# How to use arterial pressure to assess Hemodynamics ?

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# Conflicts of interest

UNIVERSITÉ DE REIMS CHAMPAGNE-ARDENNE

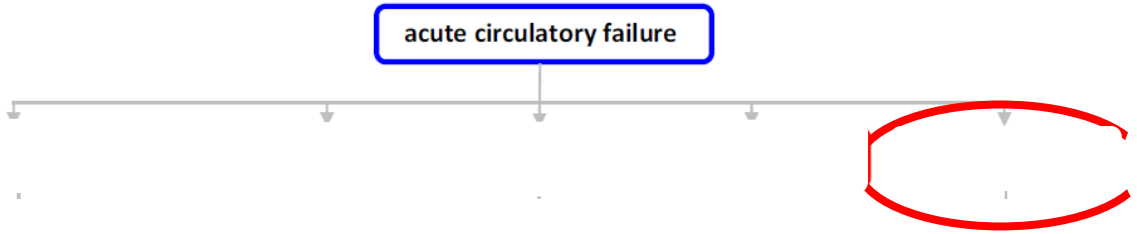
- Recieved Honoraria for Lectures from Baxter
- Recieved Honoraria From AOP for Consulting
- Member of the scientific board of Vitaris

*Intensive Care Med (2016) 42:1350–1359*

CONFERENCE REPORTS AND EXPERT PANEL

# Less invasive hemodynamic monitoring in critically ill patients

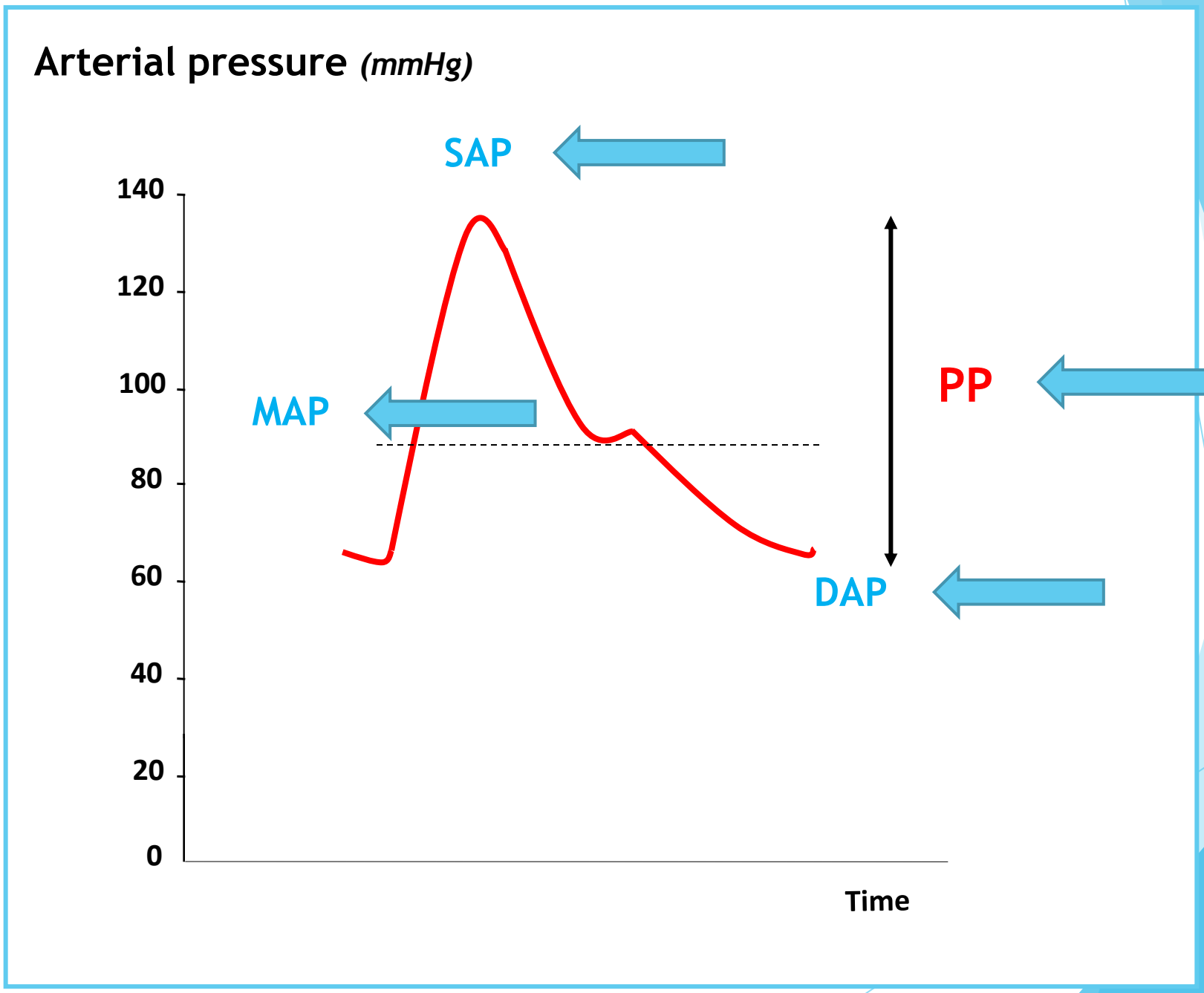
Jean-Louis Teboul[1*], Bernd Saugel[2], Maurizio Cecconi[3], Daniel De Backer[4], Christoph K. Hofer[5], Xavier Monnet[1], Azriel Perel[6], Michael R. Pinsky[7], Daniel A. Reuter[2], Andrew Rhodes[3], Pierre Squara[8], Jean-Louis Vincent[9] and Thomas W. Scheeren[10]




