



Hospices Civils de Lyon



AER
ACTUALITÉS EN RÉANIMATION

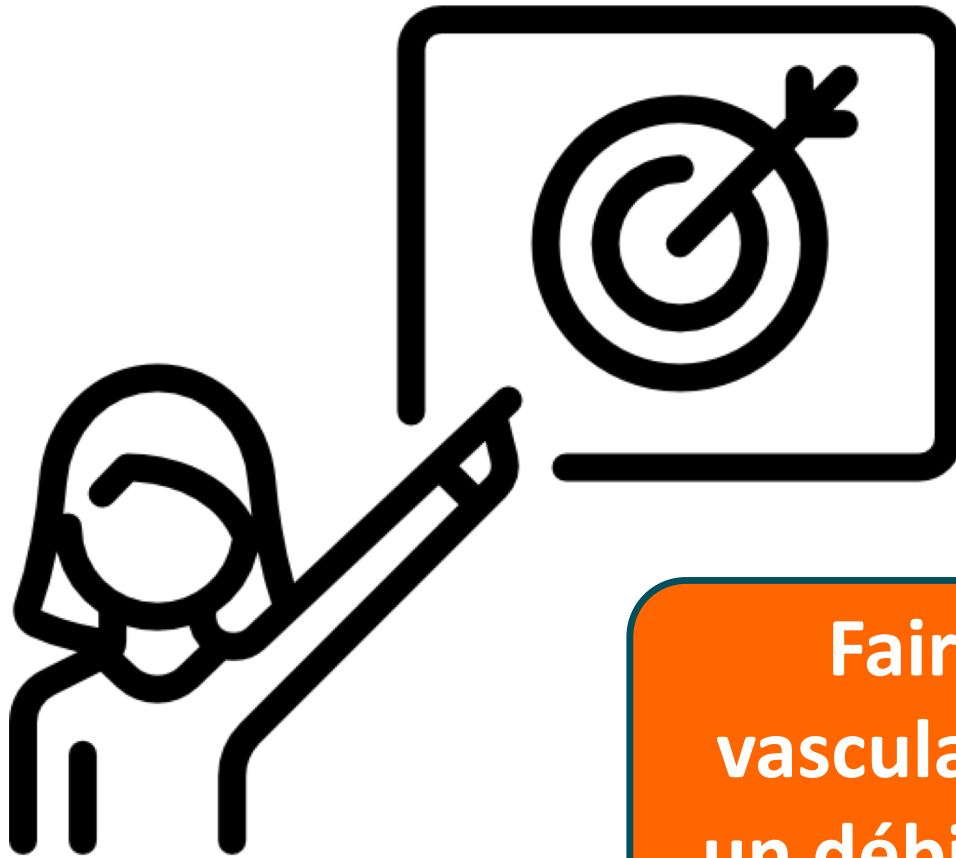
Gestion du remplissage vasculaire

Pr Martin COUR

Médecine Intensive - Réanimation

Hôpital Edouard Herriot - Lyon

Le 17/11/2022



**Faire un remplissage
vasculaire pour augmenter
un débit cardiaque trop bas**



R

Réanimer

O

Optimiser

S

Stabiliser

E

Evacuer

Malbrain MLNG, et al. Intravenous fluid therapy in the perioperative and critical care setting: Executive summary of the International Fluid Academy (IFA). *Ann Intensive Care*. 2020



R

Réanimer

O

Optimiser

S

Stabiliser

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**R**

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**R**

Réanimer

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Optimiser

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Malbrain MLNG, et al. Intravenous fluid therapy in the perioperative and critical care setting: Executive summary of the International Fluid Academy (IFA). *Ann Intensive Care*. 2020

**R**

Réanimer

O

Optimiser

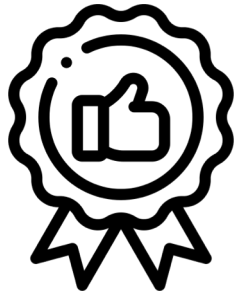
S

Stabiliser

E

Evacuer

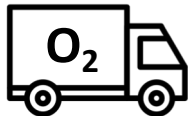
Malbrain MLNG, et al. Intravenous fluid therapy in the perioperative and critical care setting: Executive summary of the International Fluid Academy (IFA). *Ann Intensive Care*. 2020



Intérêts du remplissage vasculaire



Augmenter le débit cardiaque



Augmenter le transport en O₂



Augmenter la pression artérielle

Traitement de 1^{ère} ligne dans chocs



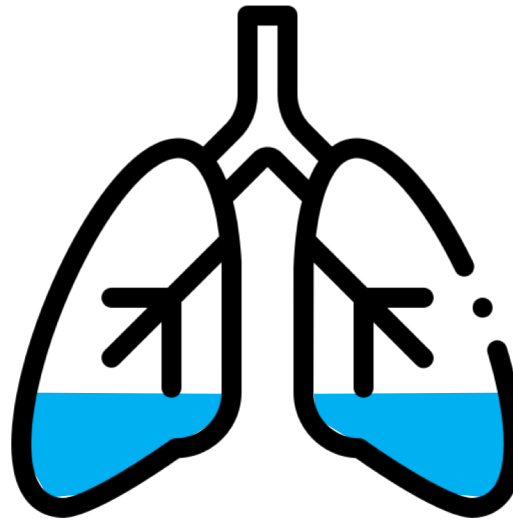
Comment le remplissage vasculaire augmente la pression artérielle ?

En augmentant le débit cardiaque (DC)

Pression = débit x résistance



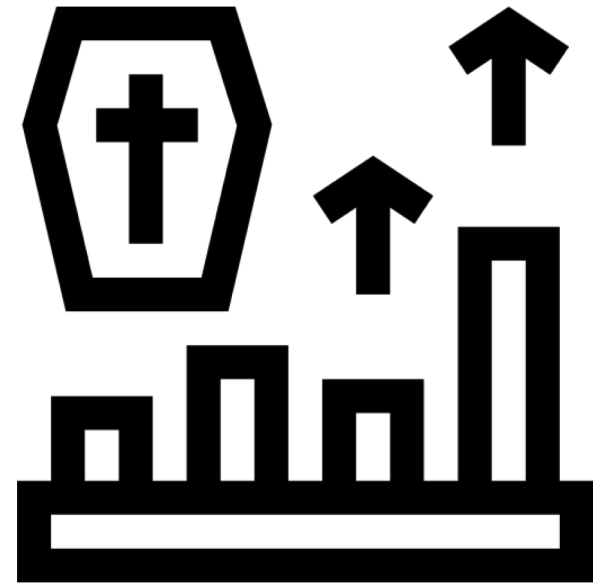
**Oedèmes
périphériques**



**Oedème
pulmonaire**



**Altération de la
microcirculation**



O'Connor ME, Prowle JR. Fluid overload. *Crit Care Clin.* 2015

Sepsis in European intensive care units: Results of the SOAP study*

Jean-Louis Vincent, MD, PhD, FCCM; Yasser Sakr, MB, BCh, MSc; Charles L. Sprung, MD; V. Marco Ranieri, MD; Konrad Reinhart, MD, PhD; Herwig Gerlach, MD, PhD; Rui Moreno, MD, PhD; Jean Carlet, MD, PhD; Jean-Roger Le Gall, MD; Didier Payen, MD; on behalf of the Sepsis Occurrence in Acutely Ill Patients Investigators



>3000



199



24



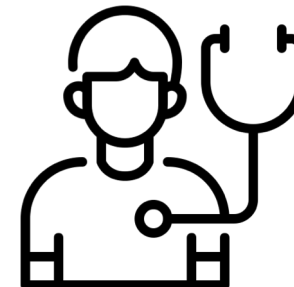
Excès de fluide (72h)
FDR indépendant de mortalité

OR = 1.1 [1.0-1.1] (par litre)



Insuffisance circulatoire ?

Hypotension artérielle / bas débit / hypoperfusion ?



oui

Hypovolémie évidente ?

Hémorragie active, phase initiale choc septique, etc

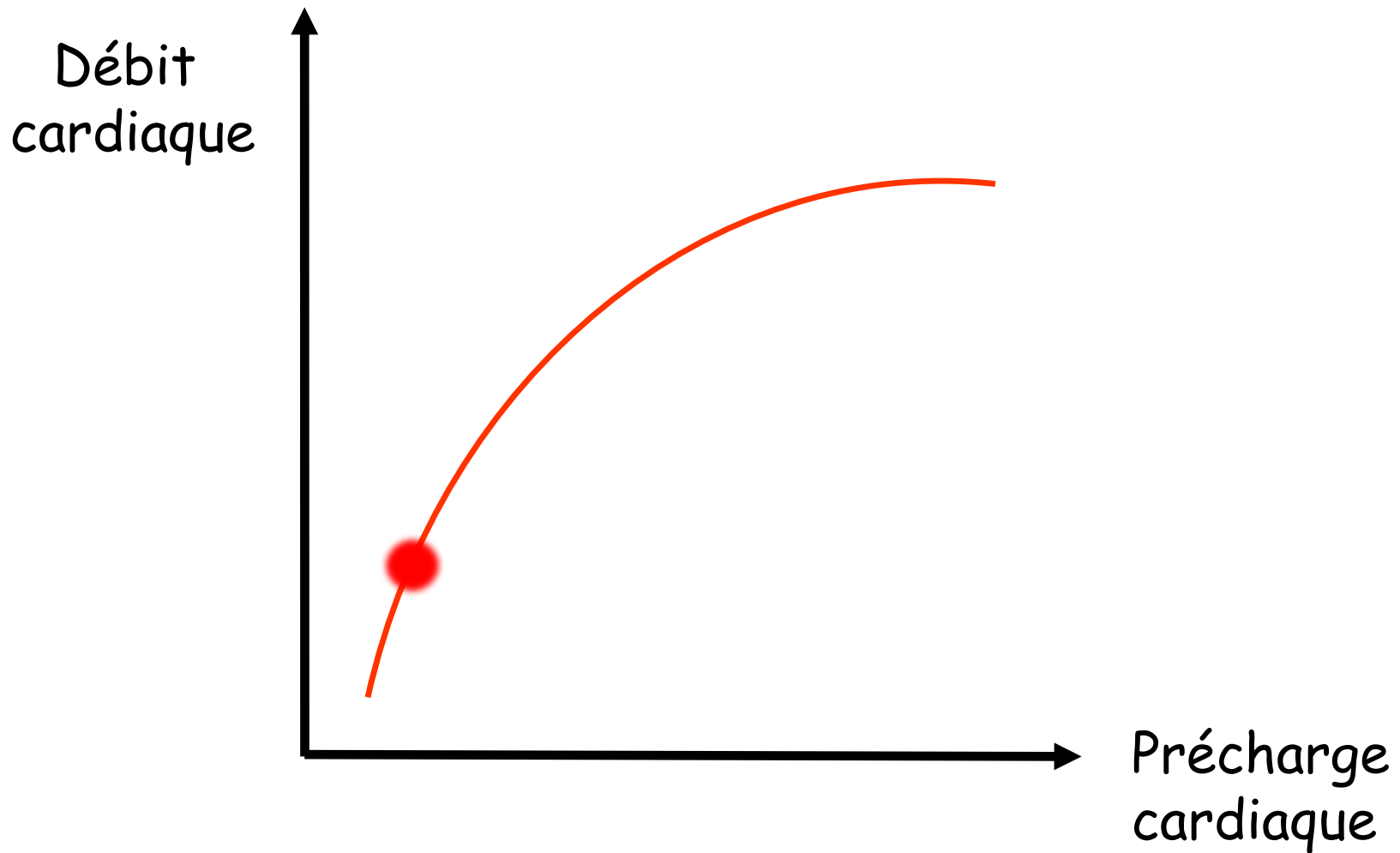
oui

Remplissage

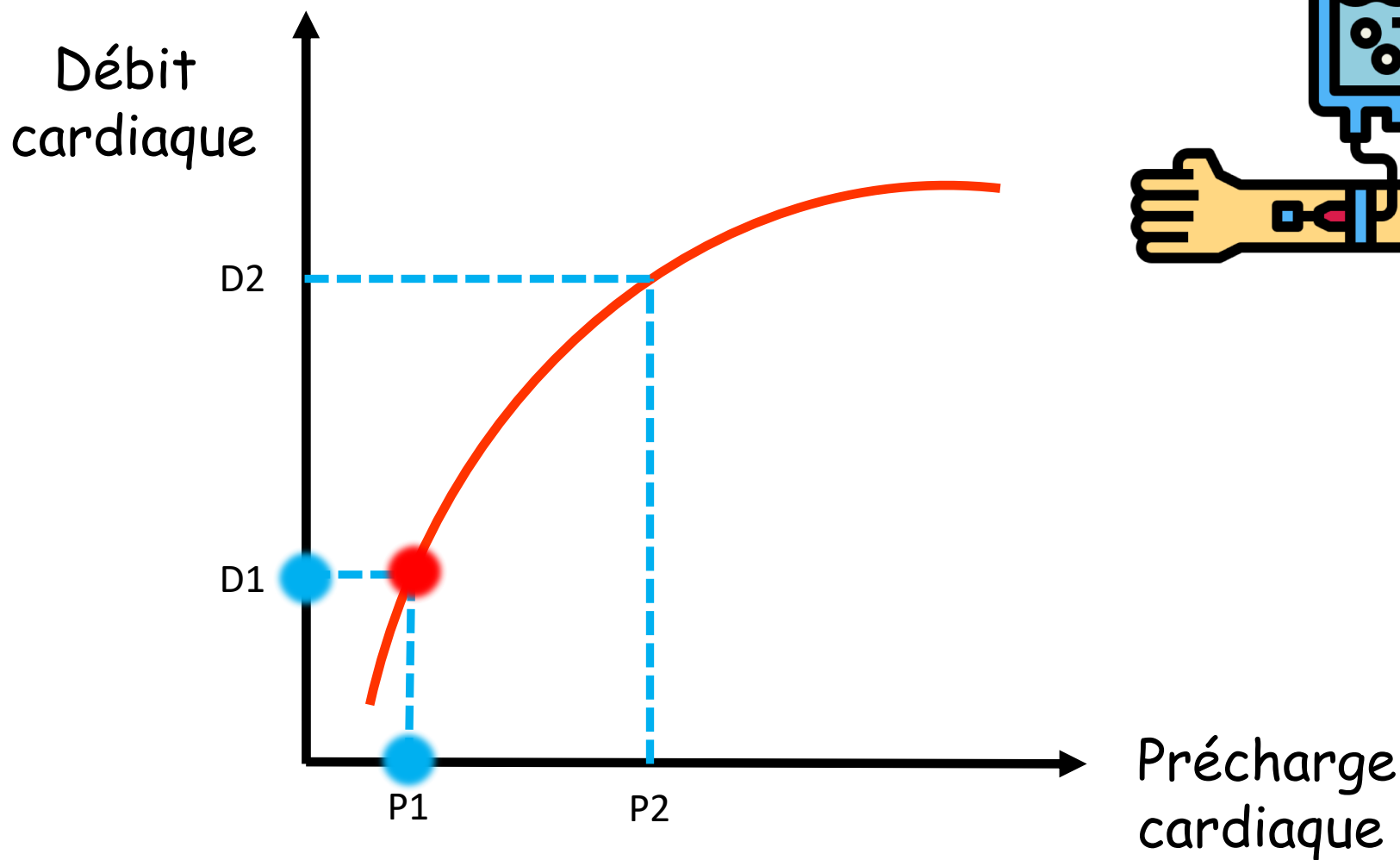
non

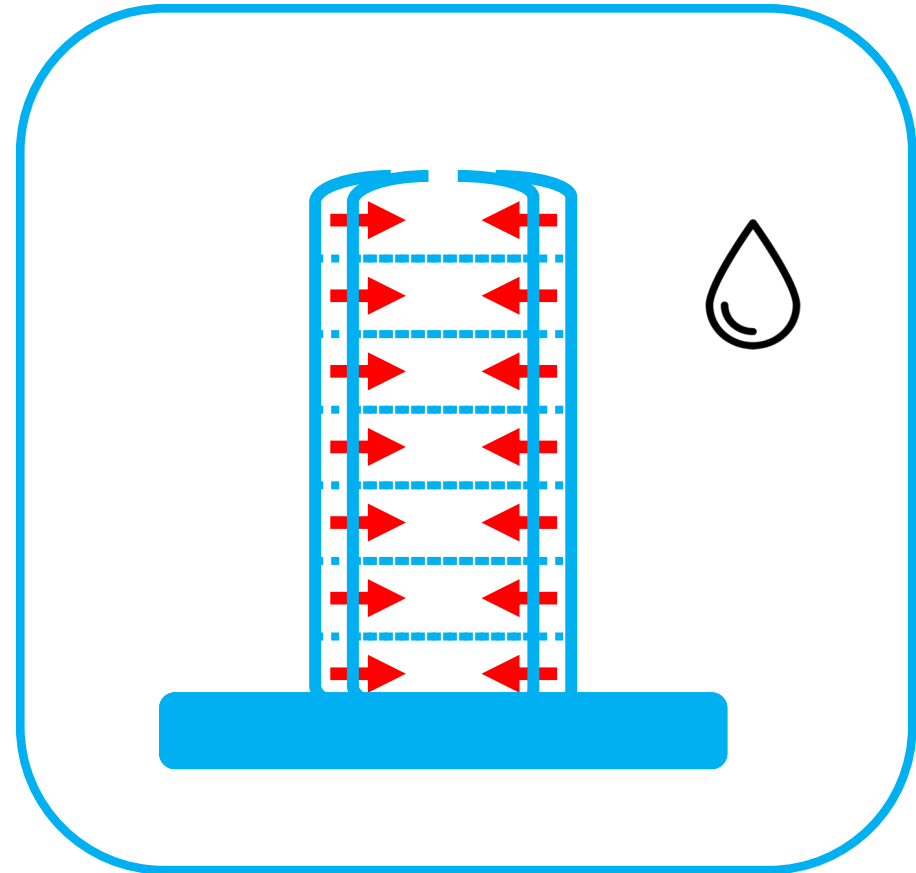
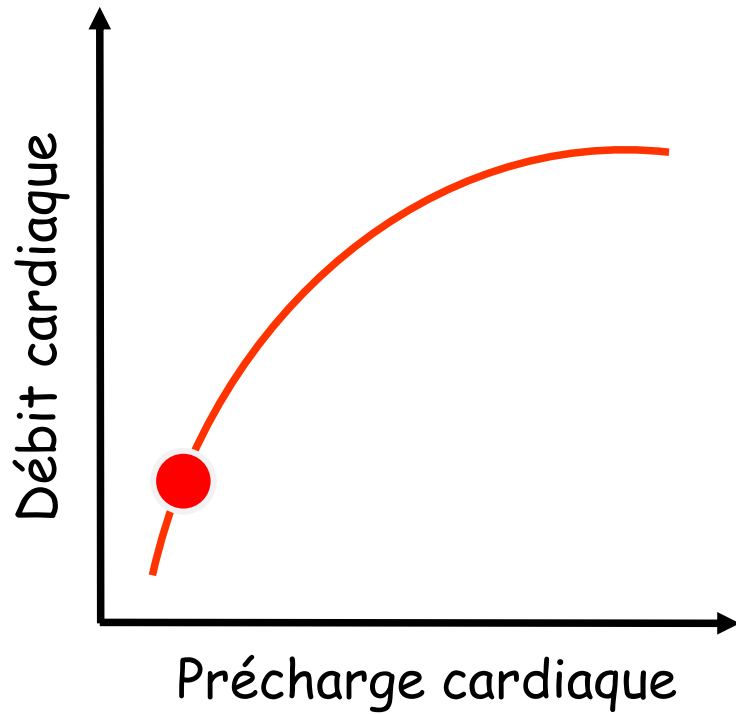
Précharge dépendance ?

