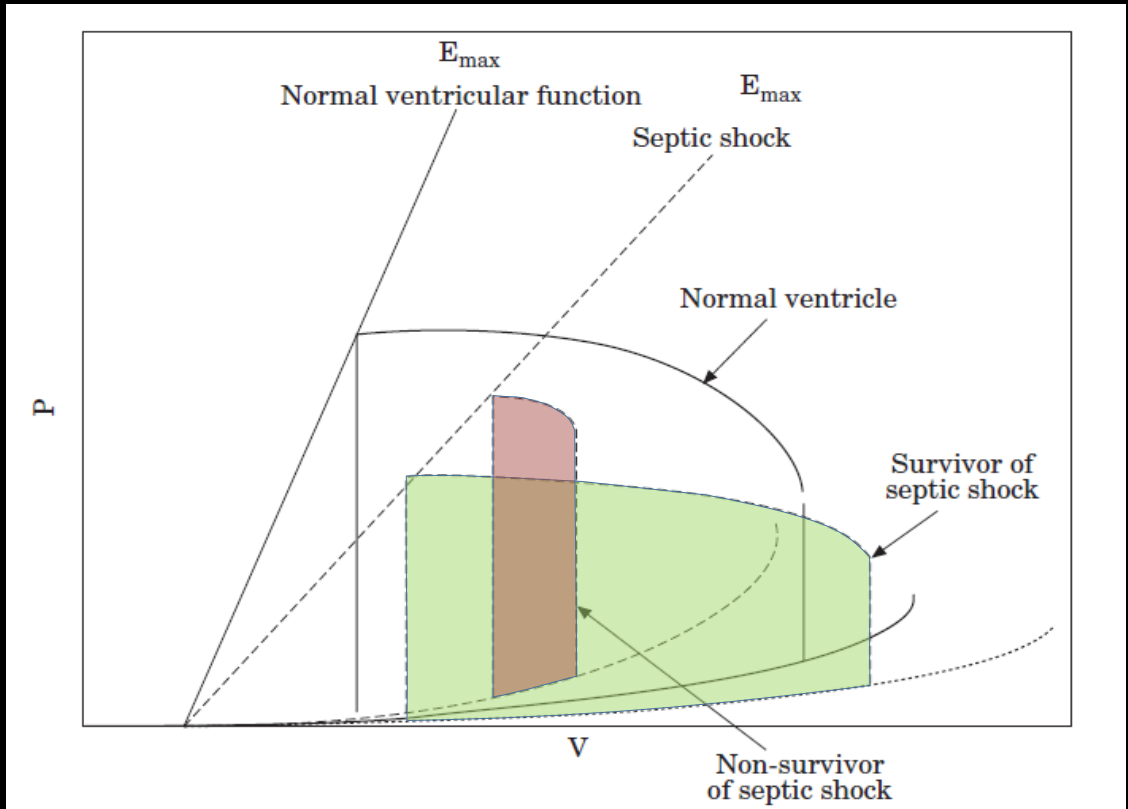


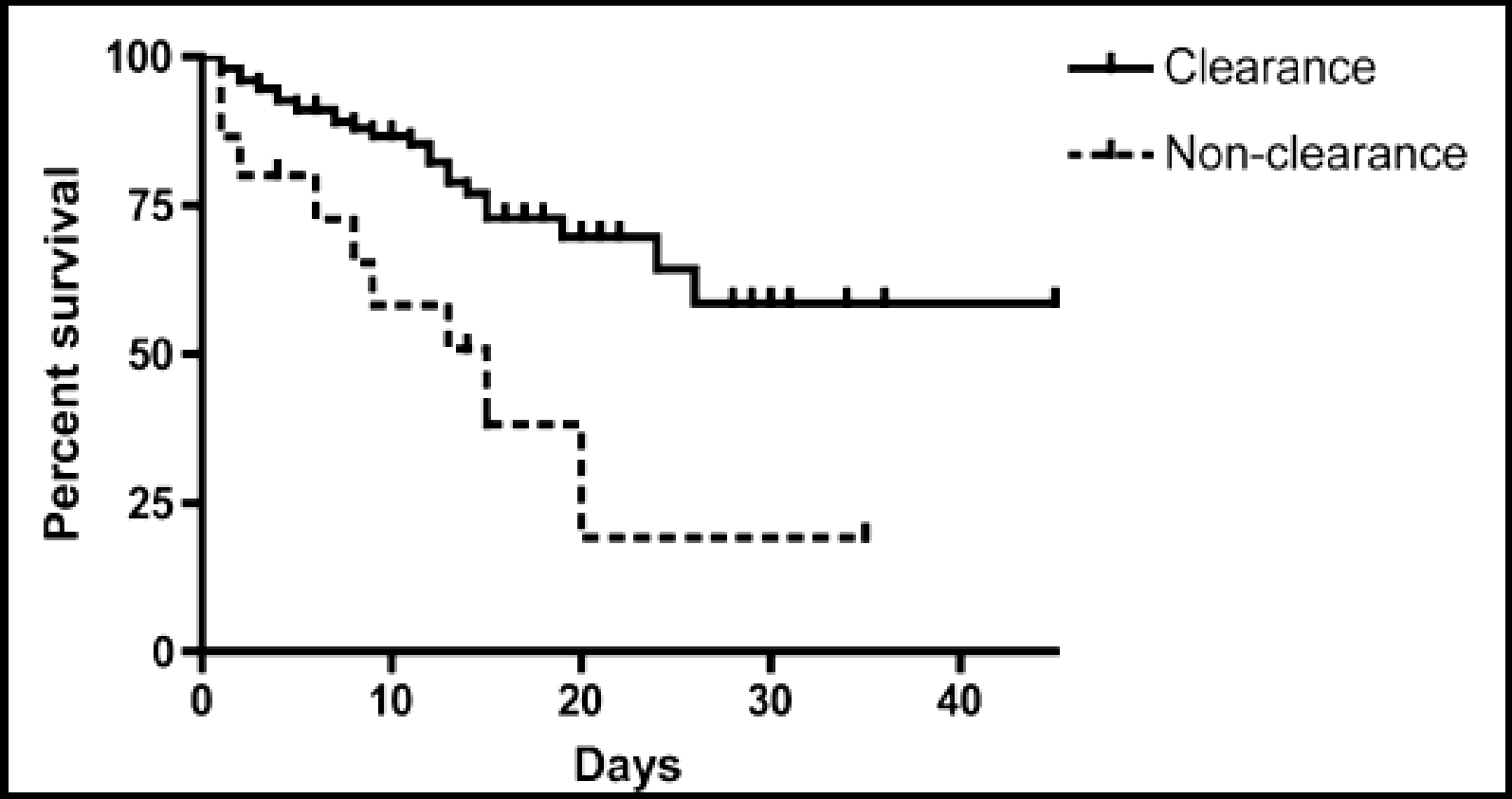
Figure 1 Theoretical pressure–volume loops in normal controls, survivors and non-survivors of septic shock. In non-survivors, failure to increase ventricular compliance results in inability to maintain stroke volume and hence cardiac output. Similar changes are seen in both right and left ventricles[19].

