CHU Hôpitaux de Bordeaux

Inserm
Institut national de la santé et de la recherche médicale

université de BORDEAUX

Interactions cardiopulmonaires : approche physiologique, limites, applications au guidage du remplissage vasculaire

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Cours Européens, Lacanau

Samedi 11 juin 2016

Interactions Cardiopulmonaires

- **Approche Physiologique**
  - Relation VES-Précharge et VES-postcharge
  - Analyse de la courbe de pression artérielle
- **Significativité**
- **Implications Cliniques**
- **Limites**
- **Perspectives**

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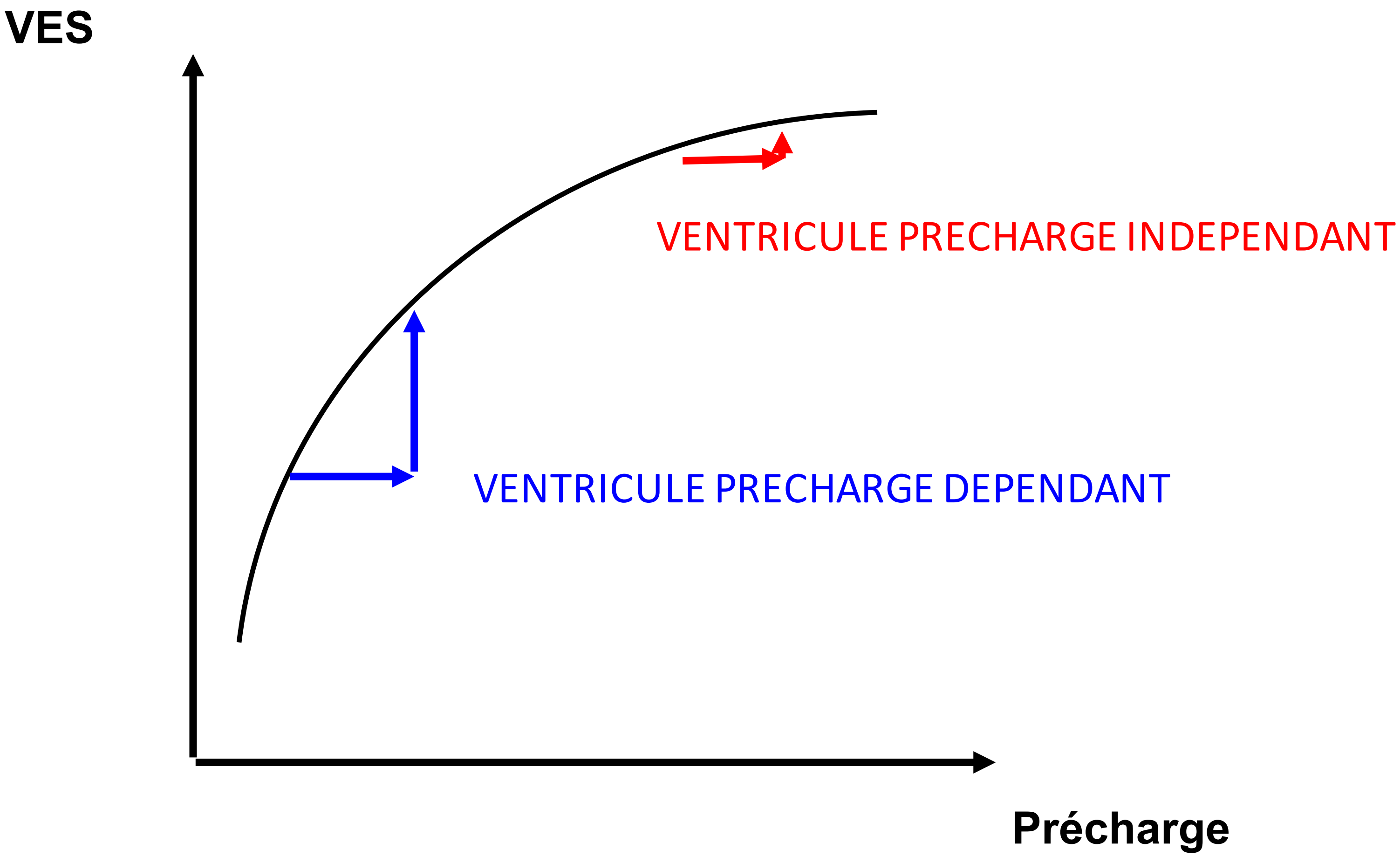
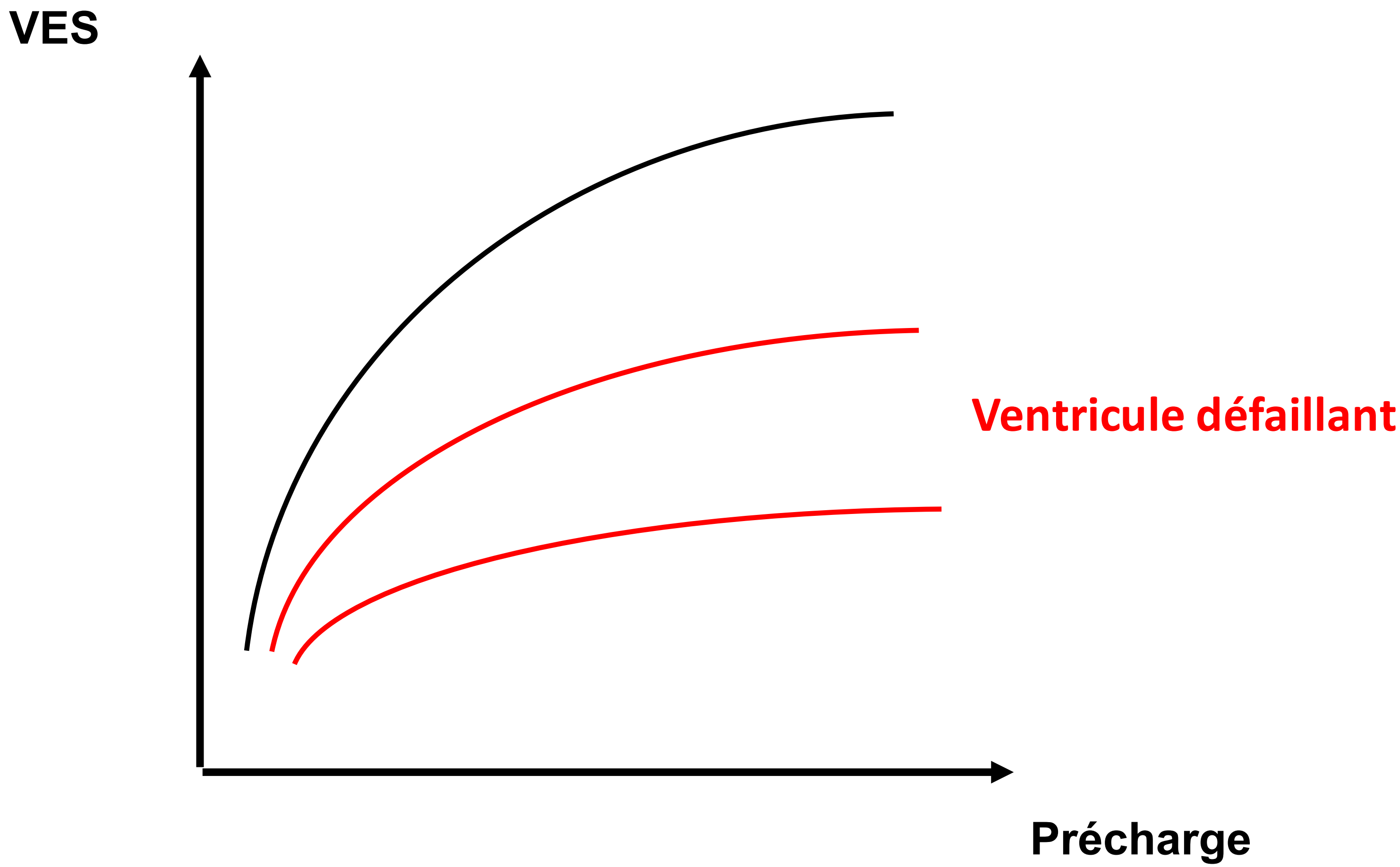
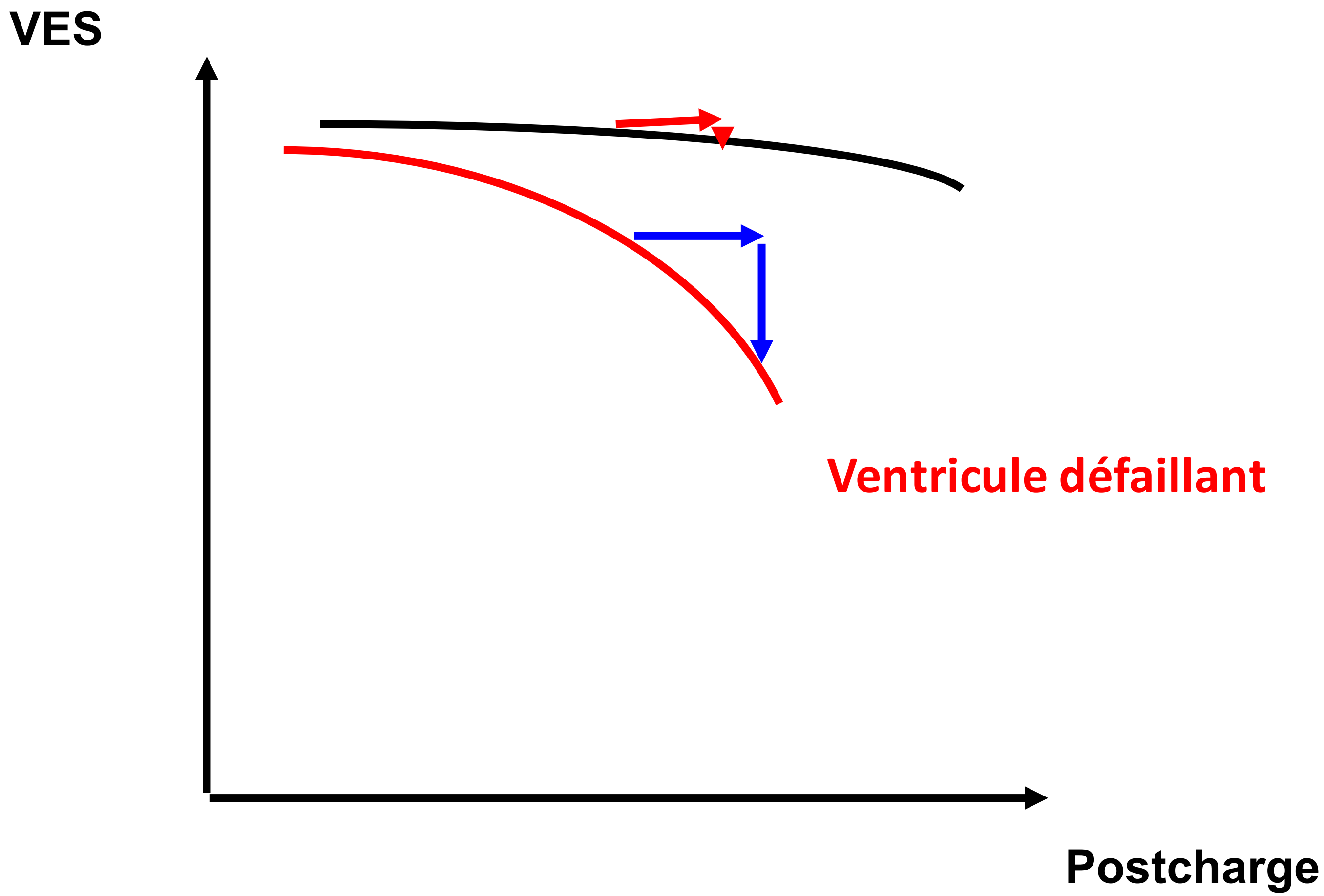
Relation VES - Précharge



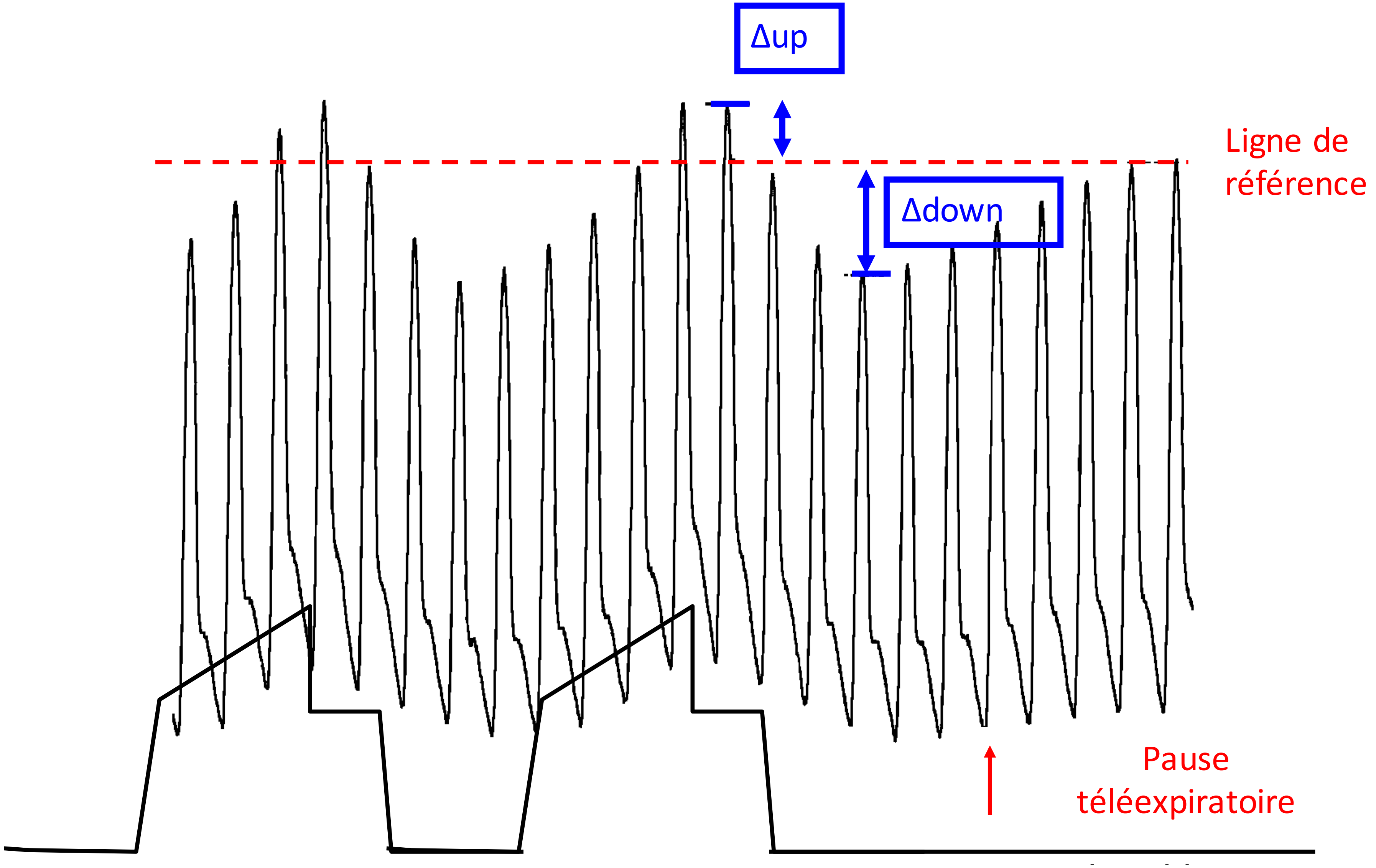
Relation VES - Précharge



Relation de VES - Postcharge



Analyse de la courbe de PA



Delta-down

Insufflation Mécanique

1. Diminution précharge VD

   Augmentation des pressions intrathoraciques

2. Augmentation postcharge VD

   Augmentation pressions transpulmonaires

Delta-down

Insufflation Mécanique

1. Diminution précharge VD

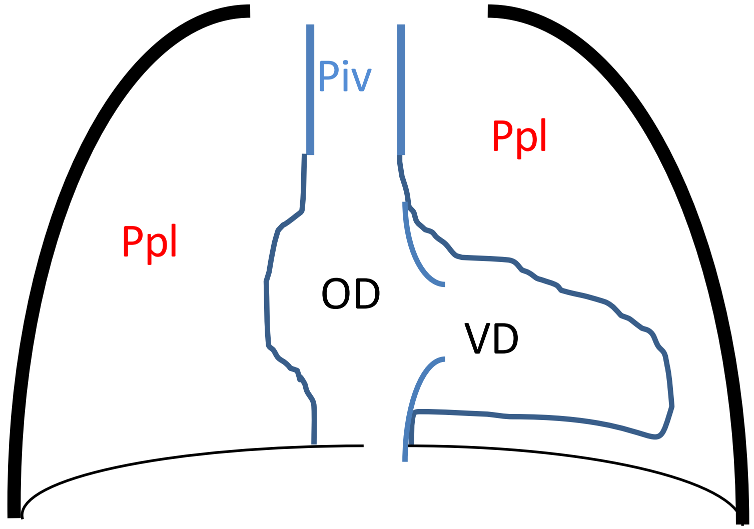
Augmentation des pressions intrathoraciques

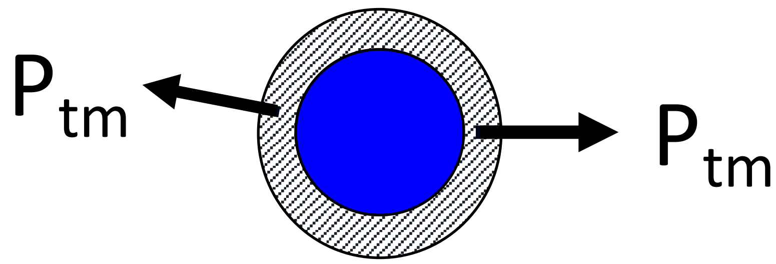
2. Augmentation postcharge VD

Augmentation pressions transpulmonaires

Pression Transmurale

Pression de distension d'un vaisseau ou d'une cavité cardiaque

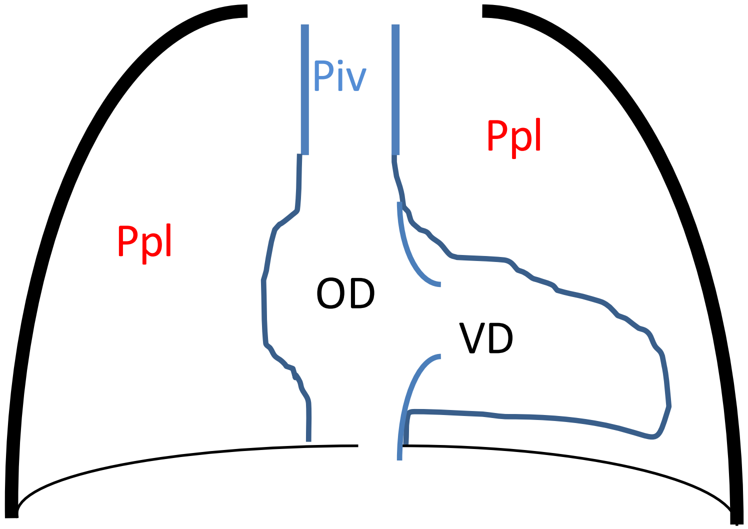




Ptm = Piv – Pev

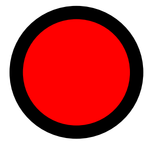
Pression extravasculaire (Pev)= pression pleurale