## How can we use Arterial pressure?

- Analysis of the static values
- Analysis of the dynamic variation of AP values

- **Analysis of the static values**
- Analysis of the dynamic variation of AP values


Arterial pressure (mmHg)
SAP
140
120
100
MAP
80
60
PP
DAP
40
20
0
Time

# Is it important to consider DAP in septic shock ?

**1. DAP is a** reflection of vasomotor tone → **a low DAP** is mainly due to a **depressed arterial tone**


-

**a DAP** is mainly due to a **depressed arterial to low tone**

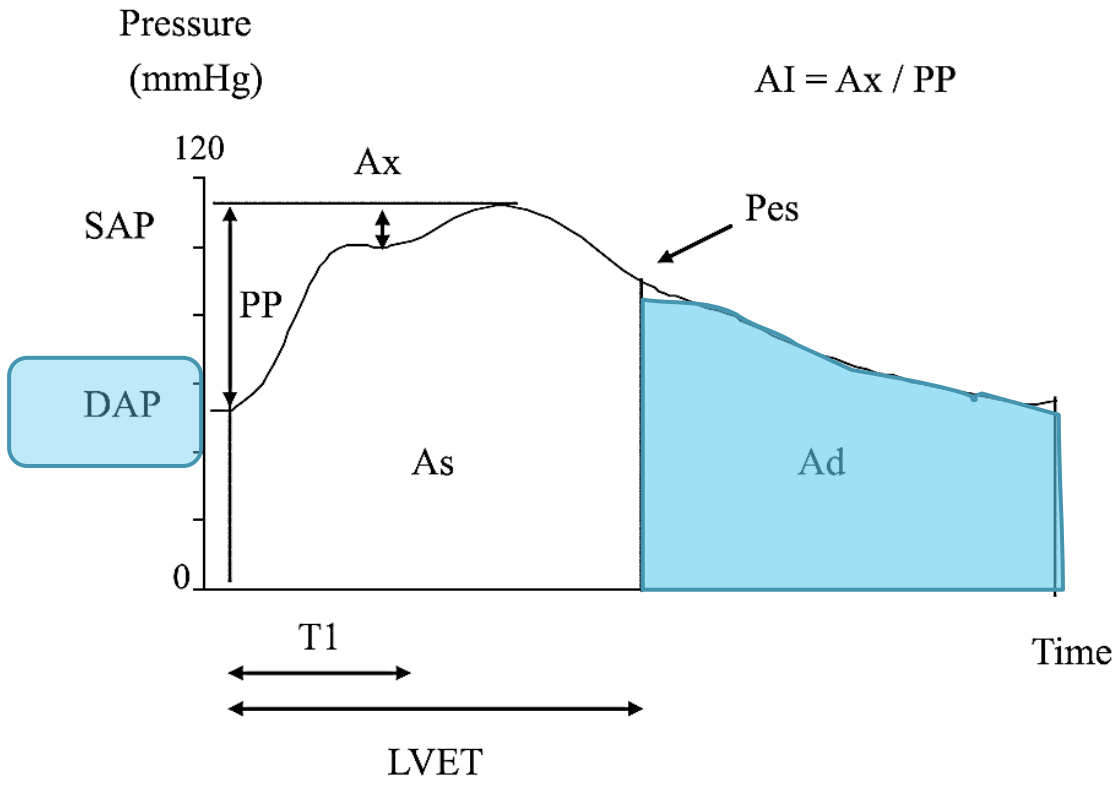
Intensive Care Med (2007) 33:1931–1937
DOI 10.1007/s00134-007-0738-4

ORIGINAL

Bouchra Lamia
Jean-Louis Teboul
Xavier Monnet
David Osman
Julien Maizel
Christian Richard
Denis Chemla

# Contribution of arterial stiffness and stroke volume to peripheral pulse pressure in ICU patients: an arterial tonometry study

