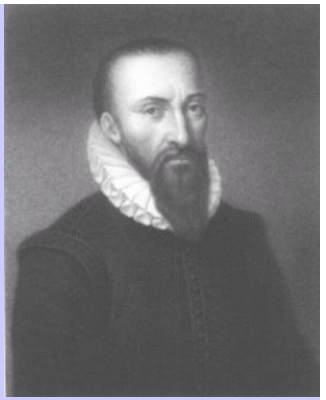
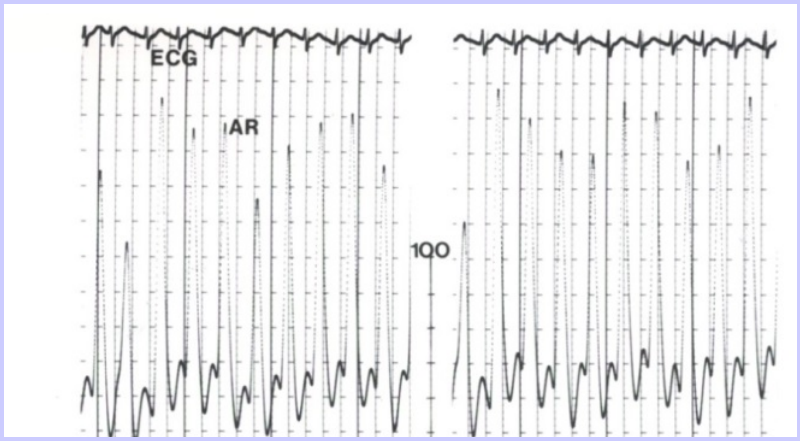


Monitorage du retentissement hémodynamique

Antoine Vieillard-Baron, Boulogne, France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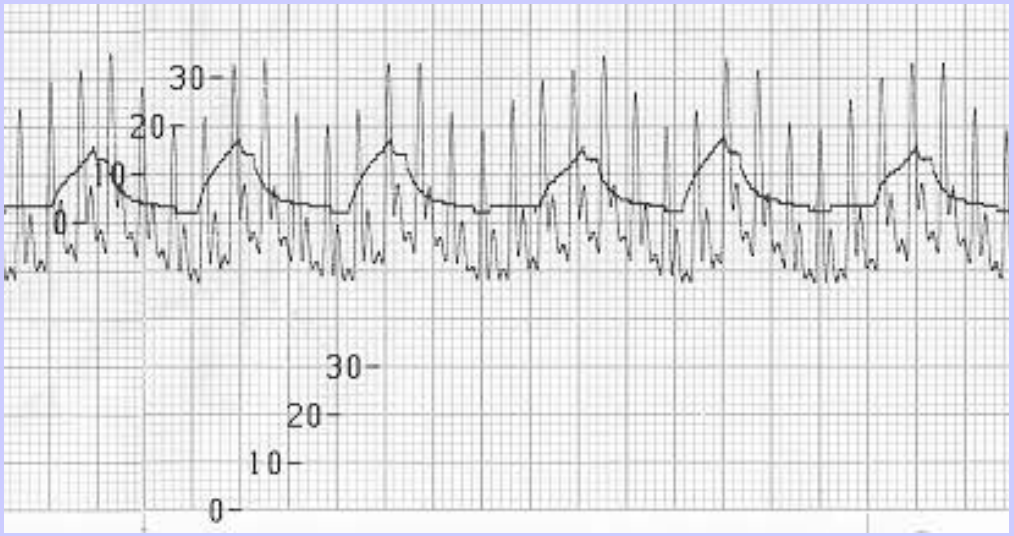
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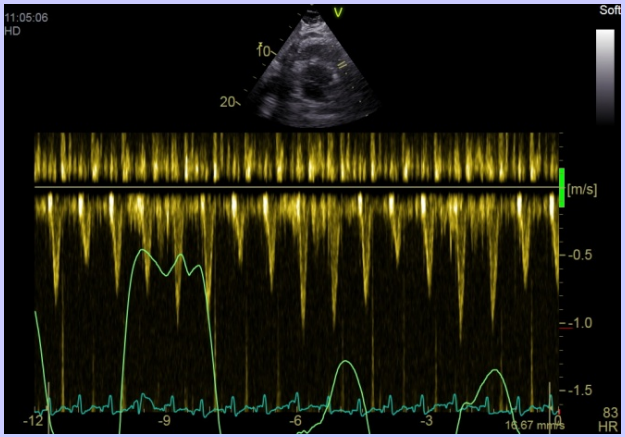
11:05:06
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[m/s]
-0.5
-1.0
-1.5
-12
-9
-6
-3
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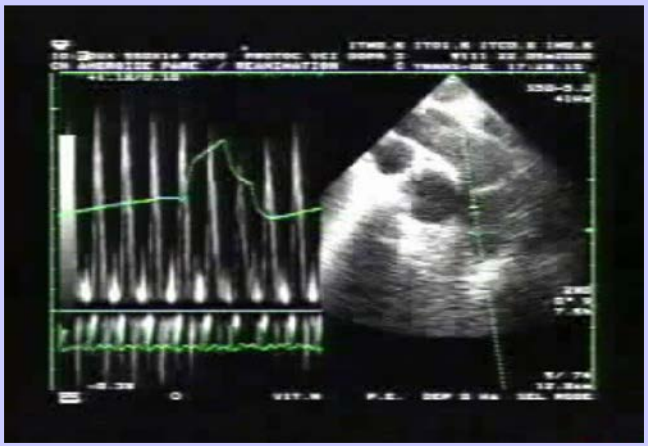
83
HR