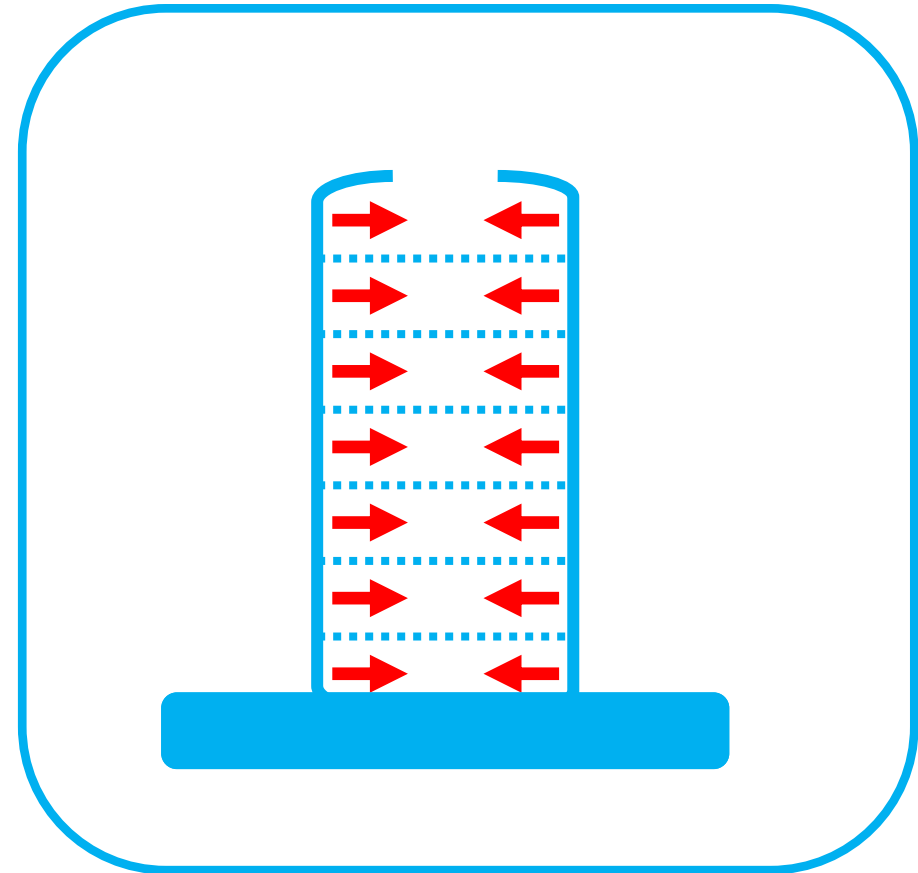
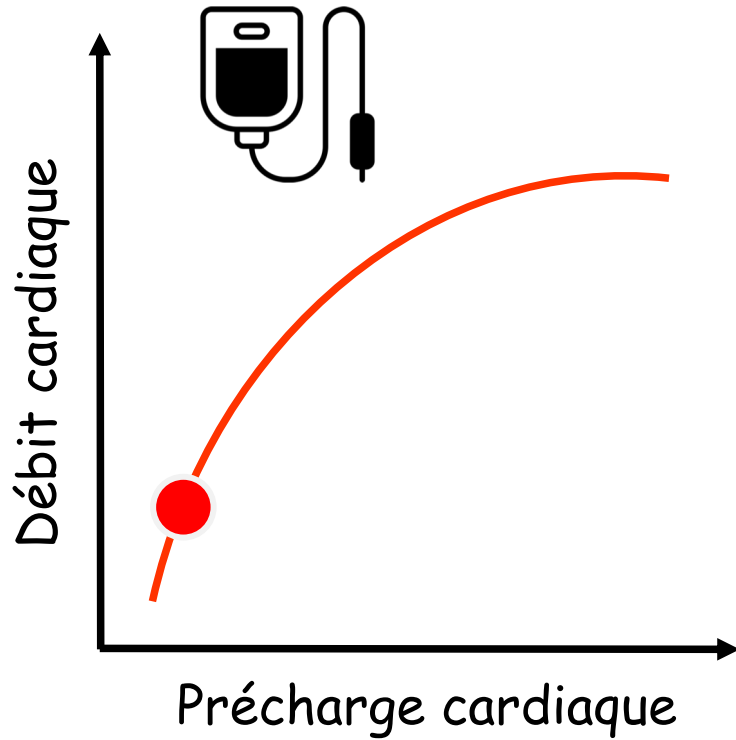
Loi de Franck-Starling

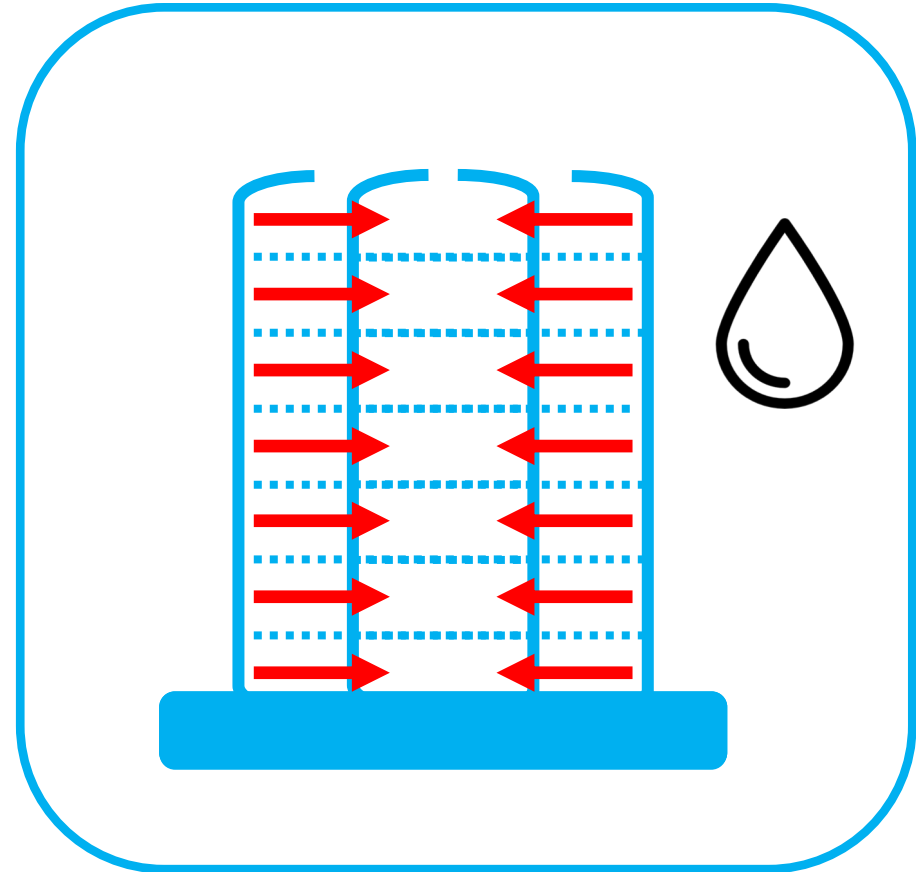
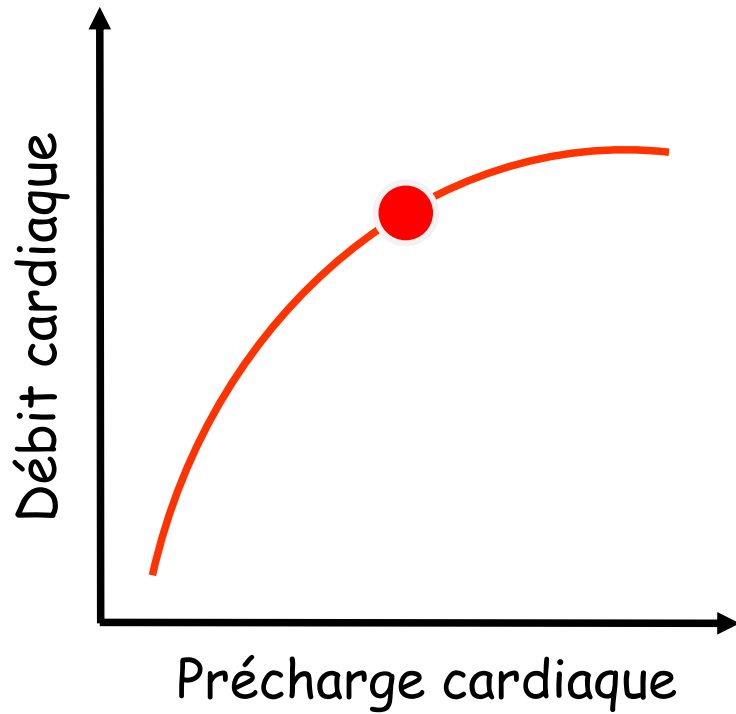


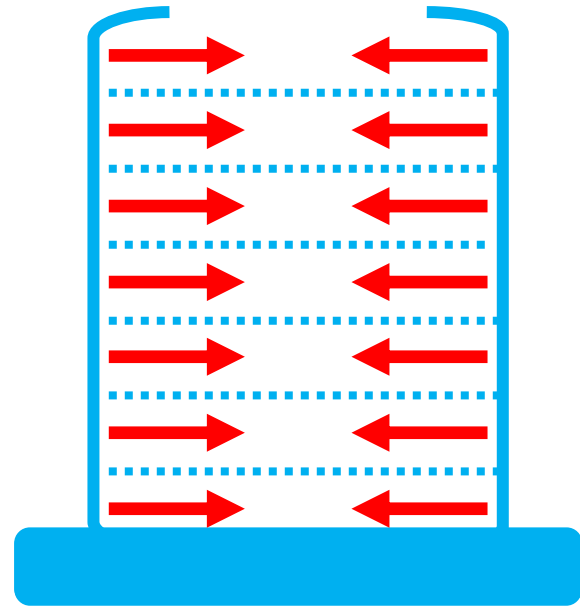
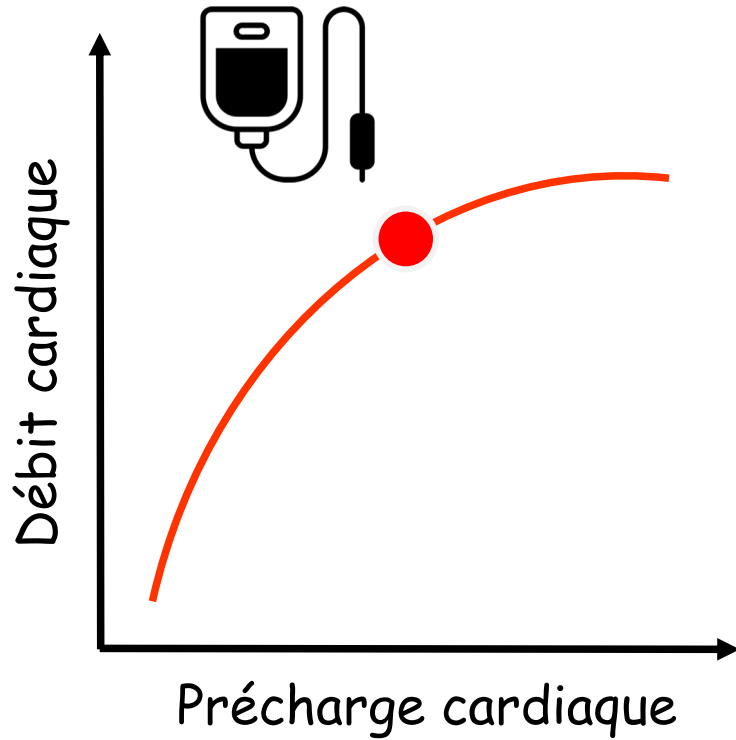
Loi de Franck-Starling

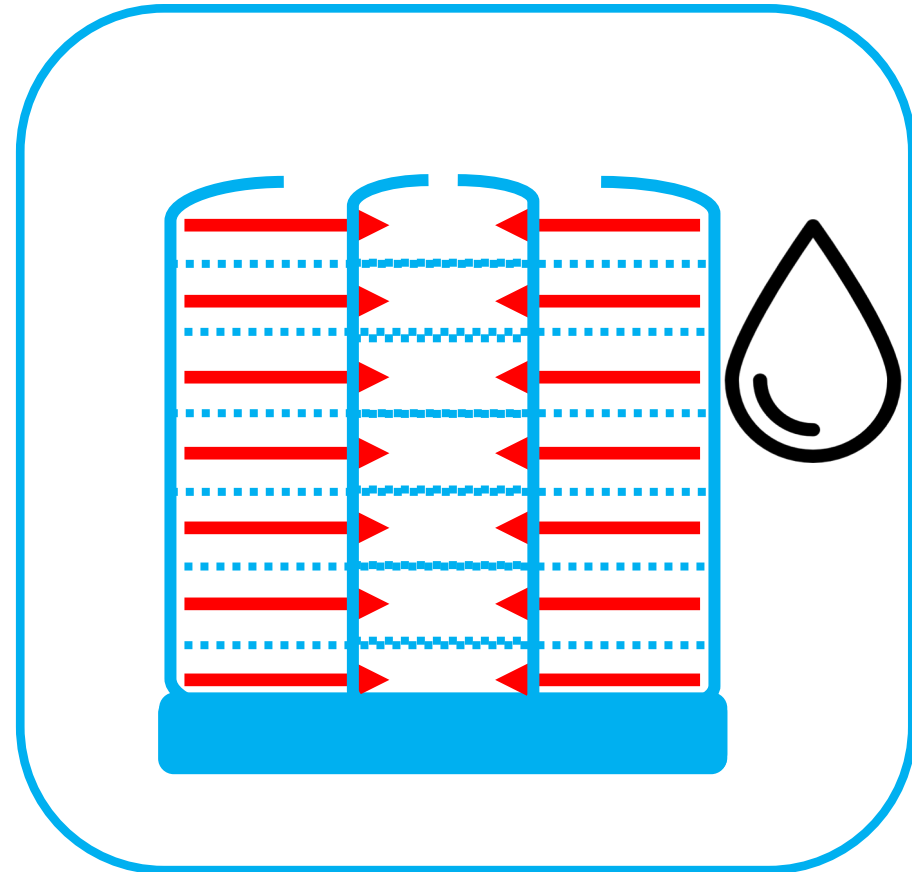
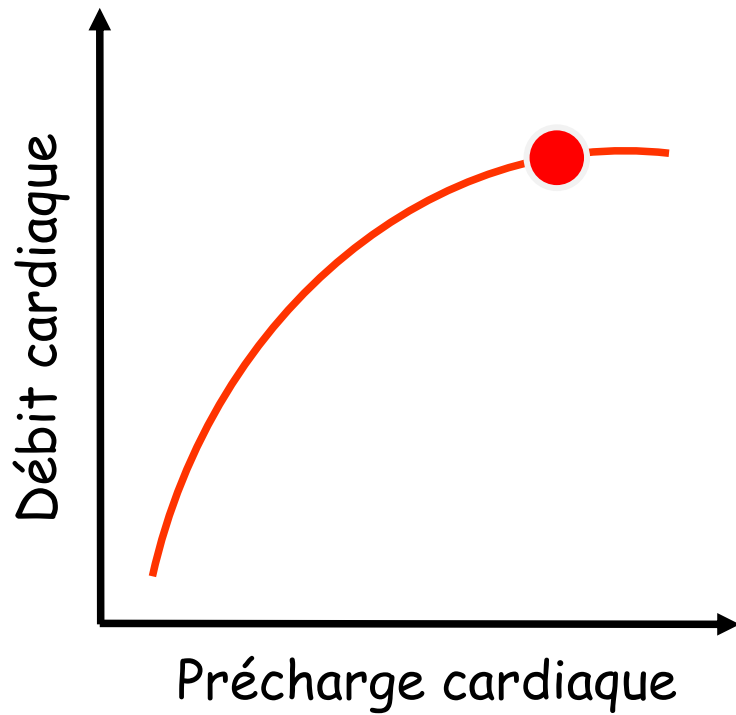