## 67 ICU patients




Peripheral **resistance**

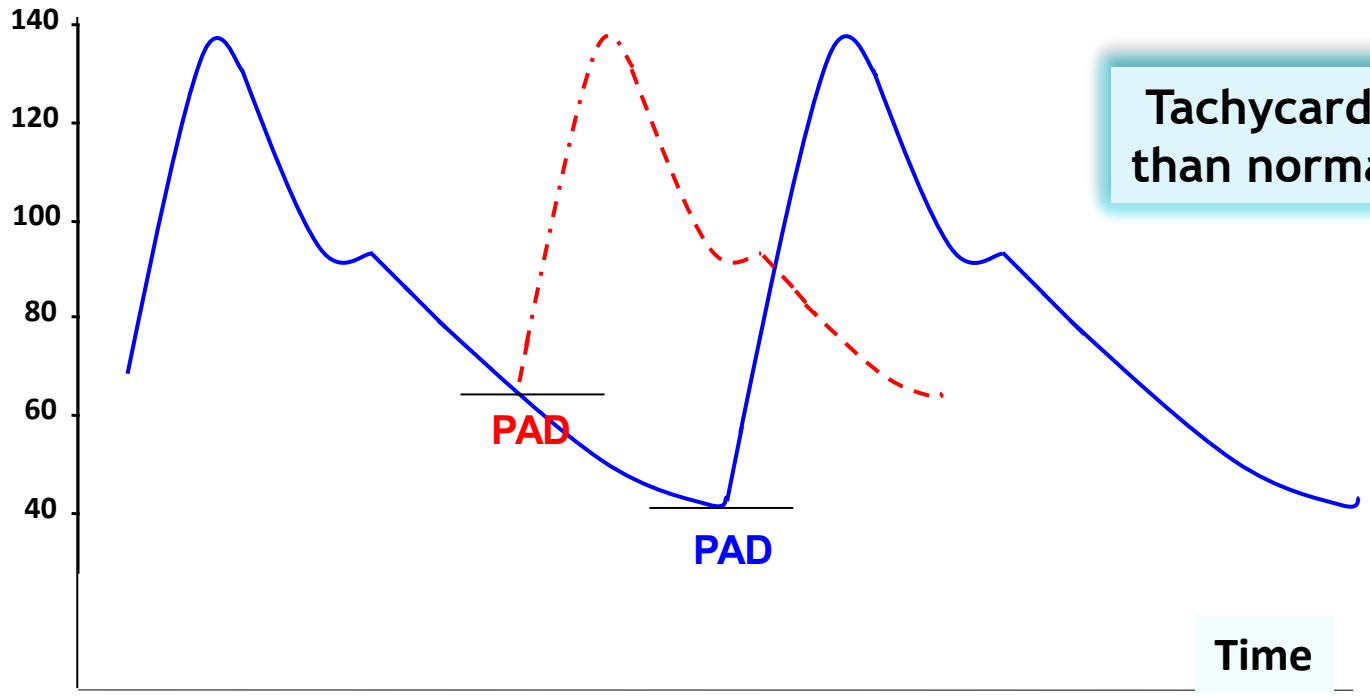
- **related** to peripheral **DAP** (**r = 0.71**) ($p<0.001$)
- but **not related** to peripheral **SAP** ($r^2 = 0.04$) and **PP** ($r^2 = 0.02$)

# Is it important to consider DAP in septic shock ?

**1. DAP is a** reflection of vasomotor tone → **a low DAP** is mainly due to a **depressed arterial tone**

**BUT**

**Always consider heart rate**




**Tachycardia** should theoretically result **in a higher than normal DAP**

# Is it important to consider DAP in septic shock ?

**1. DAP is a** reflection of vasomotor tone  a low DAP is mainly due to a **depressed arterial tone**

→ **a low DAP** may be seen during **Bradycardia**

# Is it important to consider DAP in septic shock ?

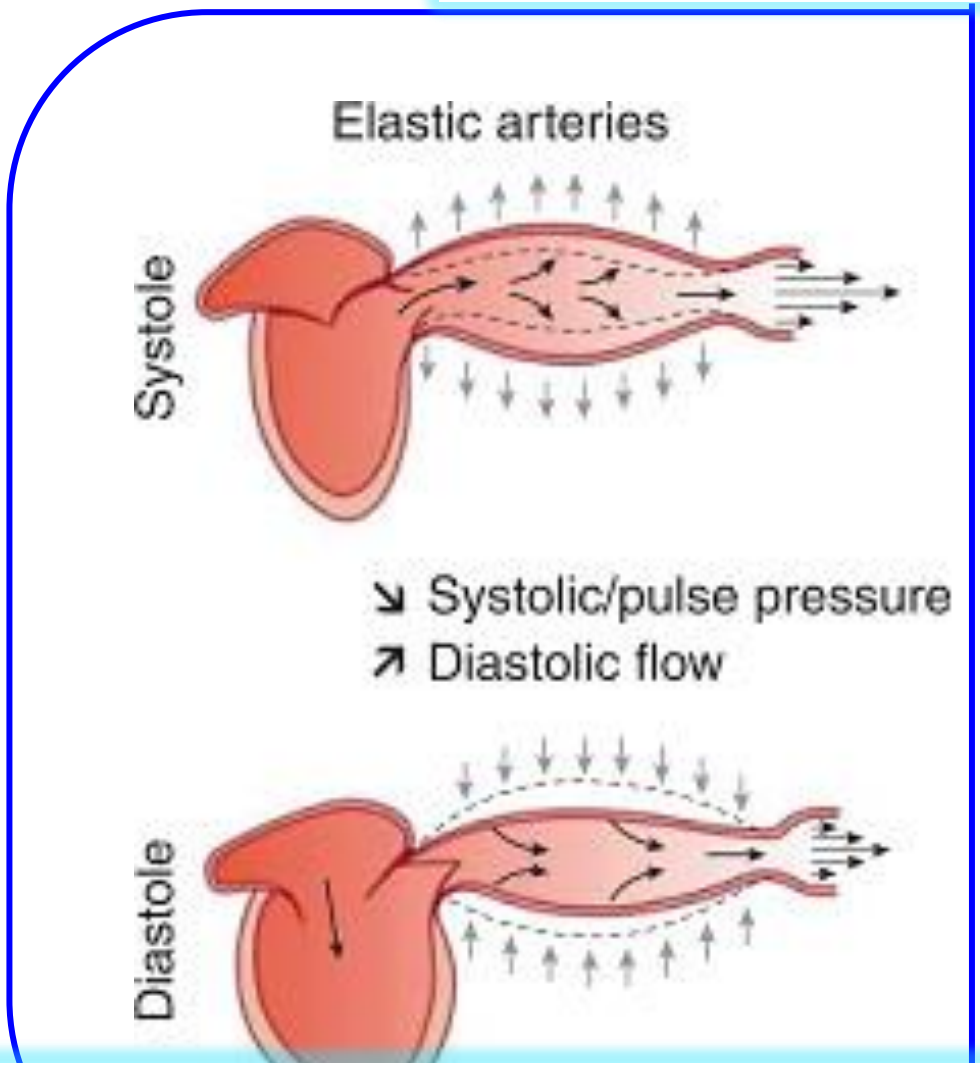
1. **DAP is a** reflection of vasomotor tone