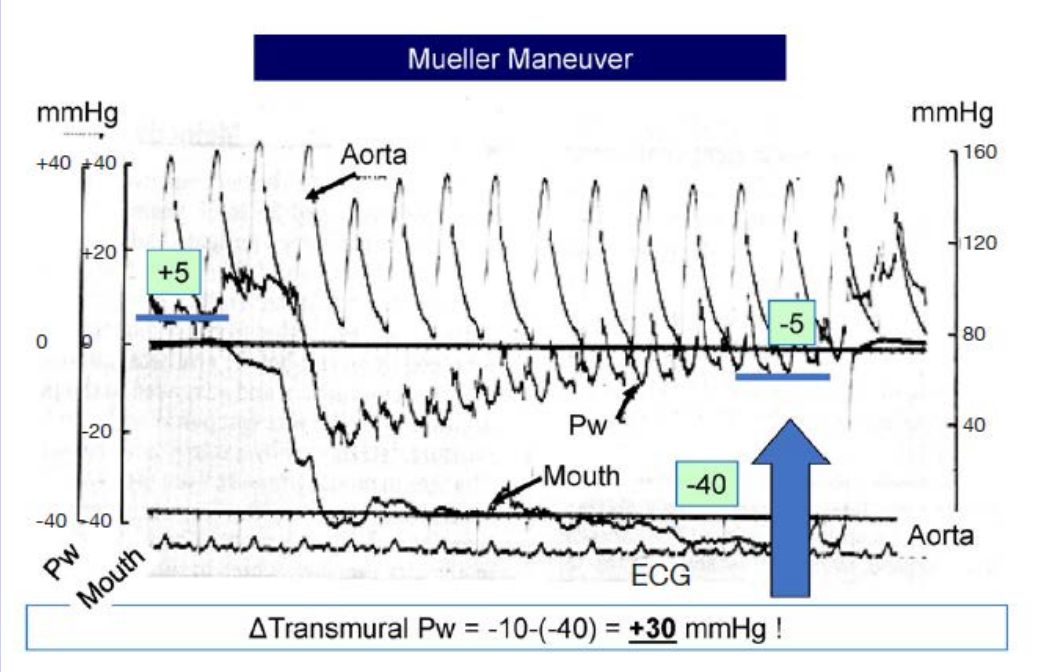


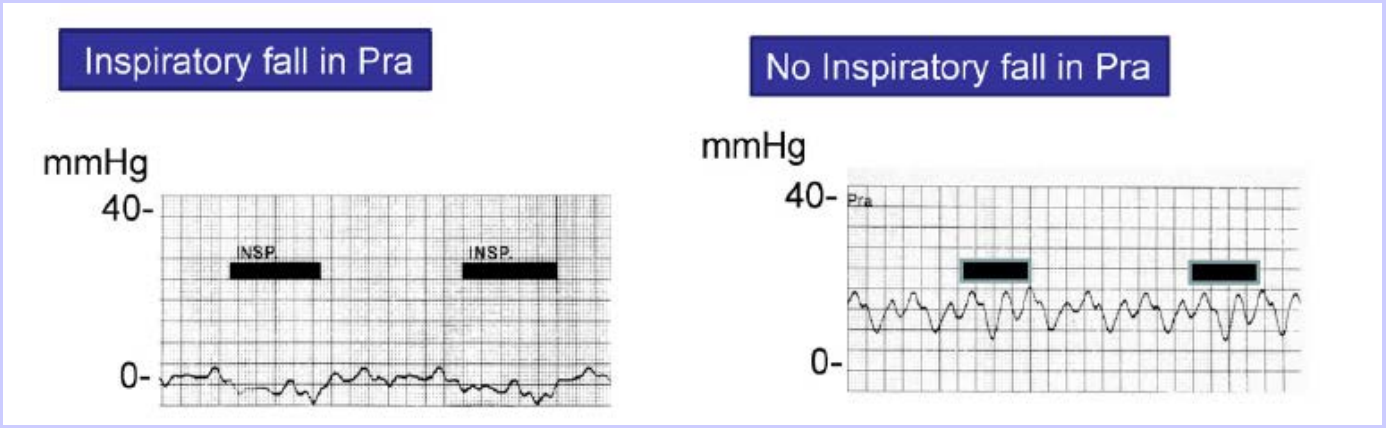
Ventilation spontanée

Heart-Lung interaction in spontaneous breathing subjects: the basics

Sheldon Magder

ATM 2018

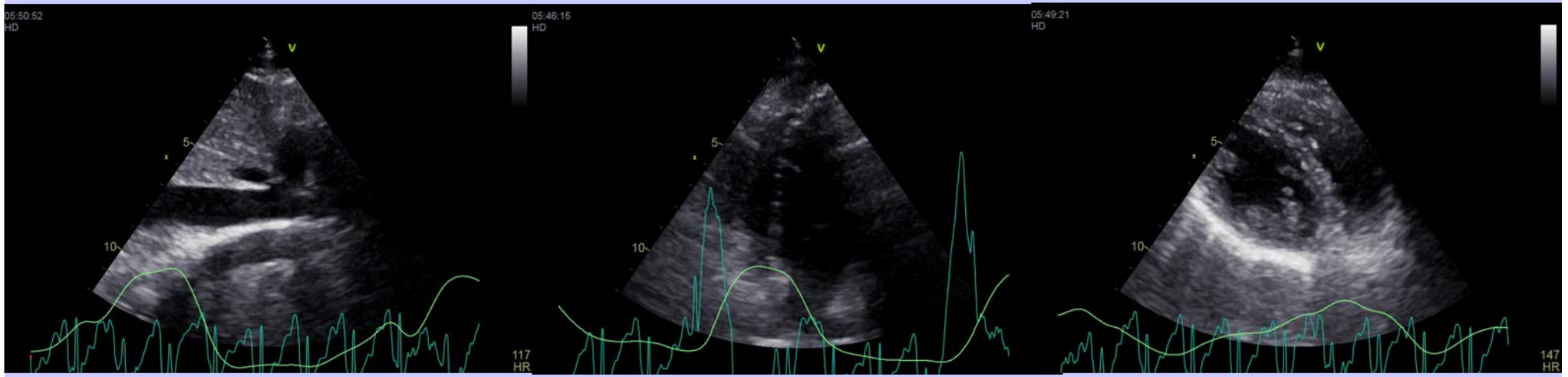


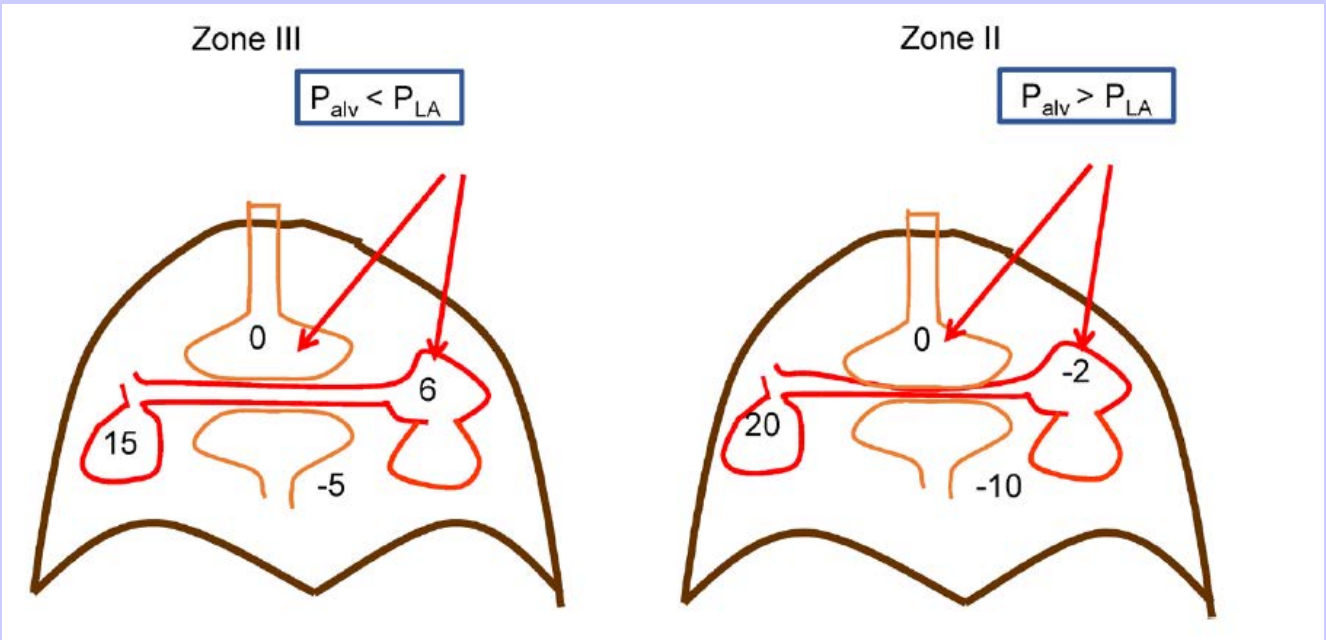


Assessment of the effects of inspiratory load on right ventricular function

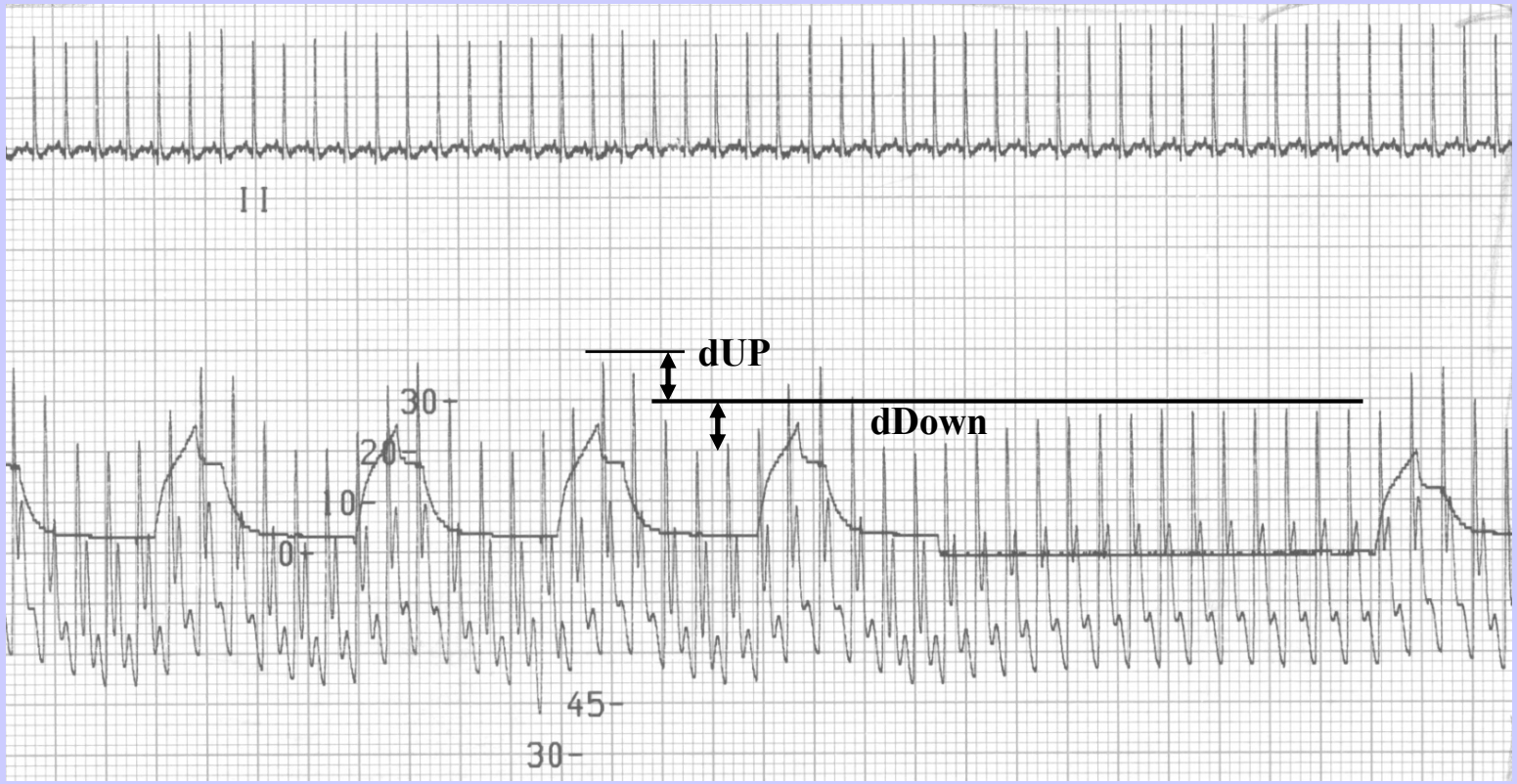
2016

Xavier Repessé[a], *Cyril Charron*[a], *and Antoine Vieillard-Baron*[a,b,c]





Ventilation en pression positive


II
dUP
dDown
30
20
10
0
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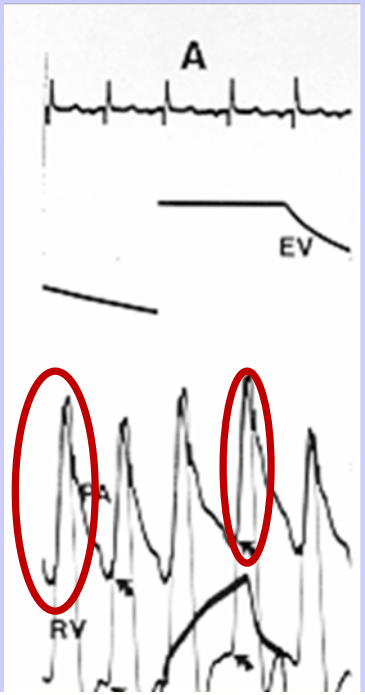
30

Jardin Catheterization and Cardiovascular Diagnosis 1989

PEEP 0



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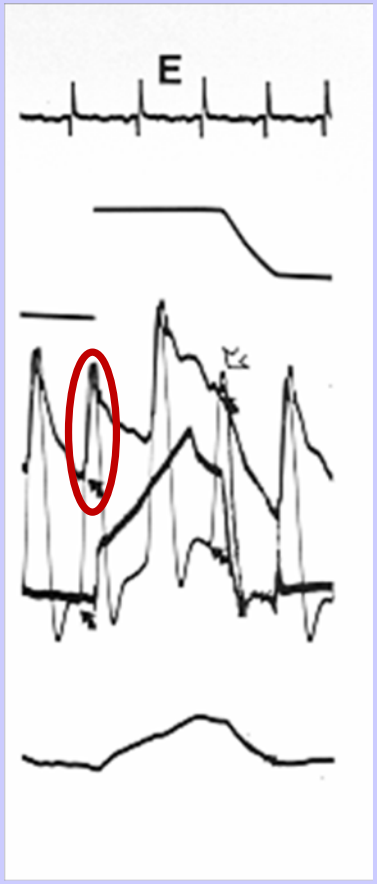
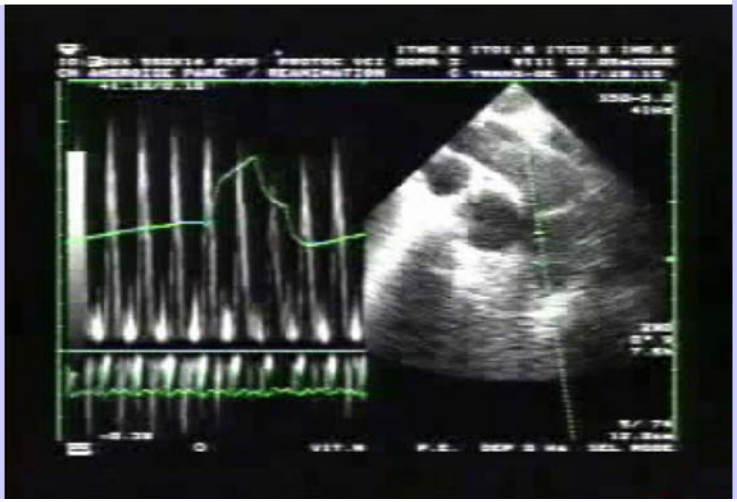


Cyclic Changes in Arterial Pulse during Respiratory Support Revisited by Doppler Echocardiography

Antoine Vieillard-Baron, Karim Chergui, Roch Augarde, Sebastien Prin, Bernard Page, Alain Beauchet, and François Jardin

Medical Intensive Care Unit and the Department of Biostatistics, University Hospital Ambroise Paré, Assistance Publique Hôpitaux de Paris, Boulogne Cedex, Paris, France

Am J Respir Crit Care Med 2003



Venous Return at Various Right Atrial Pressures and the Normal Venous Return Curve[1]

ARTHUR C. GUYTON, ARTHUR W. LINDSEY, BERRY ABERNATHY AND TRAVIS RICHARDSON

From the Department of Physiology and Biophysics, University of Mississippi School of Medicine, Jackson, Mississippi