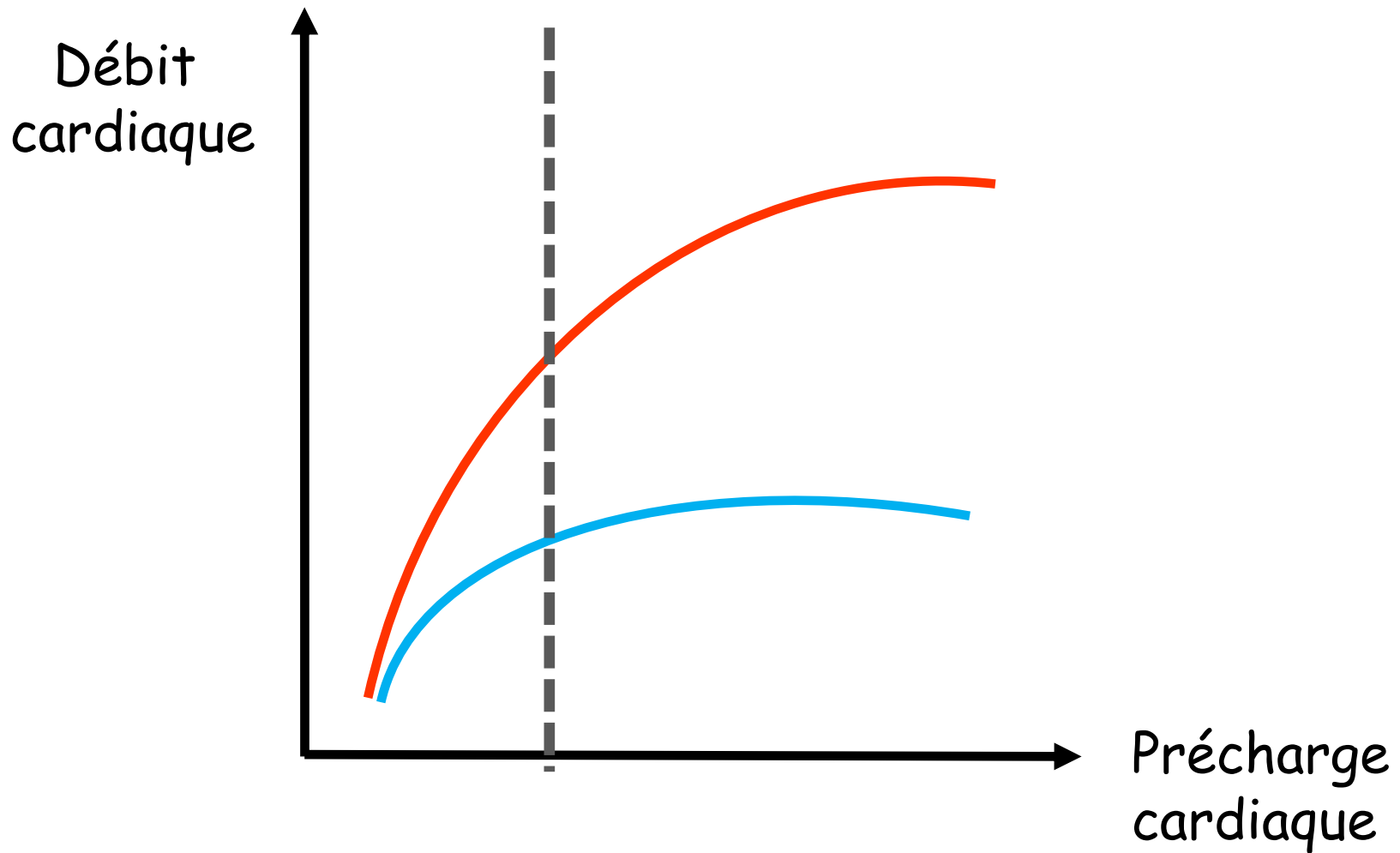


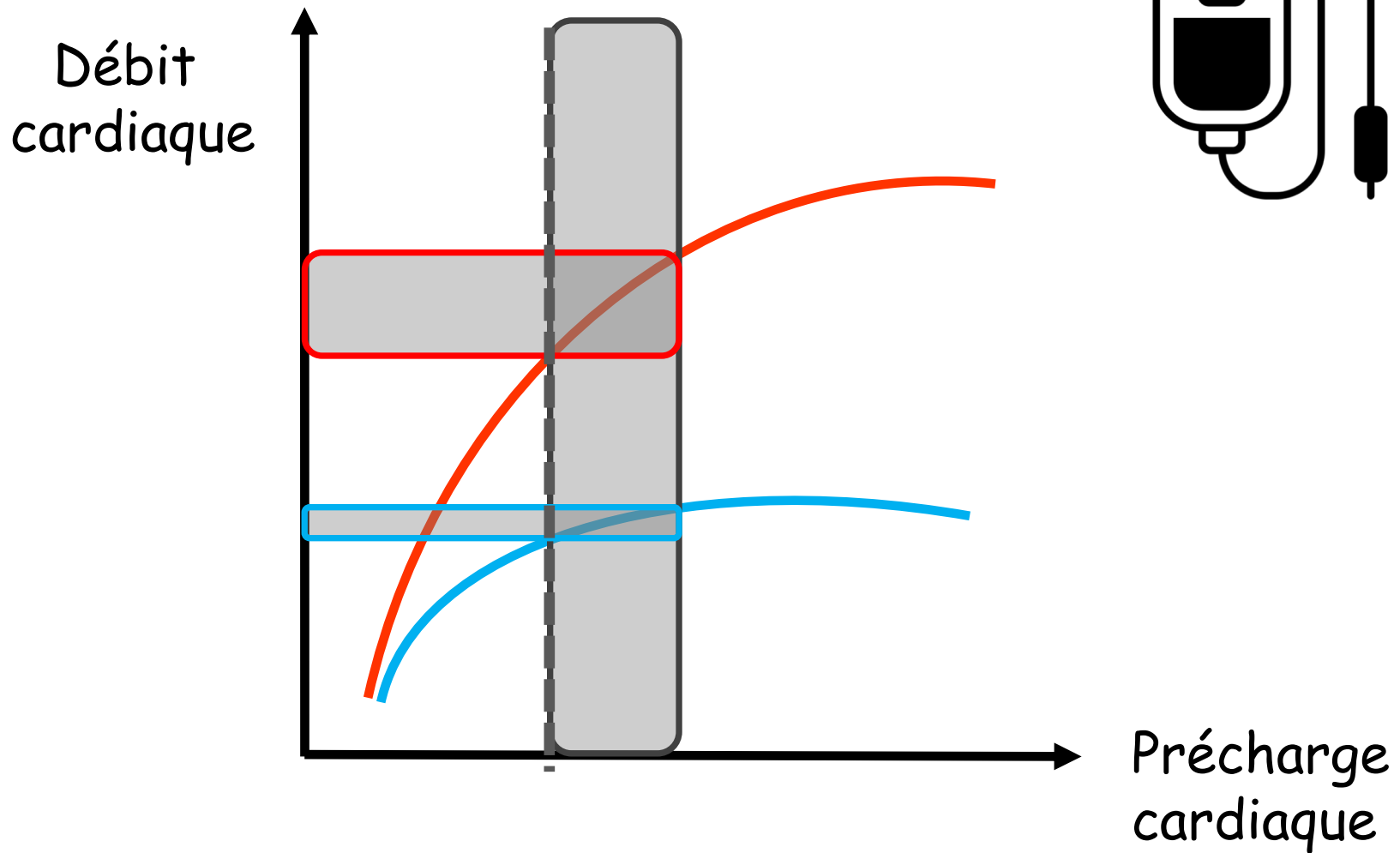


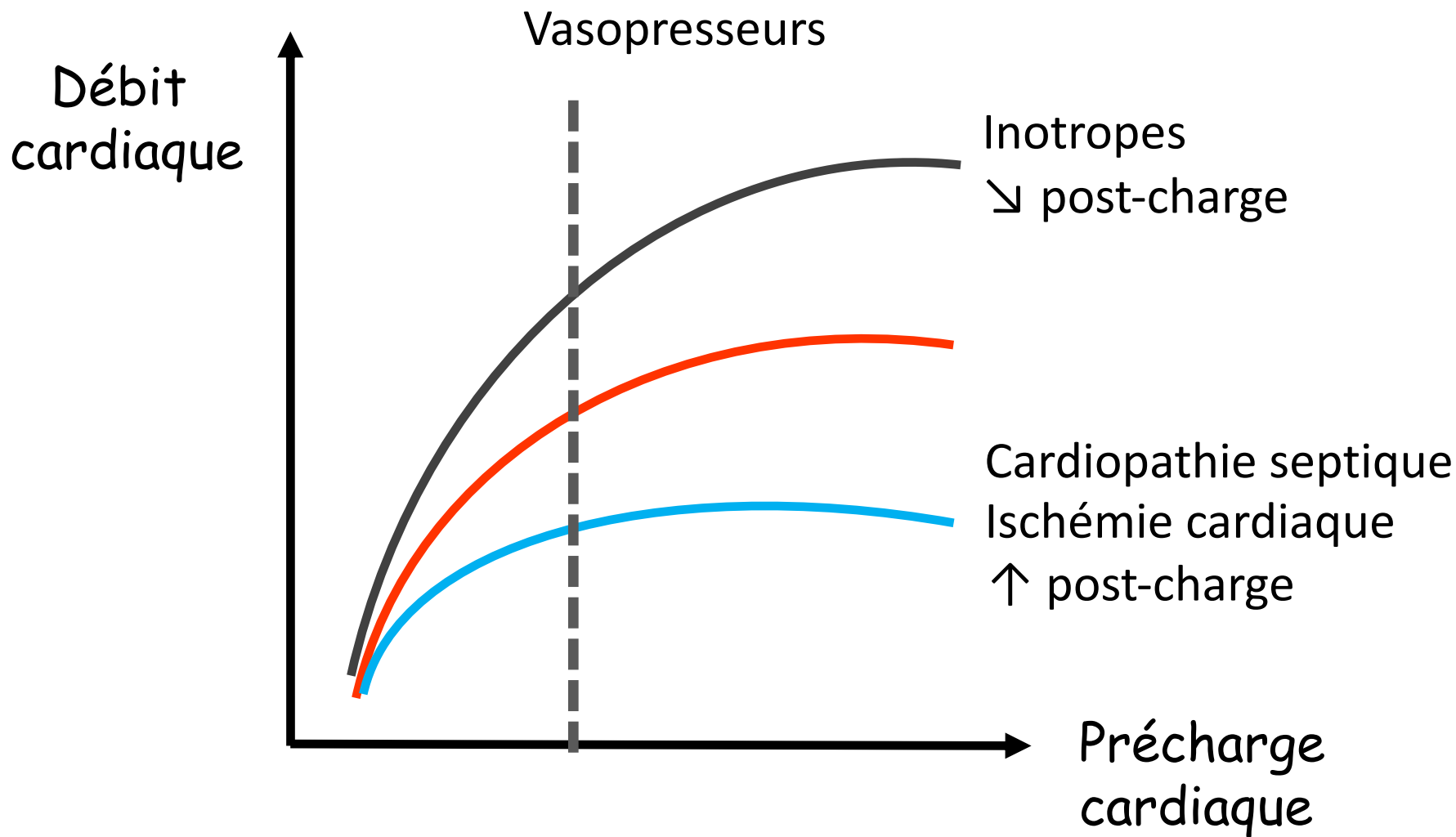


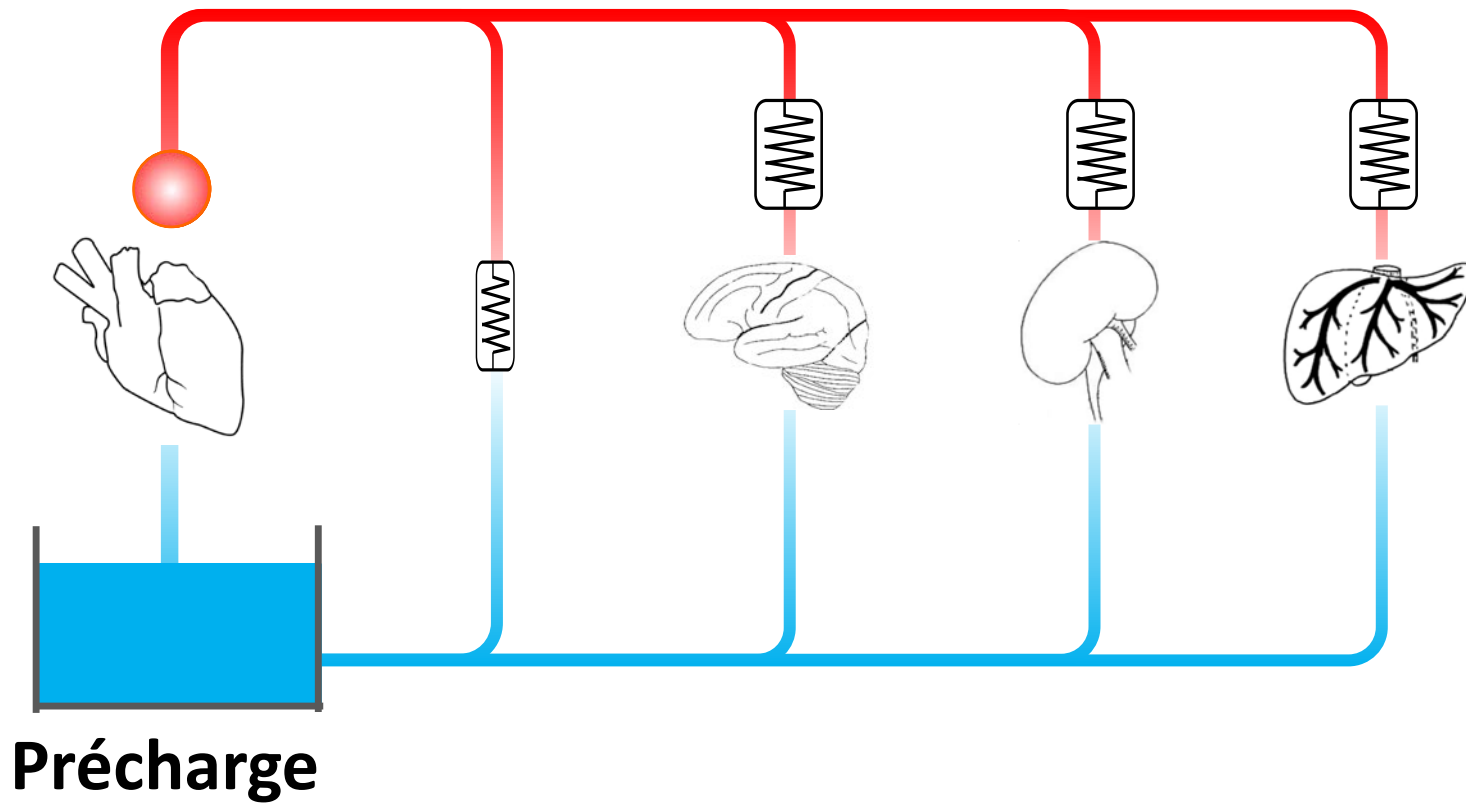


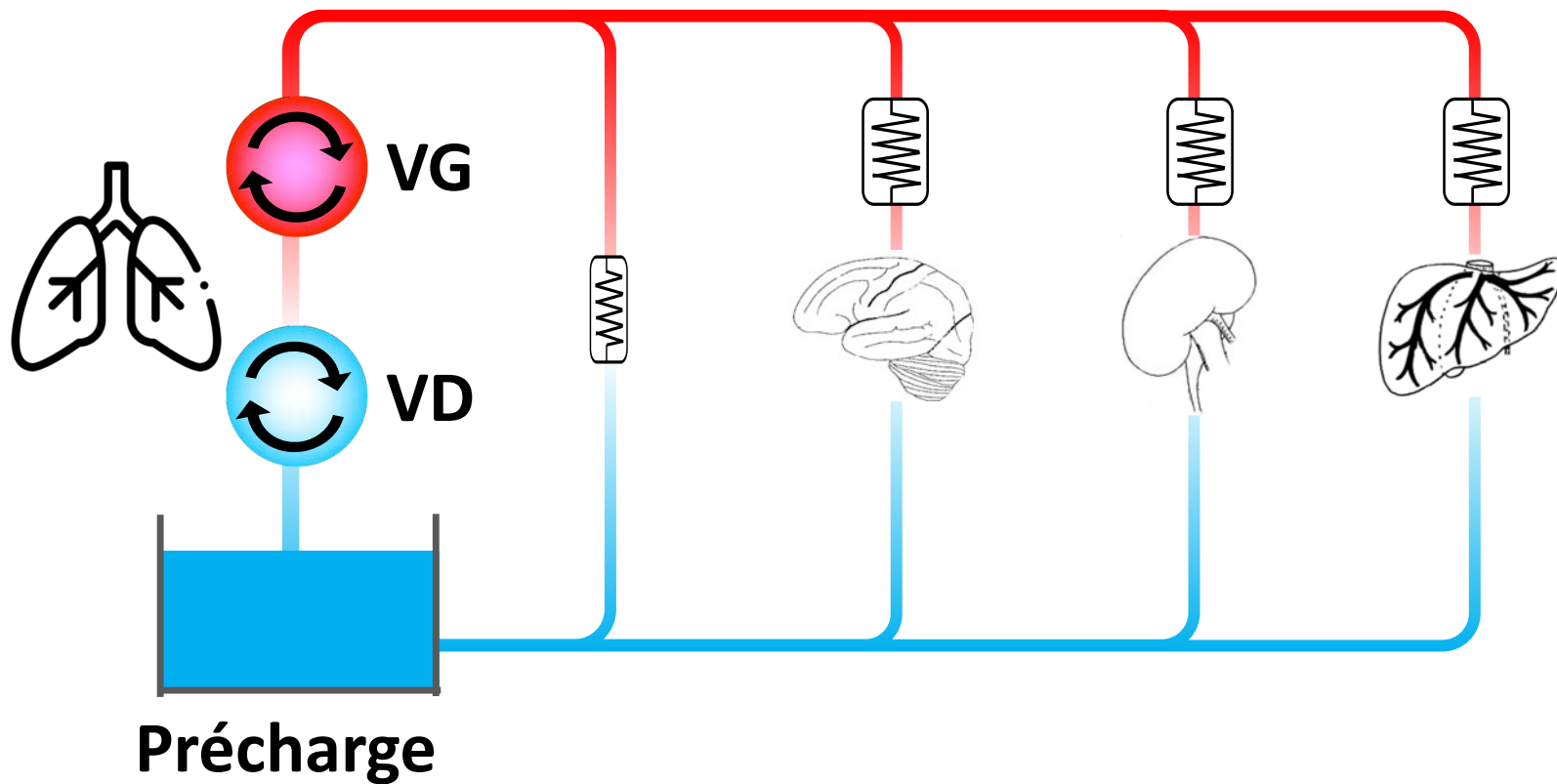






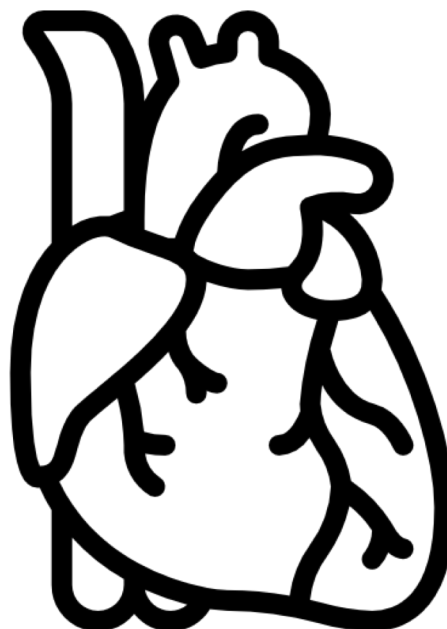






**Diamètre veine
cave sup.**

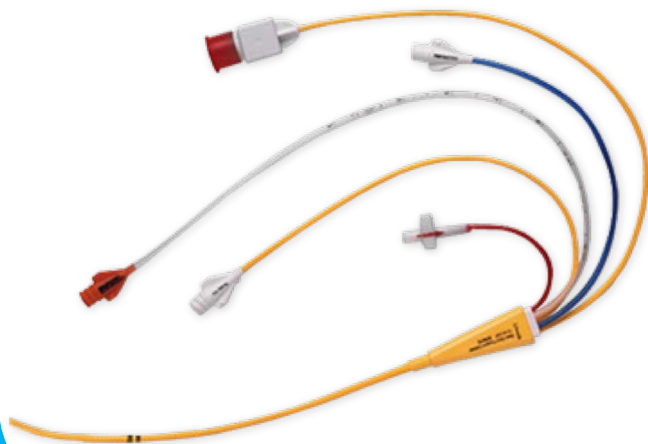
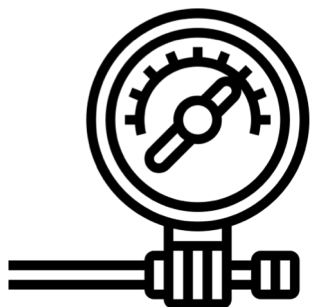
PVC



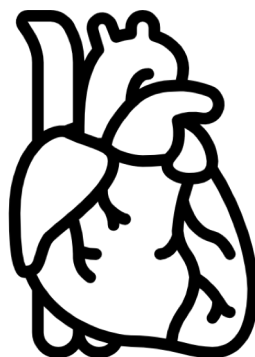
Taille du VG

PTDVG

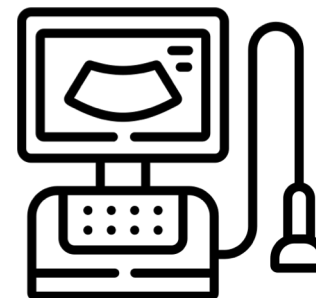
**Diamètre veine
cave inf.**



Evaluer

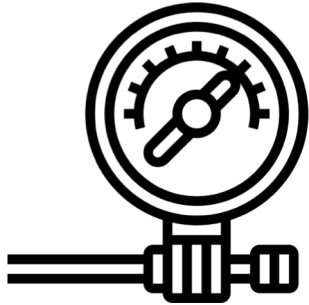


Précharge



Approche invasive

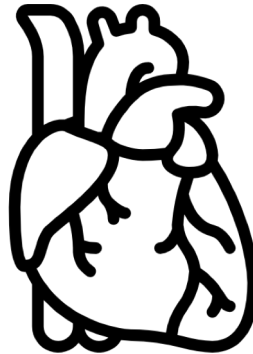
Approche non invasive



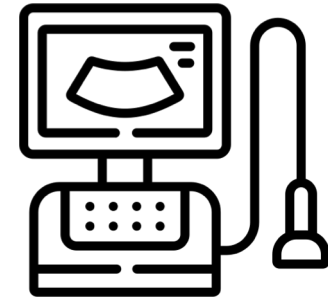
Mesure PVC
Mesure POD
Mesure PAPO (PTDVG)
VTDG / thermodilution