Pression Transmurale



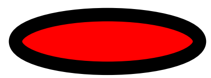
$$Ptm = Piv - Ppl$$

Insufflation mécanique



Augmentation de la pression pleurale

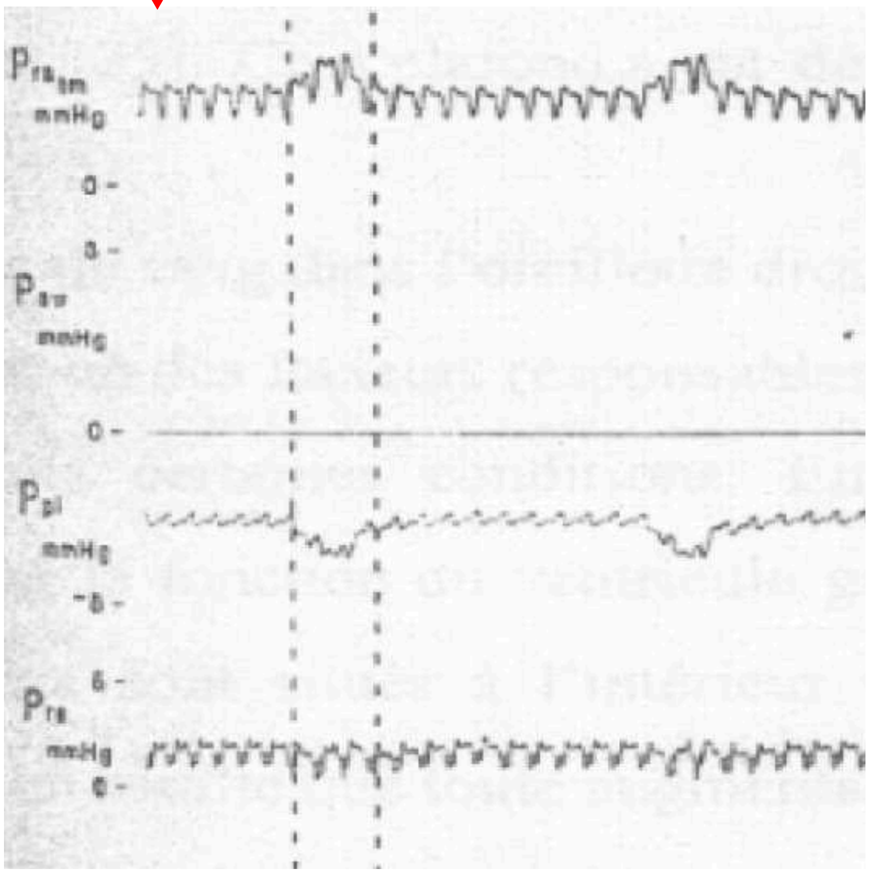
Diminution de la Ptm (intrathoracique)



PVCtm = PVC – Ppl

Ventilation en Spontanée

Inspiration



PVCtm = PVC – Ppl

Ventilation en Spontanée

Inspiration

Ventilation en pression positive

Inspiration

PVC tm

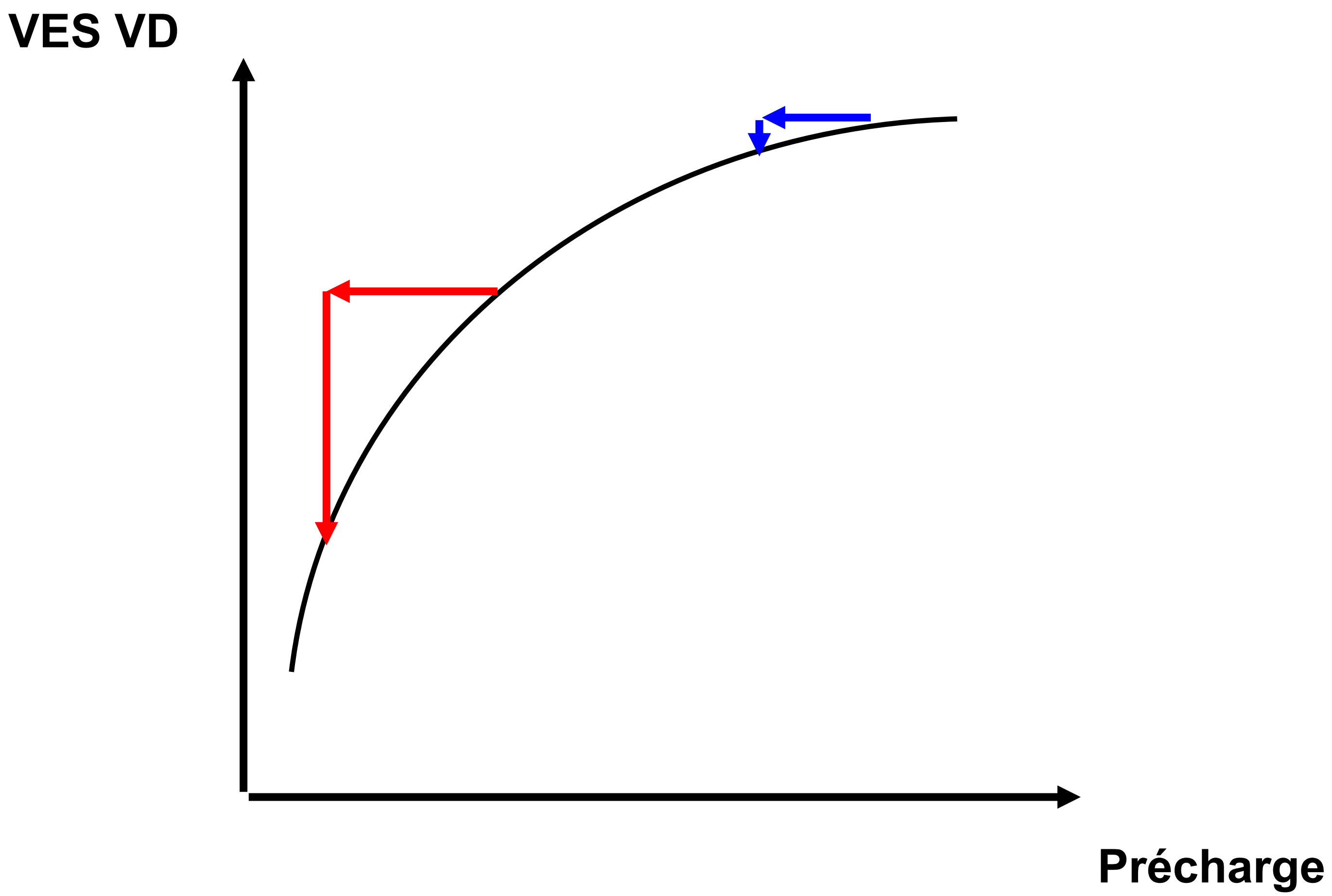
P° voies aériennes

P° pleurale

PVC

Insufflation : diminution pression transmurale = diminution du retour veineux systémique

Diminution du VES si VD précharge dépendant



Delta-down

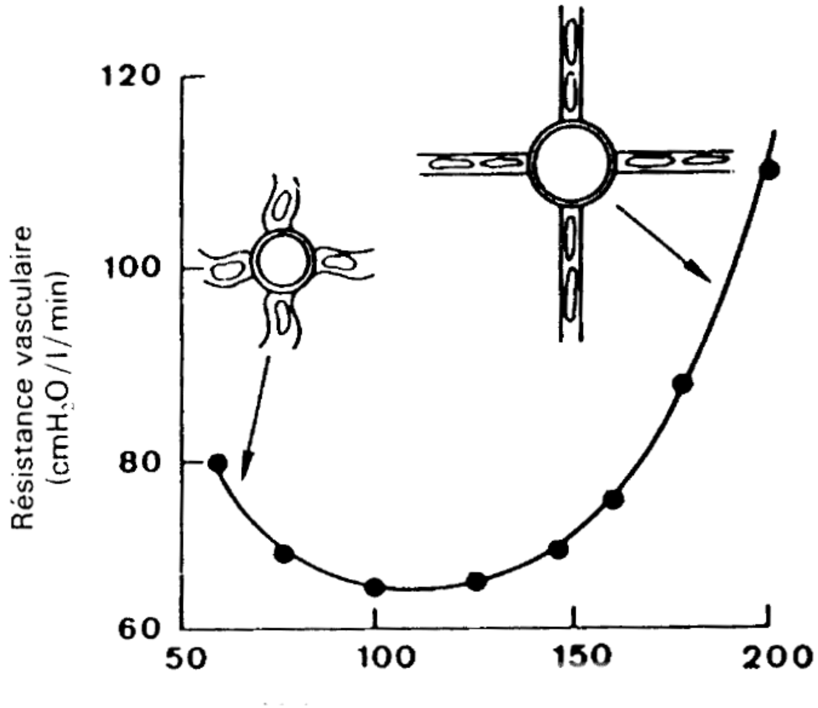
Insufflation Mécanique

1. Diminution précharge VD
   - Augmentation des pressions intrathoraciques

2. Augmentation postcharge VD

   Augmentation pressions transpulmonaires

Augmentation Postcharge VD



Volume pulmonaire (ml)

Insufflation mécanique

⬇

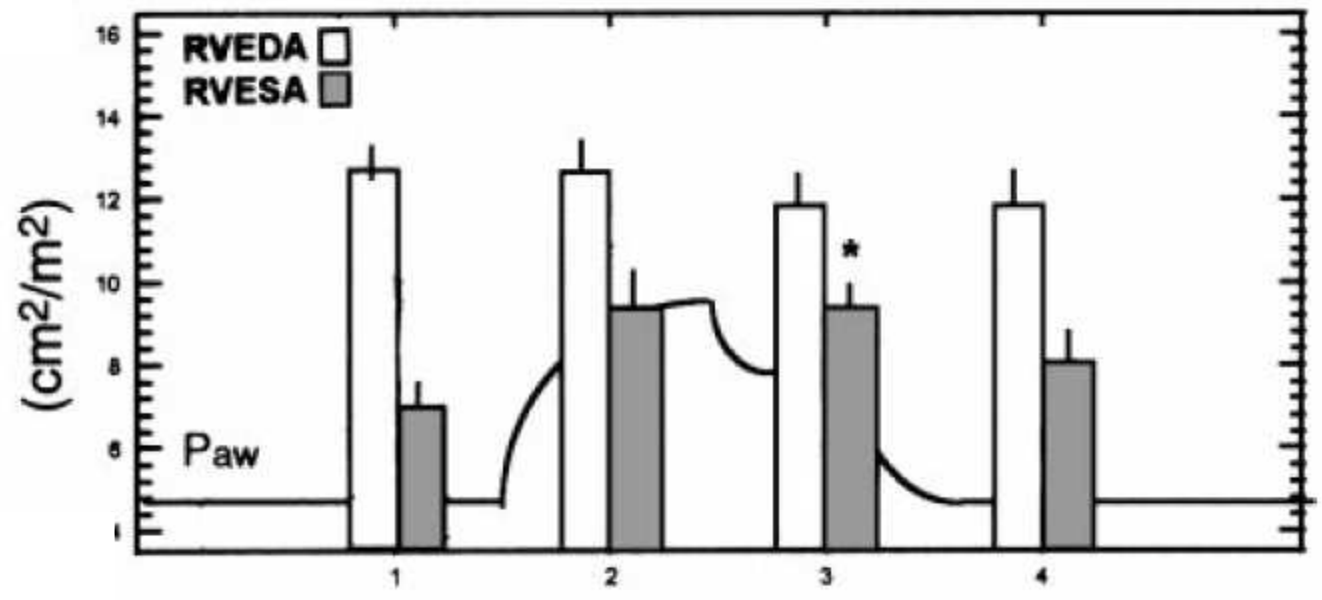
Distension alvéolaire

⬇

↓ Diamètre capillaires pulmonaires

⬇

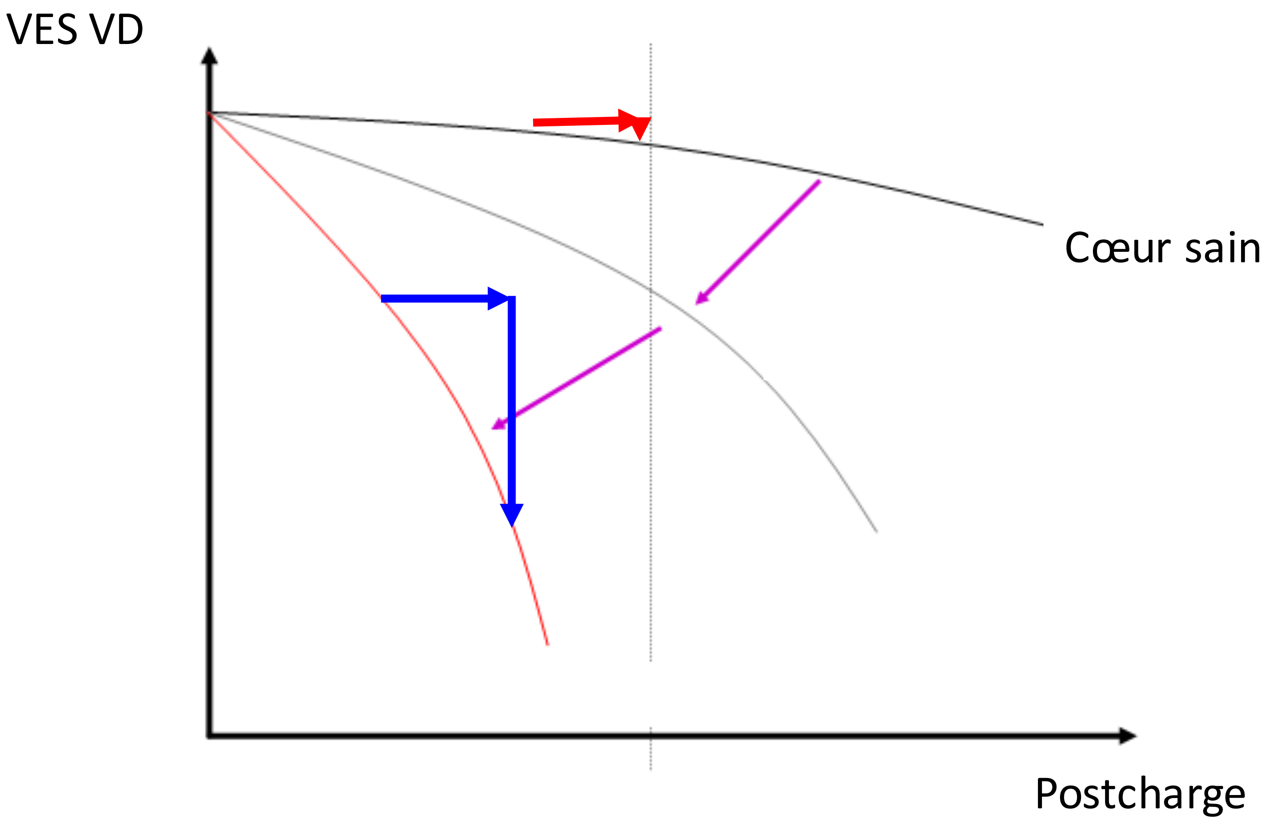
↑ cyclique des RVP



Insufflation mécanique:
Augmentation Surface télésystolique VD

Vieillard-Baron et al. J Appl Physiol 1999

Diminution du VES si VD postcharge dépendant



Delta-down

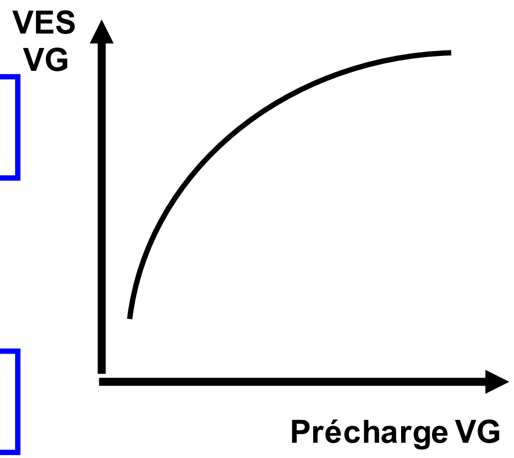
Insufflation Mécanique

↓ Précharge VD
↑ Postcharge VD
→ ↓ Volume éjection VD

Temps de transit pulmonaire

↓ Précharge VG

↓ Volume éjection VG



Delta-up

Insufflation Mécanique

1. Augmentation de la précharge VG

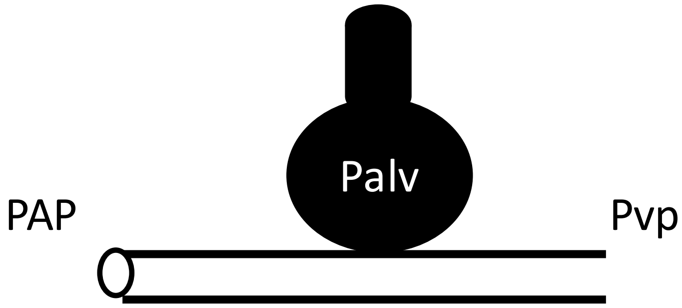
2. Diminution de la contrainte pariétale myocardique