a **low DAP** is mainly due to a **depressed arterial tone**

a **low DAP** may be seen during **Bradycardia**

→ **Arterial stiffness**

The **cardiac pump** generates a **pulsatile flow**




The **arteries** a

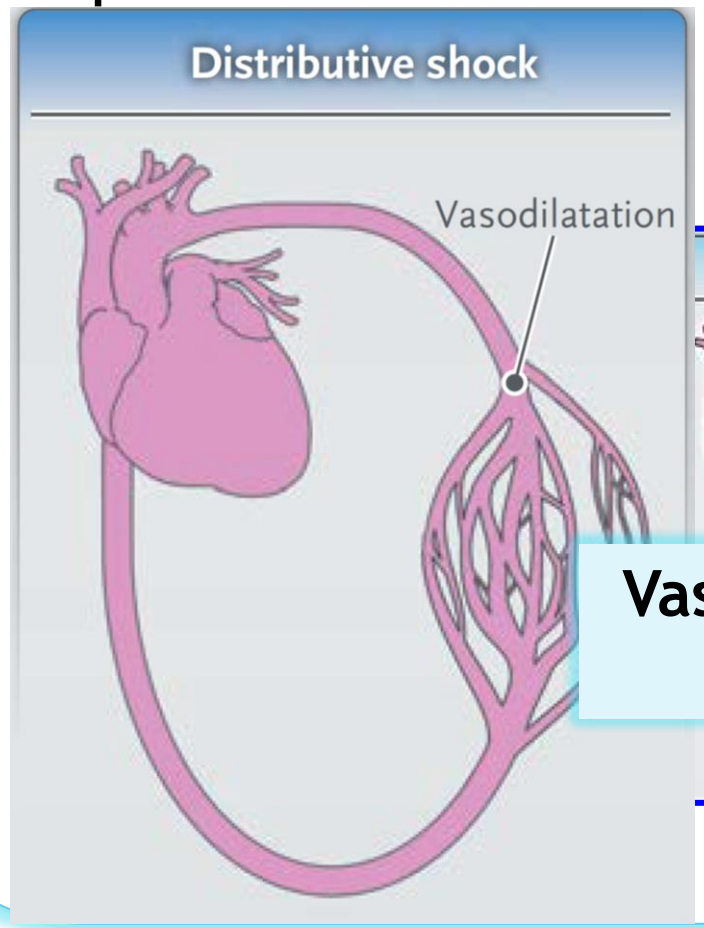
In patients **with stiff arteries the diastolic part** of aortic pressure **is reduced**

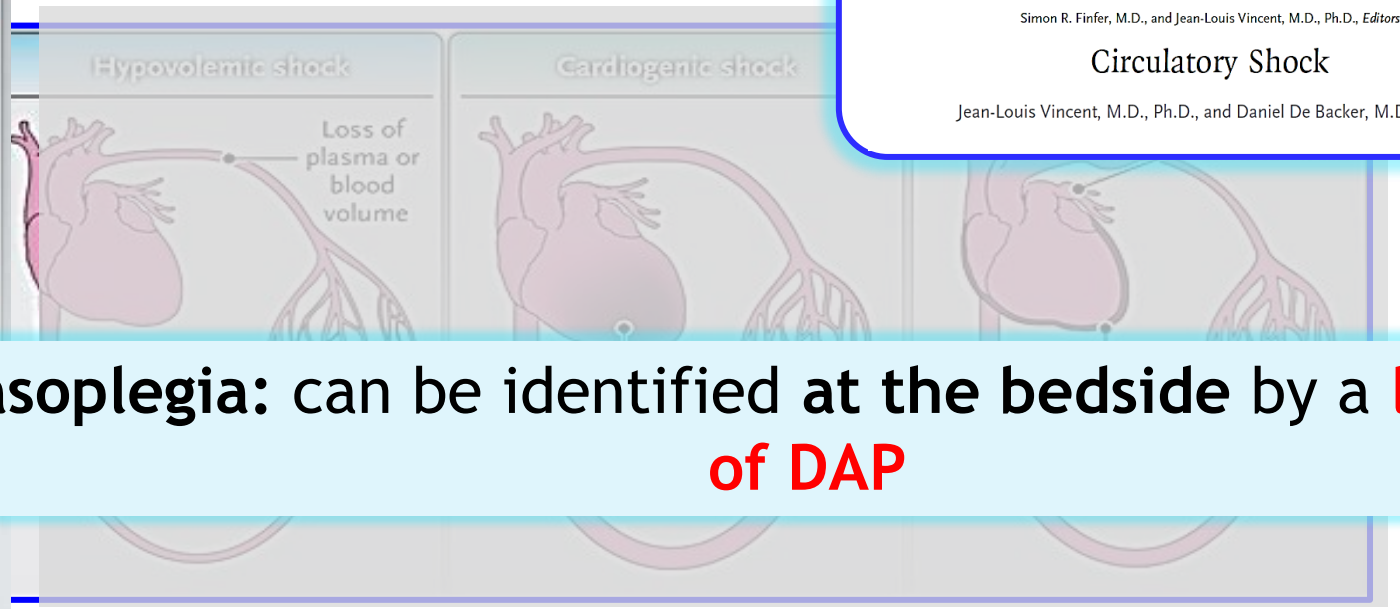
part of the **stroke volume** during the **systole** and by **restituting** it during the **diastole**