Approche invasive

Evaluer

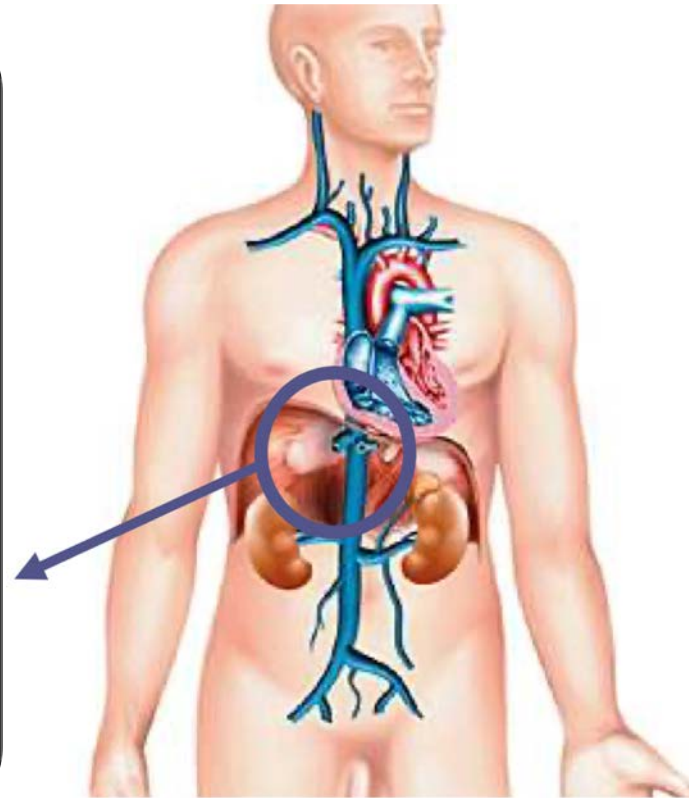
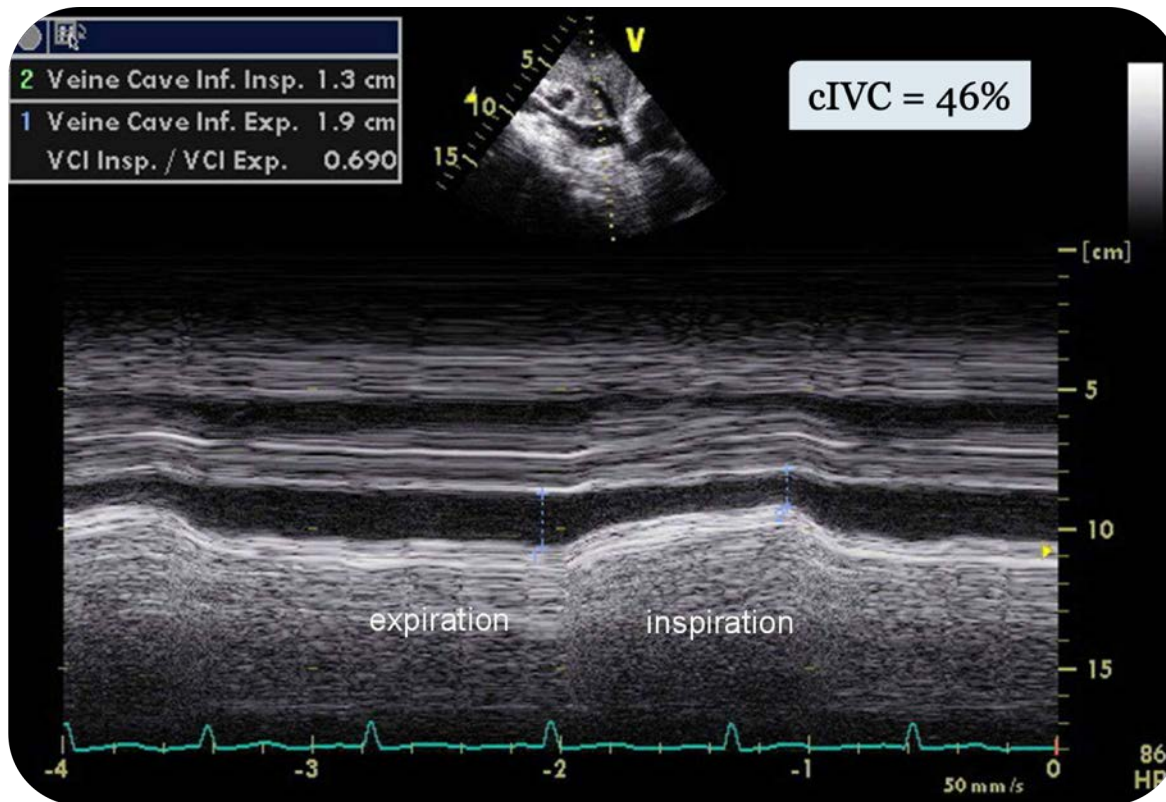


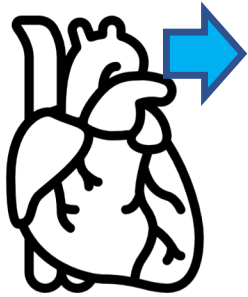
Précharge



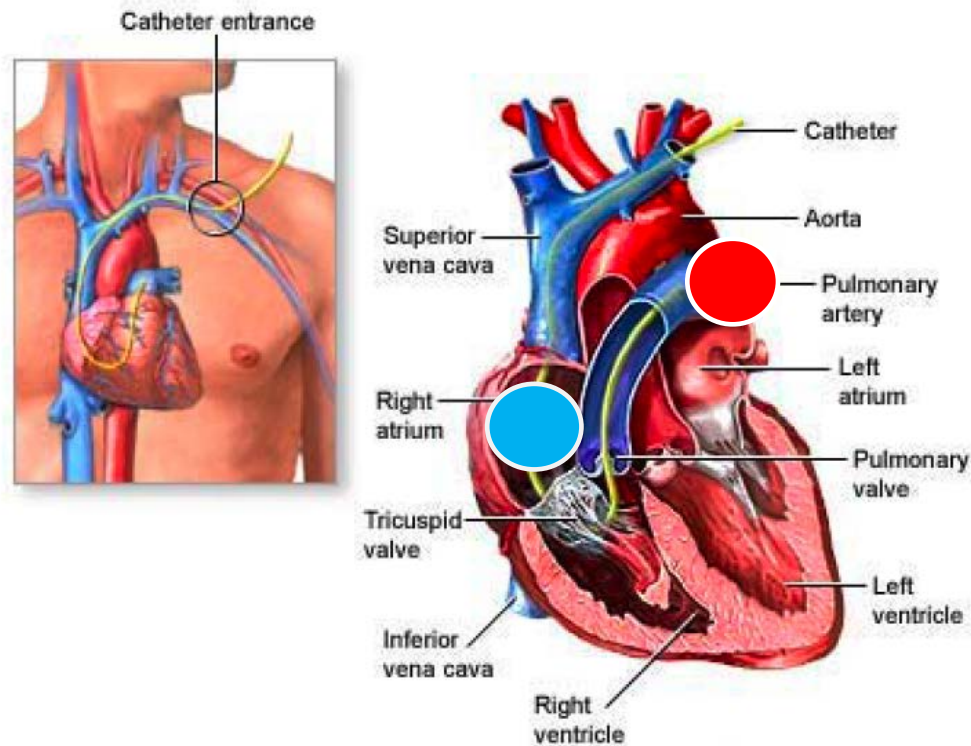
Estimation PVC
Mesure diamètre VC
Mesure taille du VG
Estimation PTDVG

Approche non invasive

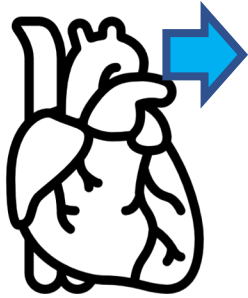




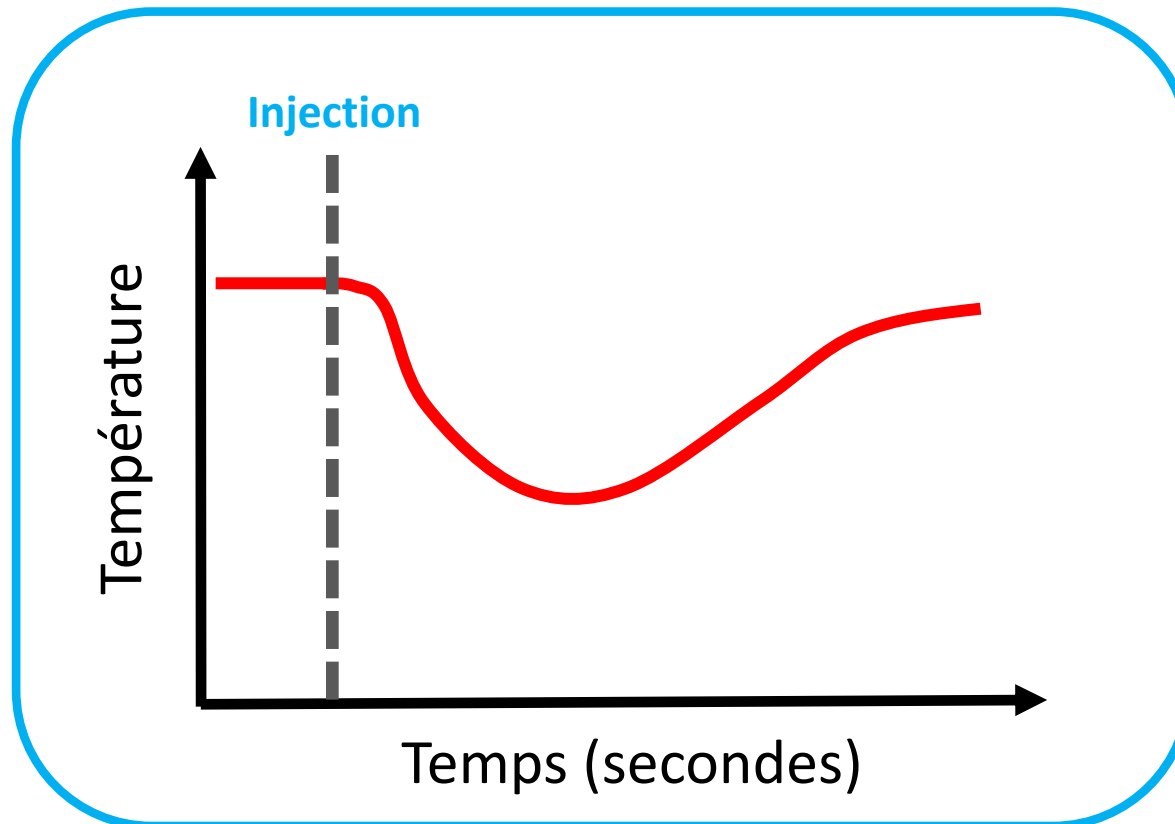
Volume d'éjection
Débit cardiaque



Approche invasive

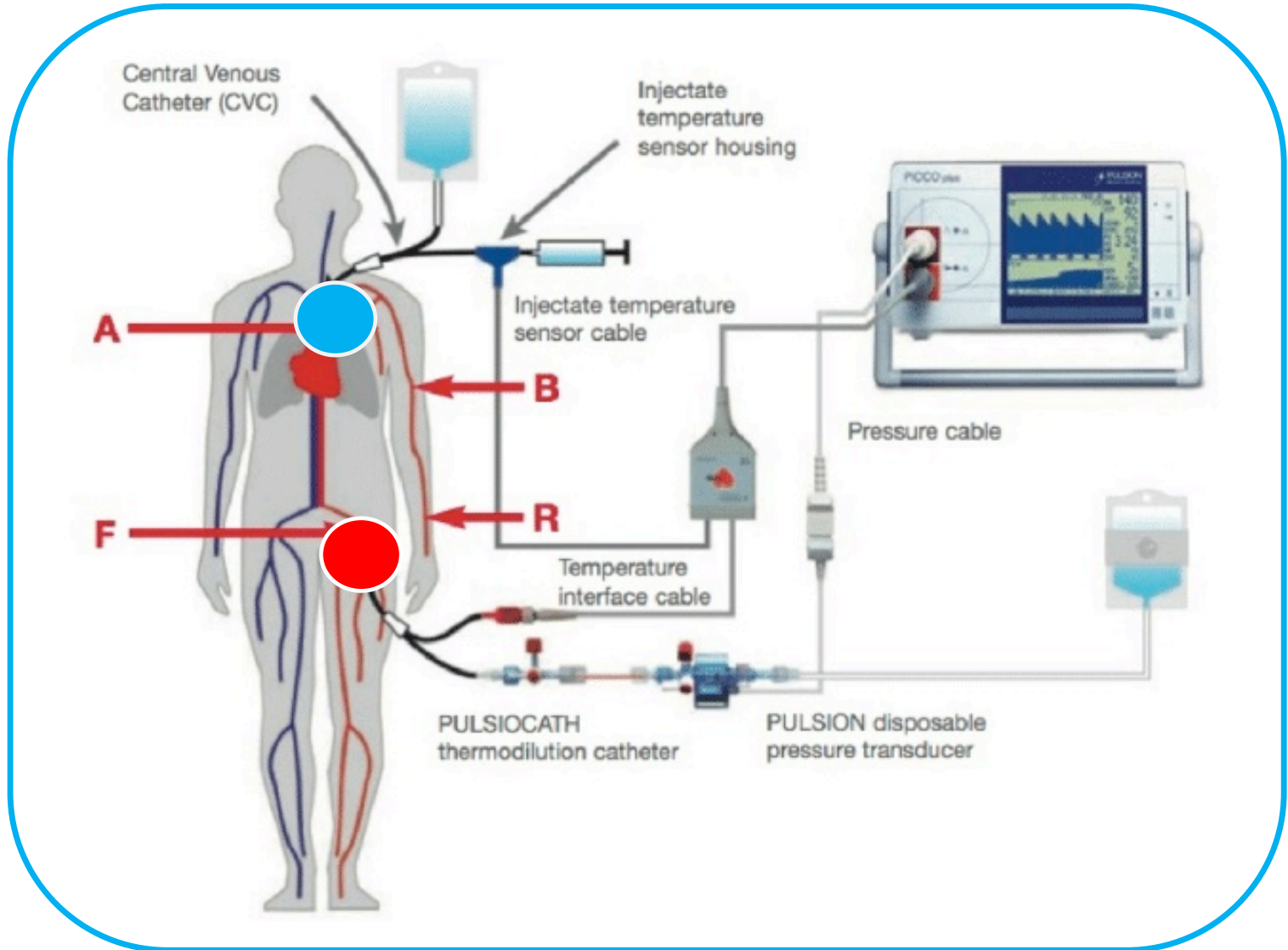
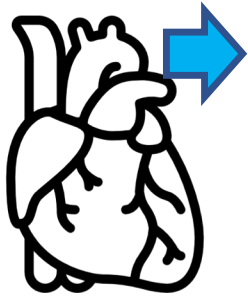


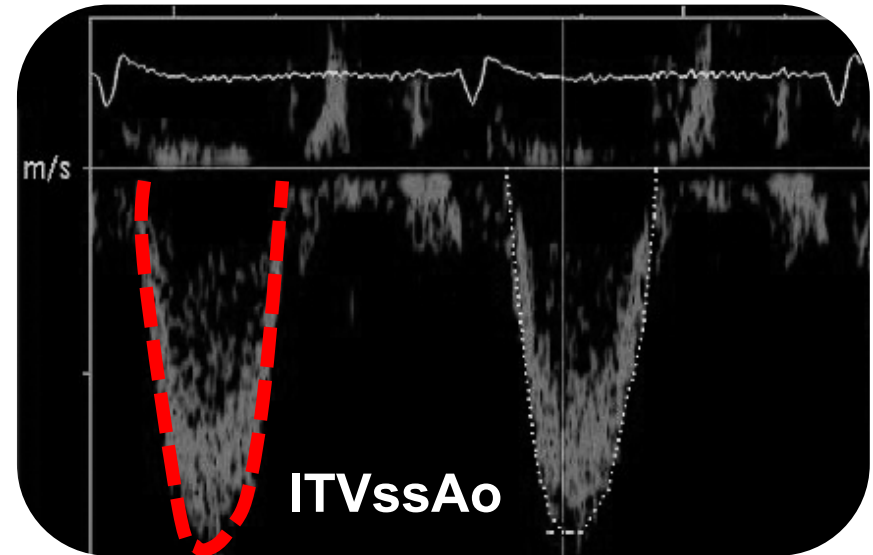
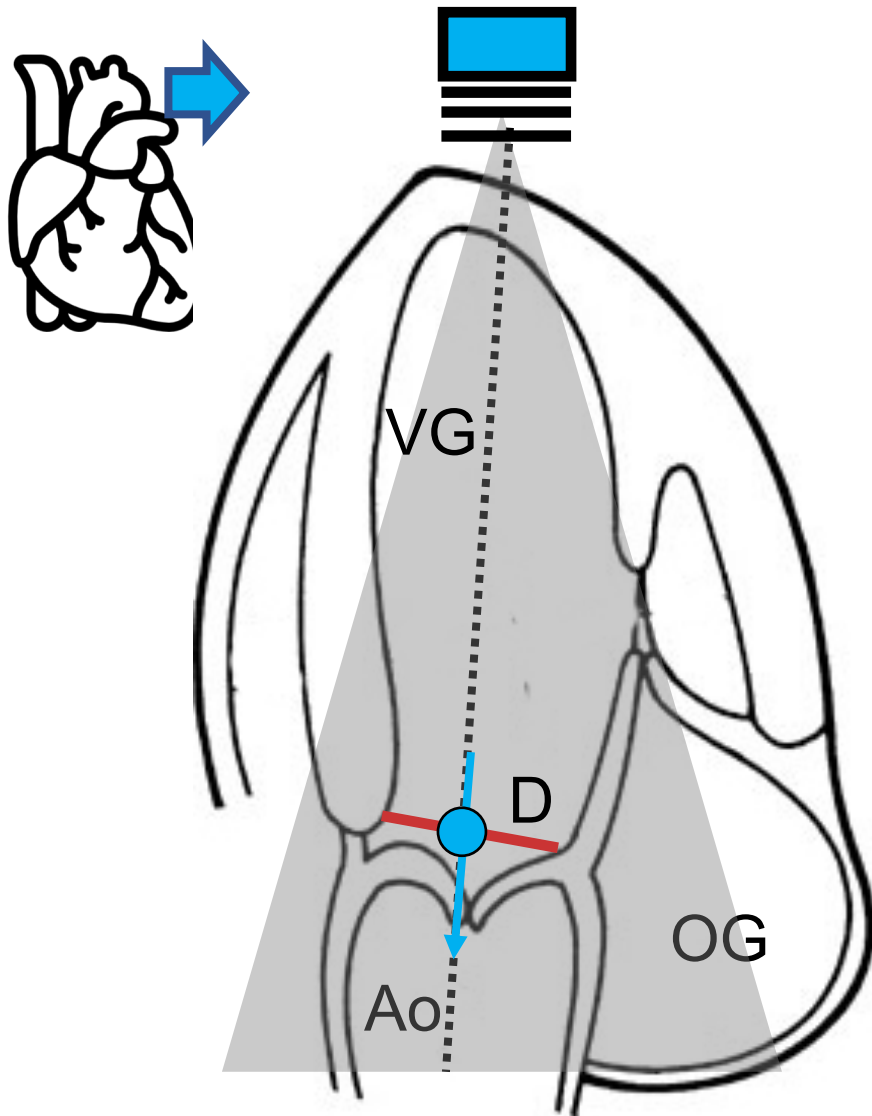
Volume d'éjection
Débit cardiaque