Delta-up

Insufflation Mécanique

1. Augmentation de la précharge VG
2. Diminution de la contrainte pariétale myocardique

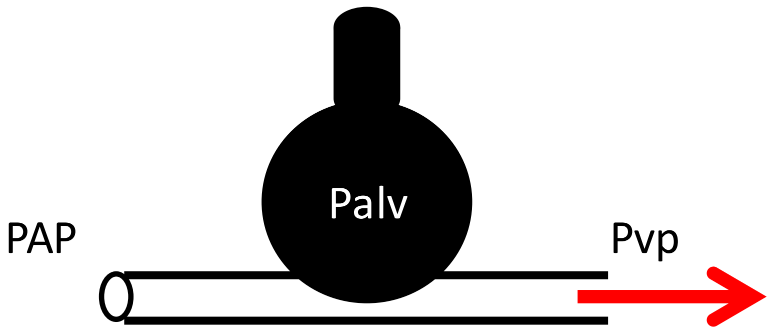
EXPIRATION



PAP > Pvp > Palv

Zone III de West

INSUFFLATION MECANIQUE



PAP > Palv > Pvp

Zone II de West

Effet de chasse du sang veineux pulmonaire vers l'oreillette gauche

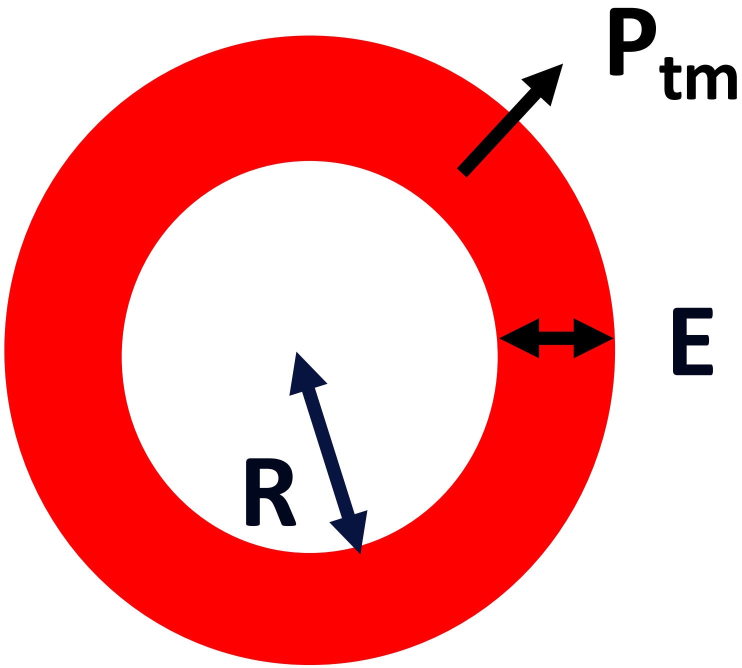
D'après Vieillard-Baron

Delta-up

Insufflation Mécanique

1. Augmentation de la précharge VG
2. Diminution de la contrainte pariétale myocardique

Contrainte Pariétale Circonférentielle



Loi de Laplace

$$\sigma = (P_{tm} \times R) / E$$

Contrainte Pariétale Circonférentielle

Insufflation mécanique

⬇

↓ Ptm, ↓ R donc ↓ σ

⬇

Augmentation du VES

Loi de Laplace

$$\sigma = (P_{tm} \times R) / E$$

Delta-up

Insufflation Mécanique

↓

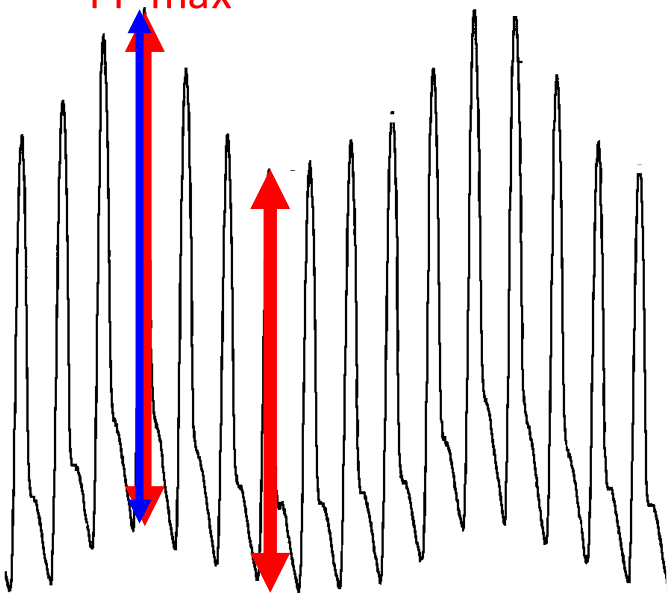
↑ Précharge VG

Diminution Contrainte pariétale VG

↓

↑ Volume éjection VG

Delta-PP



$$\Delta PP = \frac{PPmax - PPmin}{(PPmax + PPmin)\ /\ 2} \times 100$$

Pression pulséee = PAS - PAD

$$\text{Pression pulsée} = k. \frac{VES}{\text{Compliance artérielle}}$$

Compliance constante au cours d'un cycle respiratoire

Variations de pression pulsée

=

Variations de VES

Insufflation Mécanique

Diminution VES VD

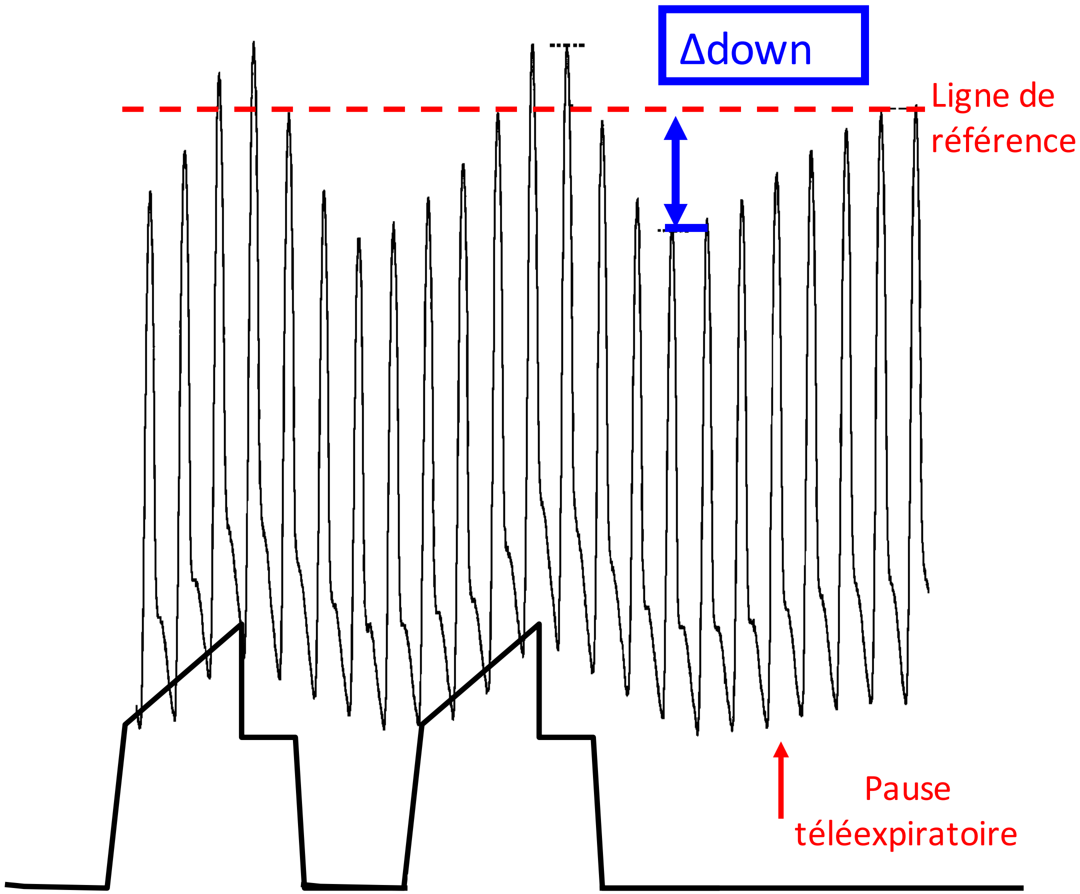
– ↓ précharge VD
– ↑ postcharge VD

↓

Temps de transit pulmonaire

↓

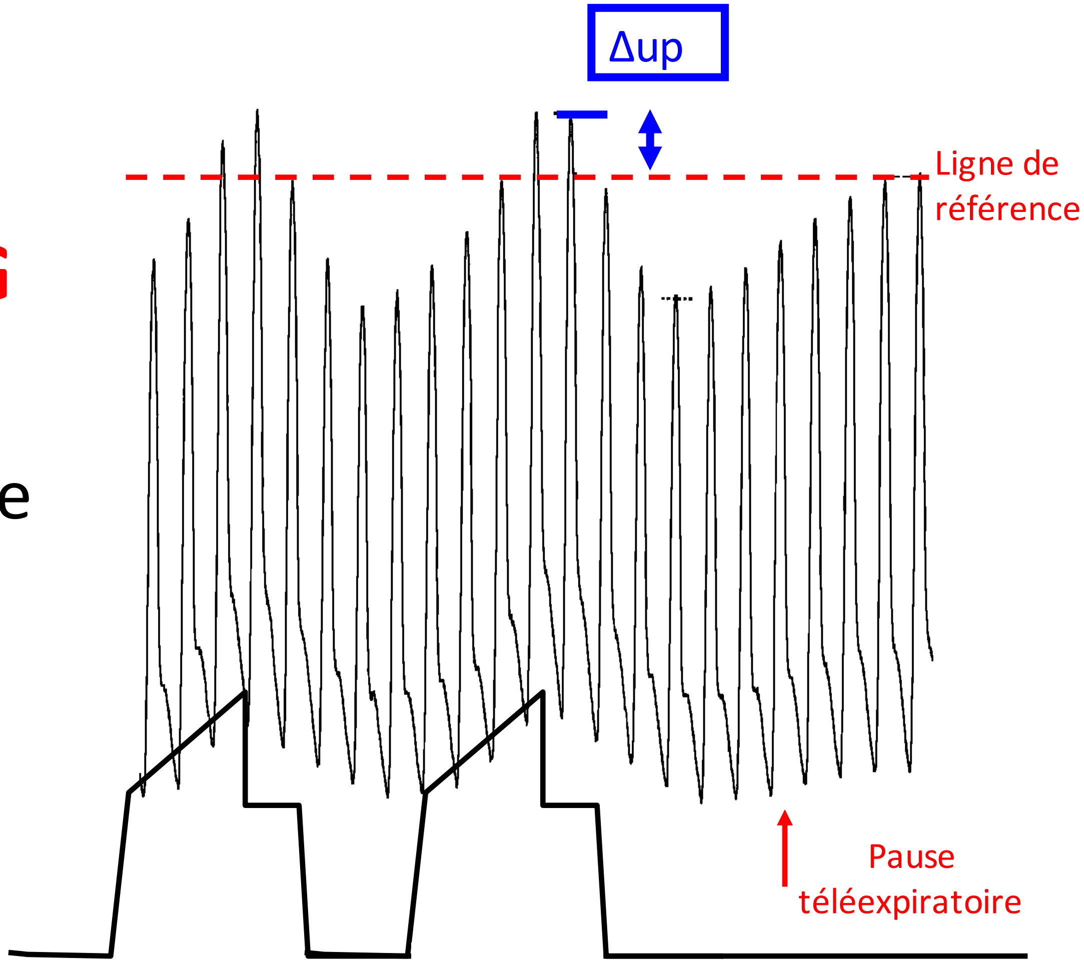
Diminution VES VG



Insufflation Mécanique

Augmentation VES VG

- ↑ Précharge VG
- ↓ contrainte pariétale



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Significativité

Delta-down

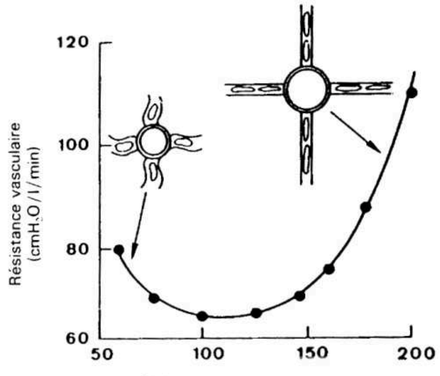
– Effet précharge VD : Hypovolémie

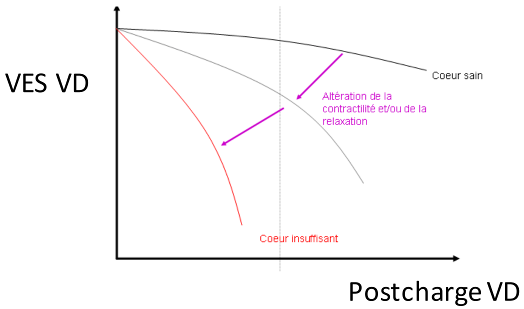
Significativité

Delta-down

- Effet précharge VD : Hypovolémie

- Effet postcharge VD : Insuffisance cardiaque droite



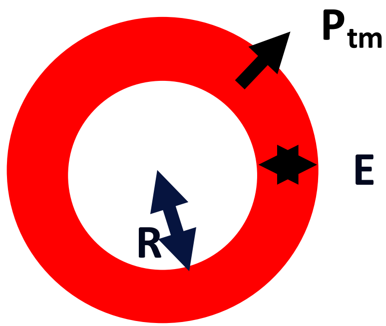


Significativité

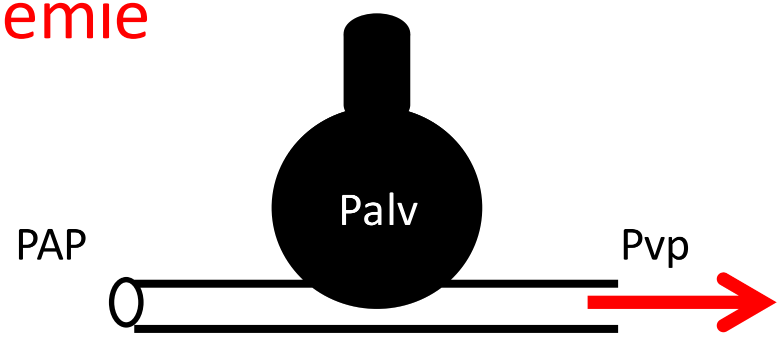
Delta-up

– Insuffisance cardiaque gauche

$$\sigma = (P_{tm} \times R) / E$$



– Hypervolémie



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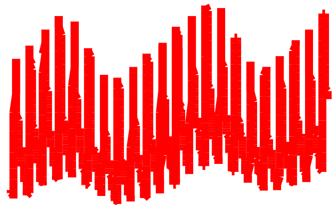
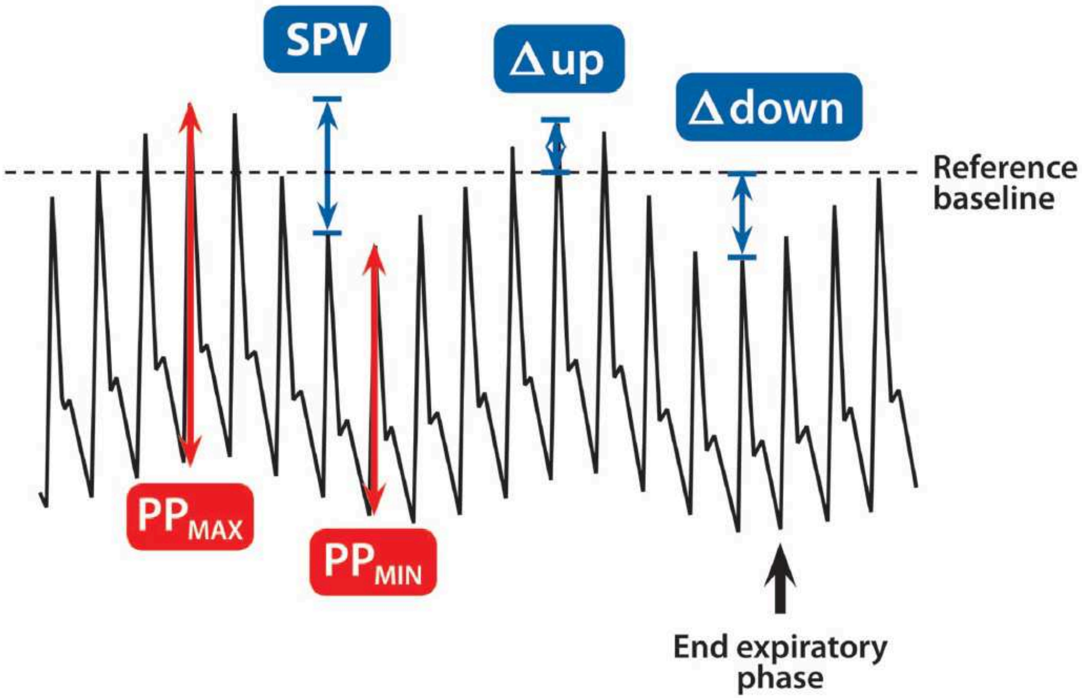
Indices Dérivés des Interactions Cardio-Respiratoires

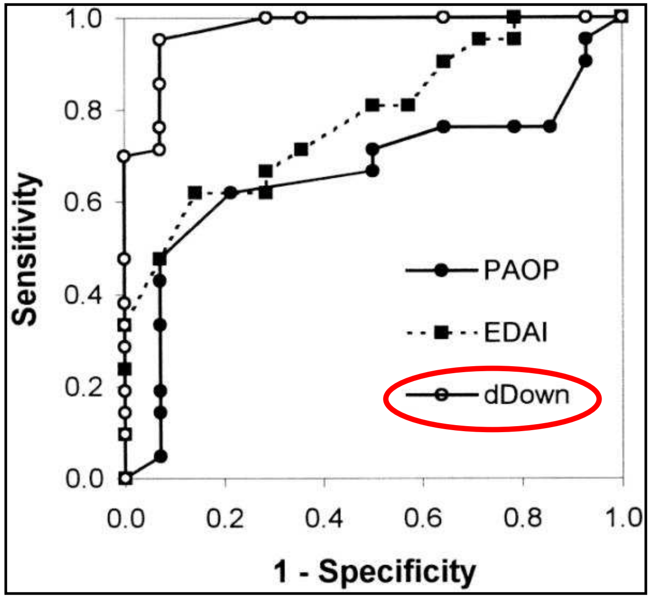
Courbe de Pression Artérielle
Deltadown, DPP, VVE



Systolic Pressure Variation as a Guide to Fluid Therapy in Patients with Sepsis-induced Hypotension

Δdown

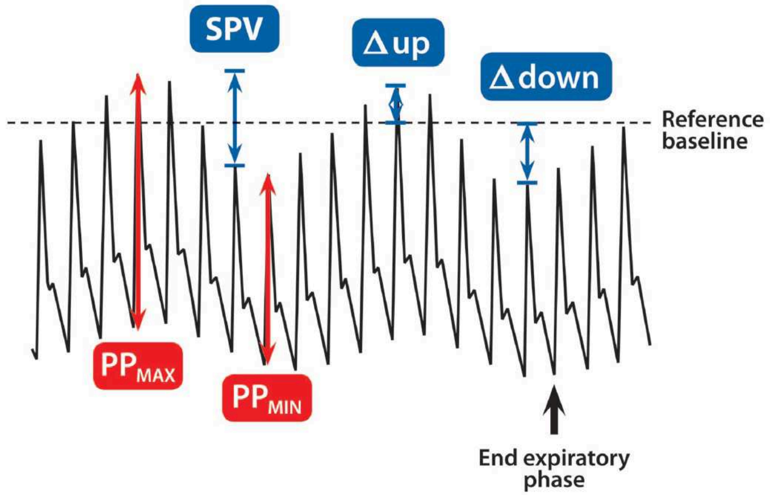


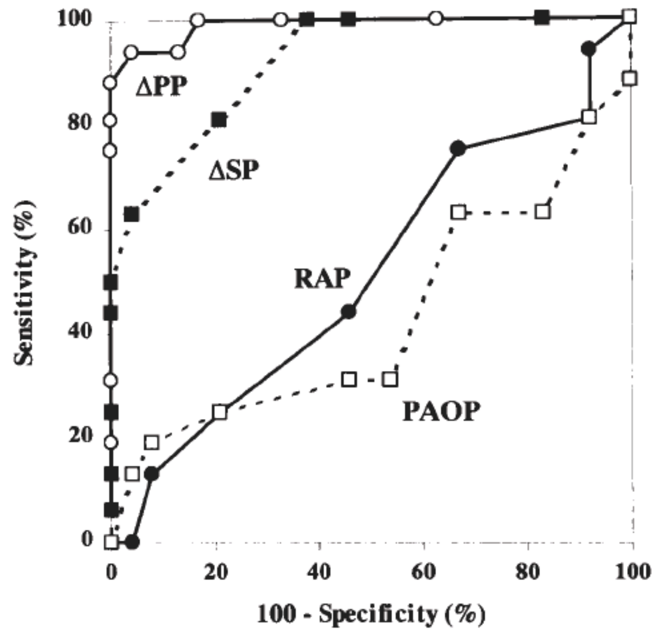


Δdown≥5 mmHg
VPP=95%
VPN=93%

Tavernier et al. Anesthesiology 1998

Relation between Respiratory Changes in Arterial Pulse Pressure and Fluid Responsiveness in Septic Patients with Acute Circulatory Failure





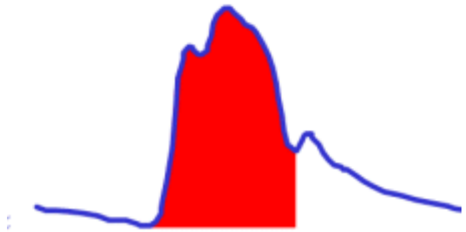
ΔPP ≥ 13%

Se=94%

Sp=96%

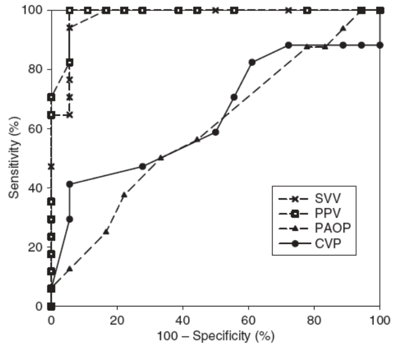
Michard et al. AJRCCM 2010

VVE



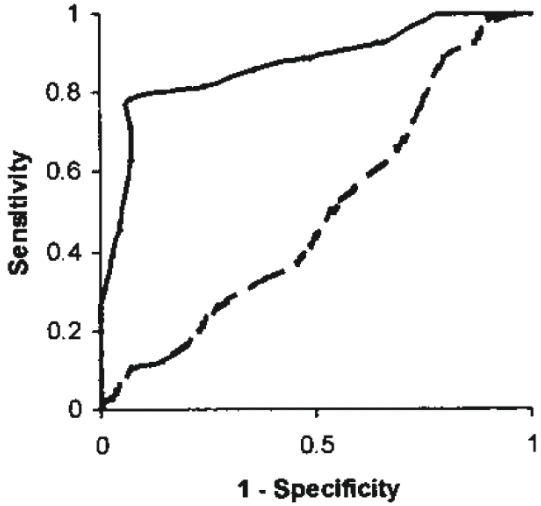
Uncalibrated pulse contour-derived stroke volume variation predicts fluid responsiveness in mechanically ventilated patients undergoing liver transplantation *Br J Anaesth* 2008; **101**: 761–8

M. Biais, K. Nouette-Gaulain, V. Cottenceau, P. Revel and F. Sztark*



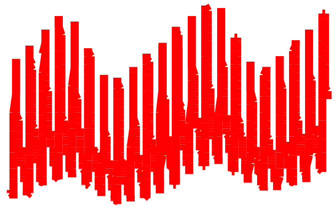
Stroke Volume Variation as a Predictor of Fluid Responsiveness in Patients Undergoing Brain Surgery

Haim Berkenstadt, MD*, Nevo Margalit, MD†, Moshe Hadani, MD†, Zeev Friedman, MD*, Eran Segal, MD*, Yael Villa, PhD*, and Azriel Perel, MD*