Am J Physiol 1957

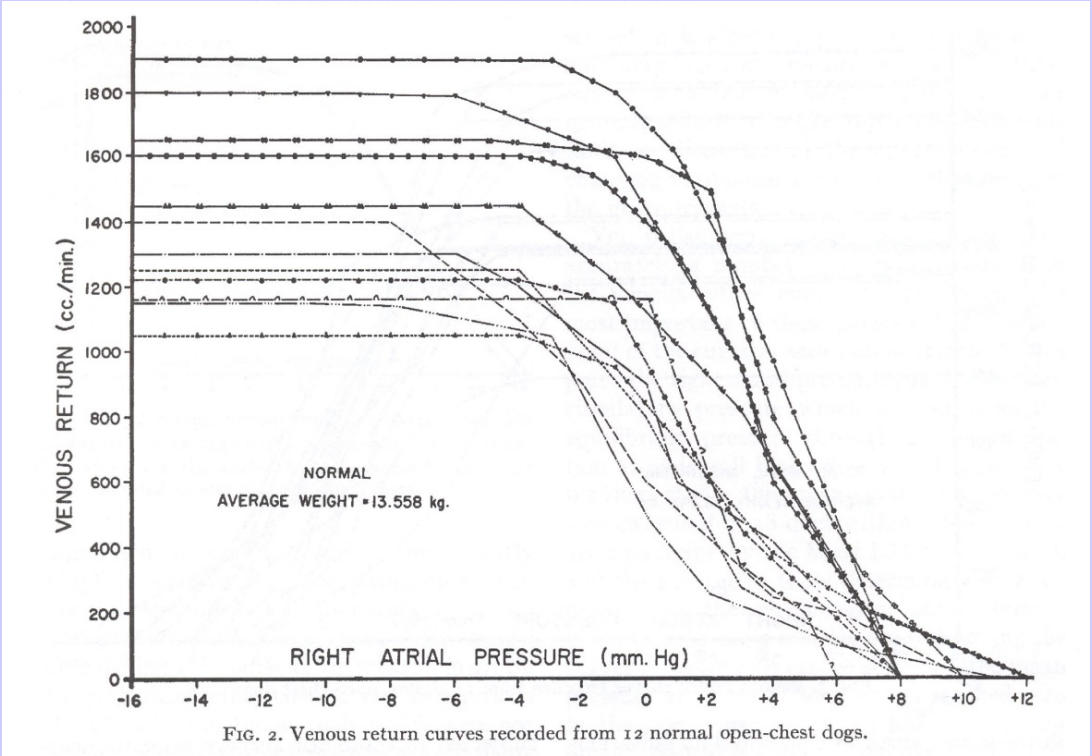


FIG. 2. Venous return curves recorded from 12 normal open-chest dogs.

$$RVS = PSM - POD/R$$

RESEARCH ARTICLE

Impact of positive pressure ventilation on mean systemic filling pressure in critically ill patients after death

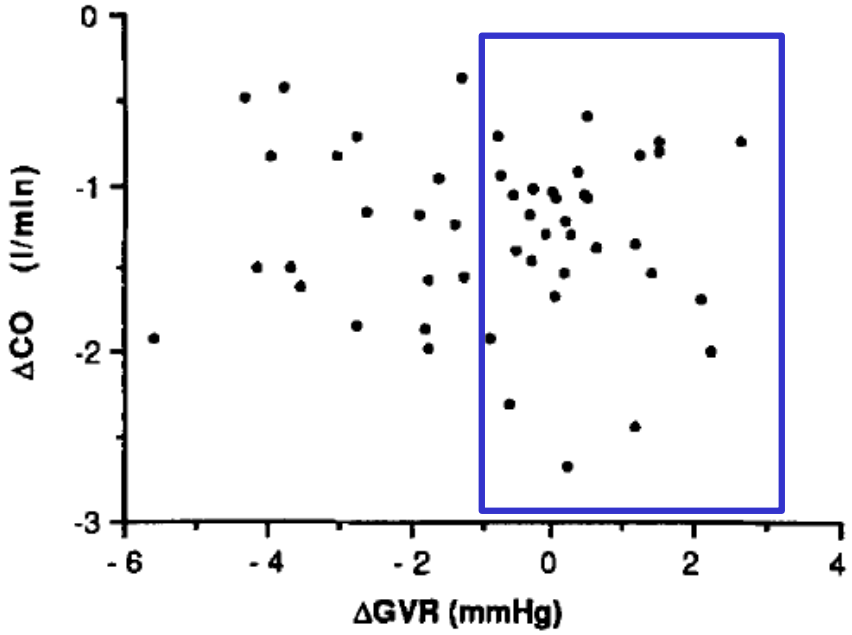
Xavier Repessé,[1] Cyril Charron,[1] Guillaume Geri,[1,2,3] Alix Aubry,[1,2] Alexis Paternot,[1,2] Julien Maizel,[4,5] Michel Slama,[4,5] and Antoine Vieillard-Baron[1,2,3]

112 patients

Table 3. *Effect of PEEP and tidal ventilation on the P_{ms} measured on the central venous catheter and on the arterial catheter*

	Effect on P_{ra} (SE)	*P*	Effect on P_{art} (SE)	*P*
Insp vs. Exp	+2.4 (0.06)	<0.001	+1.9 (0.05)	<0.001
PEEP vs. ZEEP	+1.2 (0.06)	<0.001	+1.0 (0.05)	<0.001
(InspPEEP) vs. (Insp#ZEEP)	+1.5 (0.09)	<0.001	+1.1 (0.06)	<0.001
(Insp#PEEP) vs. (Exp#PEEP)	+2.6 (0.09)	<0.001	+2.1 (0.07)	<0.001
(Insp#PEEP) vs. (Exp#ZEEP)	+3.6 (0.09)	<0.001	+2.9 (0.06)	<0.001
(Insp#ZEEP) vs. (Exp#PEEP)	+1.2 (0.09)	<0.001	+1.0 (0.06)	<0.001
(Insp#ZEEP) vs. (Exp#ZEEP)	+2.1 (0.09)	<0.001	+1.8 (0.06)	<0.001
(Exp#PEEP) vs. (Exp#ZEEP)	+1.0 (0.09)	<0.001	+0.9 (0.06)	<0.001

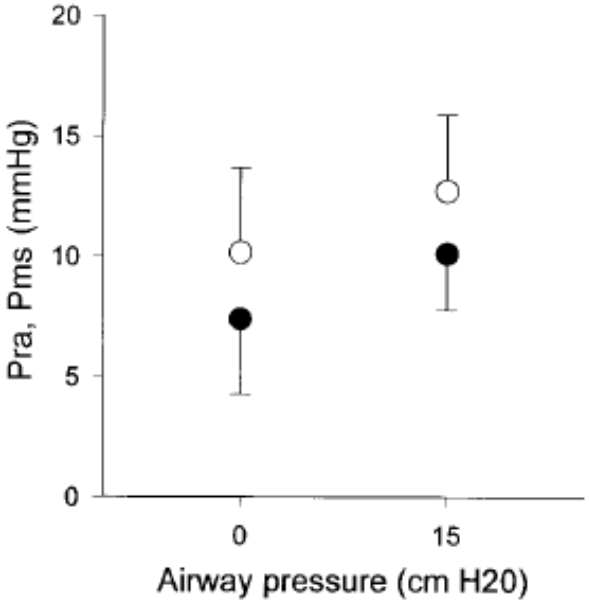
Effects of Positive End-expiratory Pressure on the Gradient for Venous Return[1–3]



Fessler HE Am Rev Respir Dis 1991

Influence of positive airway pressure on the pressure gradient for venous return in humans

Jellinek H, JAP 2000



Adaptations of the Peripheral Circulation to PEEP

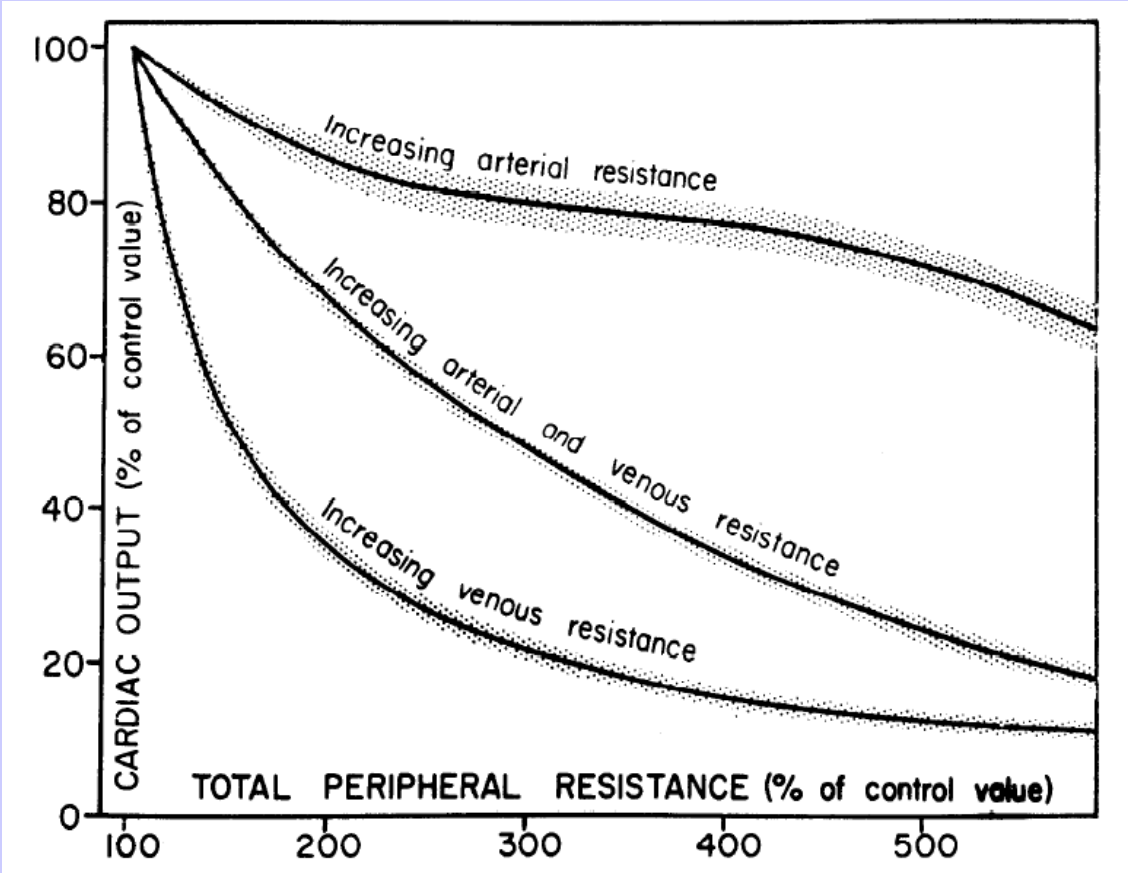
Nanas and Magder 1992

	PEEP cm H_2O		
	Zero ($X \pm SD$)	10 cm ($X \pm SD$)	20 cm ($X \pm SD$)
Cardiac output, L/min	2.8 ± 1.1	2.4* ± 0.9	2.0† ± 0.6
PCWP, mm Hg	4.3 ± 2.4	9.5* ± 2.6	12.6† ± 2.1
CVP, mm Hg	3.2 ± 1.2	7.1* ± 1.9	10.3† ± 2.0
Heart rate, beats/min	152.0 ± 15.8	166.0* ± 23.9	166.0 ± 20.6
SAP, mm Hg	149.8 ± 20.6	137.5 ± 29.3	122.7† ± 18.6
MAP, mm Hg	136.9 ± 21.6	116.2 ± 43.2	103.0† ± 34.7*
MCFP, mm Hg	11.6 ± 3.0	15.0* ± 3.6	18.7† ± 3.3
Compliance, ml/kg·mm Hg	1.8 ± 0.4	1.7 ± 0.4	1.7 ± 0.4
Resistance to venous return, mm Hg·ml·min	3.3 ± 1.3	3.6* ± 1.3	4.5† ± 1.5
Change in Peo, mm Hg	–	2.9* ± 0.4	5.4† ± 0.8
MCFP-Pra, mm Hg	8.4 ± 2.2	7.9 ± 2.2	8.4 ± 2.2

Relative importance of venous and arterial resistances in controlling venous return and cardiac output[1]