Approche invasive

Evaluation du débit cardiaque

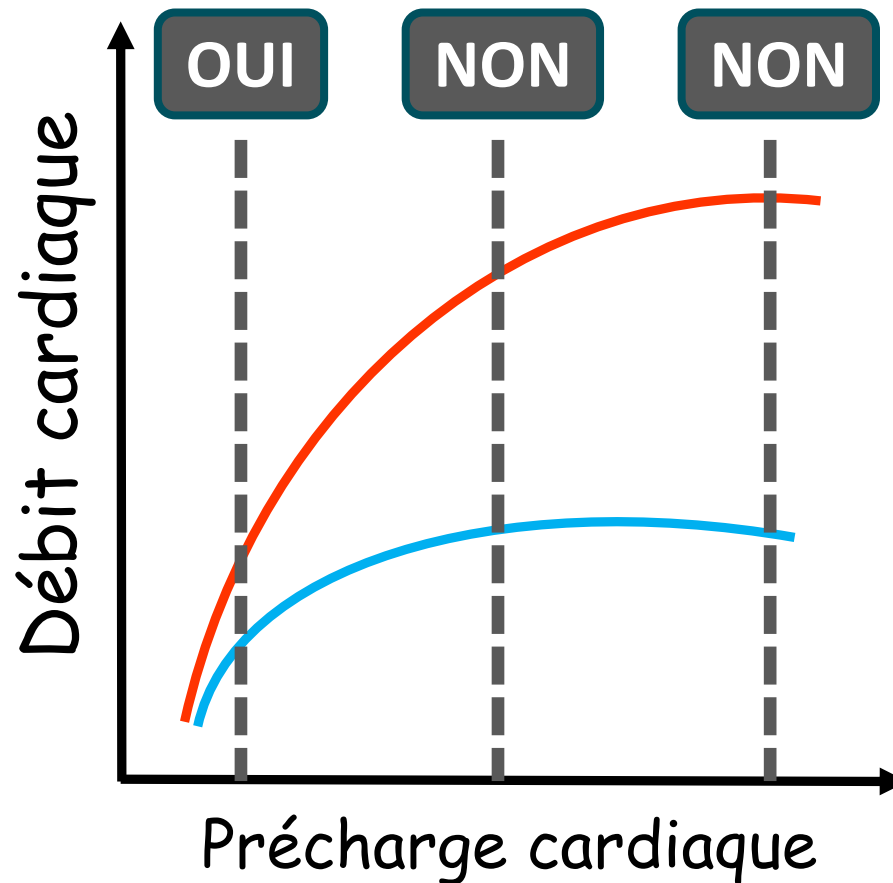




$$\begin{aligned} \text{VES} &= \text{ITVssAo} \times \text{surface} \\ \text{VES} &= \text{ITVssAo} \times \pi D^2 / 4 \\ \text{Débit} &= \text{VES} \times \text{FC} \end{aligned}$$

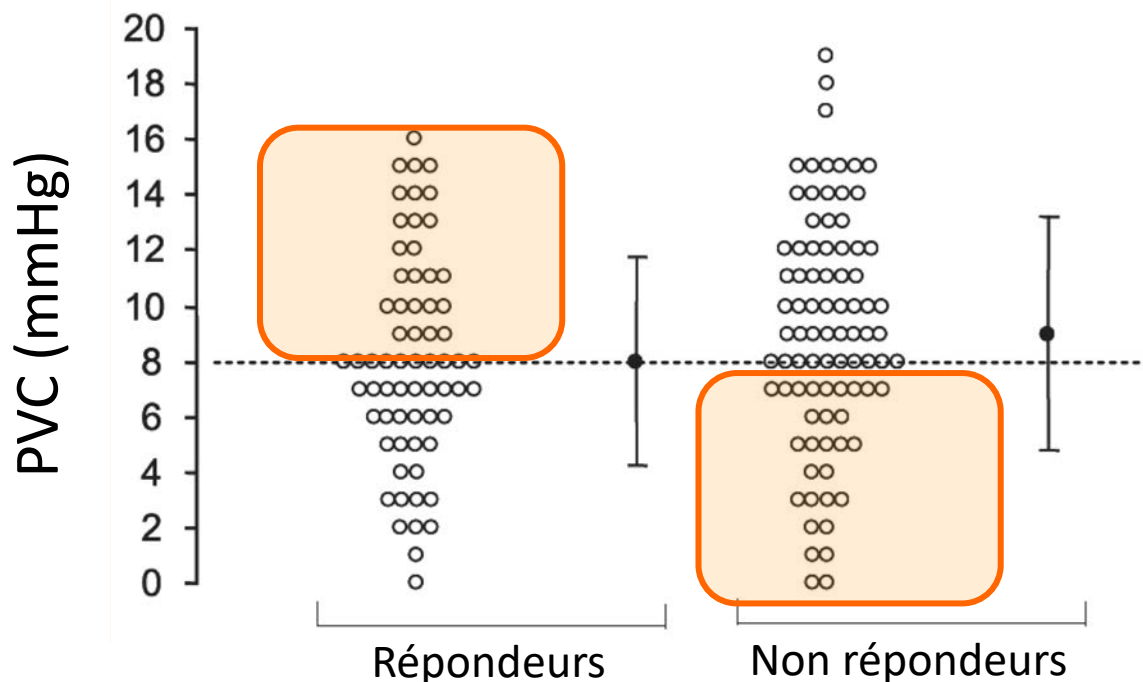
Approche non invasive

Peut-on utiliser les indices statiques pour prédire la réponse au remplissage vasculaire ?



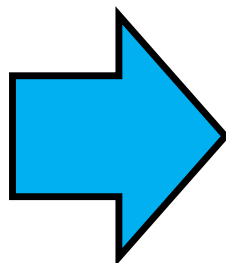
Cardiac filling pressures are not appropriate to predict hemodynamic response to volume challenge*

David Osman, MD; Christophe Ridel, MD; Patrick Ray, MD; Xavier Monnet, MD, PhD; Nadia Anguel, MD; Christian Richard, MD; Jean-Louis Teboul, MD, PhD





500 ml de SSI



Augmentation du
débit cardiaque ?

Augmentation de
la PA ?

Si non : potentiels effets indésirables

Précharge dépendance ?



Arythmie cardiaque ?

Ventilation spontanée ?

Compliance < 30-40 ?

oui



Lever de jambe passif

Mini remplissage

non



Lever de jambe passif

Mini remplissage

Variation PP

Variation VCI / VCS

Passive leg raising predicts fluid responsiveness in the critically ill*

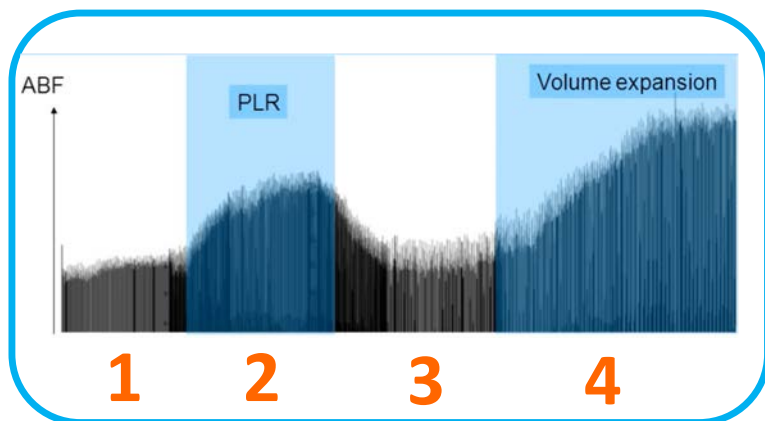
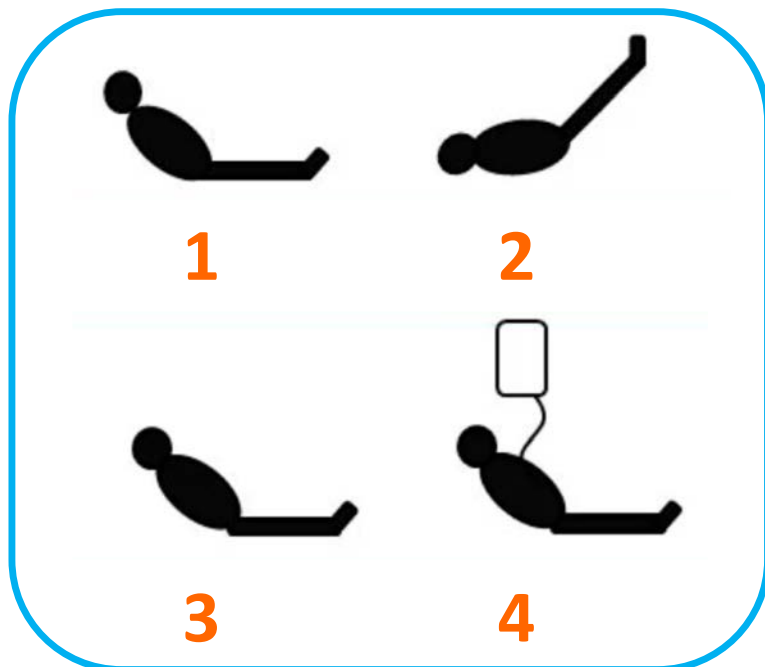
Xavier Monnet, MD, PhD; Mario Rienzo, MD; David Osman, MD; Nadia Anguel, MD; Christian Richard, MD; Michael R. Pinsky, MD, Dr hc; Jean-Louis Teboul, MD, PhD

Crit Care Med 2006

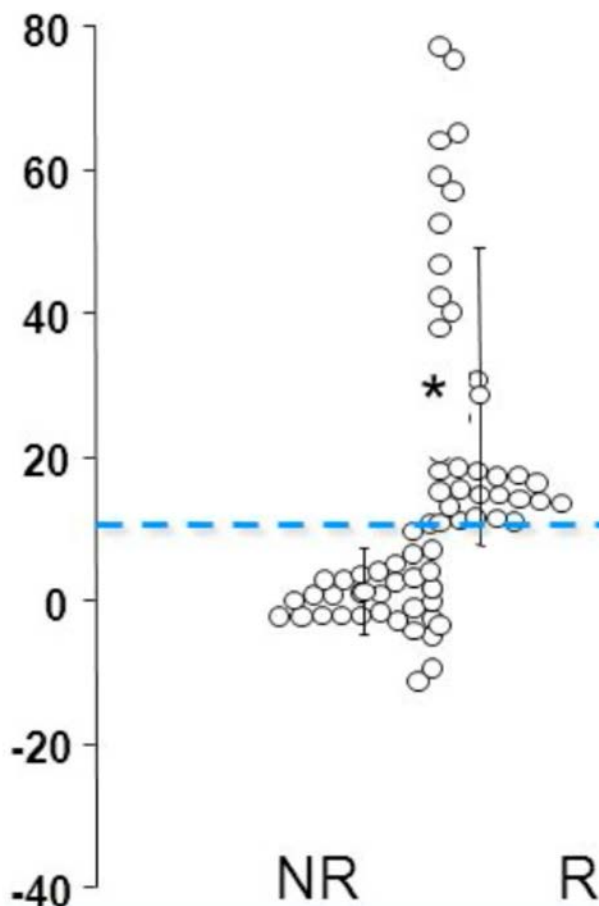


Lever de jambe passif = épreuve remplissage

Lever de jambe passif



% Changements de débit aortique induits par le LJP



Monnet et al. *Annals of Intensive Care* (2022) 12:46
<https://doi.org/10.1186/s13613-022-01022-8>

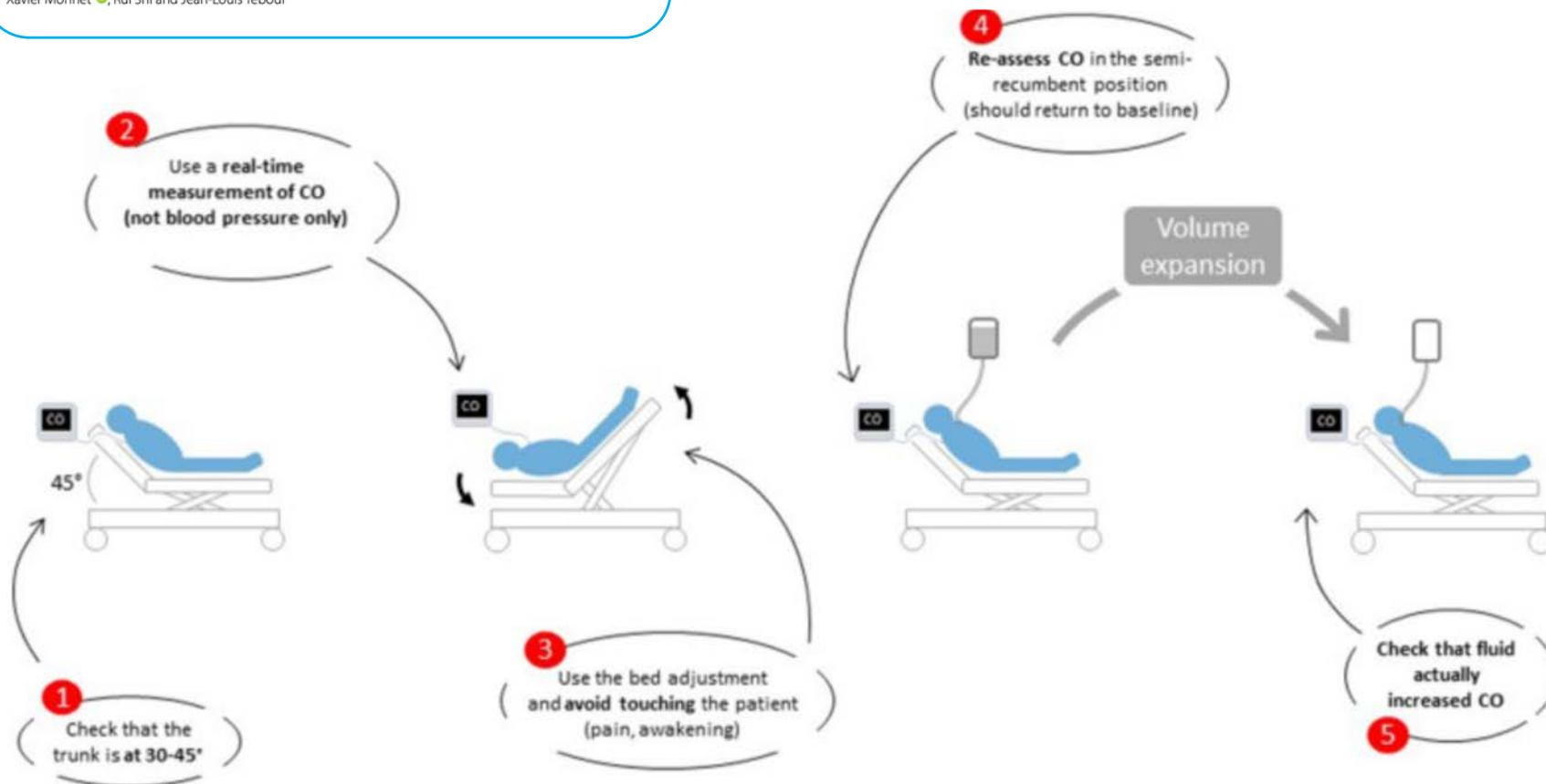
 Annals of Intensive Care

REVIEW

Open Access

Prediction of fluid responsiveness. What's new?

Xavier Monnet^{*}, Rui Shi and Jean-Louis Teboul



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

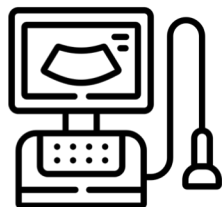
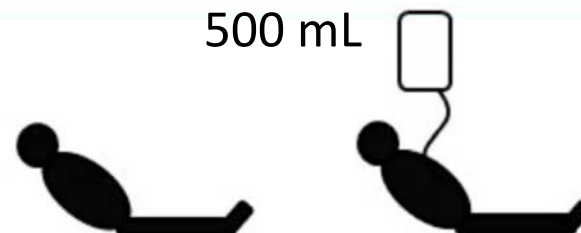


n=35

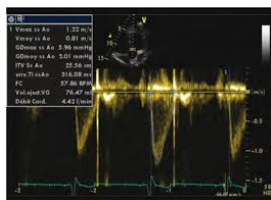
100 mL



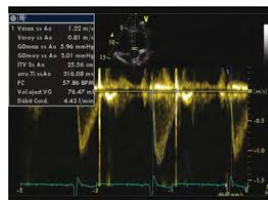
500 mL



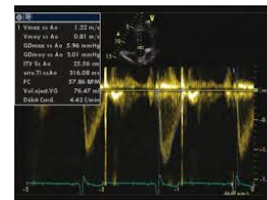
ITVssAo -> VES



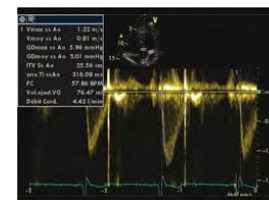
1



2



3

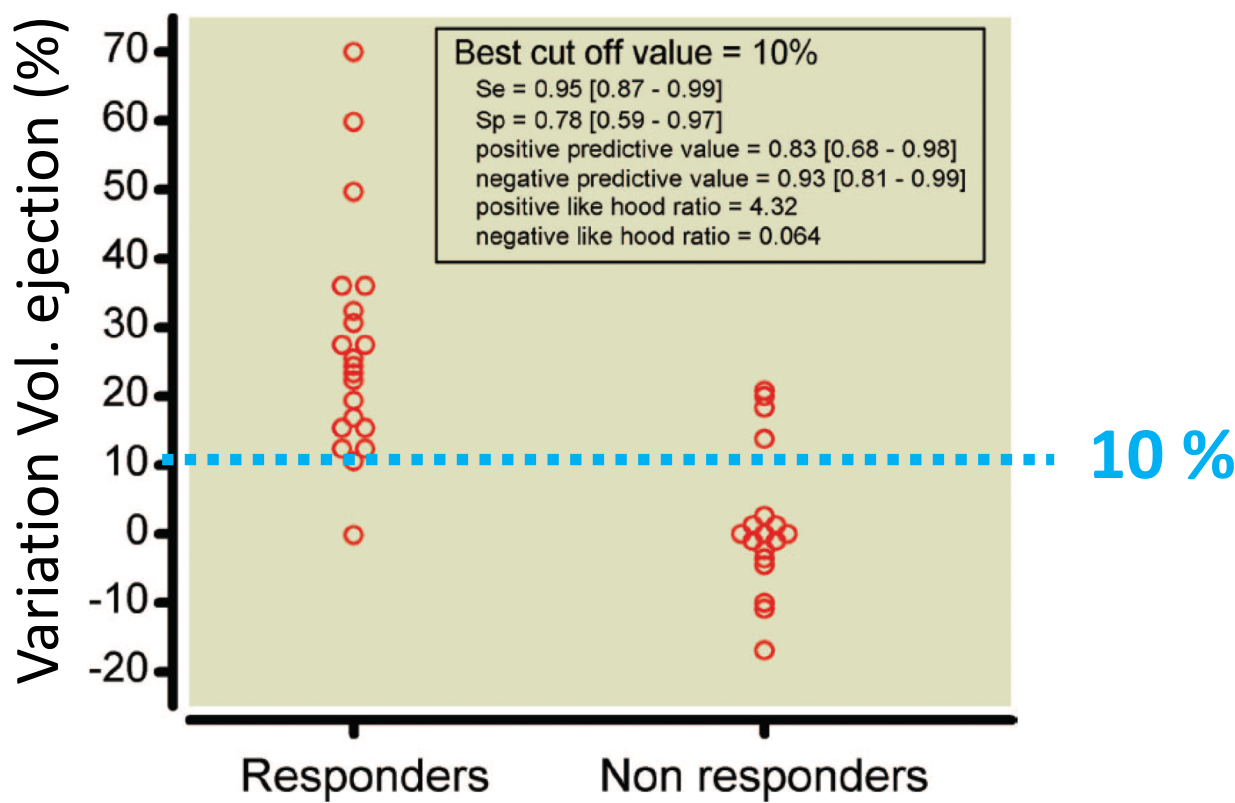


4

Muller L 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



Muller L et al. *Anesthesiology*. 2011

Monnet et al. *Annals of Intensive Care* (2022) 12:46
<https://doi.org/10.1186/s13613-022-01022-8>