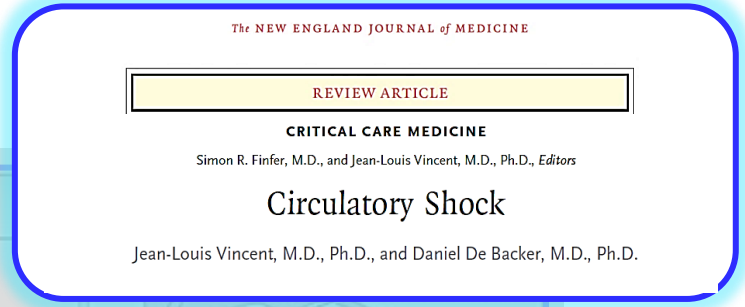
# Is it important to consider DAP in septic shock ?

1. DAP is a reflection of vasomotor tone

2. **Septic shock is caracterised by vasodilation and a low vasomotor tone:** DAP may help the





The NEW ENGLAND JOURNAL of MEDICINE

REVIEW ARTICLE

CRITICAL CARE MEDICINE

Simon R. Finfer, M.D., and Jean-Louis Vincent, M.D., Ph.D., *Editors*

Circulatory Shock

Jean-Louis Vincent, M.D., Ph.D., and Daniel De Backer, M.D., Ph.D.

**Vasoplegia:** can be identified **at the bedside** by a **low value of DAP**

# Is it important to consider DAP in septic shock ?

1. DAP is a reflection of vasomotor tone
2. Septic shock is caracterised by vasodilation and a low vasomotor tone
3. **DAP is the major component Of MAP**

Review

# Clinical review: Interpretation of arterial pressure wave in shock states

Bouchra Lamia[1], Denis Chemla[2], Christian Richard[3] and Jean-Louis Teboul[3]

*Critical Care* 2005, **9**:601-606

$$MAP = DAP + 1/3(SAP - DAP) \quad (3)$$

This formula can be rewritten as follows:

$$MAP = (2/3 \times DAP) + (1/3 \times SAP) \quad (4)$$

In other words, this rule of thumb implies that **DAP contributes** more **to MAP**, by **a factor of two,** than does SAP.

Frequently a **Low MAP** is mainly due **to a low DAP**

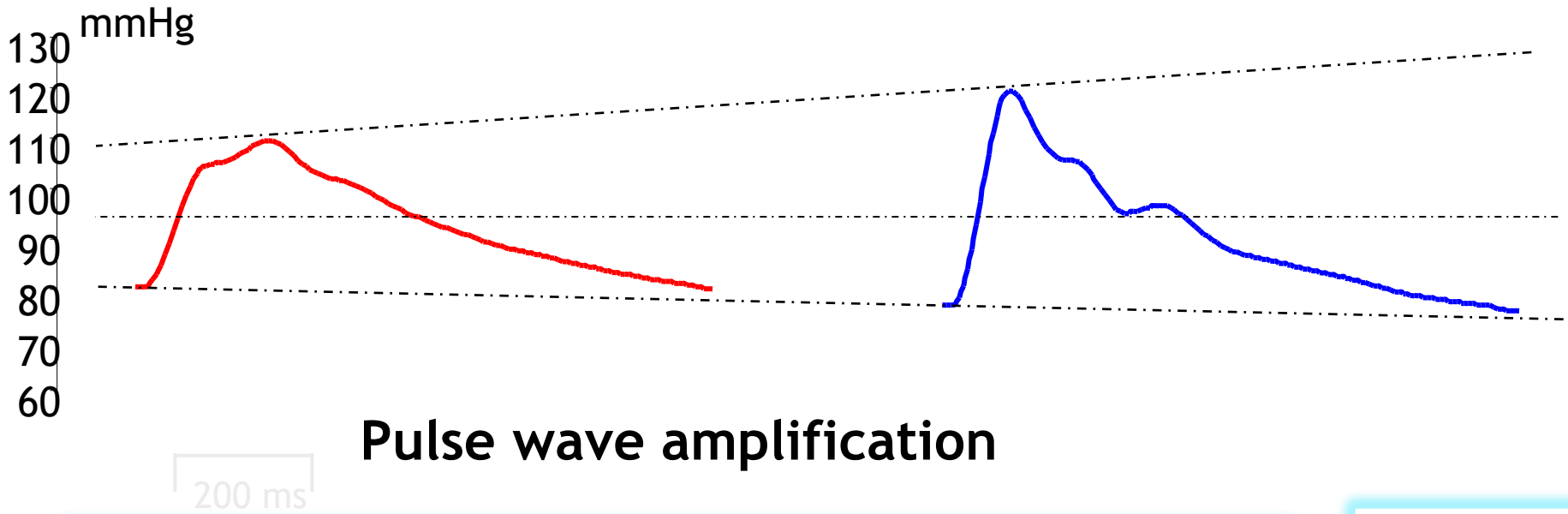
# Is it important to consider DAP in septic shock ?