Price S. Eur Heart J. 1999 May;20(10):715-24

SHOCK, Vol. 32, No. 1, pp. 35–39, 2009

MULTICENTER STUDY OF EARLY LACTATE CLEARANCE AS A DETERMINANT OF SURVIVAL IN PATIENTS WITH PRESUMED SEPSIS

Ryan C. Arnold,* Nathan I. Shapiro,† Alan E. Jones,‡ Christa Schorr,§



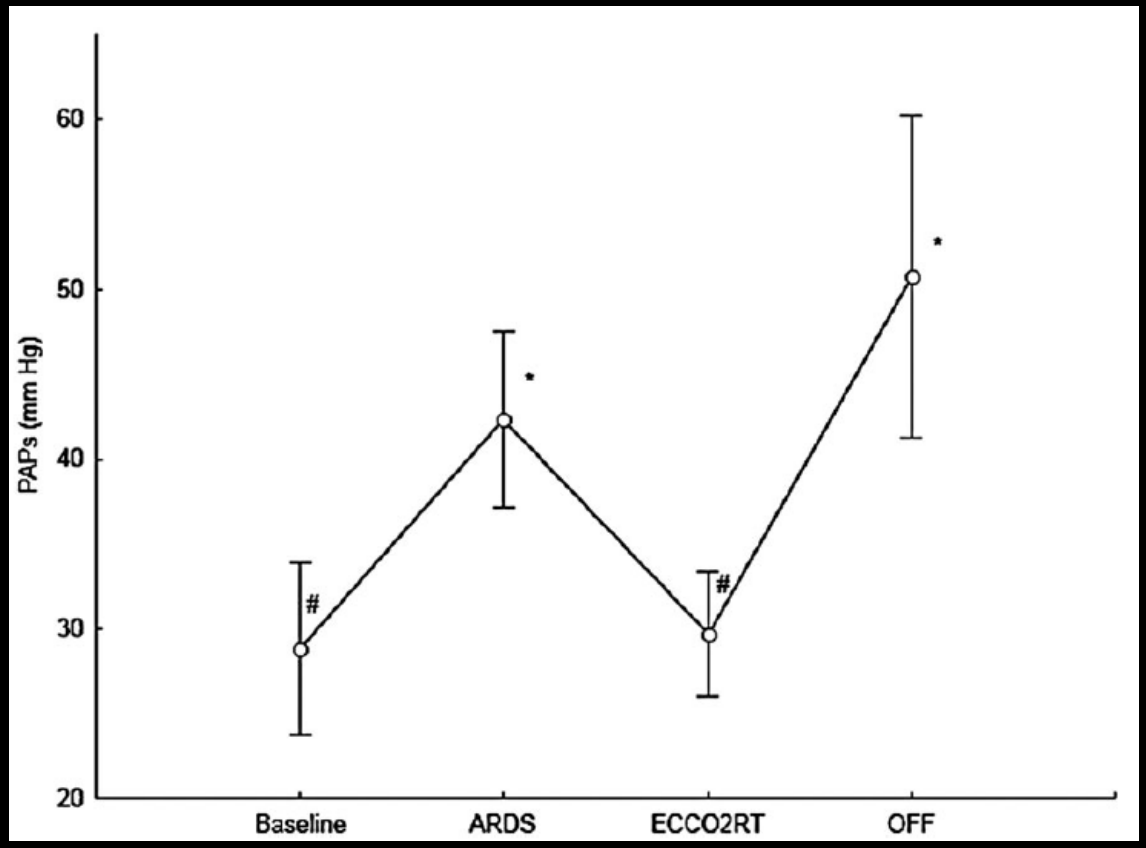
ARDS is frequent in septic patients

ECMO fosters protective ventilation

Established role

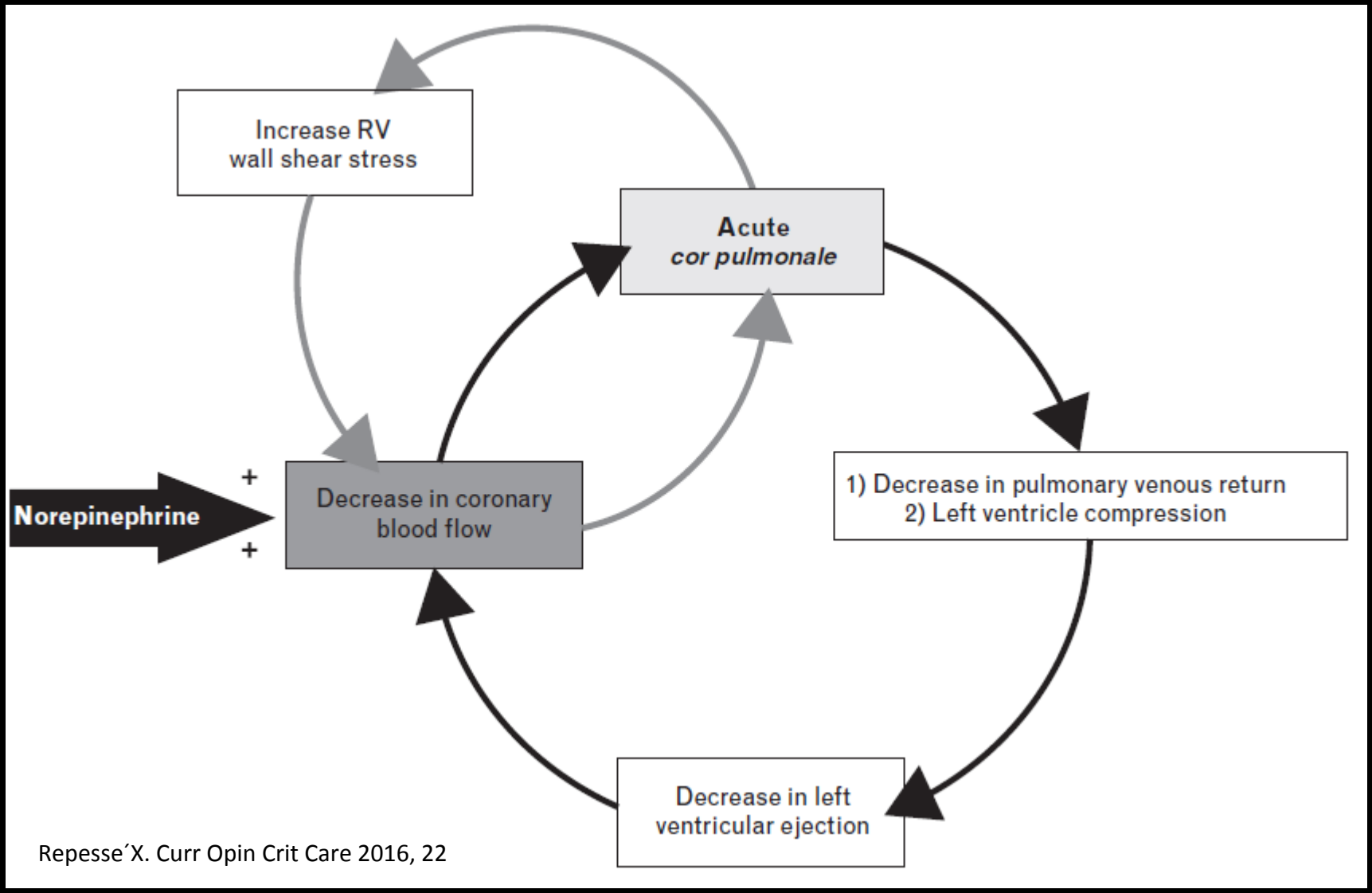
VV-ECMO in Septic Shock related ARDS

Hypercapnia induced by protective ventilation causes pulmonary hypertension and strain on RV



Morimont P. Acta Anaesthesiol Scand. 2015 Apr;59(4):448-56

Central role of RV in circulatory failure in ARDS



Repesse´X. Curr Opin Crit Care 2016, 22

Pulmonary vascular dysfunction in refractory acute respiratory distress syndrome before veno-venous extracorporeal membrane oxygenation

C. Lazzeri[1], G. Cianchi[2], M. Bonizzoli[2], S. Batacchi[2], P. Terenzi[2], P. Bernardo[1], S. Valente[1], G. F. Gensini[1,3] and A. Peris[2]