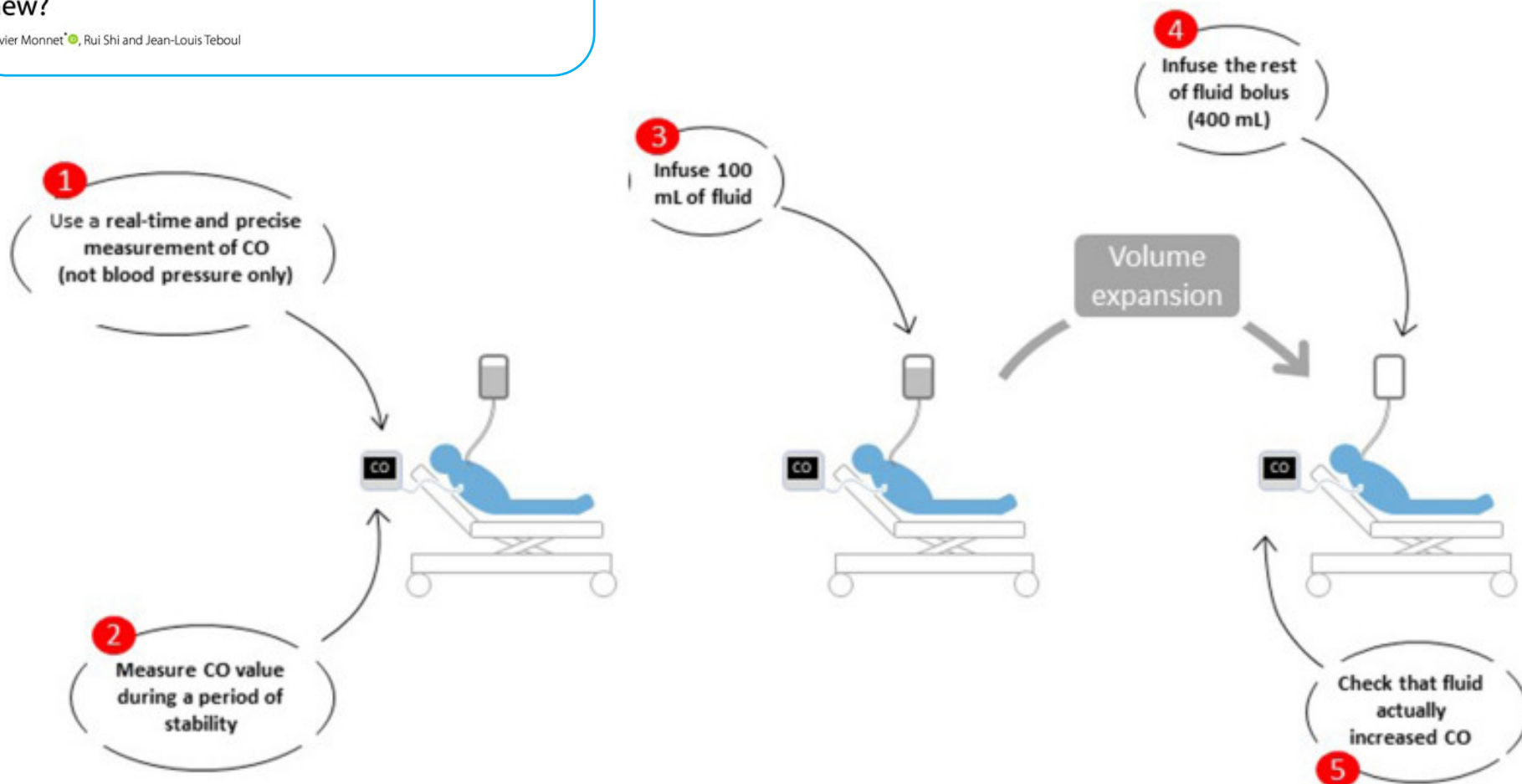
Annals of Intensive Care

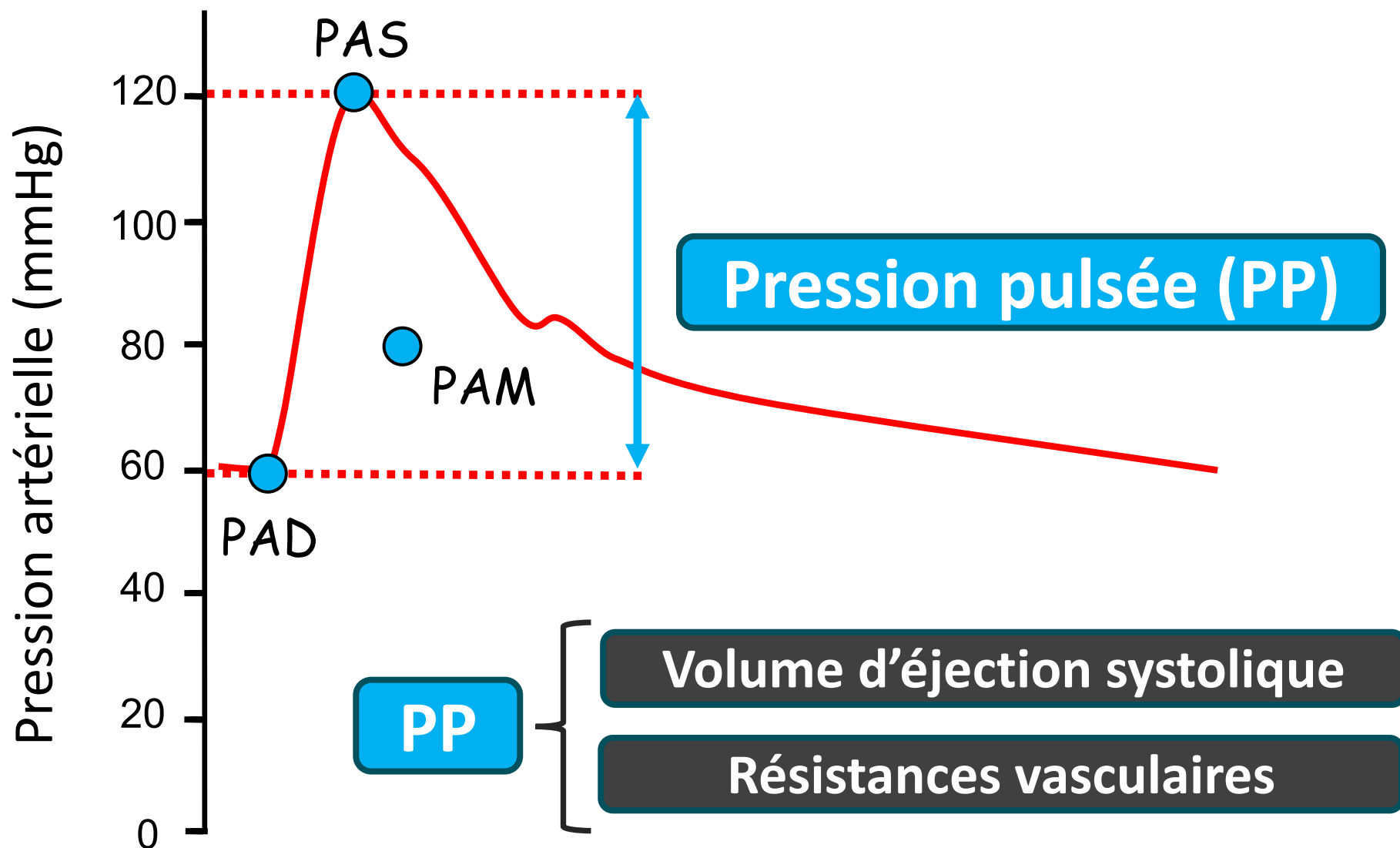
REVIEW

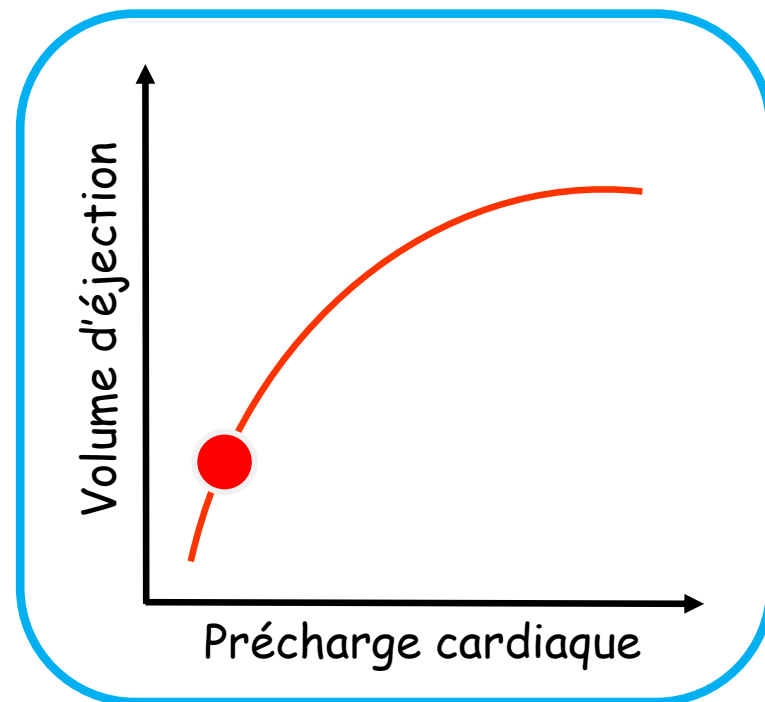
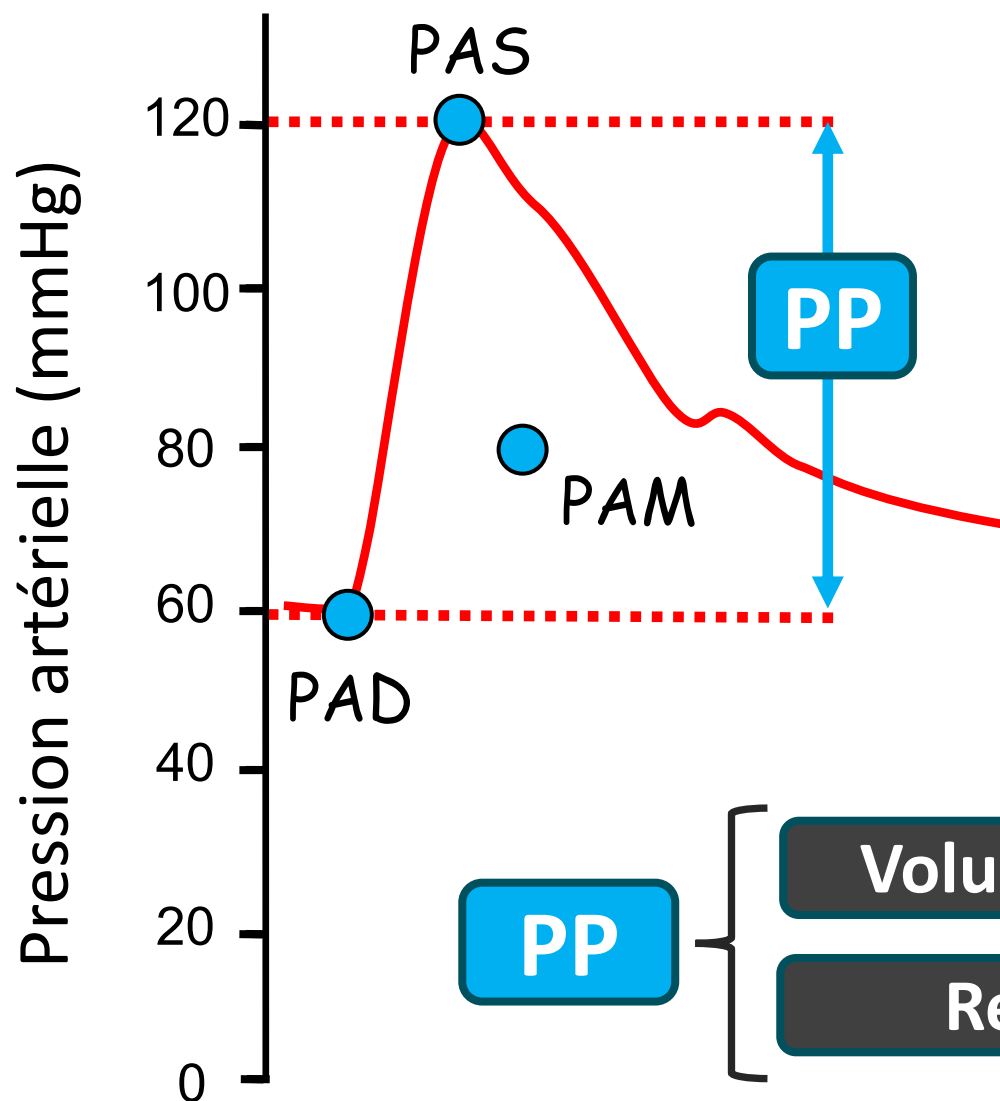
Open Access

Prediction of fluid responsiveness. What's new?