ARTHUR C. GUYTON, BERRY ABERNATHY, JIMMY B. LANGSTON, BERWIND N. KAUFMANN AND HILTON M. FAIRCHILD

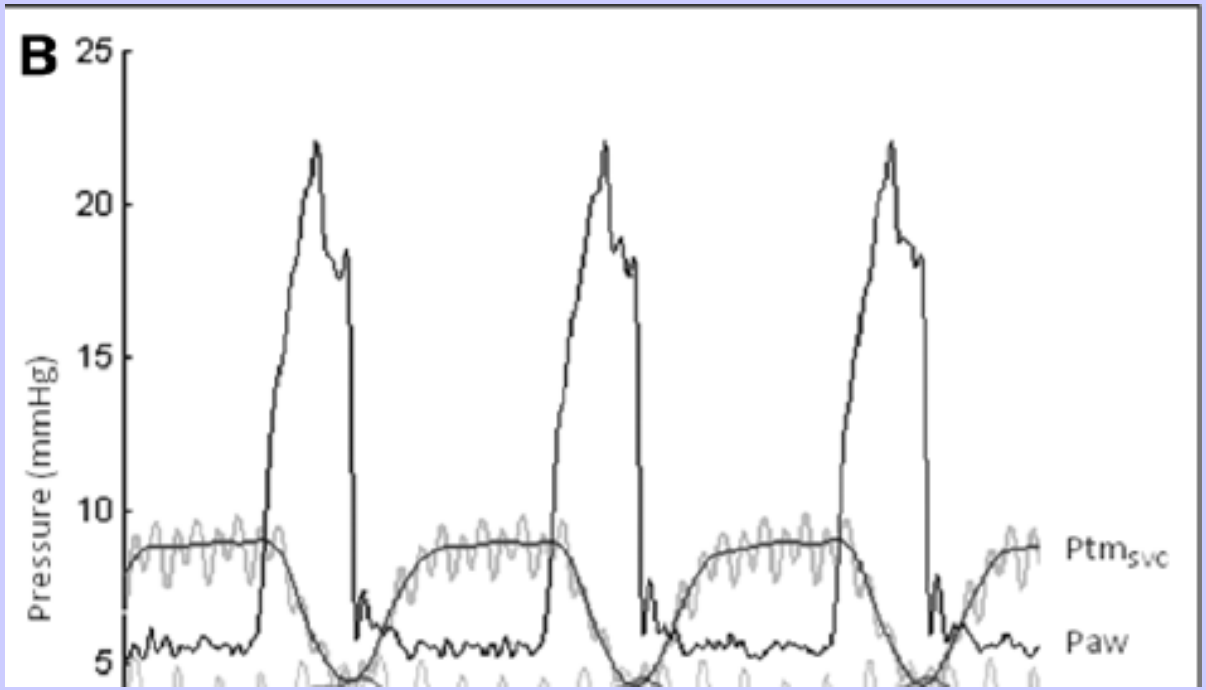
Am J Physiol 1959



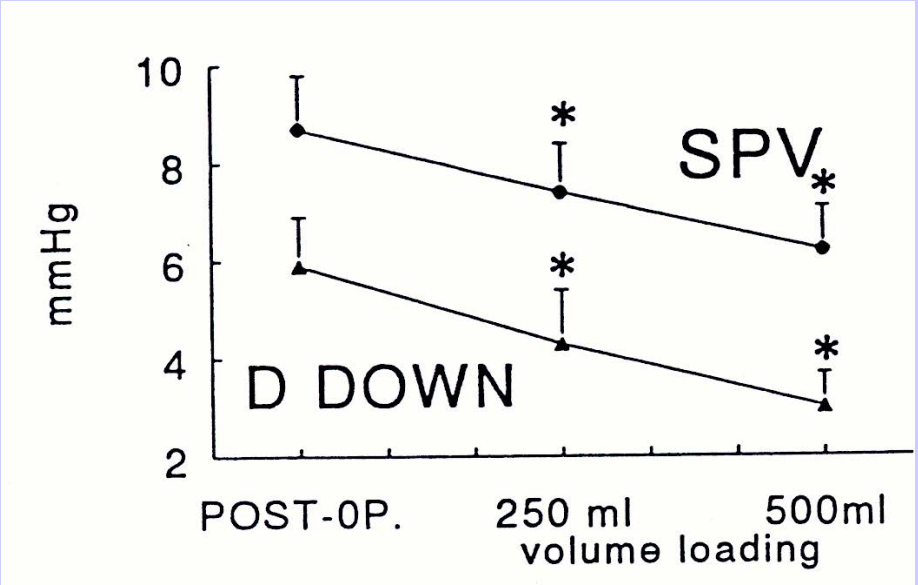
Mechanical Ventilation–Induced Intrathoracic Pressure Distribution and Heart-Lung Interactions*

Benno Lansdorp, MSc[1,2]; Charlotte Hofhuizen, MD[2]; Martijn van Lavieren, MSc[1]; Henri van Swieten, MD, PhD[3]; Joris Lemson, MD, PhD[2]; Michel J. A. M. van Putten, MSc, MD, PhD[1]; Johannes G. van der Hoeven, MD, PhD[2]; Peter Pickkers, MD, PhD[2]

Crit Care Med 2012



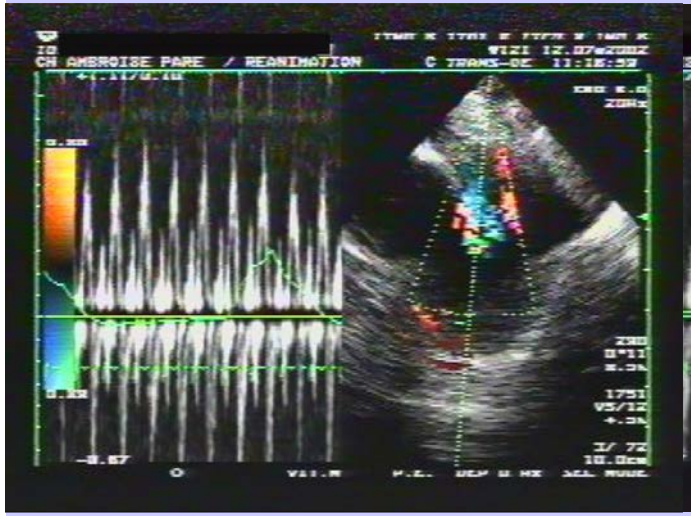
Coriat Anesth Analg 1994

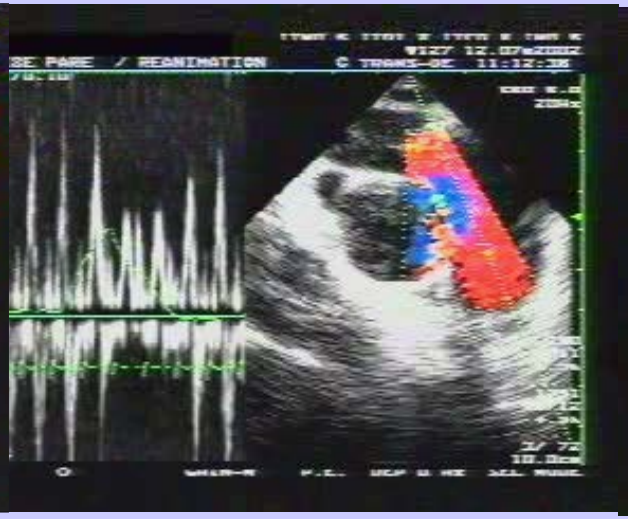


CI 3.7 L/min/m^2

CI 2.5 L/min/m^2

CI 4.5 L/min/m^2





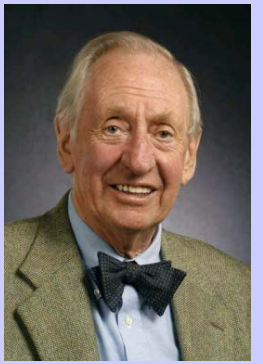
ZEEP

PEEP 5

PEEP 5 expansion

WHITTENBERGER
J Appl Physiol 1960

WEST
J Appl Physiol 1964



PVR

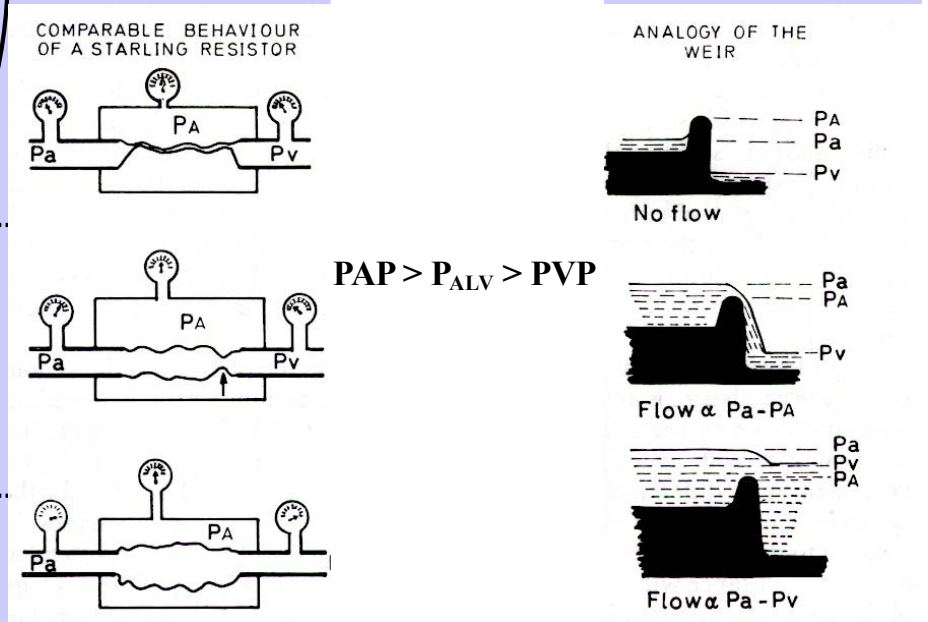
Zone 1

Zone 2

Zone 3

TPP
(cmH_2O)