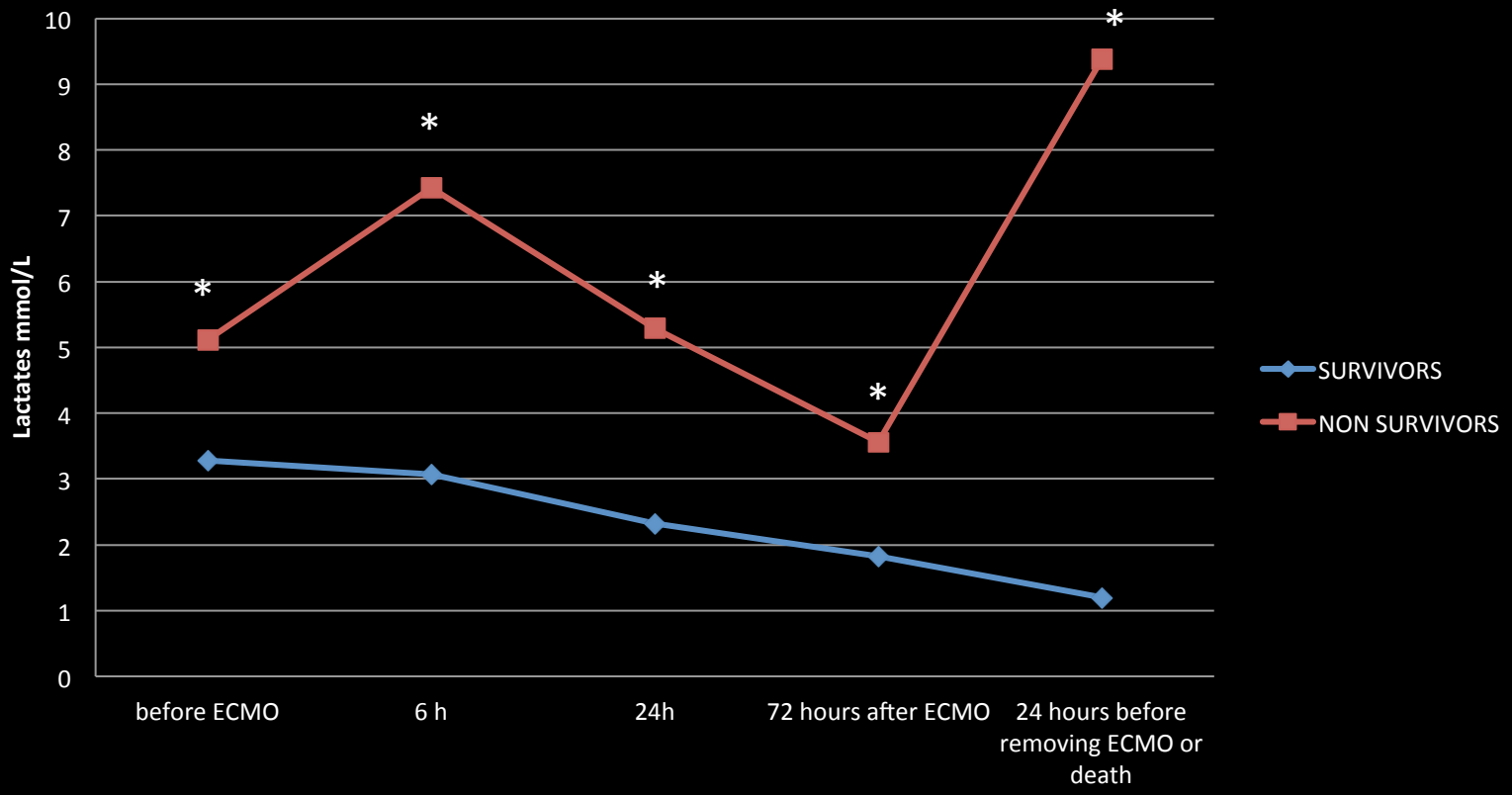
LV EF (%)	50 ± 9.5; 55 (20–58)
LV EF < 50%	6/21 (28.5%)
SPAP (mmHg)	53.7 ± 7.9
TAPSE (mm)	14.7 ± 4.5
TAPSE < 16 mm (%)	10/21 (47.6%)
Acute cor pulmonale	2/21 (9.5%)

Pulmonary vascular dysfunction in refractory acute respir distress syndrome before veno-venous extracorporeal membrane oxygenation

C. Lazzeri[1], G. Cianchi[2], M. Bonizzoli[2], S. Batacchi[2], P. Terenzi[2], P. Bernardo[1], S. Valente[1], G. F. and A. Peris[2]