Xavier Monnet^{*}, Rui Shi and Jean-Louis Teboul

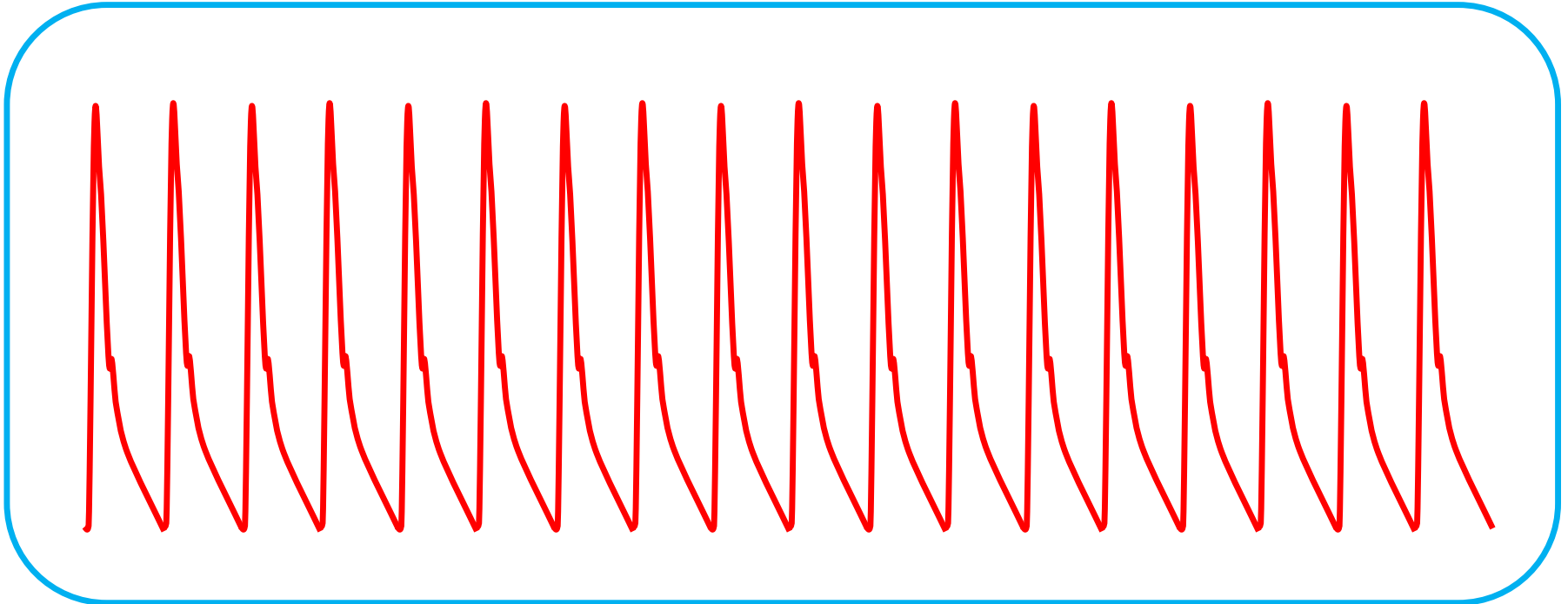






Volume d'éjection systolique

Résistances vasculaires



Ventilation mécanique

Augmentation P_{ALV}



Augmentation P_{OD}



Chute gradient
retour veineux



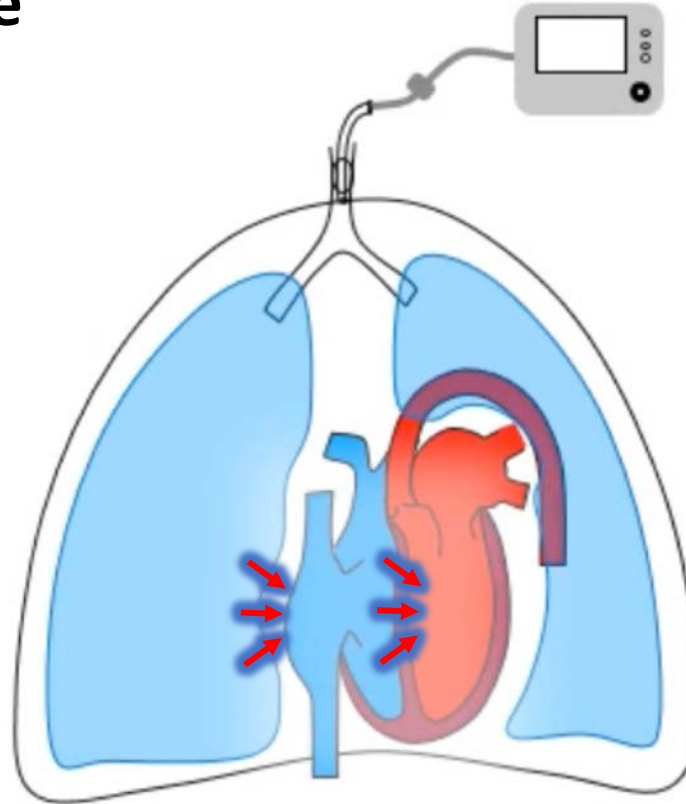
Si pré-charge
dépendance



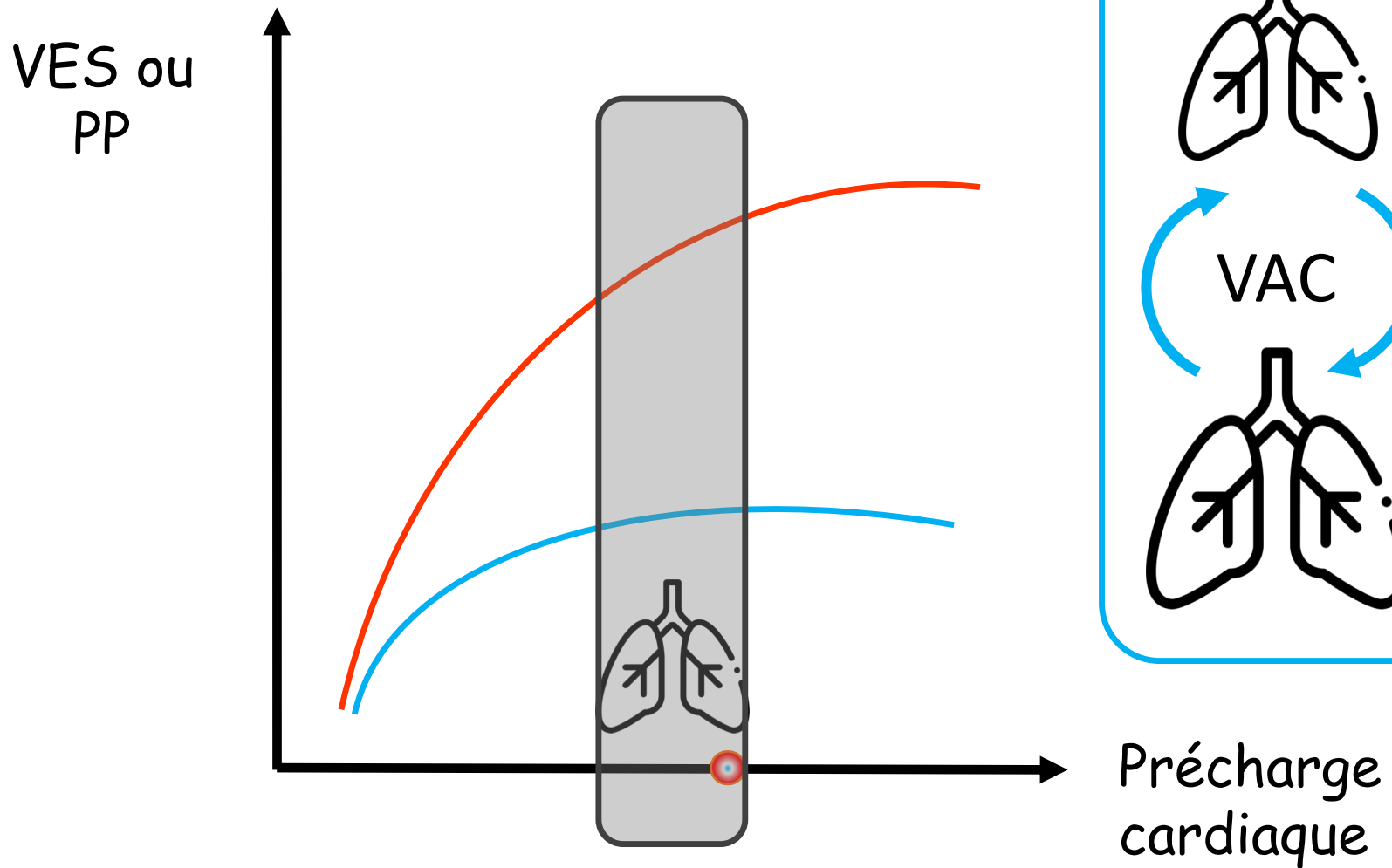
Baisse du volume d'éjection

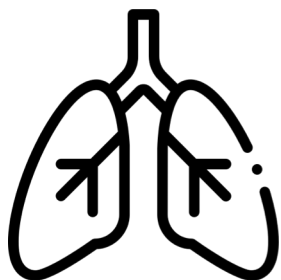
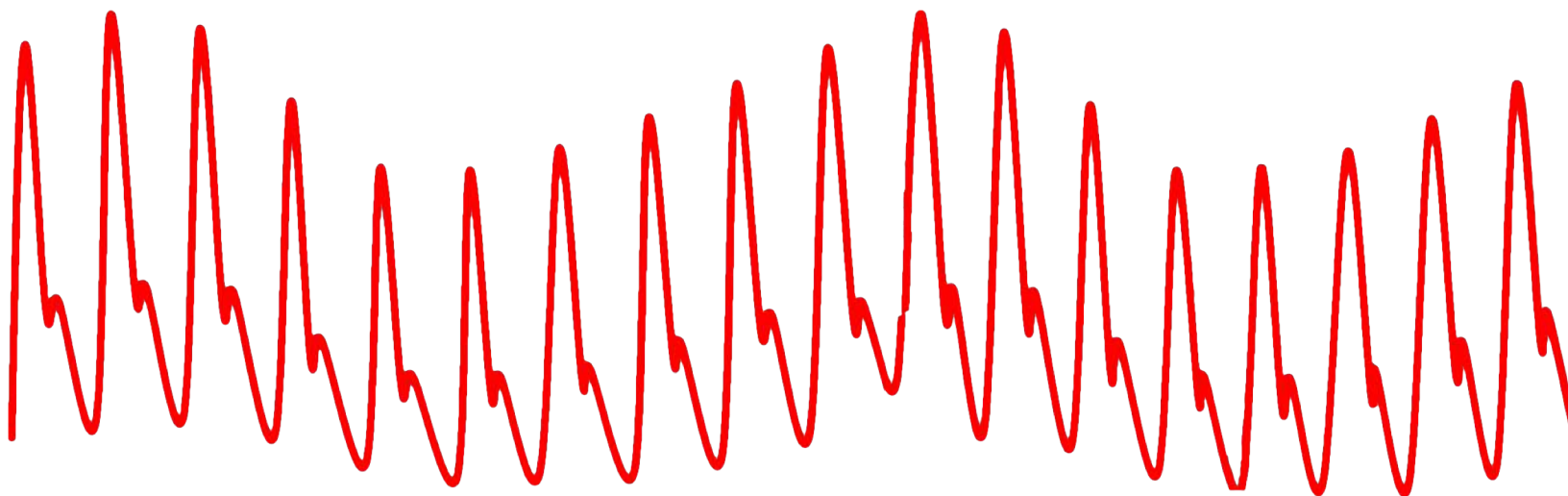


Baisse PP



Loi de Franck-Starling

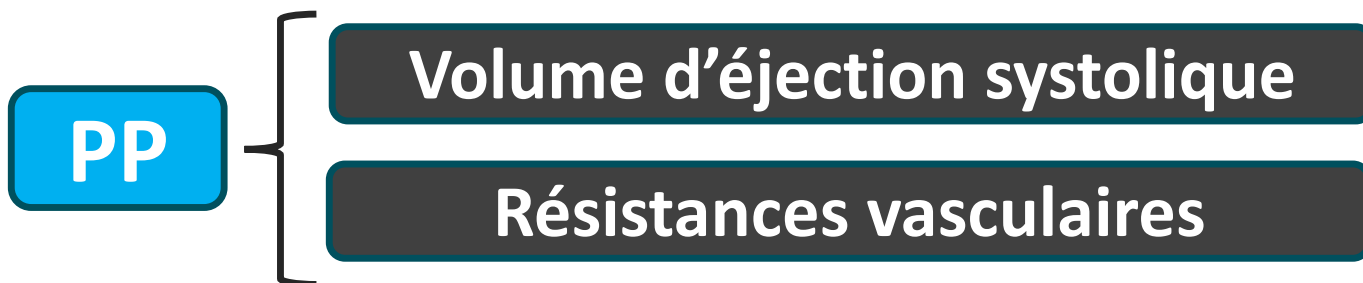
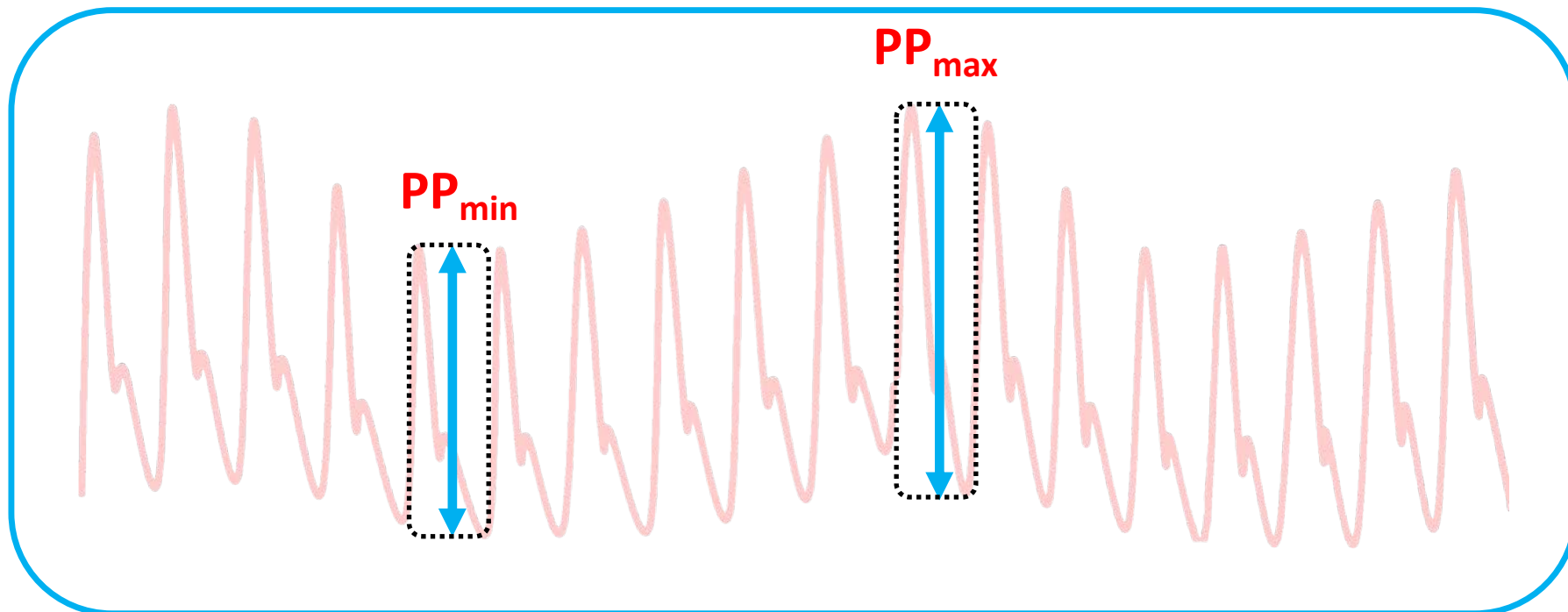


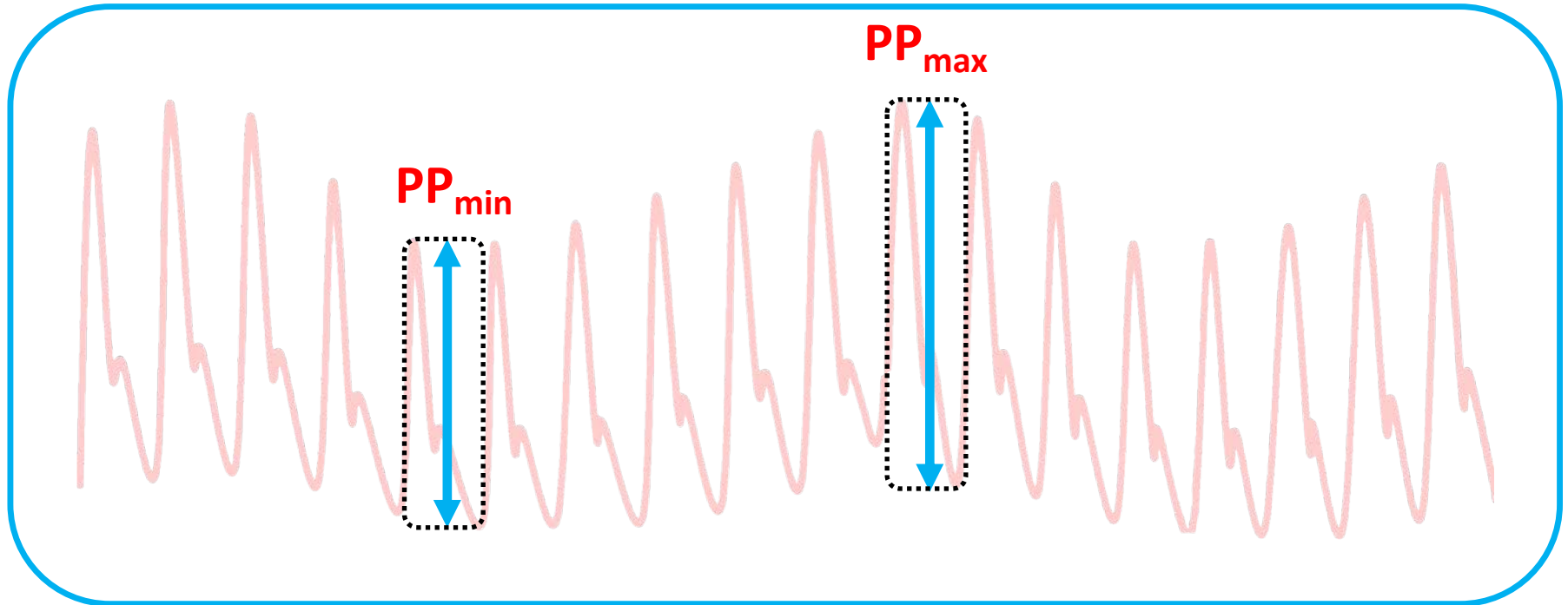


PP

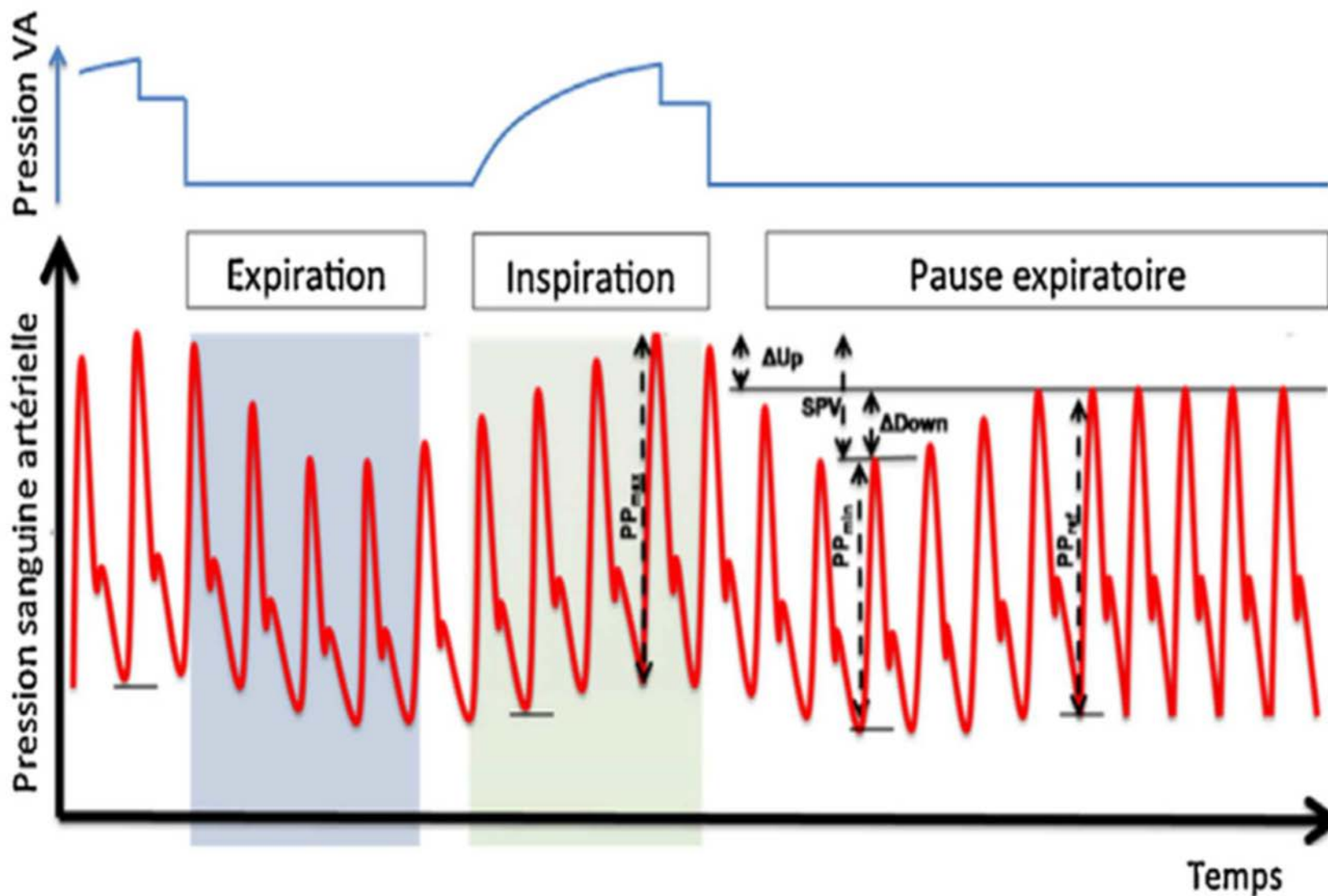
Volume d'éjection systolique

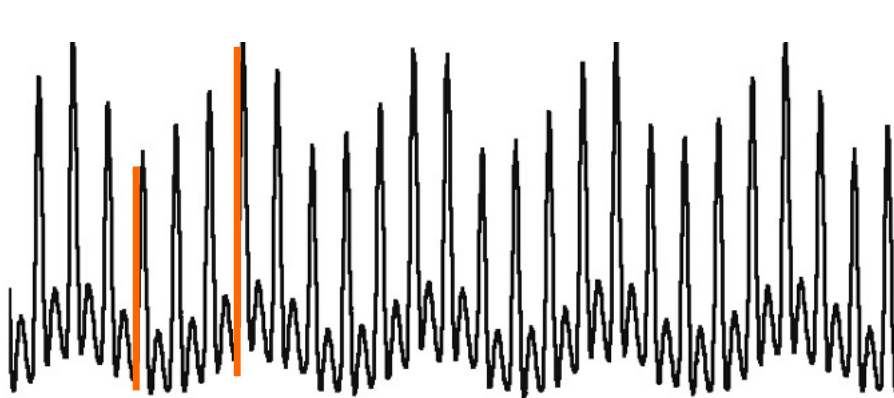
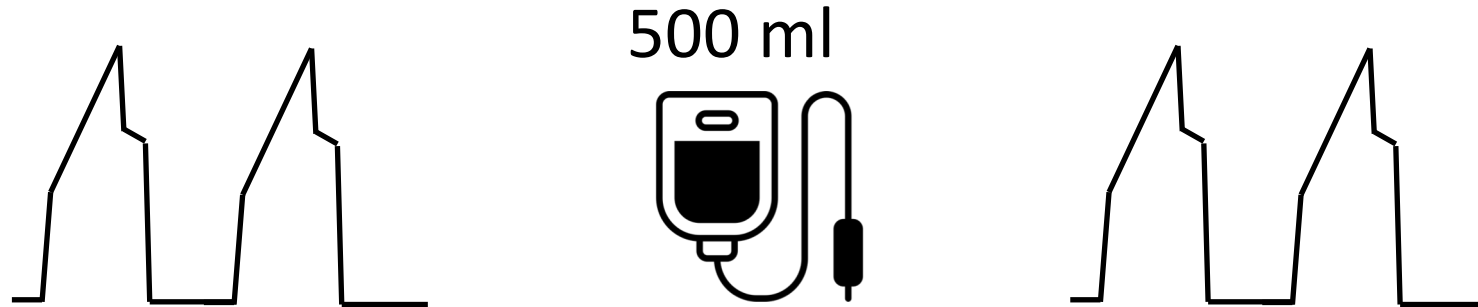
Résistances vasculaires