$P_{ALV} > PAP > PVP$

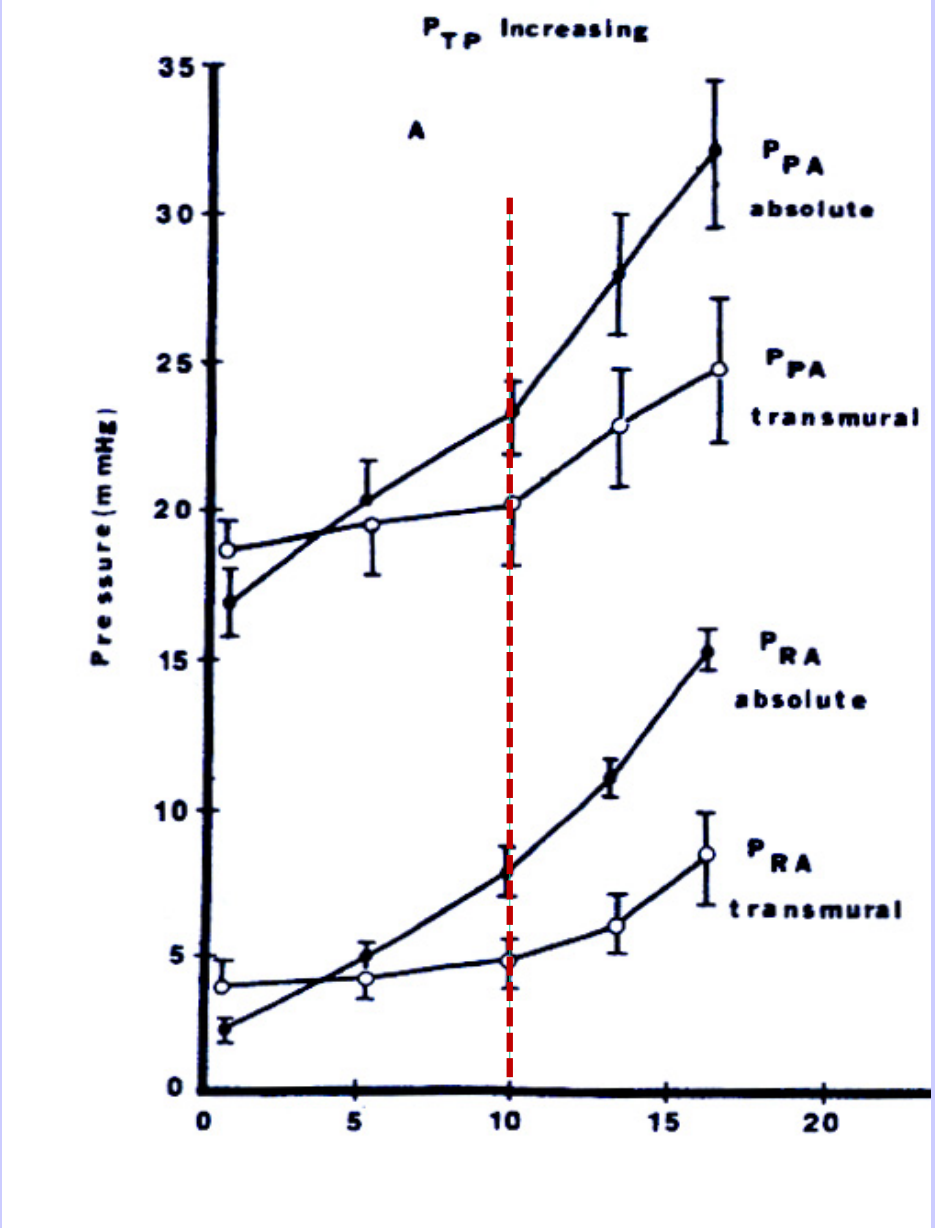


$PAP > P_{ALV} > PVP$

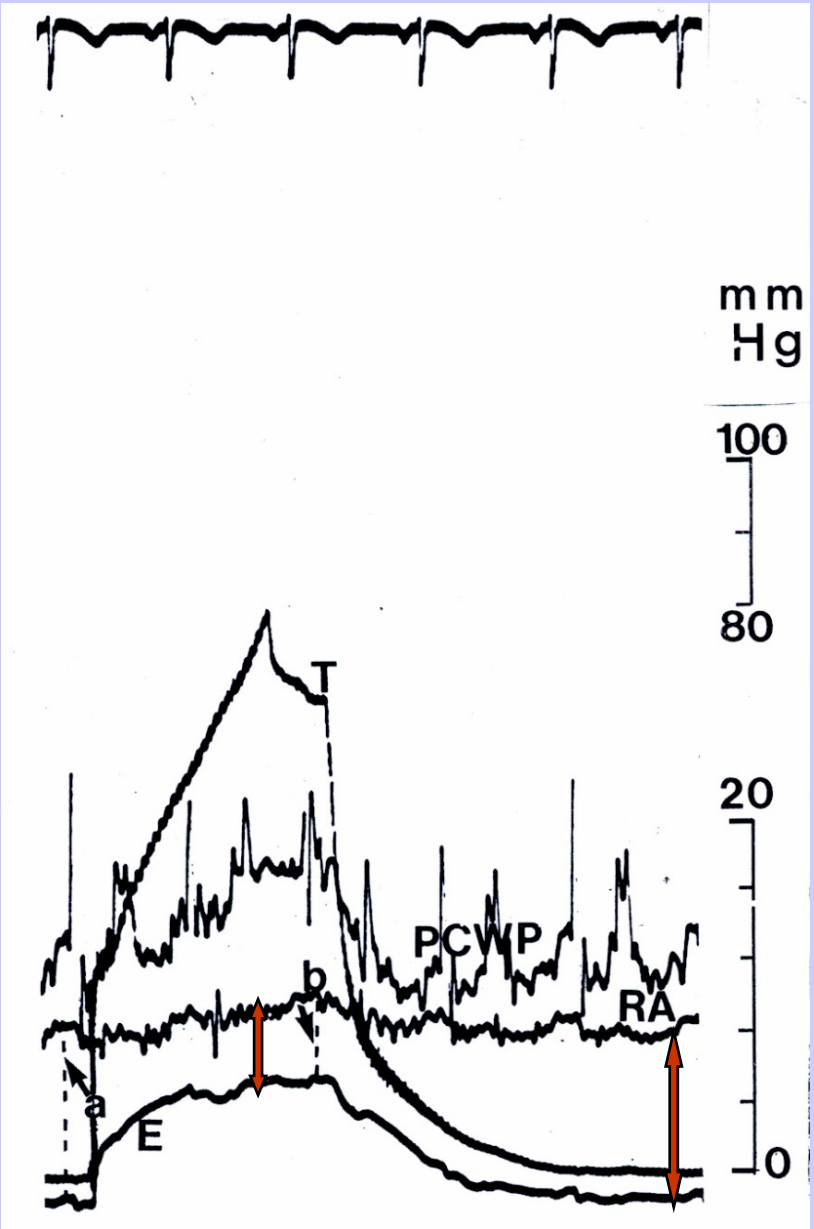
$PAP > PVP > P_{ALV}$

Cardiovascular effects of increasing airway pressure in the dog

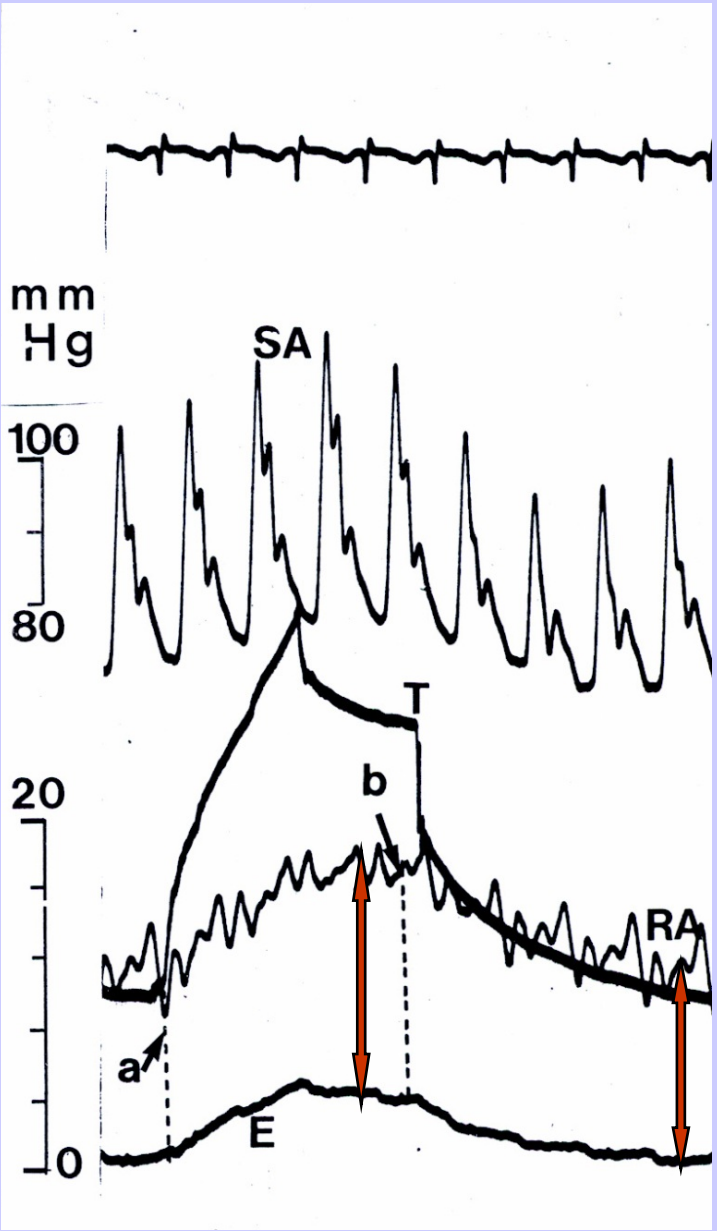
Scharf Am J Physiol 1977



Preload effect



Afterload effect

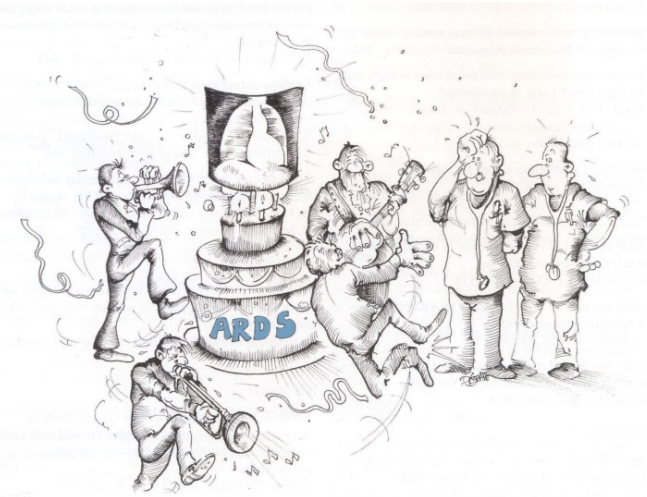


REVIEW

Experts' opinion on management of hemodynamics in ARDS patients: focus on the effects of mechanical ventilation

A. Vieillard-Baron[1,2,3*], M. Matthay[4], J. L. Teboul[5,6], T. Bein[7], M. Schultz[8], S. Magder[9] and J. J. Marini[10]

Intensive Care Med 2016



Happy 50th birthday ARDS!

HEMODYNAMIC FAILURE

SIGNIFICANT PPV

YES

Hemodynamic effect of MV

RELATIVE, ABSOLUTE HYPOVOLEMIA

- Non-dilated RV
- SVC respiratory variations
- Low CVP
- Small IVC

-DISCUSS FLUID EXPANSION (benefits/risks balance)

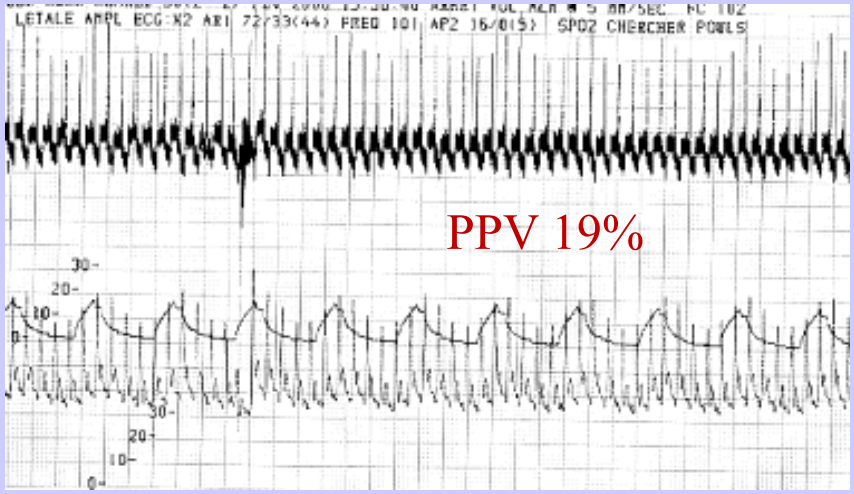
RV OVERLOAD

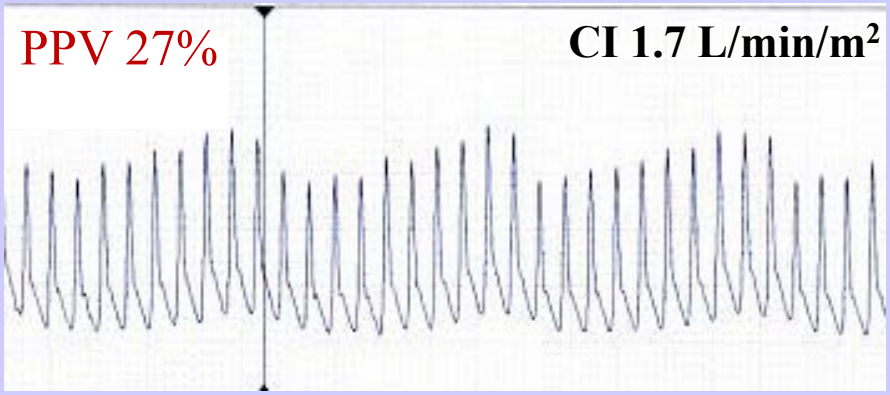
- Dilated RV +/- ACP
- No SVC respiratory variations
- Elevated CVP
- Large IVC

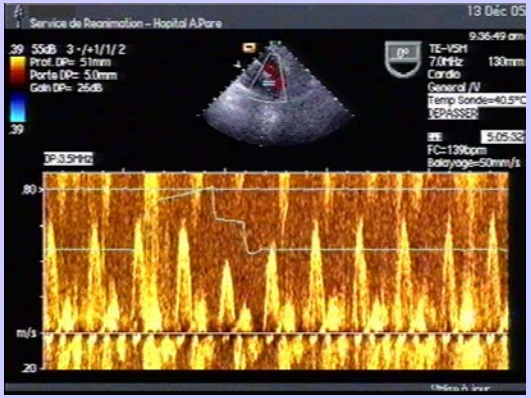
-NO FLUID EXPANSION
-NOREPINEPHRINE
-RESPIRATORY SETTINGS ADAPTATION (Driving pressure, Pplateau, PEEP?)
-LIMIT HYPERCAPNIA
-PRONE POSITION?