1. DAP is a reflection of vasomotor tone
2. Septic shock is caracterised by vasodilation and a low vasomotor tone
3. DAP is the major component Of MAP
4. **DAP is constant through the vascular tree**

# The peripheral AP is different from the central (aortic) AP

**Central** pressure wave

**Peripheral** pressure wave




**Pulse wave amplification**

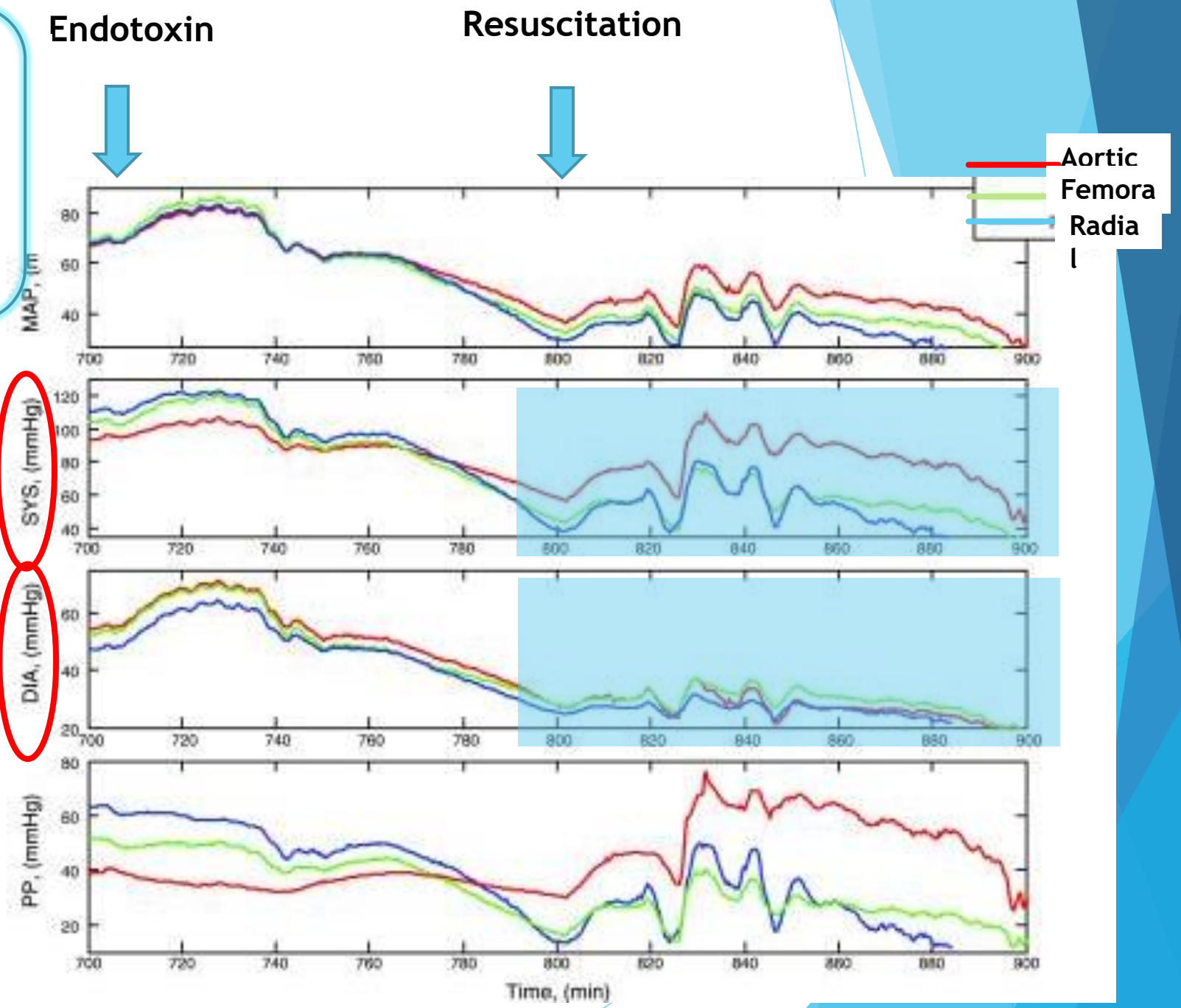
**femoral SAP** and **PP** < **radial SAP** and **PP**

Not the case of **DAP**

Peripheral vascular decoupling in porcine endotoxic shock

Feras Hatib, Jos R. C. Jansen, and Michael R. Pinsky

J Appl Physiol (1985). 2011 Sep; 111(3): 853–860.