Indices Dérivés des Interactions Cardio-Respiratoires

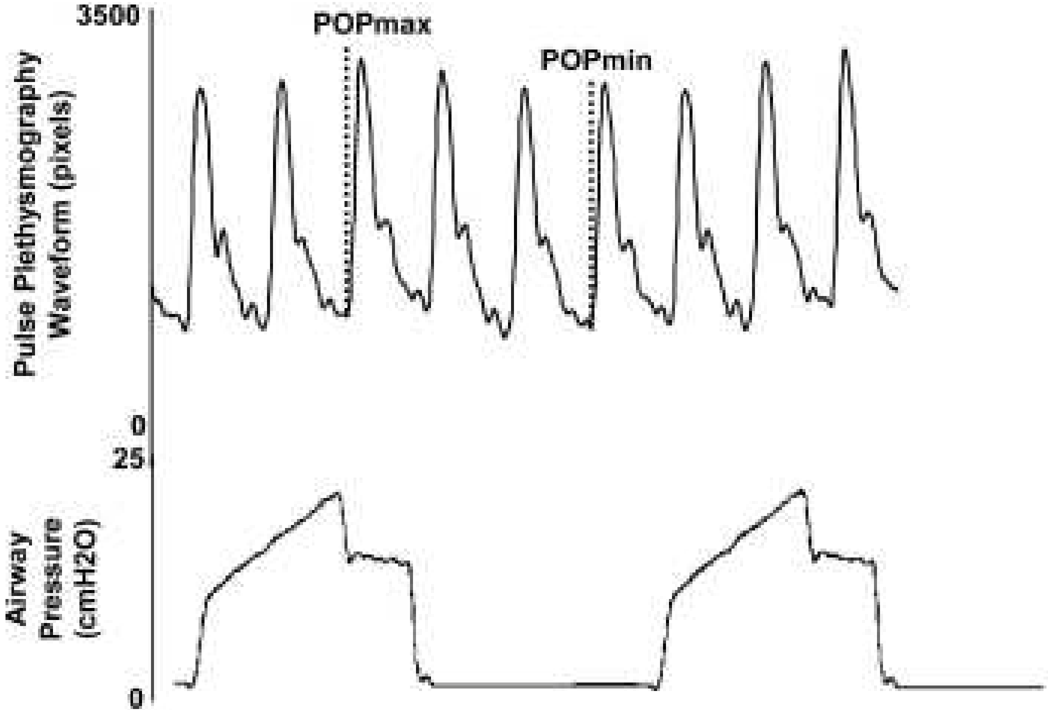
Courbe de Pression Artérielle
Deltadown, DPP, VVE



Courbe de Plethysmographie

Respiratory Variations in Pulse Oximetry Plethysmographic Waveform Amplitude to Predict Fluid Responsiveness in the Operating Room

ΔPOP



$$\Delta POP = \frac{POPmax - POPmin}{(POPmax + POPmin) / 2} \times 100$$

ΔPOP ≥ 13 %

Sensibilité = 80%

Spécificité = 90%

Cannesson et al. Anesthesiology 2007

Limites

Réanimation et Noradrénaline

Poor Agreement between Respiratory Variations in Pulse Oximetry Photoplethysmographic Waveform Amplitude and Pulse Pressure in Intensive Care Unit Patients

Svein Aslak Landsverk, M.D., Lars O. Hoiseth, M.D.,† Per Kvandal, M.D.,‡ Jonny Hisdal, Ph.D.,§ Oivind Skare, Ph.D.,|| Knut A. Kirkeboen, M.D., Ph.D.#*

Anesthesiology 2008; 109:849–55

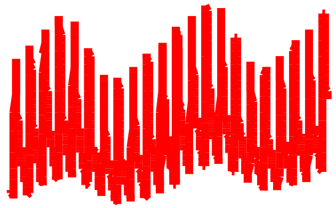
Impact of norepinephrine on the relationship between pleth variability index and pulse pressure variations in ICU adult patients

Matthieu Biais[1,2*], Vincent Cottenceau[3], Laurent Petit[3], Françoise Masson[3], Jean-François Cochard[3] and François Sztark[2,3]

Critical Care 2011, **15**:R168

Indices Dérivés des Interactions Cardio-Respiratoires

Courbe de Pression Artérielle
Deltadown, DPP, VVE



Courbe de Plethysmographie

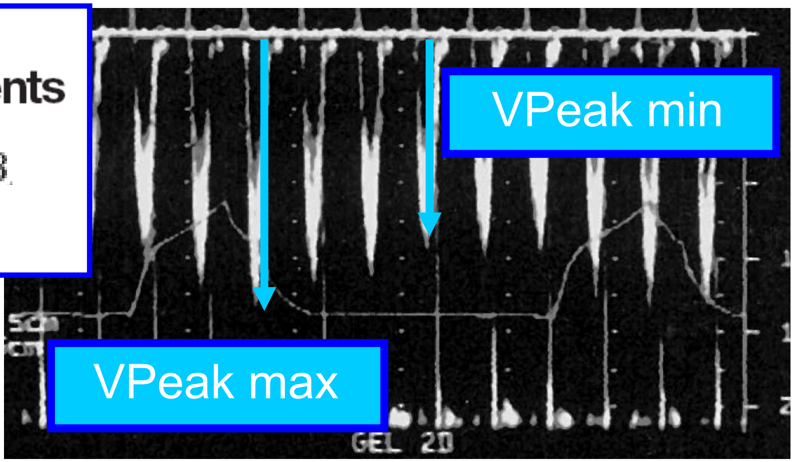
Indices Echographiques

Echocardiographie doppler

Respiratory Changes in Aortic Blood Velocity as an Indicator of Fluid Responsiveness in Ventilated Patients With Septic Shock*

CHEST 2001; 119:867–873

Marc Feissel, MD; Frédéric Michard, MD; Isabelle Mangin, MD; Olivier Ruyer, MD; Jean-Pierre Faller, MD; and Jean-Louis Teboul, MD, PhD



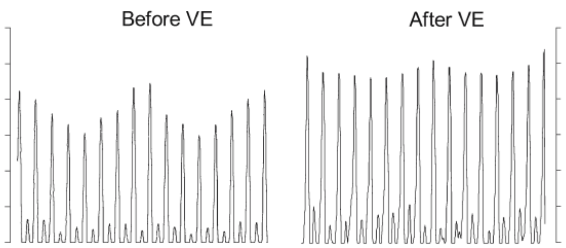
Doppler œsophagien

Intensive Care Med (2005) 31:1195–1201
DOI 10.1007/s00134-005-2731-0

ORIGINAL

Xavier Monnet
Mario Rienzo
David Osman
Nadia Anguel
Christian Richard
Michael R. Pinsky
Jean-Louis Teboul

Esophageal Doppler monitoring predicts fluid responsiveness in critically ill ventilated patients



Variations Respiratoires des Veines Caves

Veine Cave Inférieure = Extra-thoracique
Sous VM, elle se dilate à l'inspiration

Veine Cave Supérieure = Intra-thoracique
Sous VM, elle se collabe à l'inspiration

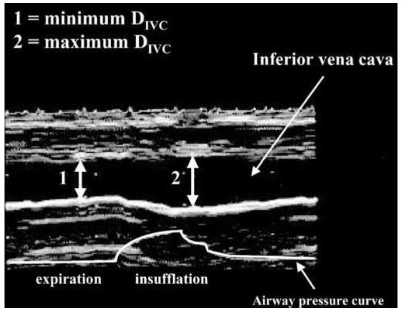
ΔVCI

Intensive Care Med (2004) 30:1834–1837
DOI 10.1007/s00134-004-2233-5

BRIEF REPORT

Marc Feissel
Frédéric Michard
Jean-Pierre Faller
Jean-Louis Teboul

The respiratory variation in inferior vena cava diameter as a guide to fluid therapy



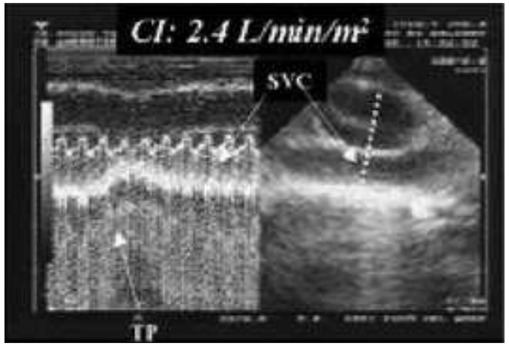
ΔVCS

Intensive Care Med (2004) 30:1734–1739
DOI 10.1007/s00134-004-2361-y

ORIGINAL

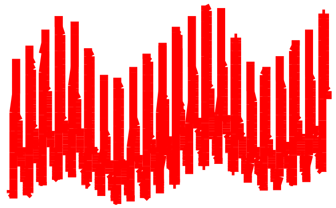
Antoine Vieillard-Baron
Karim Chergui
Anne Rabiller
Olivier Peyrouset
Bernard Page
Alain Beauchet
François Jardin

Superior vena caval collapsibility as a gauge of volume status in ventilated septic patients



Indices Dérivés des Interactions Cardio-Respiratoires

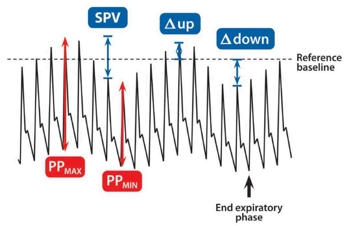
Courbe de Pression Artérielle
Deltadown, DPP, VVE



Courbe de Plethysmographie

Indices Echographiques

Pause Télé-Expiratoire



Occlusion Télé-Expiratoire

Predicting volume responsiveness by using the end-expiratory occlusion in mechanically ventilated intensive care unit patients

Xavier Monnet, MD, PhD; David Osman, MD; Christophe Ridel, MD; Bouchra Lamia, MD; Christian Richard, MD; Jean-Louis Teboul, MD, PhD

Crit Care Med 2009; 37:951–956

Pause télé-expiratoire

↓

Absence de prochain cycle inspiratoire

↓

Absence de diminution de précharge

↓

Augmentation du VES

Augmentation

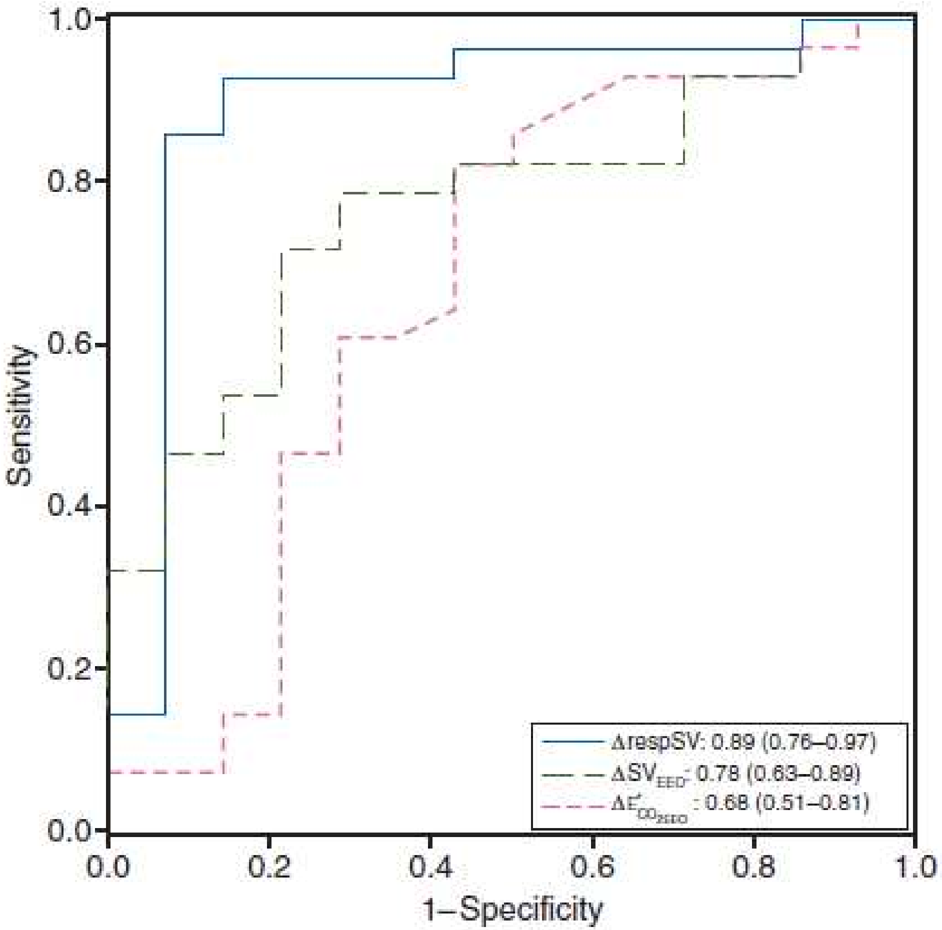
≥ 5% PP

≥ 5% IC

Prédit la réponse au RV

Occlusion Télé-Expiratoire

End-expiratory occlusion manoeuvre does not accurately predict fluid responsiveness in the operating theatre



42 patients, peropératoire

Guinot et al. Brit J Anaesth 2014

Interactions Cardiopulmonaires

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Dynamic changes in arterial waveform derived variables and fluid responsiveness in mechanically ventilated patients: A systematic review of the literature*

Crit Care Med 2009; 37:2642–2647

Paul E. Marik, MD, FCCM; Rodrigo Cavallazzi, MD; Tajender Vasu, MD; Amyn Hirani, MD

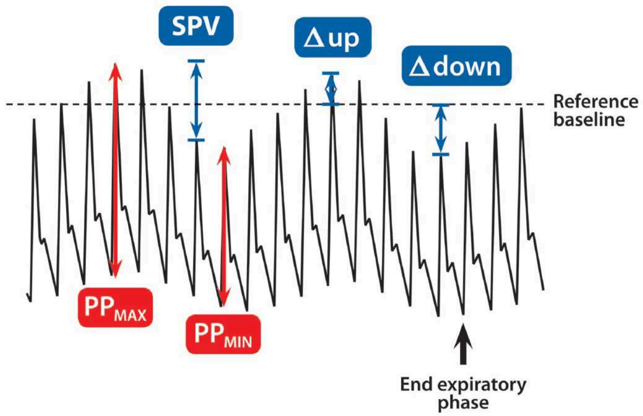
Parameter	PPV (n = 14)
ROC area	0.94 (0.92–0.96)
Sensitivity	0.89 (0.82–0.94)
Specificity	0.88 (0.81–0.92)
Positive likelihood ratio	7.26 (4.46–11.80)
Negative likelihood ratio	0.12 (0.07–0.21)
Diagnostic odds ratio	59.86 (23.88–150.05)

Author	Year	n	Patient	Dynamic Variable SPV	PPV	SVV	Fluid Challenge	TV (mL/kg)	Device	Cardiac End Point
Lee (52)	2007	20	Neurosurg	N	Y	N	7 mL/kg HES	10	Esophageal Doppler	SVI
Cannesson (53)	2007	25	C.Surg[a]	N	Y	N	500 mL HES	8–10	PAC	CI
Cannesson (54)	2008	25	C.Surg[a]	N	Y	N	500 mL HES	8–10	PAC	CI
Auler (55)	2008	59	Post C.Surg	N	Y	N	20 mL/kg LR	8	PAC	CO
Belloni (56)	2008	19	C.Surg[a]	Y	Y	Y	7 mL/kg HES	8	LiDCO[f]/PAC	CI
Cannesson (57)	2008	25	C.Surg[a]	N	Y	N	500 mL HES	8–10	PAC	CI
Hofer (58)	2008	40	Post CABG	N	Y	Y	Trendelenburg	8–10	FloTrac[g]/PiCCO	SV
Biasis (59)	2008	35	Liver transplant	N	Y	Y	Albumin 20 mL × BMI	8–10	FloTrac/TEE	CO

Ça Marche !!!!

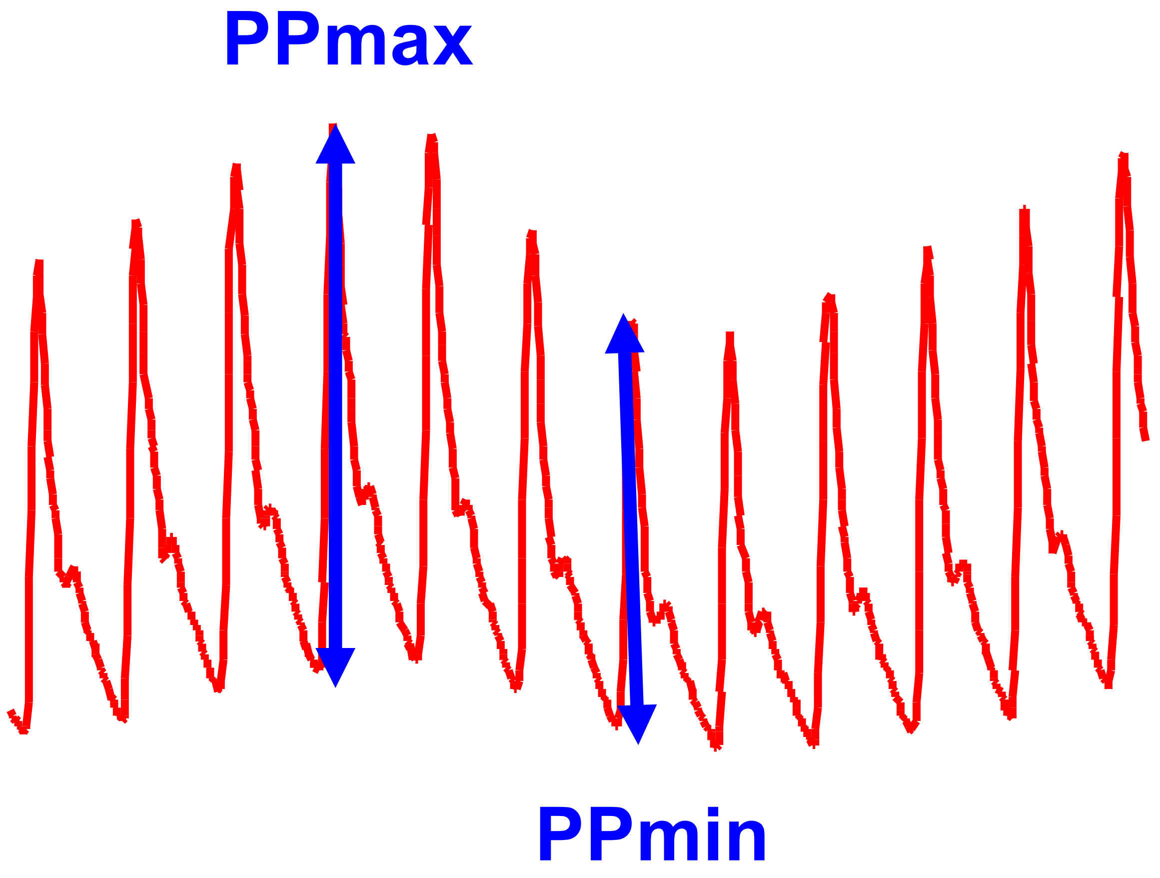
Sauf Quand ça ne Marche Pas ...

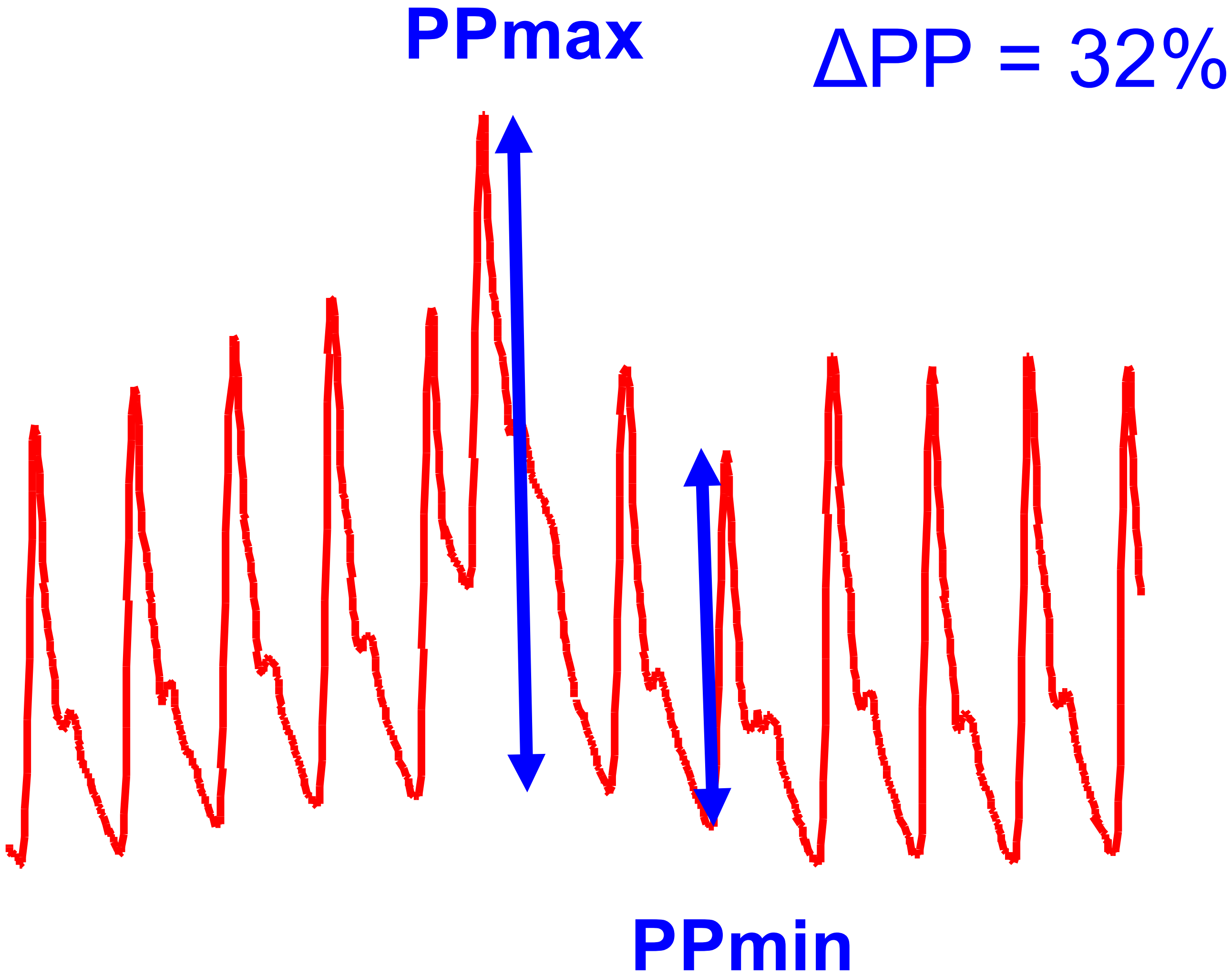
Arythmie



SPV
Δup
Δdown
Reference baseline
PP MAX
PP MIN
End expiratory phase

ΔPP = 14%




PPmax
ΔPP = 32%
PPmin

C'est Fréquent ?