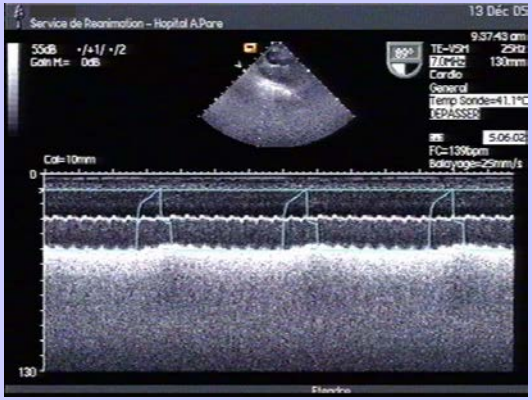
NO

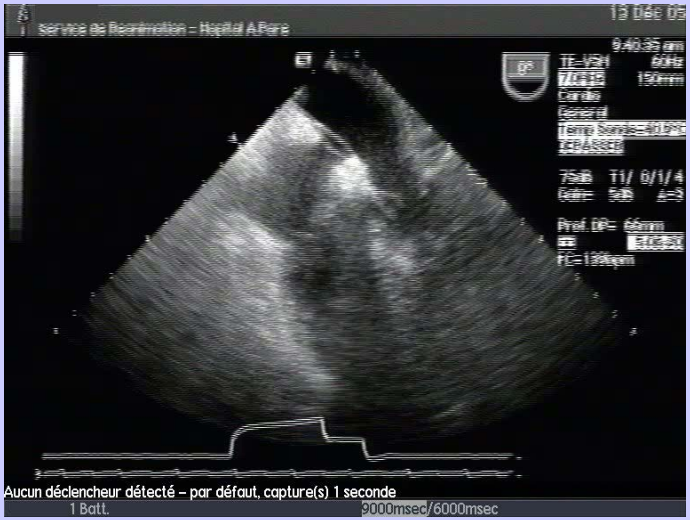
No hemodynamic effect of MV (consider norepinephrine)


PPV 19%


PPV 27%
CI 1.7 L/min/m²


Service de Reanimation – Hopital A.Pare
13 Déc 05

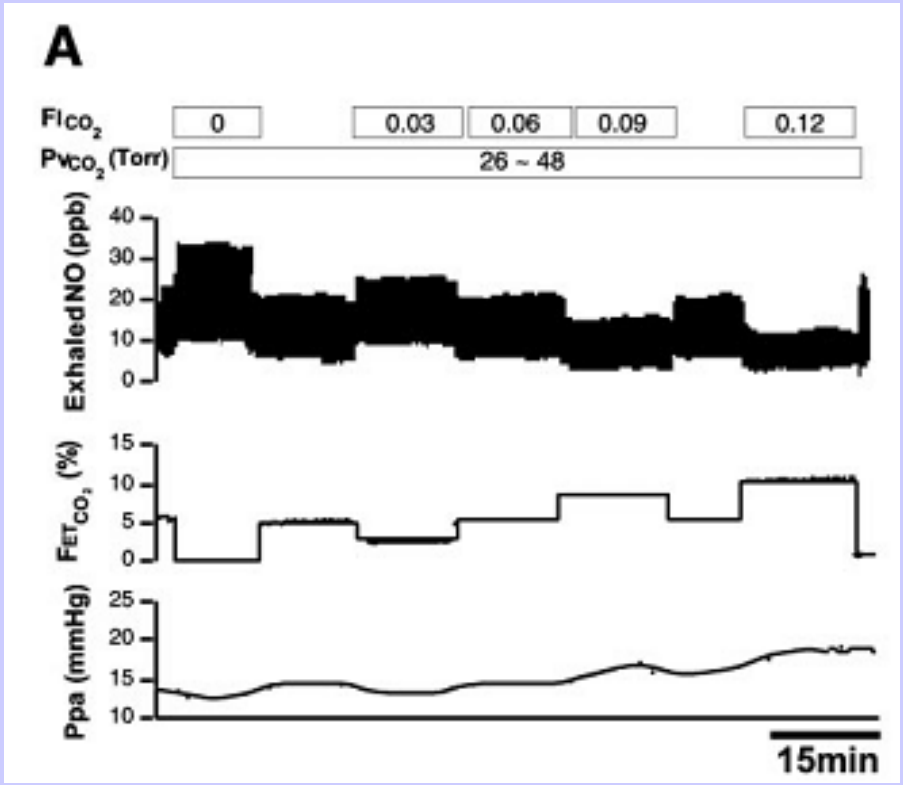

Service de Reanimation – Hopital A.Pare
13 Déc 05

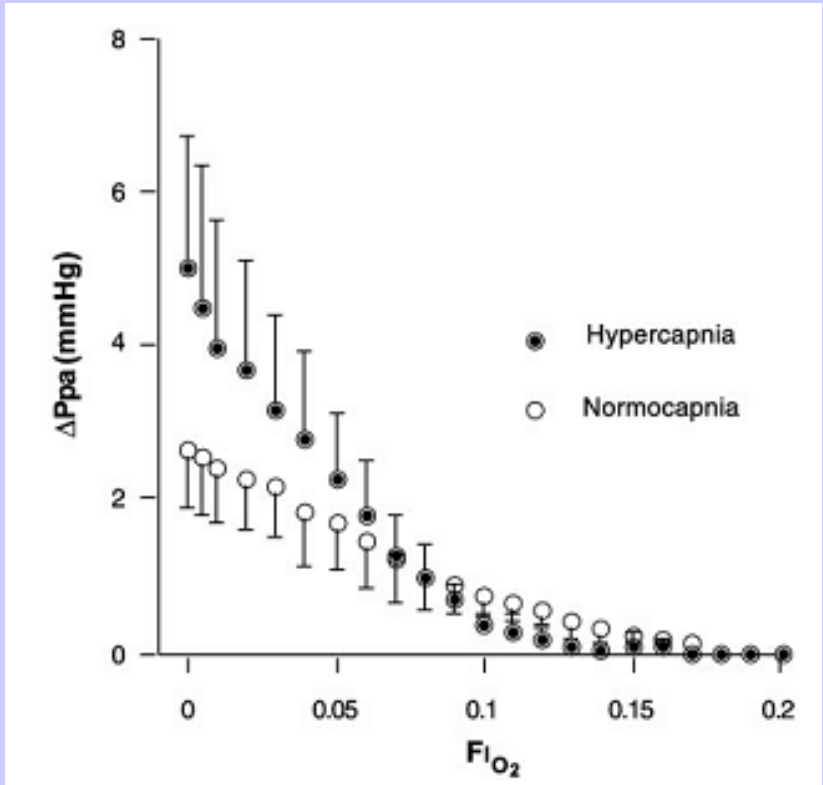

Service de Reanimation – Hopital A.Pare
13 Déc 05
Aucun déclencheur détecté – par défaut, capture(s) 1 seconde
1 Batt.
9000msec/6000msec

J Appl Physiol
91: 1121–1130, 2001.

Role of airway nitric oxide on the regulation of pulmonary circulation by carbon dioxide

YASUSHI YAMAMOTO,[1] HITOSHI NAKANO,[1] HIROSHI IDE,[1] TOSHIYUKI OGASA,[1]
TORU TAKAHASHI,[1] SHINOBU OSANAI,[1] KENJIRO KIKUCHI,[1] AND JUN IWAMOTO[2]