# Is it important to consider DAP in septic shock ?

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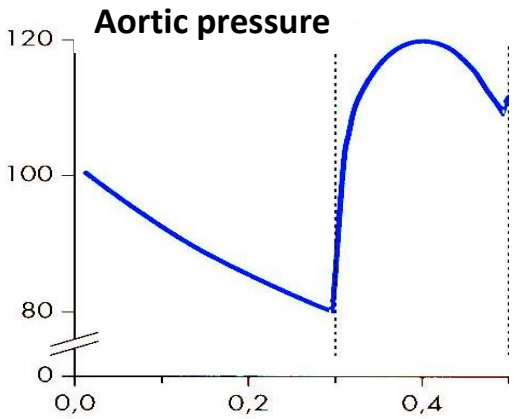
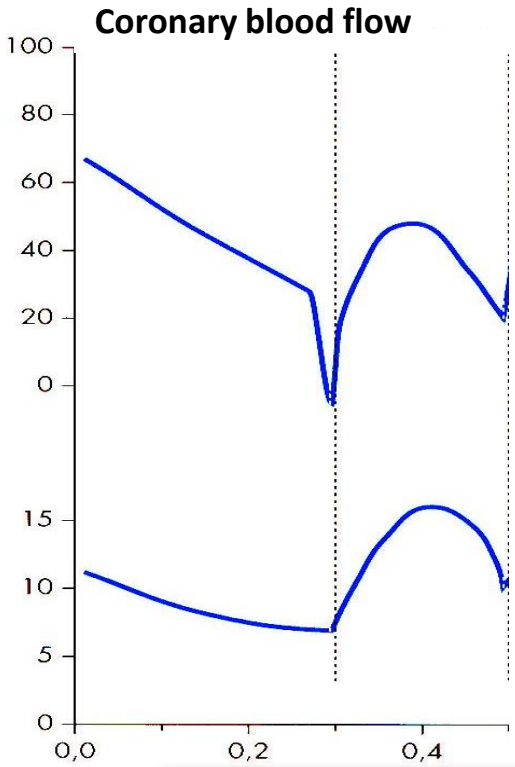
2. Septic shock is caracterised by vasodilation and a low vasomotor tone
3. DAP is the major component Of MAP
4. DAP is constant through the vascular tree
5. **DAP is the upstream  pressure for LV coronary perfusion**




**DAP is the upstream pressure for LV coronary perfusion**

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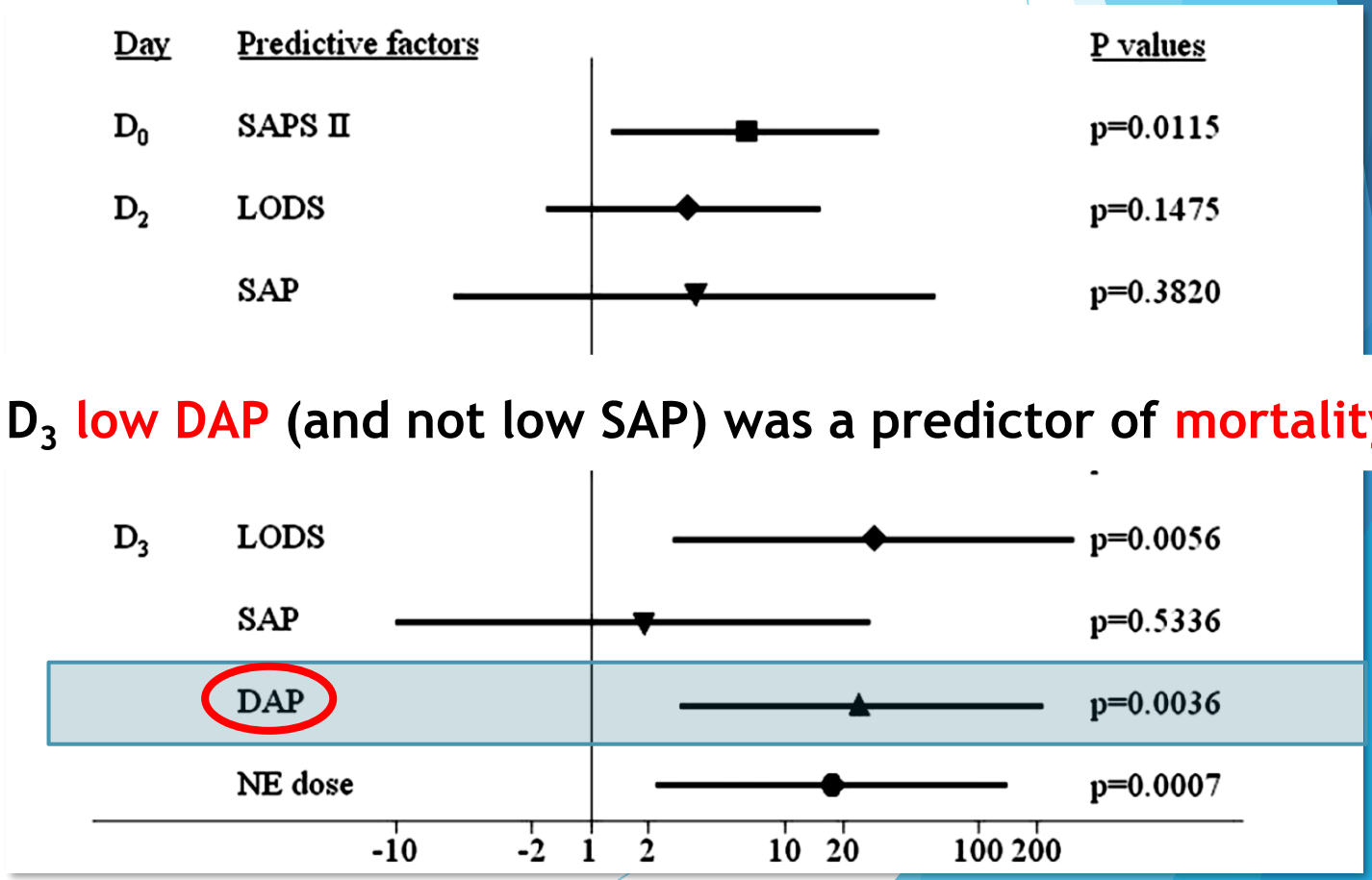
5. DAP is the upstream  pressure for LV coronary perfusion
6. **DAP is associated to outcome**