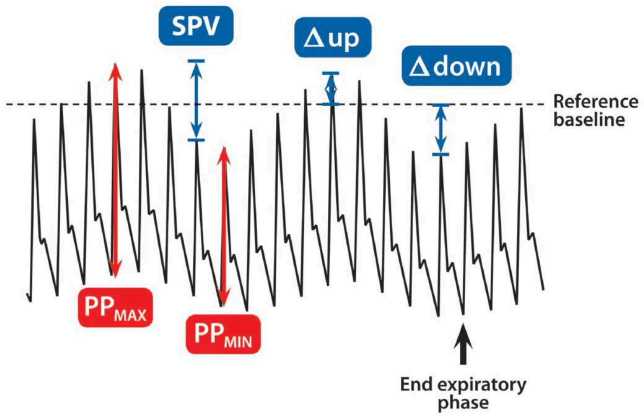
Incidence and Prognosis of Sustained Arrhythmias in Critically Ill Patients

Annane et al. Am J Respir Crit Care Med 2008

12% des patients de réanimation

Arythmie

Respiration Spontanée



Research

Open Access

How can the response to volume expansion in patients with spontaneous respiratory movements be predicted?

21 patients avec mouvements respiratoires spontanés

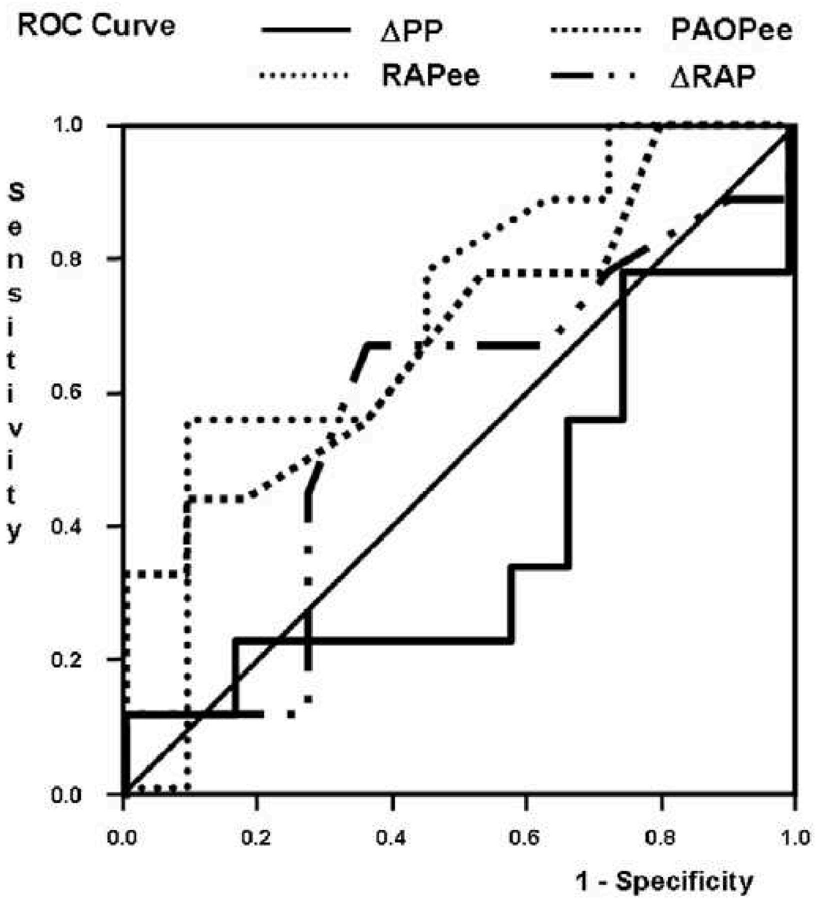
Heenen et al. Crit Care 2006

Research

Open Access

How can the response to volume expansion in patients with spontaneous respiratory movements be predicted?

21 patients avec mouvements respiratoires spontanés



AUC pour le ΔPP

=

0,40±0,13

Heenen et al. Crit Care 2006

Research

Open Access

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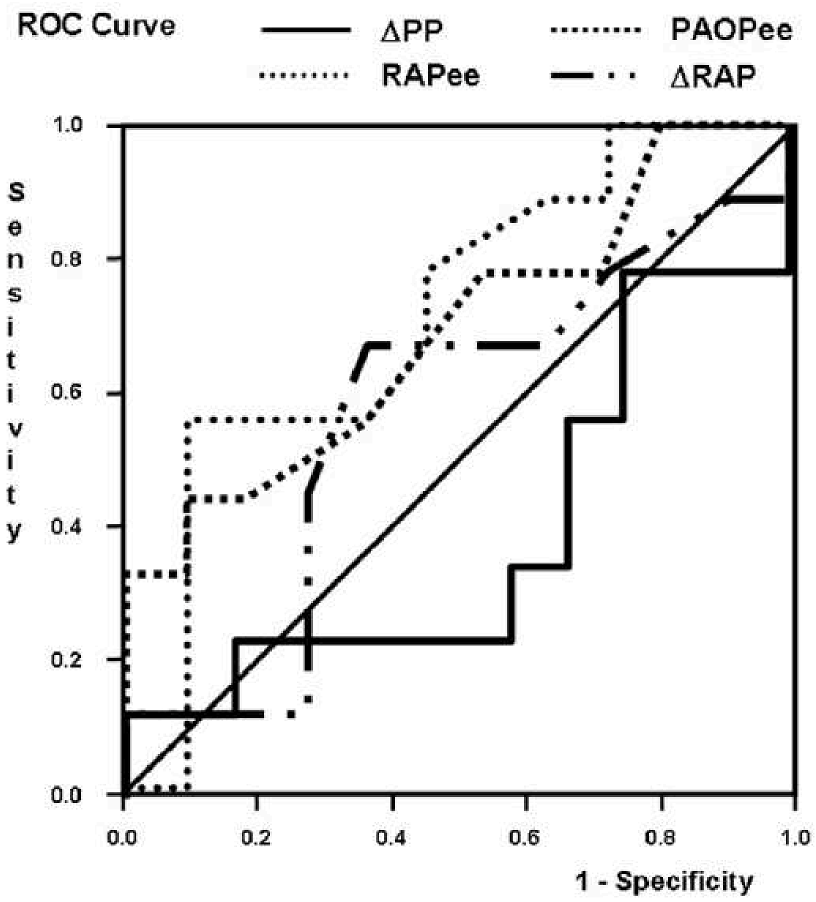
21 patients avec mouvements respiratoires spontanés



AUC pour le ΔPP

=

0,40±0,13

Capacité ΔPP à prédire la réponse au remplissage est inférieure à celle de la PVC ou de la PAPO

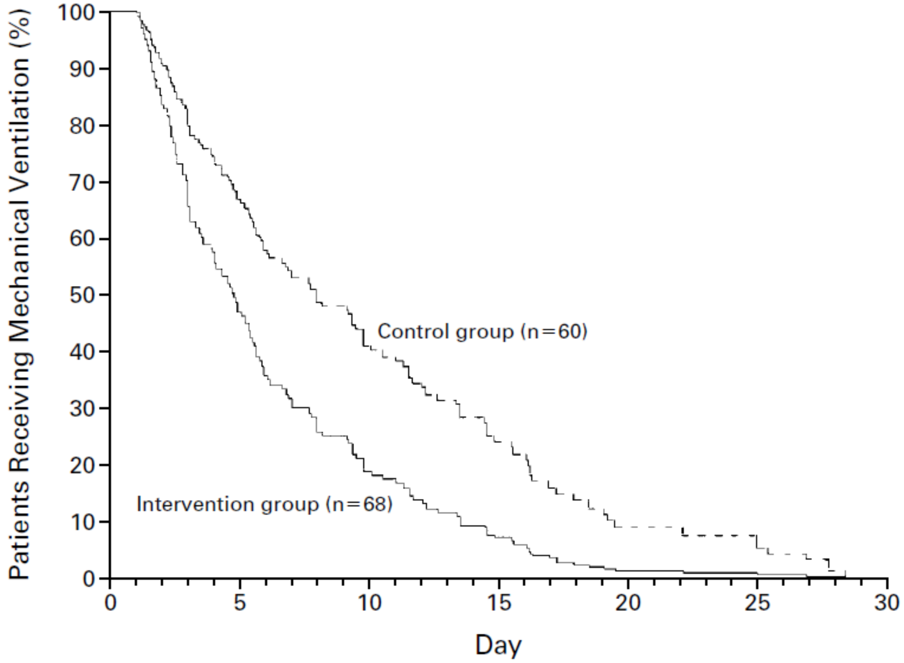
Heenen et al. Crit Care 2006

C’est Fréquent les patients en RS ?

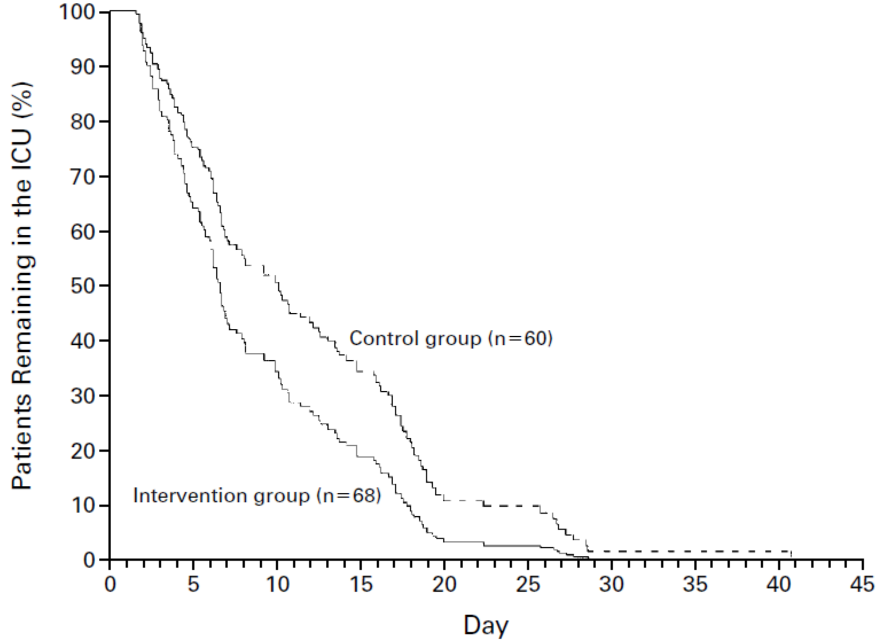
DAILY INTERRUPTION OF SEDATIVE INFUSIONS IN CRITICALLY ILL PATIENTS UNDERGOING MECHANICAL VENTILATION

The NEW ENGLAND JOURNAL of MEDICINE

Interruption quotidienne de la sédation en réanimation



Diminution durée Ventilation Mécanique



Diminution durée séjour ICU

Kress et al. N Engl J Med 2000

Textes des experts

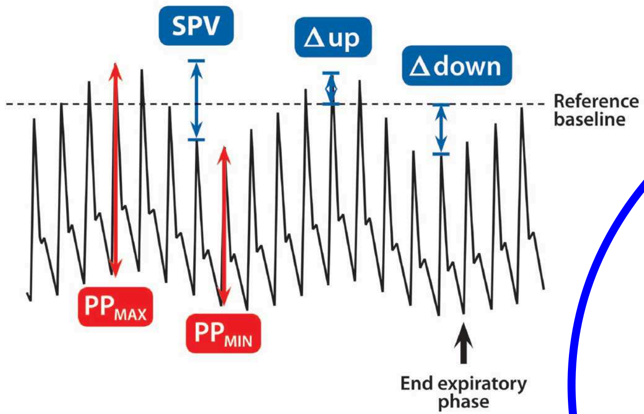
Sevrage de la sédation : modalités et conséquences☆

J. Mantz

Annales Françaises d'Anesthésie et de Réanimation 27 (2008) 611–616

Arythmie

Respiration Spontanée



Transmission de pression faible

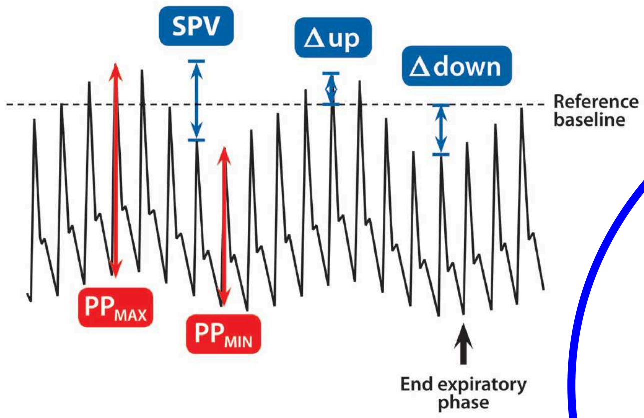
Faible Vt

Driving pressure

Compliance basse

Arythmie

Respiration Spontanée



Transmission de pression faible

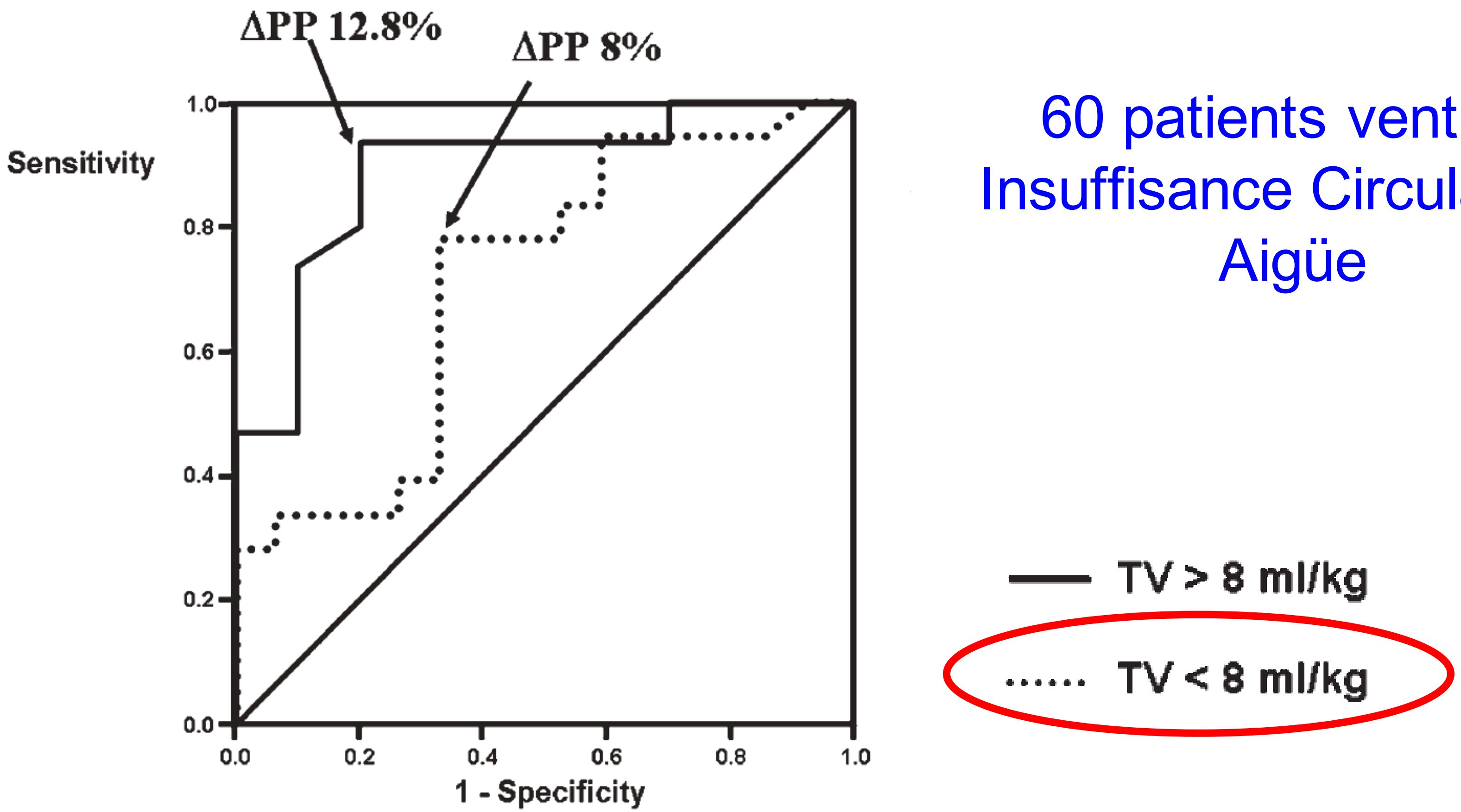
Faible Vt

Driving pressure

Compliance basse

ORIGINAL

Pulse pressure variations to predict fluid responsiveness: influence of tidal volume



60 patients ventilés
Insuffisance Circulatoire
Aigüe

De Backer et al. Intensive Care 2005

Dynamic changes in arterial waveform derived variables and fluid responsiveness in mechanically ventilated patients: A systematic review of the literature*

Crit Care Med 2009; 37:2642–2647

Paul E. Marik, MD, FCCM; Rodrigo Cavallazzi, MD; Tajender Vasu, MD; Amyn Hirani, MD

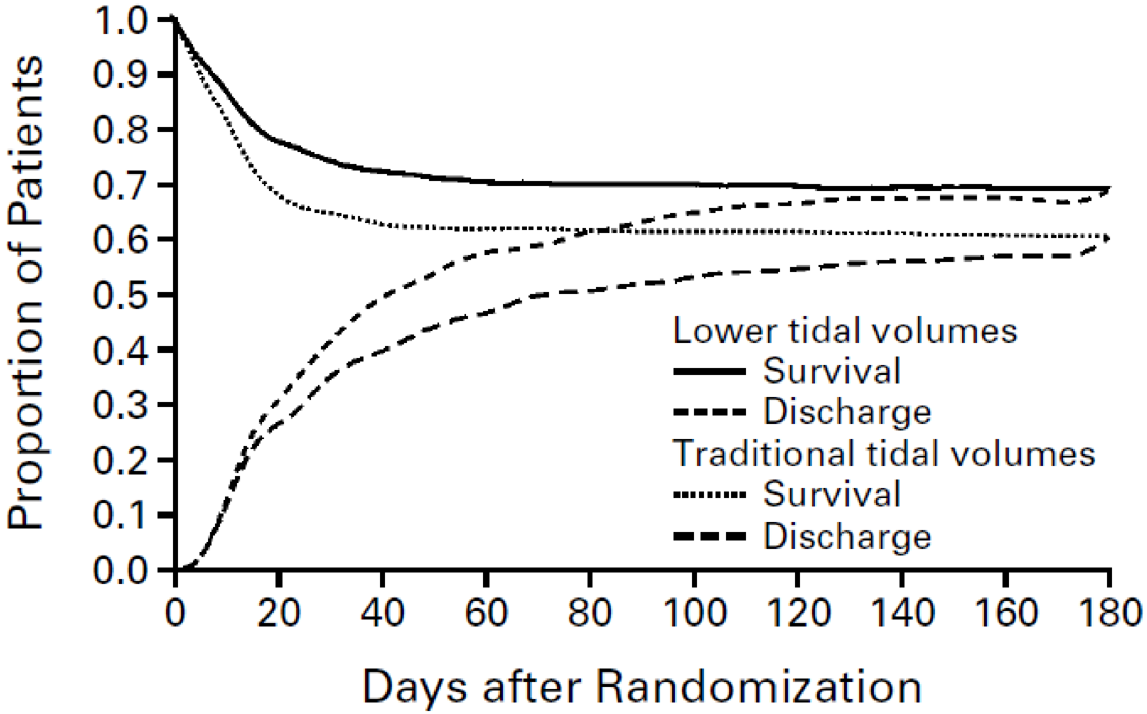
68 citations; of these, 38 citations were excluded due to study design, including studies that investigated the dynamic changes in aortic blood flow, (7, 20–22) studied patients with an open chest during cardiac surgery, (23) used pressure-support ventilation or volume-controlled ventilation with a tidal volume of <7 mL/kg, (24, 25); and five citations were