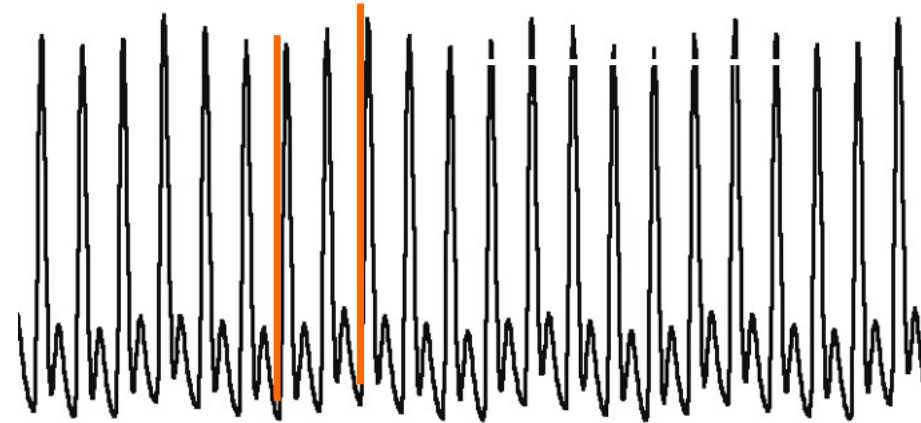
$$\Delta PP =$$





$$\Delta PP = 26\%$$

$$DC = 3 \text{ L/min}$$



$$\Delta PP = 5\%$$

$$DC = 4 \text{ L/min}$$

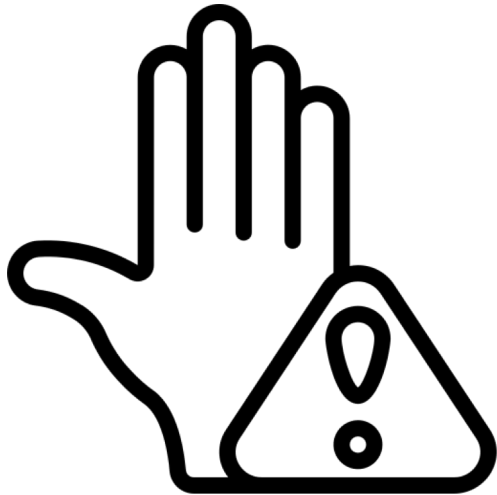
Invalidité de la variation de PP en cas :



1 - Arythmies

2 - Efforts respiratoires

Validité de la variation de PP incertaine :



1 - $V_t < 8 \text{ ml/kg}_{\text{PPT}}$

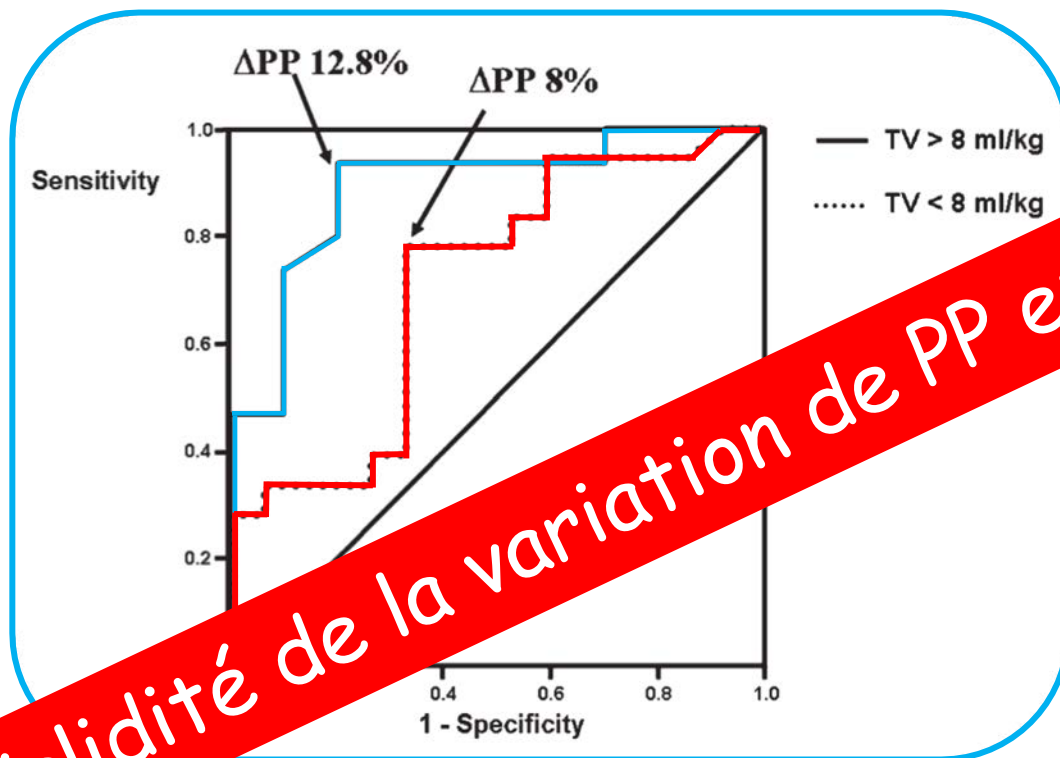
2 - $\text{Crs} < 30 \text{ ml/cmH}_2\text{O}$

3 - $\text{FR} > 40 \text{ cycles/min}$

Mais si $\Delta \text{PP} > 10\text{-}12\%$: prédictif réponse au RV

Daniel De Backer
Sarah Heenen
Michael Piagnerelli
Marc Koch
Jean-Louis Vincent

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



Validité de la variation de PP en SDRA ?

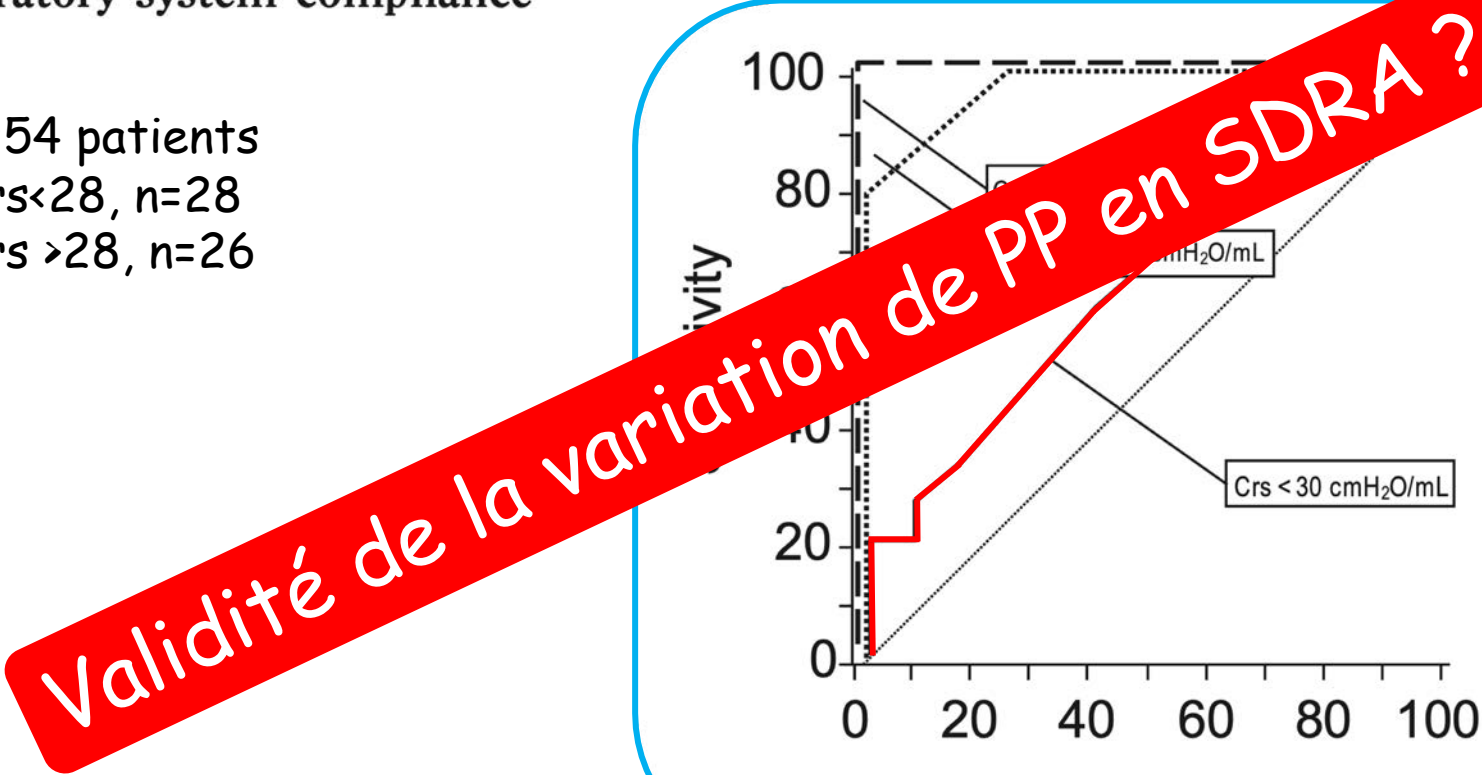
Vt < 8 ml/kg (n=27)

Vt > 8 ml/kg (n=26)

De Backer D et al. *Intensive Care Med* 2005;31:517-23

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

n=54 patients
Crs < 28, n=28
Crs > 28, n=26



Monnet X et al. *Crit Care Med* 2012;40:152-7

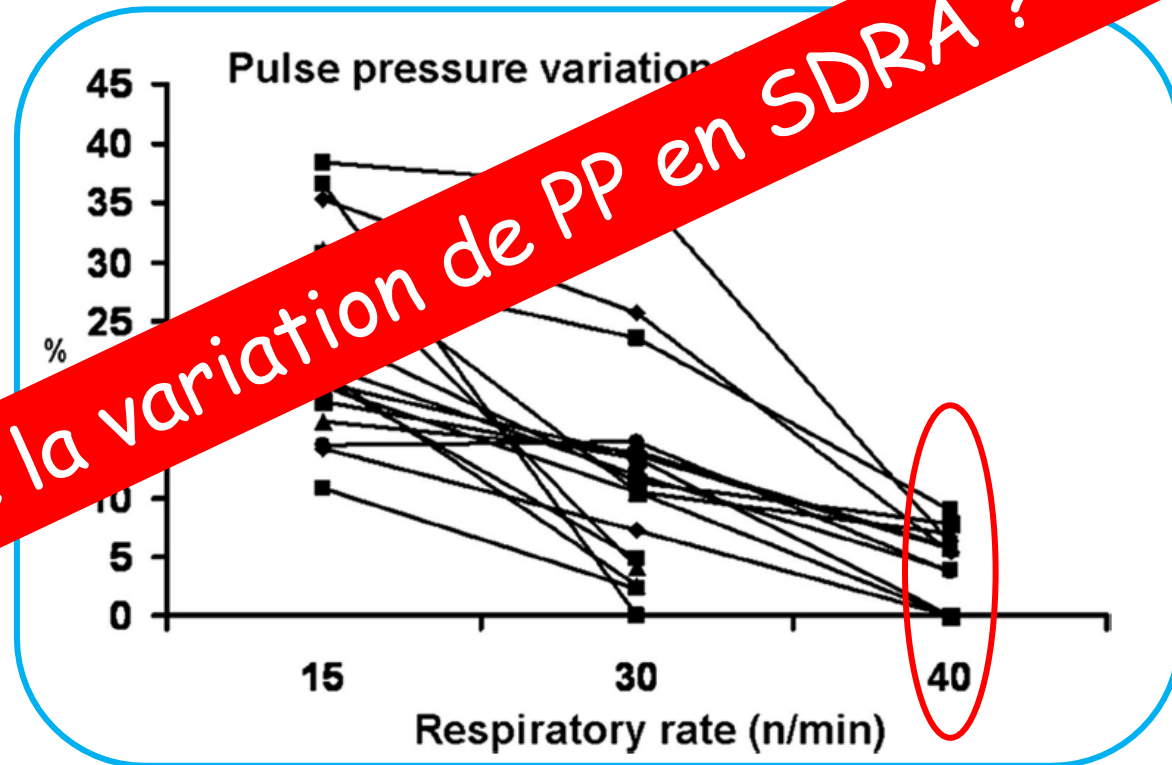
Anesthesiology 2009; 110:1092-7

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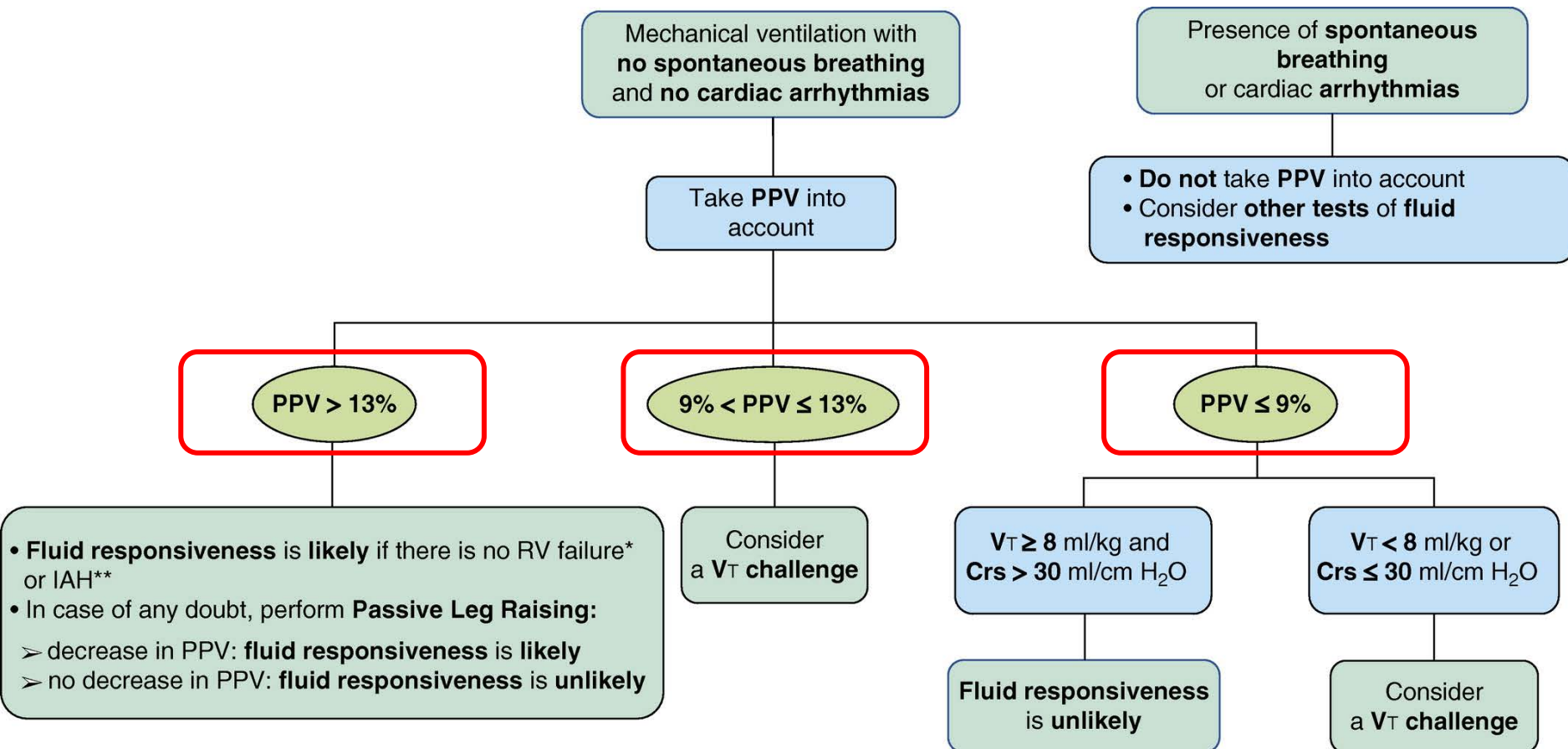
Influence of Respiratory Rate on Stroke Volume Variation in Mechanically Ventilated Patients

Daniel De Backer, M.D., Ph.D.,* Fabio Silvio Taccone, M.D.,† Roland Holsten, M.D.,‡ Fayssal Ibrahimi, M.D.,‡ Jean-Louis Vincent, M.D., Ph.D.§

n=17 patients
Choc septique
Ventilation > 8 ml/kg
DeltaPP > 10%

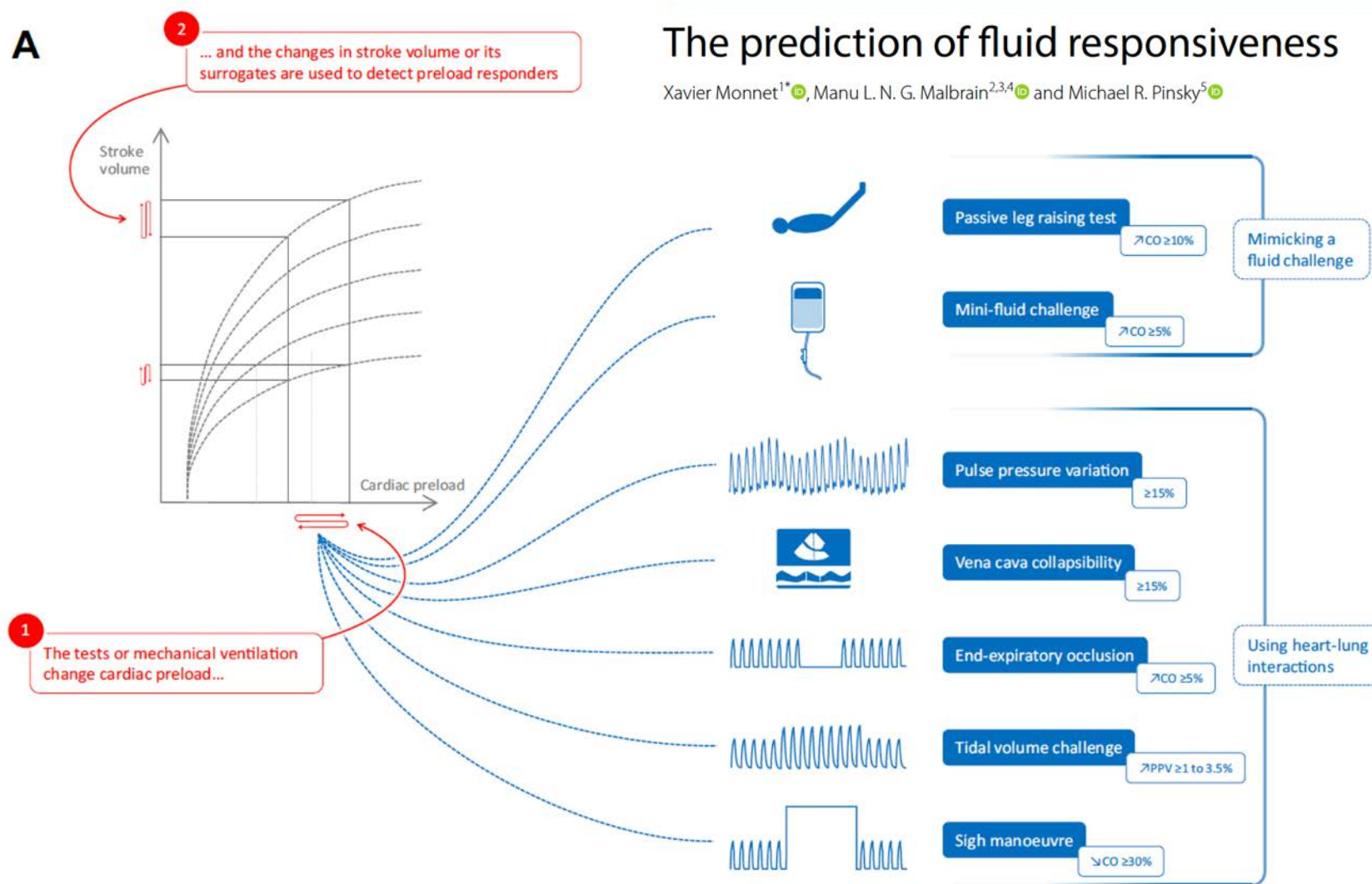


De Backer D et al. *Anesthesiology* 2009;110:1092-7



The prediction of fluid responsiveness

Xavier Monnet^{1*}, Manu L. N. G. Malbrain^{2,3,4} and Michael R. Pinsky⁵





Take home message

Merci !

RV si insuffisance circulatoire

RV si probabilité réponse +

Indices dynamiques > statiques