	Survivors $n = 9$	Dead patients $n = 12$	P values
Age (years)	56.9 ± 9.6	50.3 ± 11.2	NS
Male gender %	6/9 (66.7%)	8/12 (66.7%)	
BMI	32.3 ± 10.8	29.2 ± 7.4	NS
SAPS II	56 ± 16	44 ± 19	NS
Vasopressor infusion	6/9 (66.7%)	7/12 (60%)	0.03
Noradrenaline only	6 (66.7%)	2 (16.7%)	
Dobutamine only	0	2 (16.7%)	
Noradrenalin and dobutamine	0	3 (25%)	
Arterial blood gas			
PaO_2/FiO_2	79.7 ± 12	85.9 ± 22	NS
PaO_2 (mmHg)	73.3 ± 12	91.1 ± 31.6	NS
$PaCO_2$ (mmHg)	66.5 ± 15.9	55.4 ± 8.9	NS
ph	7.26 ± 0.06	7.35 ± 0.04	NS
Lactate (mmol/l)	1.6 ± 0.4	2.5 ± 0.6	< 0.001
ICU length (days)	27 ± 16	36 ± 32	NS
MV ventilation duration (days)	24 ± 15	35.3 ± 32	NS
ECMO duration (days)	22.6 ± 14	20.5 ± 16	NS
Echocardiographic data			
LV < 50%	0 (0%)	6(50%)	0.04 (chi-square)
LV EF (%)	56.1 ± 2	46.9 ± 11	0.02
Pulmonary systolic arterial pressure (mmHg)	47.7 ± 5.8	57 ± 6.7	0.004
TAPSE (mm)	16.9 ± 3.7	13 ± 4.5	0.04