VENTILATION WITH LOWER TIDAL VOLUMES AS COMPARED WITH TRADITIONAL TIDAL VOLUMES FOR ACUTE LUNG INJURY AND THE ACUTE RESPIRATORY DISTRESS SYNDROME

The NEW ENGLAND JOURNAL of MEDICINE

861 patients SDRA randomisés

12 ml/kg *vs* 6 ml/kg



Contrôle *vs* Ventilation protectrice

ARDS Network N Engl J Med 2000

Association Between Use of Lung-Protective Ventilation With Lower Tidal Volumes and Clinical Outcomes Among Patients Without Acute Respiratory Distress Syndrome

A Meta-analysis

2822 patients SANS SDRA

Ventilation protectrice *vs* Ventilation standard

	Mean (SD)		
	Protective Ventilation (n = 1416)	Conventional Ventilation (n = 1406)	*P* Value
Age, y	59.97 (7.92)	60.22 (7.36)	.93
Weight, kg	72.71 (12.34)	72.13 (12.16)	.93
Tidal volume, mL/kg IBW[a]	6.45 (1.09)	10.60 (1.14)	<.001
PEEP, cm H_2O[a]	6.40 (2.39)	3.41 (2.79)	.01
Plateau pressure, cm H_2O[a]	16.63 (2.58)	21.35 (3.61)	.006
Respiratory rate, breaths/min[a]	18.02 (4.14)	13.20 (4.43)	.01
Minute-volume, L/min[a,b]	8.46 (2.90)	9.13 (2.70)	.72
PaO_2/FIO_2[a]	304.41 (65.74)	312.97 (68.13)	.51
$PaCO_2$, mm Hg[a]	41.05 (3.79)	37.90 (4.19)	.003
pH[a]	7.37 (0.03)	7.40 (0.03)	.11

Neto et al. JAMA 2012

Association Between Use of Lung-Protective Ventilation With Lower Tidal Volumes and Clinical Outcomes Among Patients Without Acute Respiratory Distress Syndrome

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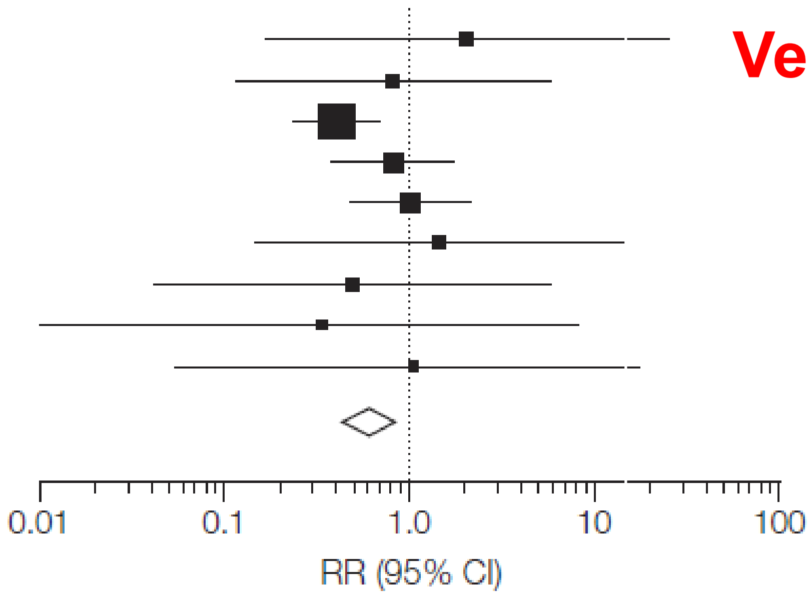


Ventilation protectrice = Diminution

MORTALITE

INFECTIONS PULMONAIRES

ATELECTASIES

Neto et al. JAMA 2012

A Trial of Intraoperative Low-Tidal-Volume Ventilation in Abdominal Surgery

The NEW ENGLAND JOURNAL of MEDICINE

400 patients randomisés

Risque de complications respiratoires

Chirurgie abdominale majeure

Ventilation protectrice : Vt=6-8 ml/kg, PEP=6-8 cmH_2O, recrutement/30 min

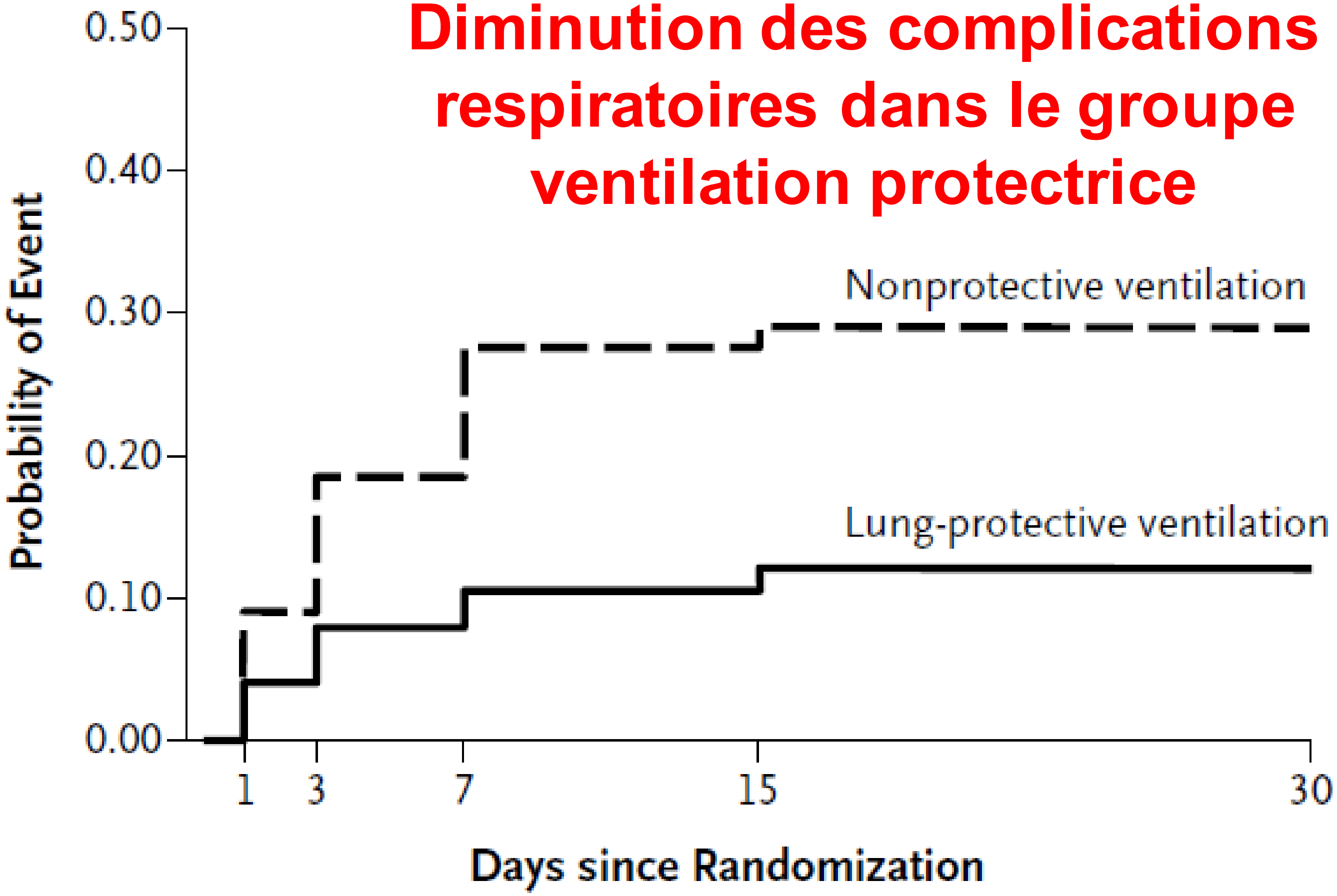
Ventilation standard : Vt=10-12 ml/kg, PEP=0, pas de recrutement

Futier et al. N Engl J Med 2013

A Trial of Intraoperative Low-Tidal-Volume Ventilation in Abdominal Surgery

The NEW ENGLAND JOURNAL of MEDICINE

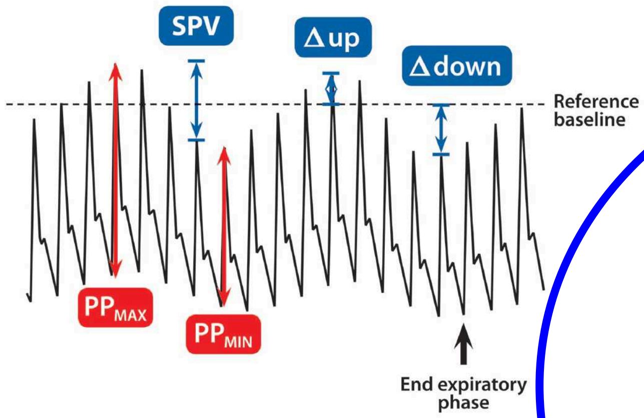
Diminution des complications respiratoires dans le groupe ventilation protectrice



Futier et al. N Engl J Med 2013

Arythmie

Respiration Spontanée



Transmission de pression faible

Faible Vt

Driving pressure

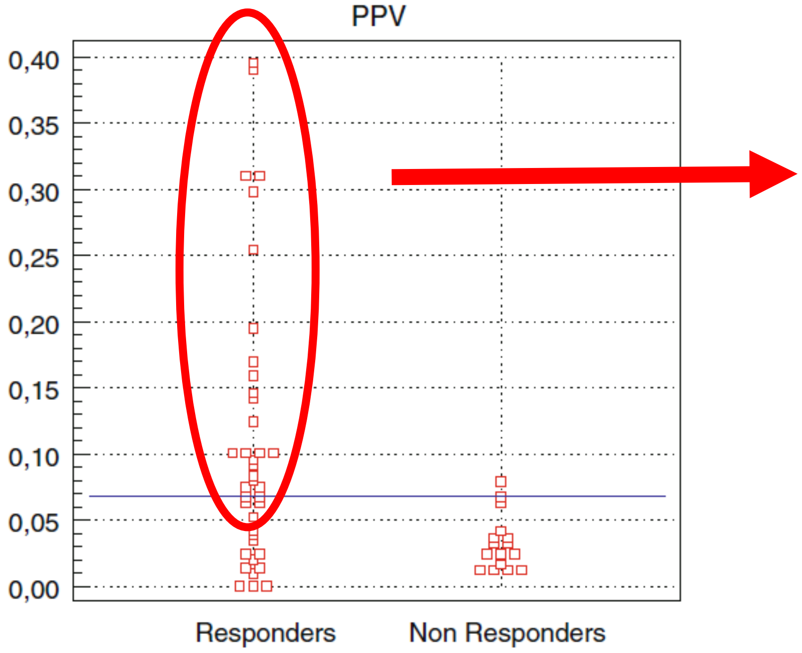
Compliance basse

The influence of the airway driving pressure on pulsed pressure variation as a predictor of fluid responsiveness

DRIVING PRESSURE = Pplat – PEP

57 patients ventilés, insuffisance circulatoire aigüe

Bas Vt : 5,5 ml/kg [3,5-7,7]



ΔPP élevé = Répondeurs

Muller et al. Intensive Care Med 2010

The influence of the airway driving pressure on pulsed pressure variation as a predictor of fluid responsiveness

DRIVING PRESSURE = Pplat – PEP

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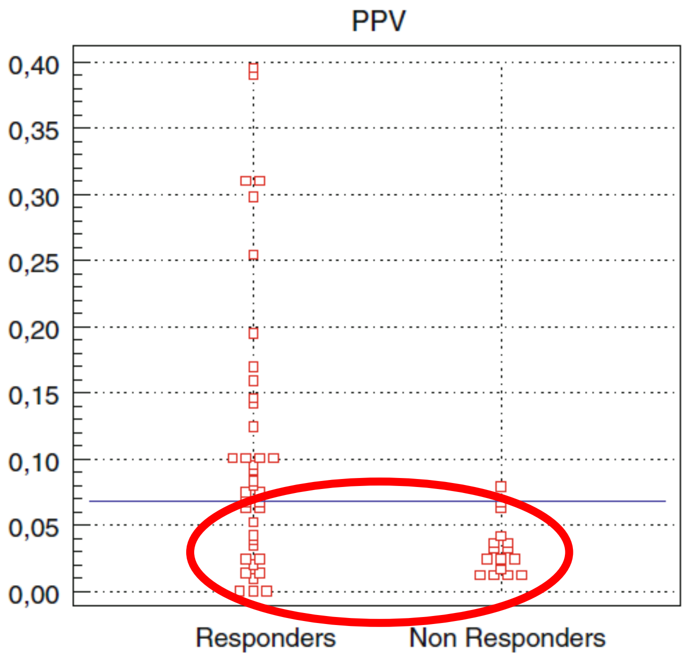
ΔPP bas ??



Muller et al. Intensive Care Med 2010

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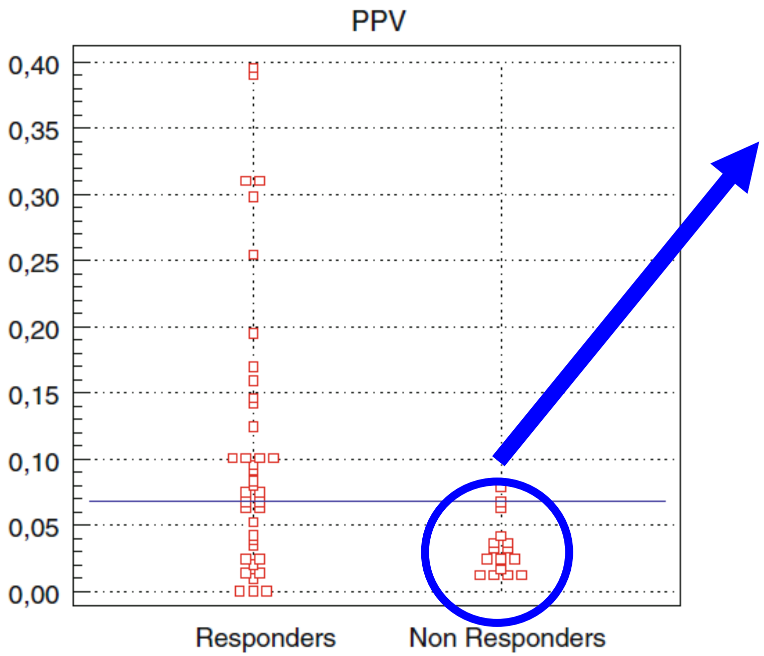

Précharge indépendance: NR

Muller et al. Intensive Care Med 2010

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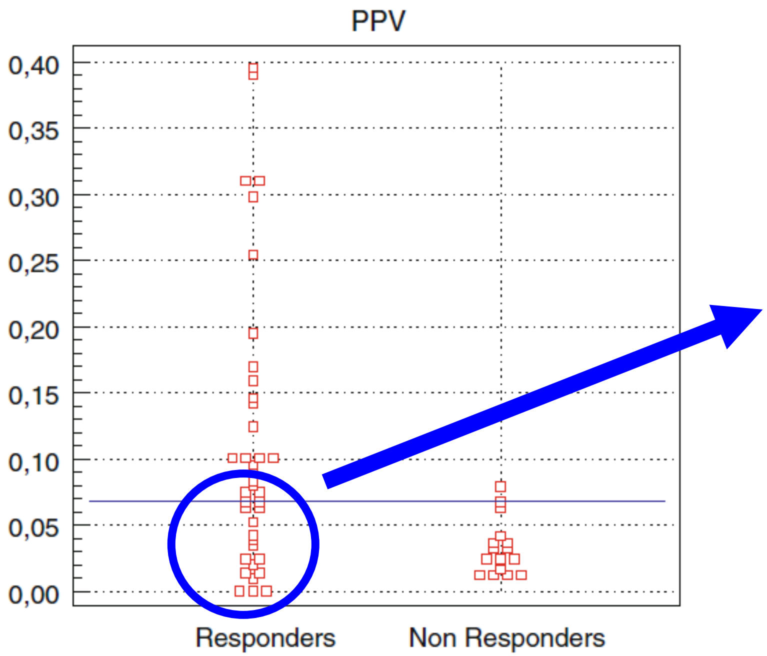


Précharge indépendance: NR

Précharge dépendance : R

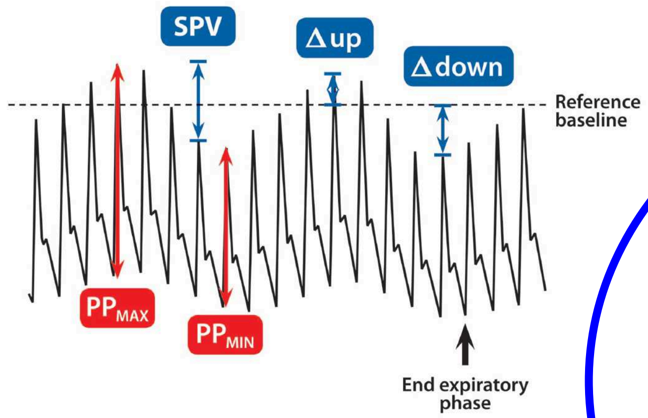
Driving pressure ≤ 20 cmH_2O

FAUX NEGATIFS +++

Muller et al. Intensive Care Med 2010

Arythmie

Respiration Spontanée



Transmission de pression faible

Faible Vt

Driving pressure

Compliance basse

Passive leg-raising and end-expiratory occlusion tests perform better than pulse pressure variation in patients with low respiratory system compliance*

54 patients insuffisance circulatoire aigue

Compliance respiratoire = Vt / (Pplat – PEP)

Monnet et al. Crit Care Med 2012

Passive leg-raising and end-expiratory occlusion tests perform better than pulse pressure variation in patients with low respiratory system compliance*

54 patients insuffisance circulatoire aigue

Compliance respiratoire = Vt / (Pplat – PEP)

27 SDRA

22 ± 3 ml/cmH_2O

Monnet et al. Crit Care Med 2012

Passive leg-raising and end-expiratory occlusion tests perform better than pulse pressure variation in patients with low respiratory system compliance*

54 patients insuffisance circulatoire aigue

Compliance respiratoire = Vt / (Pplat – PEP)

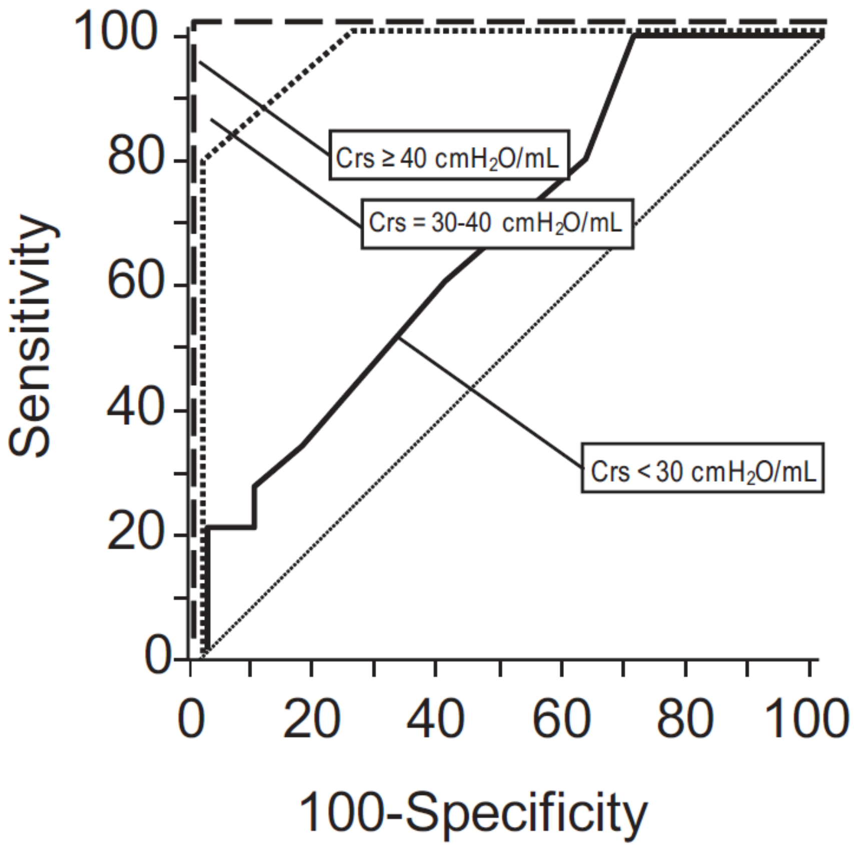
27 SDRA → 22 ± 3 ml/cmH_2O

27 non SDRA → 45 ± 9 ml/cmH_2O

Monnet et al. Crit Care Med 2012

Passive leg-raising and end-expiratory occlusion tests perform better than pulse pressure variation in patients with low respiratory system compliance*