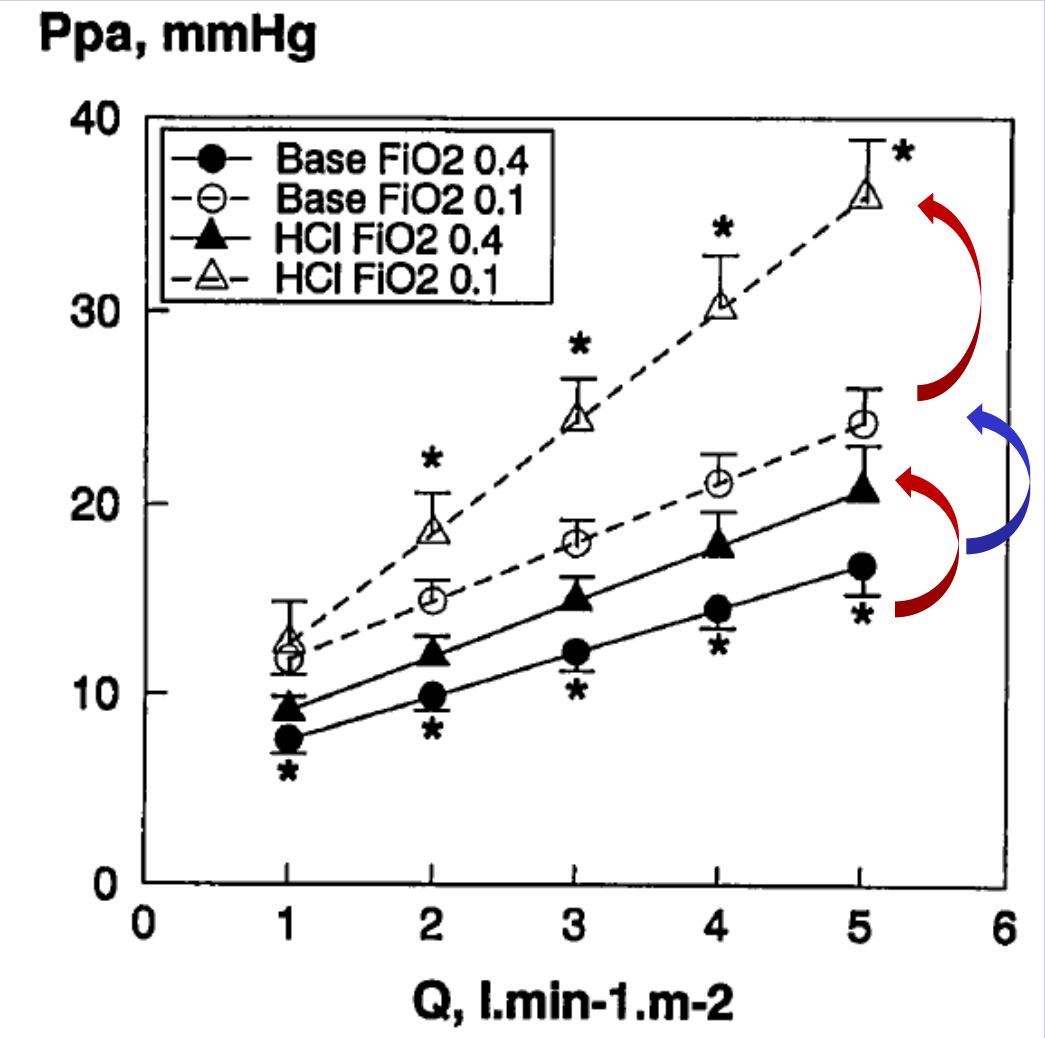




Anesthesiology
73:256–264, 1990

Enhancement of Hypoxic Pulmonary Vasoconstriction by Metabolic Acidosis in Dogs

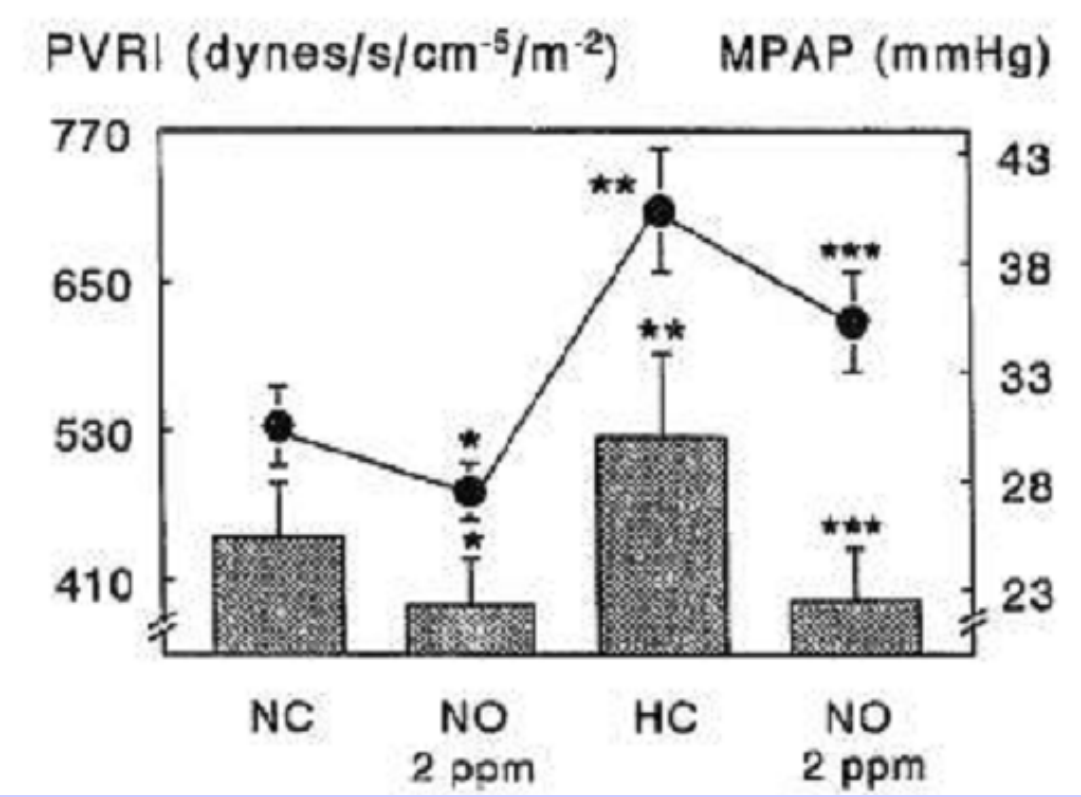
Philippe Lejeune, M.D., Serge Brimioulle, M.D.,* Marc Leeman, M.D.,* Roger Hallemans, M.D.,†*
Christian Melot, M.D., Ph.D, Robert Naeije, M.D., Ph.D.‡*



Inhaled Nitric Oxide Reverses the Increase in Pulmonary Vascular Resistance Induced by Permissive Hypercapnia in Patients with Acute Respiratory Distress Syndrome

Louis Puybasset, M.D., Thomas Stewart, M.D.,† Jean-Jacques Rouby, M.D., Ph.D.,‡ Philippe Cluzel, M.D.,§ Eric Mourgeon, M.D.,* Marie-France Belin, M.D.,§ Martine Arthaud, M.D.,‖ Catherine Landault, M.D., Ph.D.,# Pierre Viars, M.D., Ph.D.***

Anesthesiology 1994



Henri Mondor

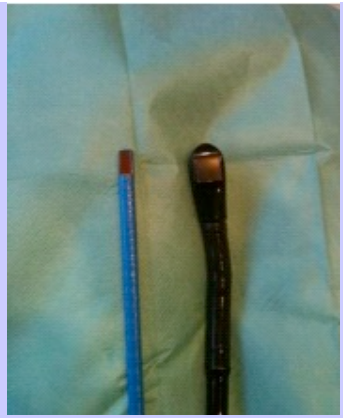
Armand Mekontso Dessap
Cyril Charron
Jérôme Devaquet
Jérôme Aboab
François Jardin
Laurent Brochard
Antoine Vieillard-Baron

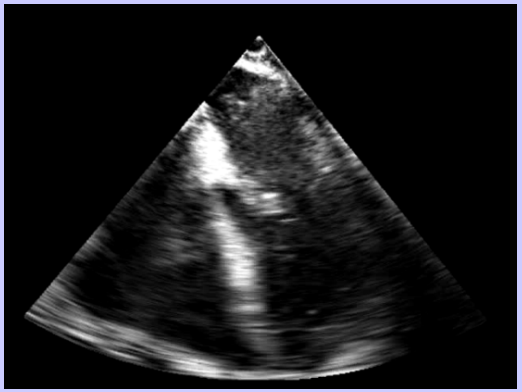
Impact of acute hypercapnia and augmented positive end-expiratory pressure on right ventricle function in severe acute respiratory distress syndrome

Ambroise Paré

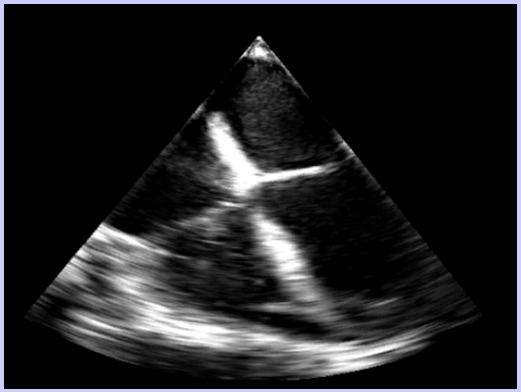
Intensive Care Med 2009

	Baseline	T1
$PaCO_2$	52 mmHg	71 mmHg
pH	7.30	7.17
Pplateau	22cmH_2O	23cmH_2O
DrivingP	17cmH_2O	12cmH_2O
RV/LV	0.64	0.85





D1, 10 p.m
$PaCO_2$: 88 mmHg
BD 14 mmol/l



D2, 7 a.m
$PaCO_2$: 55 mmHg
BD 2.3 mmol/l

ORIGINAL ARTICLE

Veno-venous extracorporeal CO_2 removal improves pulmonary hemodynamics in a porcine ARDS model

P. Morimont[1,2], J. Guiot[1,2], T. Desaive[2], V. Tchana-Sato[2], N. Janssen[2], A. Cagnina[2], D. Hella[3], F. Blaffart[3], J.-O. Defraigne[2,4], B. Lambermont[1,2]

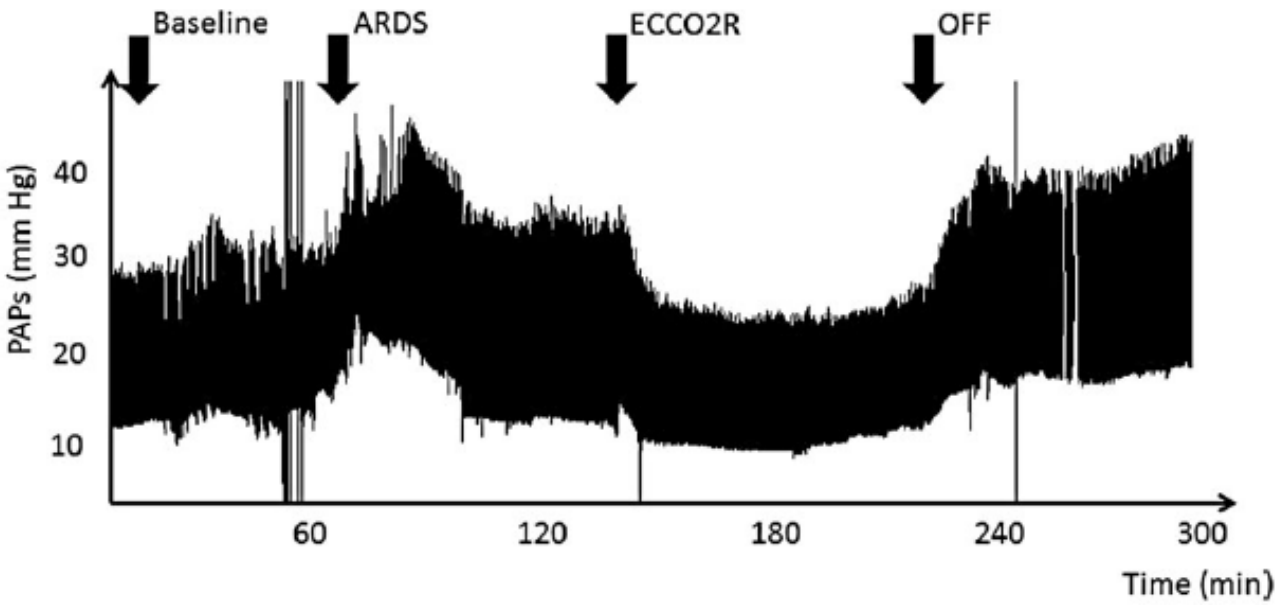
Acta Anaesthesiol Scand 2015

Table 1 Arterial blood gas data.

	PaO_2 (mmHg)	$PaCO_2$ (mmHg)	pH
Baseline	178,8 ± 42†	41,7 ± 3,6†	7,44 ± 0.05†
ARDS	54,7 ± 12,3*	78,6 ± 8,1*	7,13 ± 0.05*
$ECCO_2RT$	72,2 ± 21,0*	39,8 ± 5,6†	7,36 ± 0.05†
OFF	61,1 ± 15,12*	70,5 ± 11,2*	7,15 ± 0.05*

Table 2 Hemodynamic data.

	HR			Ees/Ea
Baseline	73 ±		93 ± 0,25	0.92 ± 0,27†
ARDS	103 ±		99 ± 0,42	0,52 ± 0,20*
$ECCO_2RT$	82 ±		95 ± 0.22	0,98 ± 0,27†
OFF	76 ±		05 ± 0,31	0,60 ± 0,14*