Lactates in ECMO survivals



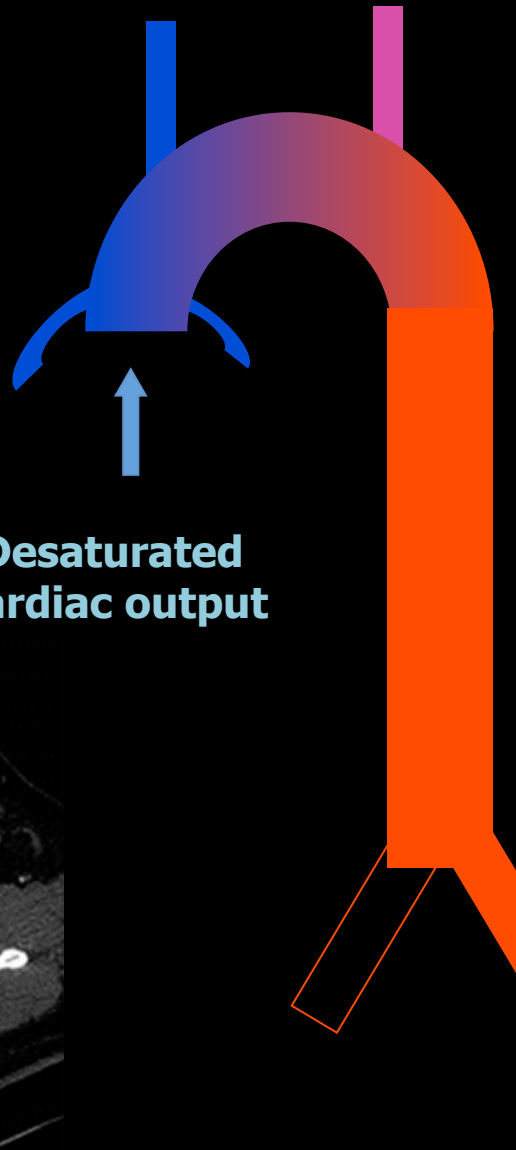
Personal data

Pulmonary & Cardiac failure

VA-ECMO

…but

Pulmonary & Cardiac failure
VA-ECMO



Desaturated cardiac output

Femoral Inflow

Pulmonary & Cardiac failure

- V-VA ECMO…
- Central cannulation…

Positive pre-ECLS cultures are a risk factor for infective complications

Table 2 Multivariate analysis of risk factors for infection by age group

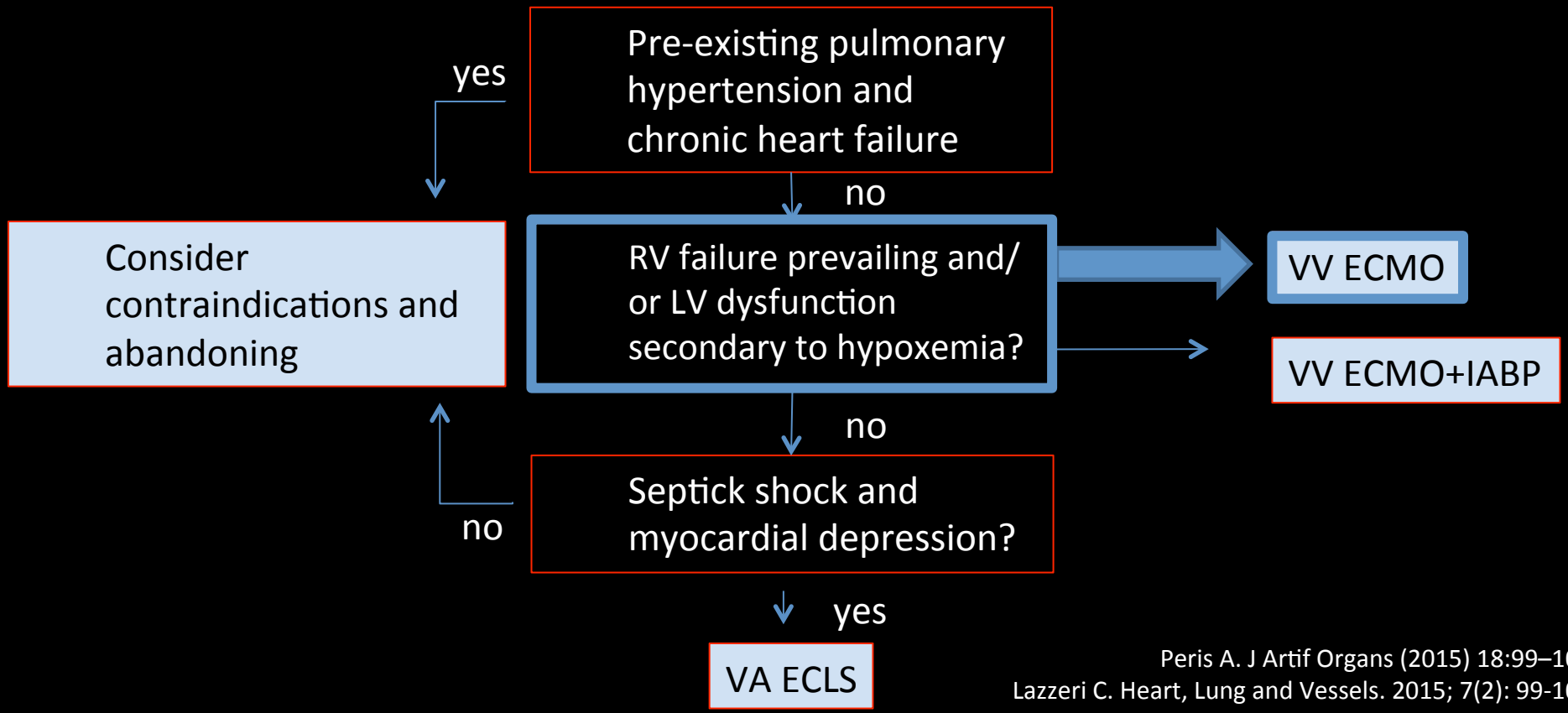
Predictor	Neonates		
	OR	95% CI	*P*
	Adult		
Positive pre-ECLS culture	2.49	1.95-3.18	<.001
ECLS duration	1.09	1.07-1.11	.002
Age	1.02	1.01-1.02	<.001
Type of complication			
Mechanical	1.54	1.22-1.95	<.001
Renal	1.53	1.17-2	.002
Cardiovascular	1.77	1.25-2.51	.001
Metabolic	2.27	1.79-2.88	<.001
Mode			
VVDL	0.11	0.01-0.88	.038

Vogel AM. Journal of Pediatric Surgery (2011) 46, 2260–2264

How do I proceed in a (septic) shocked patient…

Assess:

- RV function
- Pulmonary hypertension
- LV function



Peris A. J Artif Organs (2015) 18:99–105
Lazzeri C. Heart, Lung and Vessels. 2015; 7(2): 99-100

Do I consider to use ECMO in an adult patient with primary Septic Shock?

- No…(not yet)

Is shock a determent for ECMO?

- No…(not always)