54 patients insuffisance circulatoire aigue



Compliance > 30 ml/cmH2O

AUC = 0,98 ± 0,03

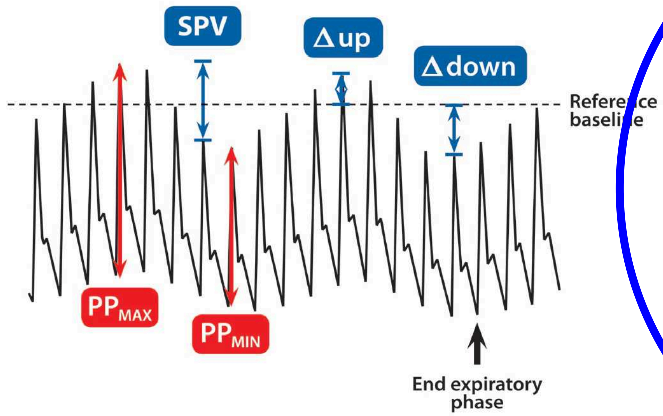
Compliance ≤ 30 ml/cmH2O

AUC = 0,69 ± 0,10

Monnet et al. Crit Care Med 2012

Arythmie

Respiration Spontanée



Transmission de pression faible

Faible Vt

Driving pressure

Compliance basse

Temps de transit pulmonaire trop court

Influence of Respiratory Rate on Stroke Volume Variation in Mechanically Ventilated Patients

17 patients ventilés (Vt=8-10 ml/kg), hypovolémiques
FR : 15, 30 et 40 (Vt et I/E identiques)

De Backer et al. Anesthesiology 2009

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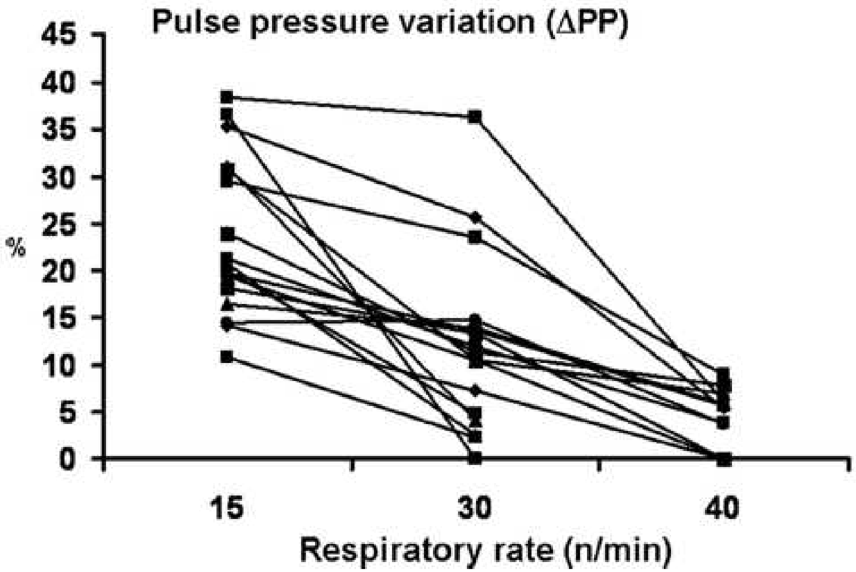
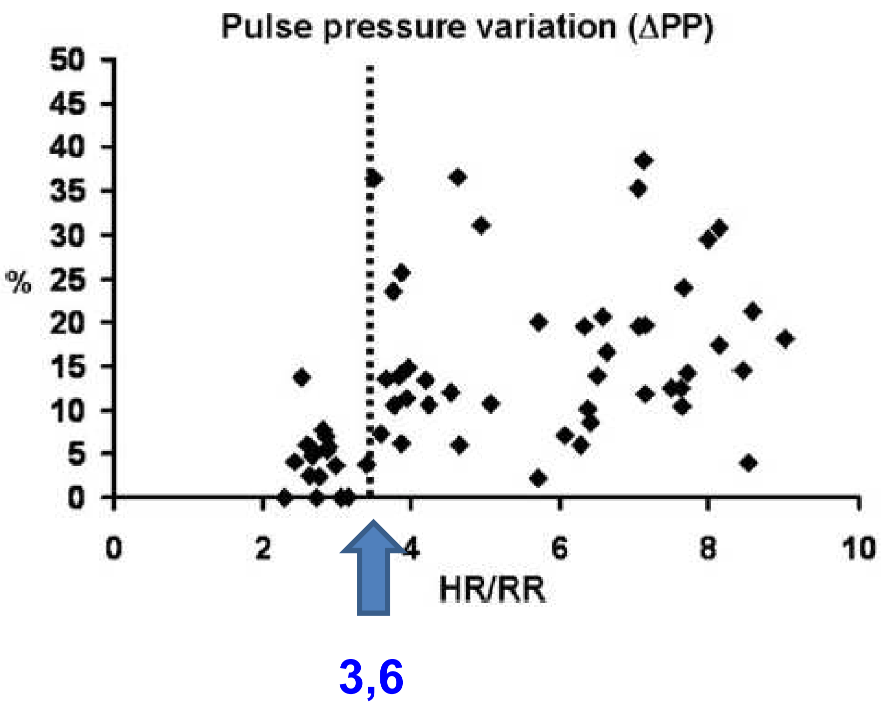


Augmentation FR = diminution du temps de transit pulmonaire
Diminution du ΔPP

De Backer et al. Anesthesiology 2009

Influence of Respiratory Rate on Stroke Volume Variation in Mechanically Ventilated Patients

17 patients ventilés (Vt=8-10 ml/kg), hypovolémiques
FR : 15, 30 et 40 (Vt et I/E identiques)



Ratio FC / FR < 3,6
ΔPP inutilisable

De Backer et al. Anesthesiology 2009

C'est Fréquent ?

Ventilation protectrice =

bas Vt et haute fréquence

Exemples

FR = 22, FC<80

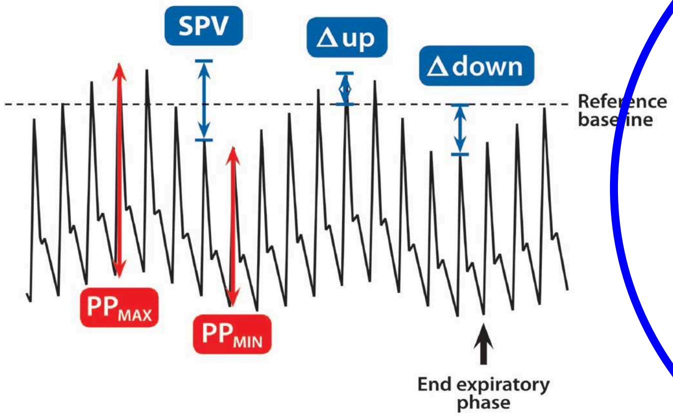
FR=25, FC<90

FC/FR < 3,6

<u>ΔPP inutilisable</u>

Arythmie

Respiration Spontanée



Transmission de pression faible

Faible Vt

Driving pressure

Compliance basse

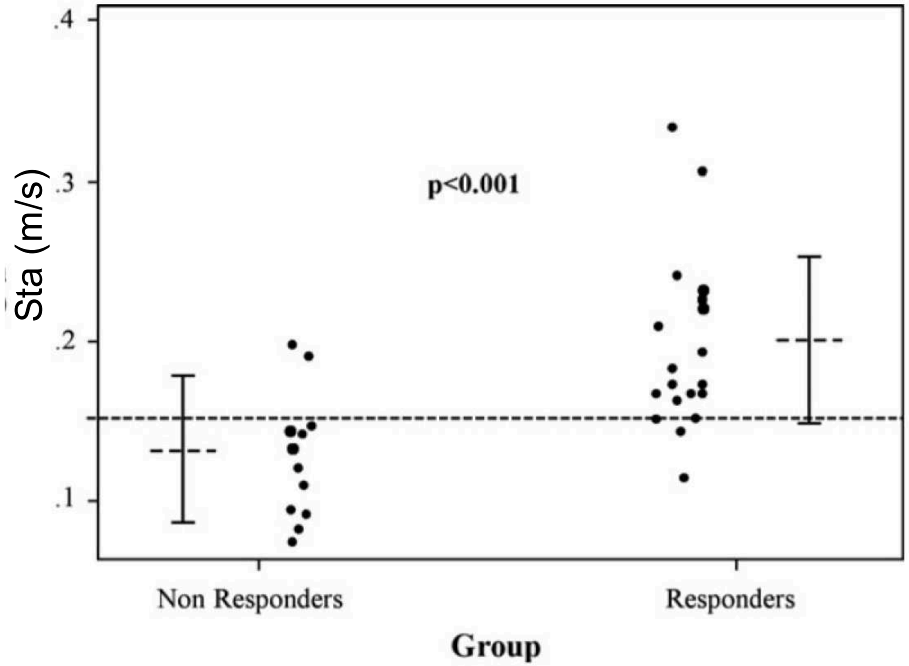
Insuffisance Cardiaque Droite

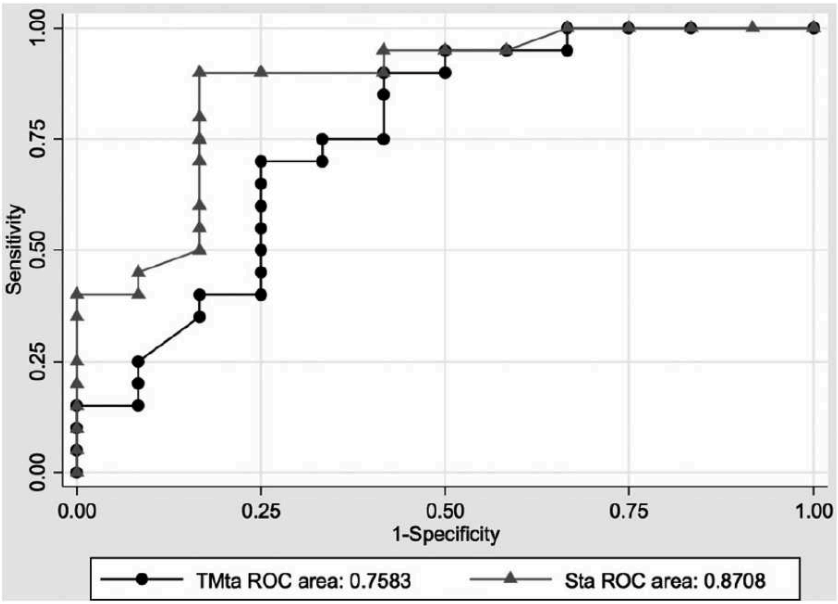
Temps de transit pulmonaire trop court

Assessing fluid responsiveness in critically ill patients: False-positive pulse pressure variation is detected by Doppler echocardiographic evaluation of the right ventricle*

35 patients ventilés ΔPP>12%

23 répondeurs





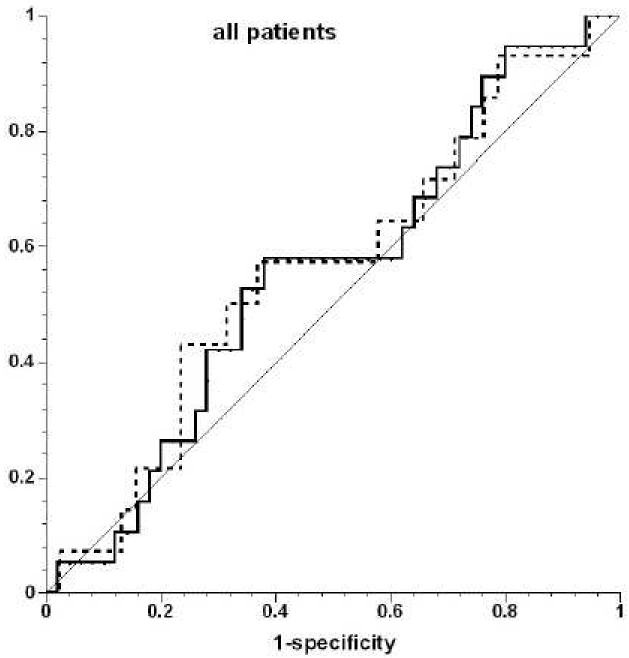
Insuffisance Cardiaque Droite = Faux Positifs

Mahjoub et al. Crit Care Med 2010

Pulse-pressure variation and hemodynamic response in patients with elevated pulmonary artery pressure: a clinical study

69 patients Insuffisance cardiaque droite

Chirurgie Cardiaque ou Choc Septique



ΔPP: AUC=0,55

Wyler von Ballmoos et al. Crit Care 2010

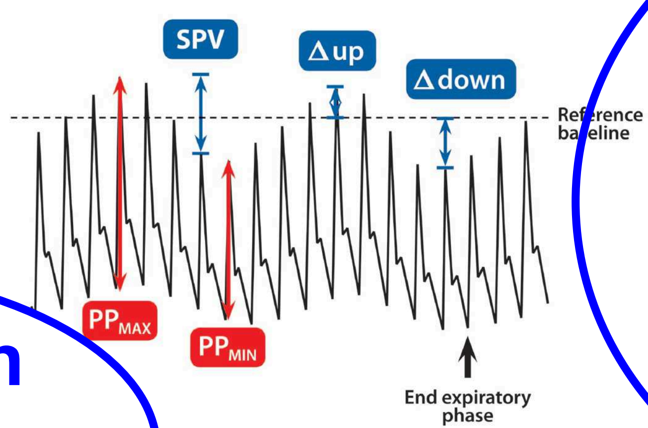
C’est Fréquent ?

> 1/3 des patients en chocs septique

Jardin et al. Crit Care Med 1990
Vieillard-Baron Anesthesiology 2001
Mahjoub et al. Crit Care Med 2009

Arythmie

Respiration Spontanée



Transmission de pression faible

Faible Vt

Driving pressure

Compliance basse

Hypertension intra-abdominale

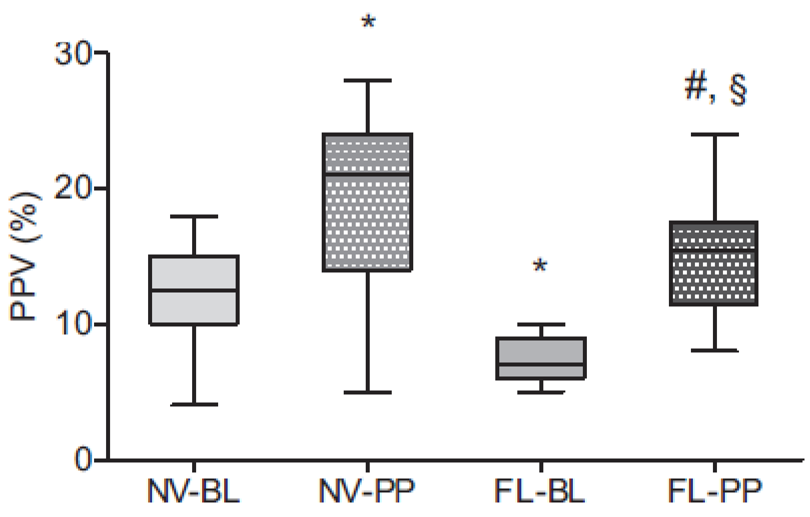
Insuffisance Cardiaque Droite

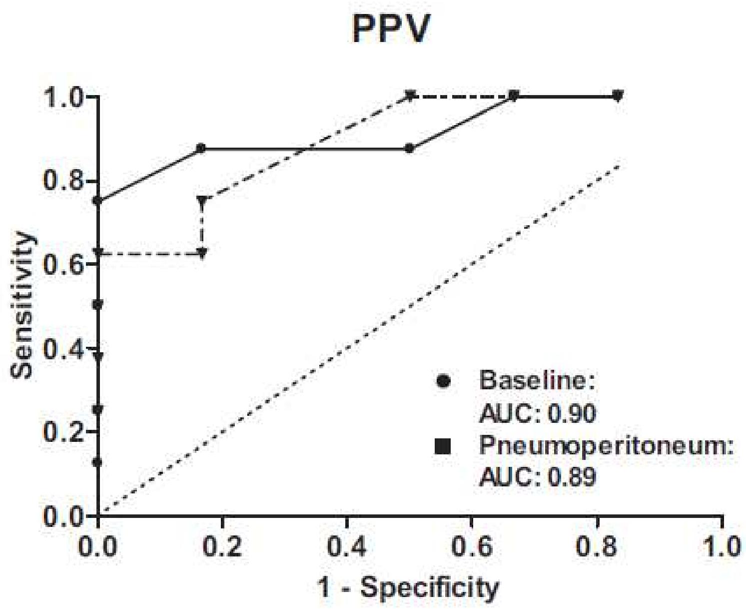
Temps de transit pulmonaire trop court

Influence of increased intra-abdominal pressure on fluid responsiveness predicted by pulse pressure variation and stroke volume variation in a porcine model*

14 cochons, augmentation PIA

Seuil du ΔPP: de 11,5% à 20,5%





Renner et al. Crit Care Med 2009

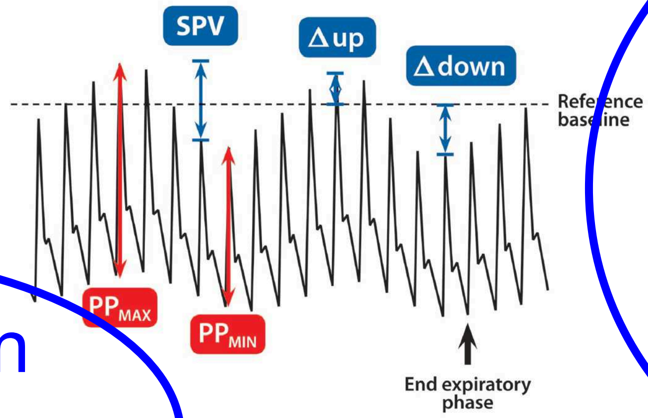
C'est Fréquent ?