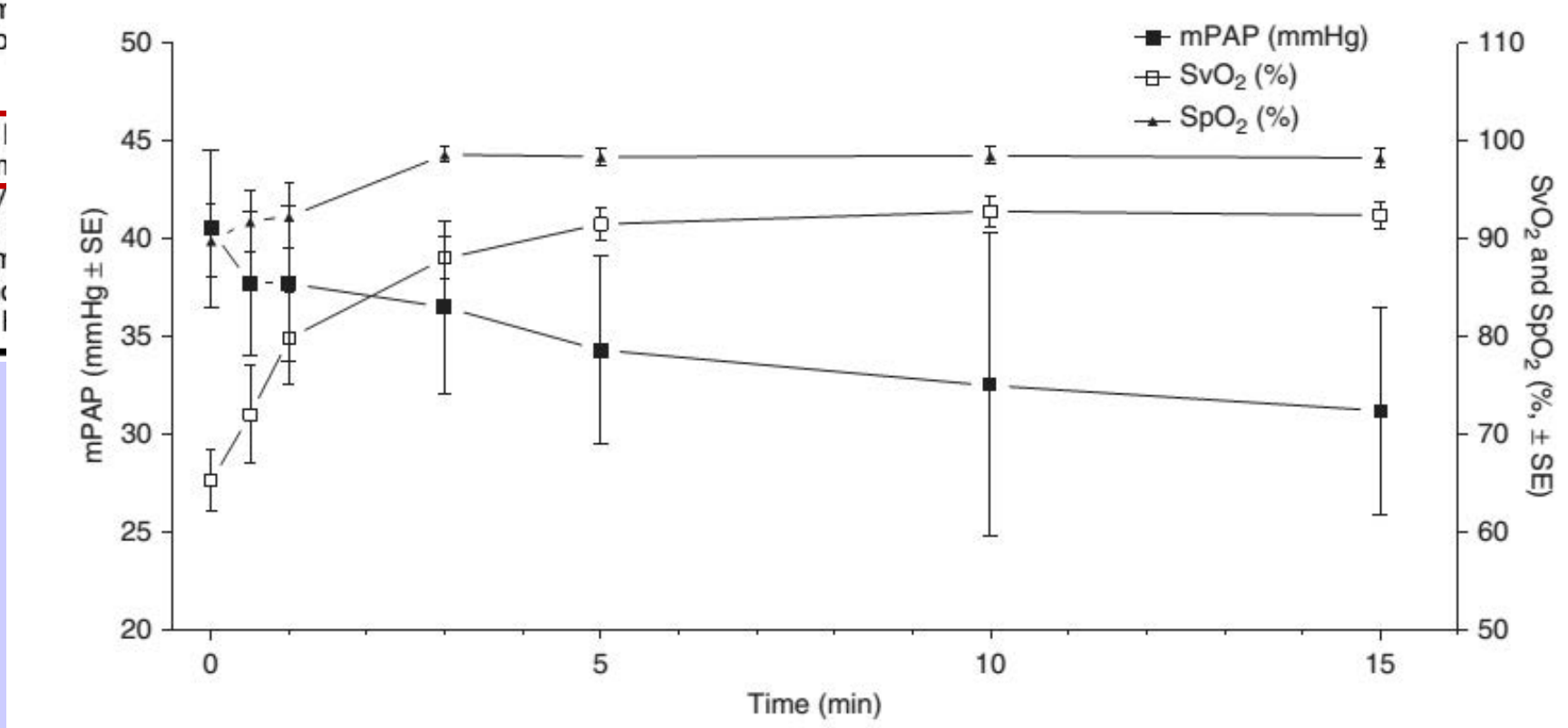


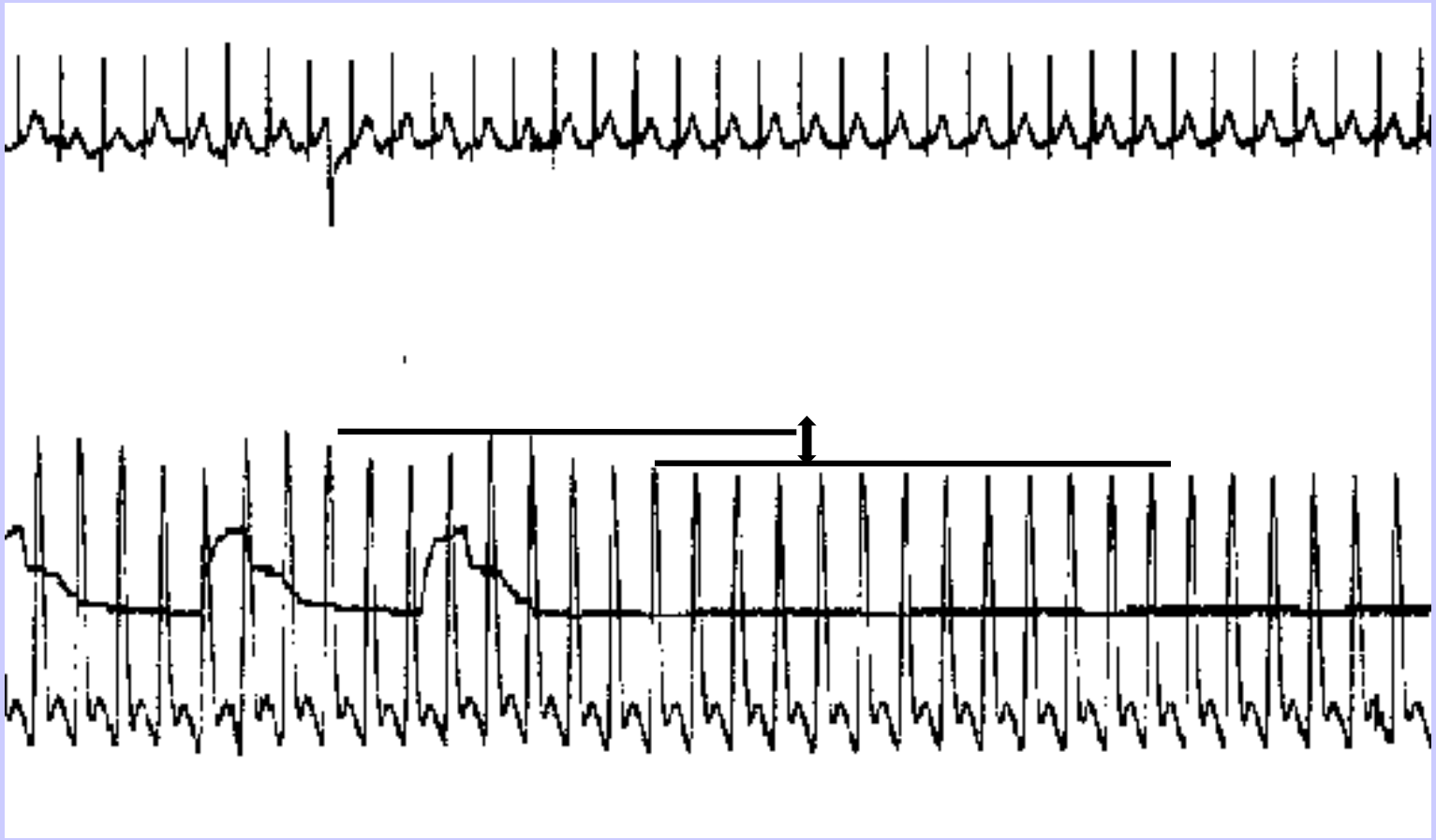
Right Ventricular Unloading after Initiation of Venovenous Extracorporeal Membrane Oxygenation

To the Editor:

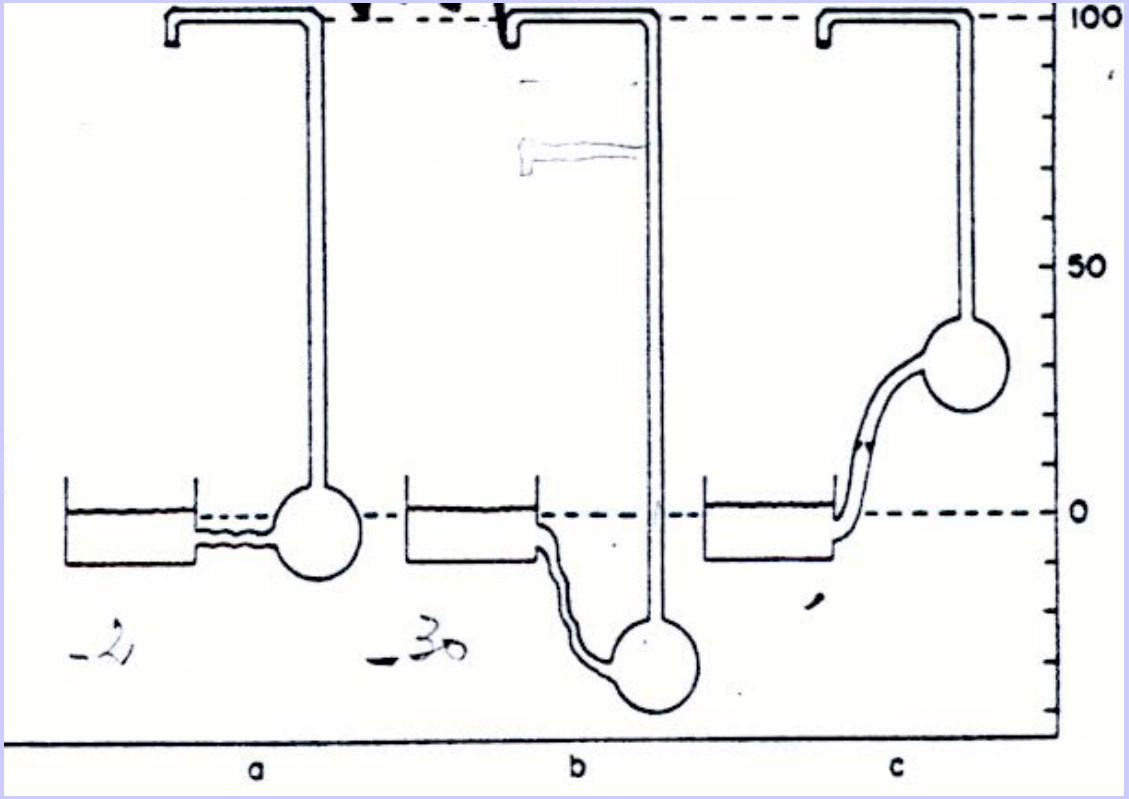
Reis Miranda AJRCCM 2015

	Baseline	Time after Initiation Venovenous Extracorporeal Membrane Oxygenation (*min*)							
		0.5	1	3	5	10	15	60	720
PIP, mbar	35 ± 2	35 ± 2	35 ± 2	29 ± 2	29 ± 2	25 ± 2	24 ± 2	22 ± 1	24 ± 1
PEEP, mbar	16 ± 2	16 ± 2	15 ± 2	14 ± 2	15 ± 2	15 ± 2	14 ± 2	14 ± 1	14 ± 1
V_T/PBW, r									2 ± 0.4
MPaw, mb									9 ± 1
F_{IO_2}, %									0 ± 3
pH									3 ± 0.3
Pa_{O_2}, mm									8 ± 6
Pa_{CO_2}, mm									7 ± 3
HR, beats/									5 ± 6*
MAP, mm									4 ± 4
mPAP, mm									3 ± 2*
Cardiac in									4 ± 0.3
CVP, mm									5 ± 3





LV AFTERLOAD EFFECT?



McGregor N Engl J Med 1979

JACC, 2018

COUNCIL PERSPECTIVES

Positive Pressure Ventilation in the Cardiac Intensive Care Unit

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TABLE 7 Key Points

- Positive pressure ventilation decreases RV preload, increases RV afterload, and decreases LV afterload.
- High-flow oxygen can avoid the need for positive pressure ventilation in some patients.
- BiPAP is preferred over CPAP when there is a need to reduce work of breathing and/or improve ventilation in patients with hypercarbia.
- PEEP is useful for oxygenation and to avoid or treat atelectasis, but can also be useful in unloading a failing LV.
- Auto-PEEP should be watched for in patients with increased airway resistance, hyperinflation, or ineffective triggering, and can lead to hemodynamic instability or barotrauma.
- Positive pressure should be avoided if possible, or used cautiously, in conditions dependent on adequate RV filling, such as acute pulmonary hypertension, RV failure. and tamponade.

http://www.echo-rea.uvsq.fr

Echocardiography in intensive care

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UFR de Médecine PIFO
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INTERNATIONAL COURSE

Monday, 01 September 2008

INTERNATIONAL COURSE ON

ECHOCARDIOGRAPHY IN THE ICU
FROM THE BASICS TO HEMODYNAMIC EVALUATION

Brussels - Erasme Hospital, November 5-7, 2008

Program 139.81 Kb

Introduction

Sunday, 02 January 2005

In the late 1980s, the Medical Intensive Care Unit of the Ambroise Paré Hospital abandoned right cardiac catheterization as a diagnostic and monitoring tool for acute circulatory and respiratory failure in intensive care.

Instead we now always use transthoracic and transesophageal echocardiography in which we have acquired great expertise and experience and which we use for the diagnostic and therapeutic management of patients presenting severe sepsis, massive pulmonary embolism, or acute respiratory distress syndrome.

Professor Antoine Vieillard-Baron and Dr Alain Beauchet, in collaboration with Professor François Jardin, **have designed this website for intensivists and intensivists trained in anesthesiology who wish to start using echocardiography in intensive care or to upgrade their use of it**.

By presenting real clinical cases and video clips, all recorded in our unit, this website constitutes a genuine tool for ongoing medical training. We shall