Kim et al. Anaesth Intensive Care 2012	42 %
Vidal et al. Crit Care Med 2008	31 %
Malbrain et al. Crit Care Med 2005	36 %

Arythmie

Respiration Spontanée

Décubitus Ventral



Transmission de pression faible

Faible Vt

Driving pressure

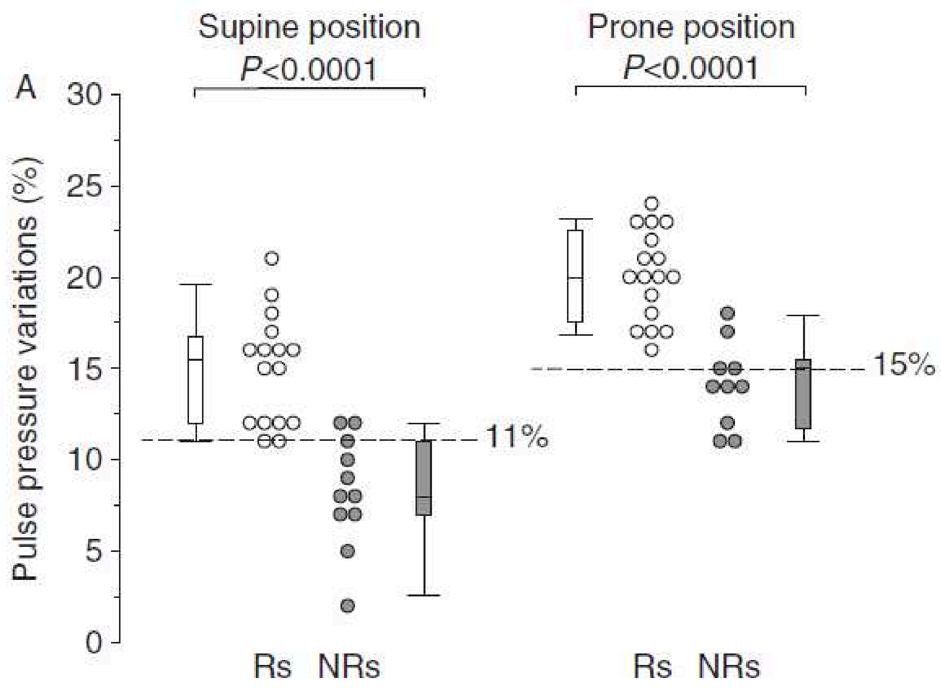
Compliance basse

Hypertension intra-abdominale

Insuffisance Cardiaque Droite

Temps de transit pulmonaire trop court

Abilities of pulse pressure variations and stroke volume variations to predict fluid responsiveness in prone position during scoliosis surgery



Décubitus ventral :

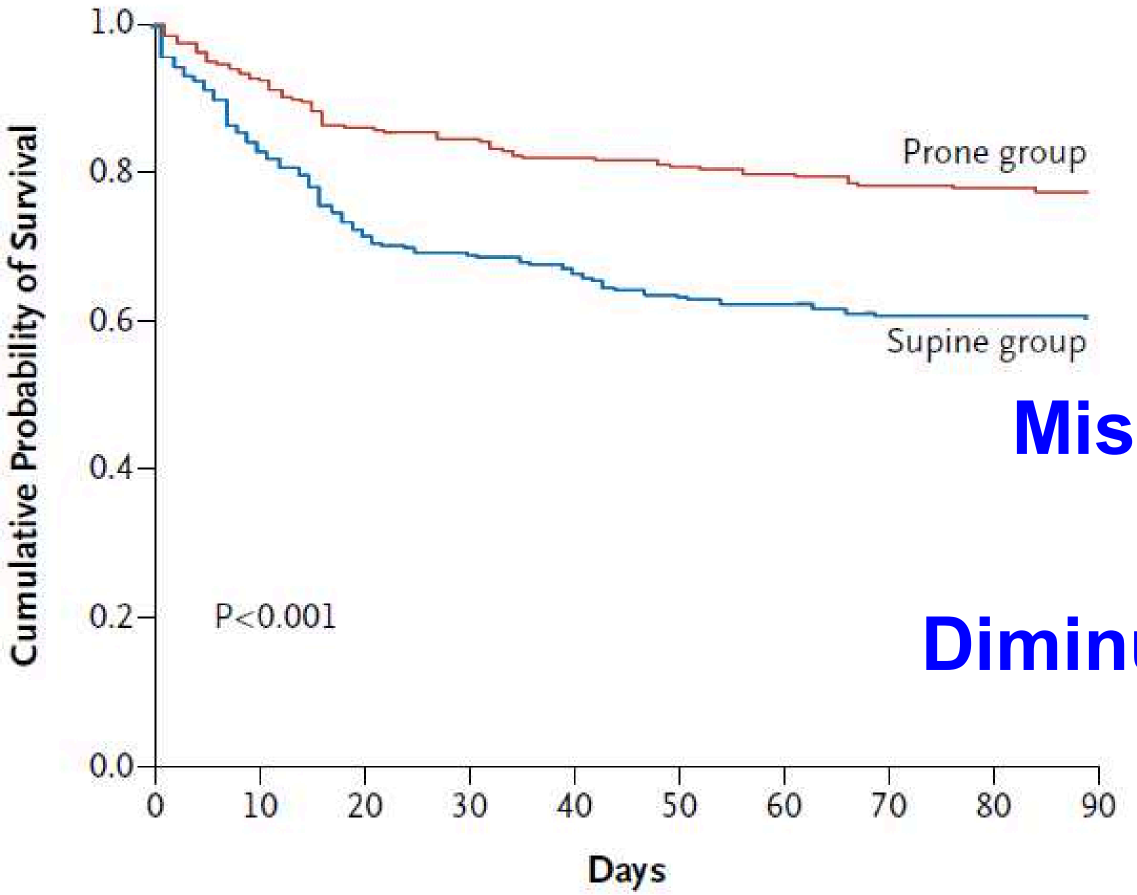
- **Augmentation ΔPP**
- **Augmentation du seuil de 11% à 15%**

Biais et al. Br J Anaesth 2010

Prone Positioning in Severe Acute Respiratory Distress Syndrome

The NEW ENGLAND JOURNAL of MEDICINE

466 patients / SDRA randomisés



Mise en DV prolongé

=

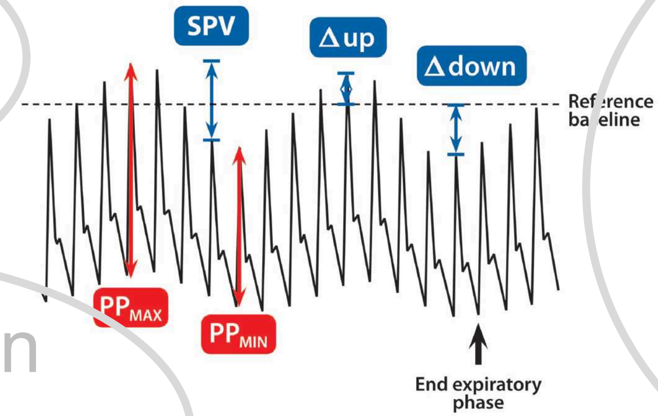
Diminution de la mortalité

Guérin et al. N Engl J Med 2013

Arythmie

Respiration
Spontanée

Décubitus
Ventral



Transmission
de pression
faible
Faible Vt
Driving pressure
Compliance basse

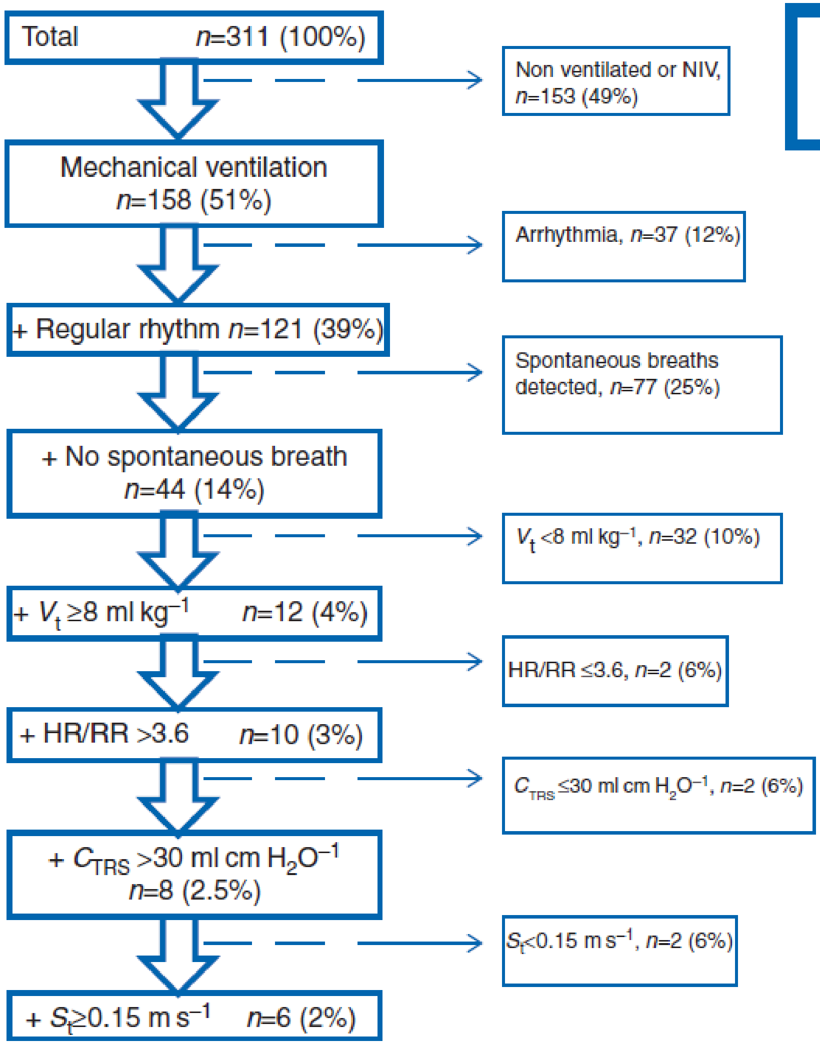
Hypertension
intra-

C’est Fréquent ?

Droite

trop court

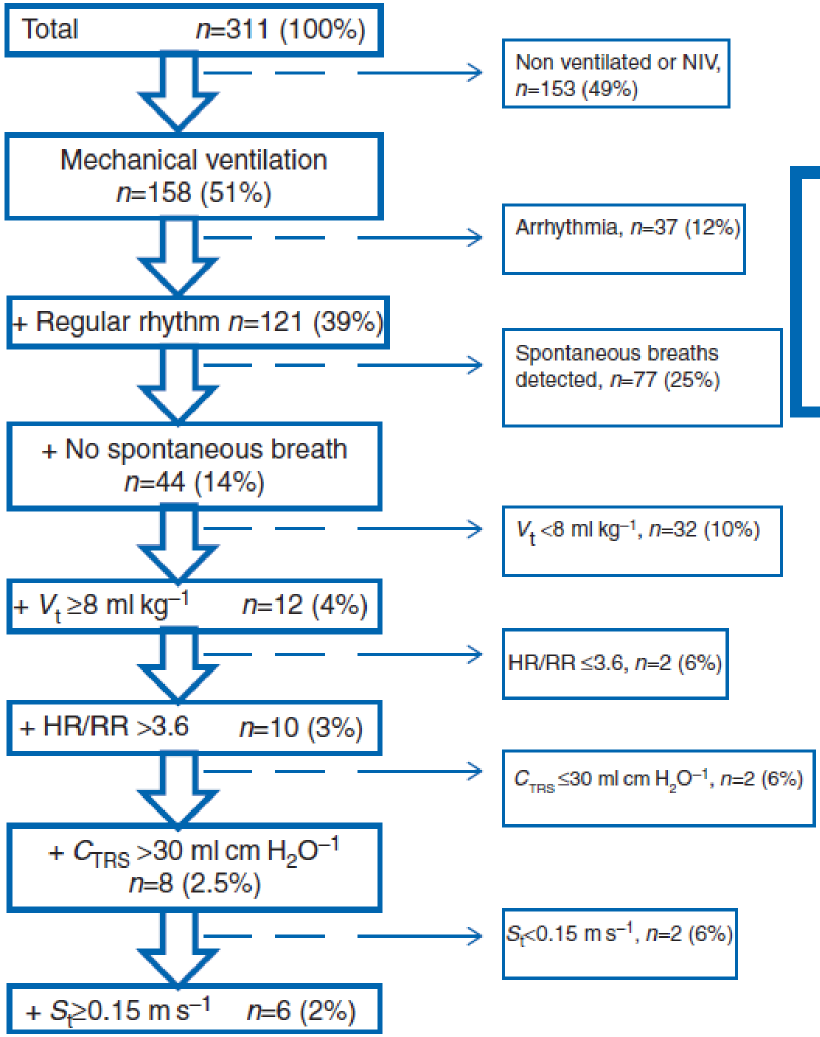
Evaluation of pulse pressure variation validity criteria in critically ill patients: a prospective observational multicentre point-prevalence study†



Total *n*=311 (100%)

Mahjoub et al. Brit J Anaesth 2014

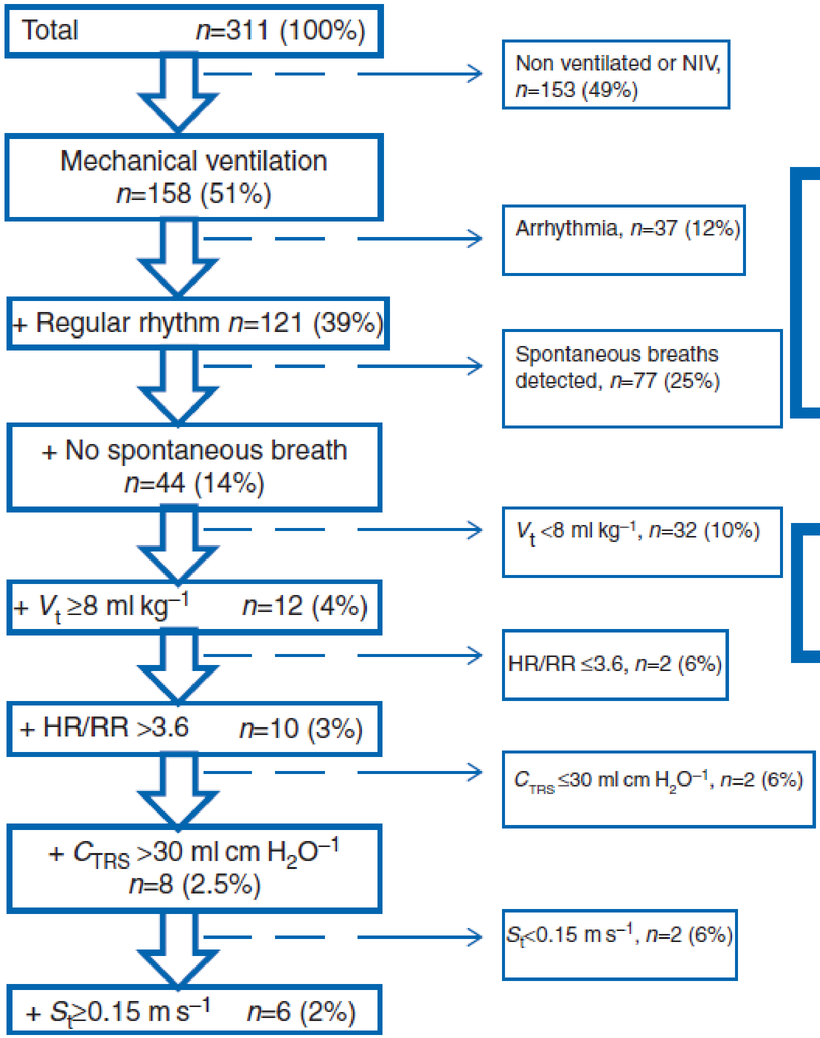
Evaluation of pulse pressure variation validity criteria in critically ill patients: a prospective observational multicentre point-prevalence study†



Mechanical ventilation
n=158 (51%)

Mahjoub et al. Brit J Anaesth 2014

Evaluation of pulse pressure variation validity criteria in critically ill patients: a prospective observational multicentre point-prevalence study†



Mechanical ventilation
n=158 (51%)

n=6 (4%)

Mahjoub et al. Brit J Anaesth 2014

		False positive	False negative
L	**Low** HR/RR ratio (Extreme bradycardia or high frequency ventilation)		✓
I	**Irregular** heart beats	✓	
M	**Mechanical** ventilation with low tidal volume		✓
I	**Increased** abdominal Pressure (Pneumoperitoneum)	✓	
T	**Thorax** open		✓
S	**Spontaneous** breathing	✓	✓

Michard et al. Crit Care 2015

Interactions Cardiopulmonaires

- **Approche Physiologique**
  - Relation VES-Précharge et VES-postcharge
  - Analyse de la courbe de pression artérielle
- **Significativité**
- **Implications Cliniques**
- **Limites**
- **Perspectives**

L’Epreuve de Remplissage

Fluid challenge revisited

- Type de fluide
- Débit de perfusion
- Objectifs du remplissage
- Limites de sécurité

J.L Vincent et al. Crit Care Med 2006

L’Epreuve de Remplissage

An Increase in Aortic Blood Flow after an Infusion of 100 ml Colloid over 1 Minute Can Predict Fluid Responsiveness

The Mini-fluid Challenge Study

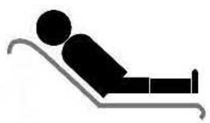
- Administration d’une faible quantité de fluide
- Monitorage de la réponse
- Prédiction de la réponse à l’administration d’une plus grande quantité de fluide

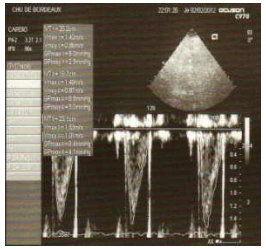
Muller et al. Anesthesiology 2011

An Increase in Aortic Blood Flow after an Infusion of 100 ml Colloid over 1 Minute Can Predict Fluid Responsiveness

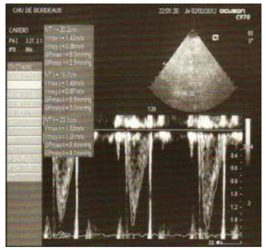
The Mini-fluid Challenge Study

Mesure ITV 1





Mesure ITV 2



HEA

100 ml

500 ml

T0

T1

1 minute

T2

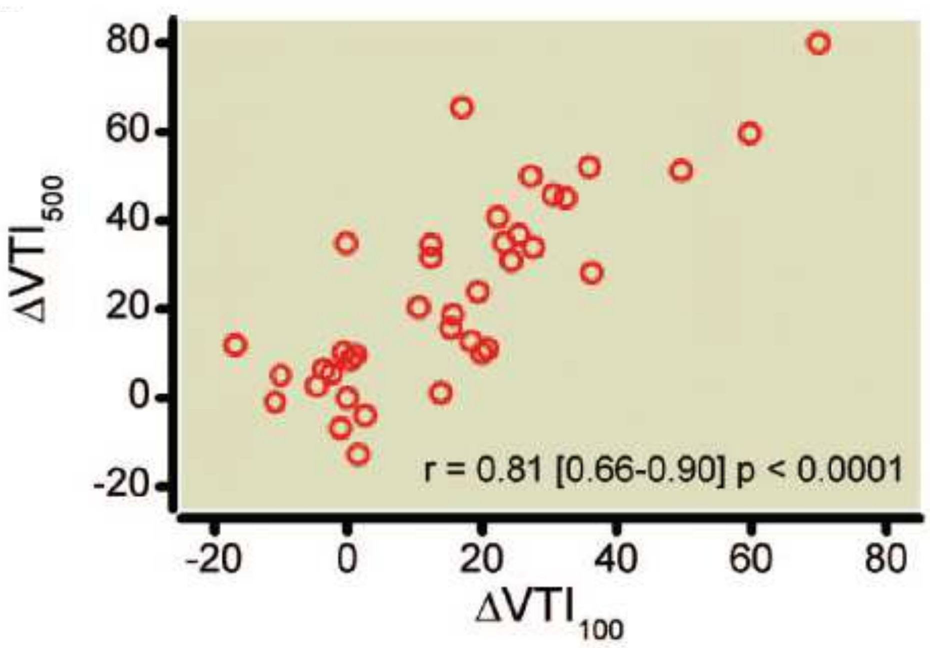
15 minutes

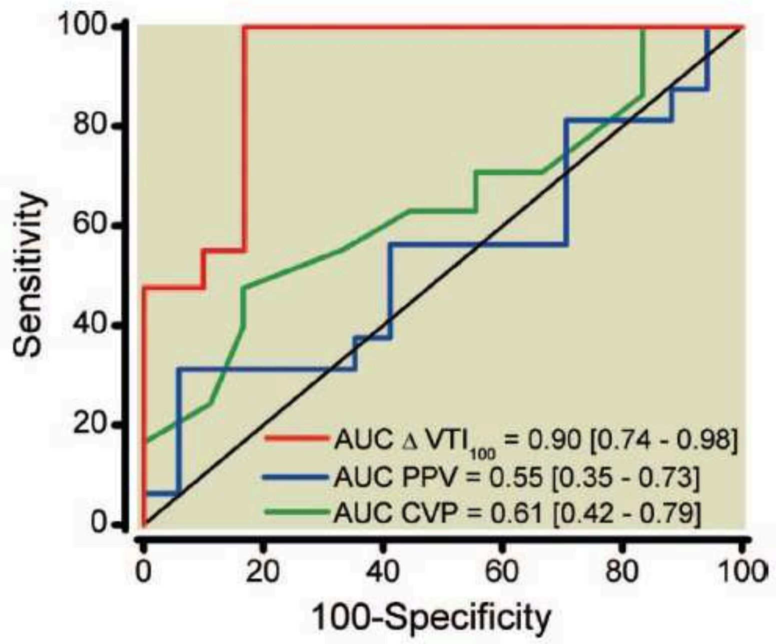
Muller et al. Anesthesiology 2011

An Increase in Aortic Blood Flow after an Infusion of 100 ml Colloid over 1 Minute Can Predict Fluid Responsiveness

The Mini-fluid Challenge Study

Une augmentation >10% de l'ITVAo après 100ml de colloide sur 1 minute prédit la réponse à un expansion volémique de 500 ml





Muller et al. Anesthesiology 2011

Conclusion

- La ventilation mécanique
  - Contraint le VD
  - Aide le VG
- Indices dynamiques
  - Prédiction expansion volémique
  - Situations rares
- Place du Mini-Fluid

Merci