# Diastolic Arterial Blood Pressure: A Reliable Early Predictor of Survival in Human Septic Shock

*Samir Benchekroune, MD, Peter C. J. Karpati, MD, Christine Berton, MD†, Cédric Nathan, MD, Joaquim Mateo, MD, Mansour Chaara, MD, Florence Riché, MD, Marie-Josèphe Laisné, MD, Didier Payen, MD, PhD, and Alexandre Mebazaa, MD, PhD*

*J Trauma.* 2008;64:1188–1195

- **68 septic shock patients**
- **Receiving NE** for at least 72 hrs
- **Observational** study




At $D_3$ low DAP (and not low SAP) was a predictor of mortality

Annals of Intensive Care (2023)
RESEARCH Open Access

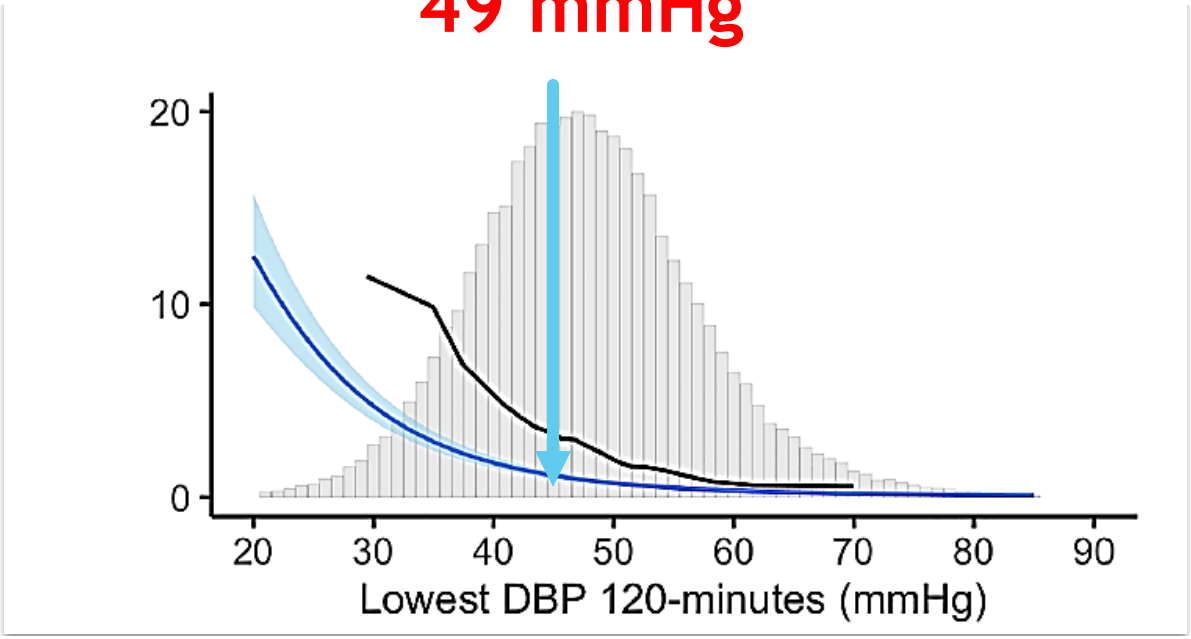
# Association of systolic, diastolic, mean, and pulse pressure with morbidity and mortality in septic ICU patients: a nationwide observational study

Ashish K. Khanna[1,2*†], Takahiro Kinoshita[3†], Annamalai Natarajan[3], Emma Schwager[3], Dustin D. Linn[3], Junzi Dong[3], Erina Ghosh[3], Francesco Vicario[3] and Kamal Maheshwari[4]

- **Retrospective observational** study, **77,328** septic patients in 364 ICUs in the eICU
- **Primary exposure** was **the lowest cumulative** value of each component; mean, systolic,diastolic, and pulse pressure, sustained for at **least 120 min** during ICU stay

Predicted Probability of ICU Mortality in Septic Shock Patients (%)

**49 mmHg**




In **septic ICU patients**, **lower level of all blood pressure** components including mean, systolic, diastolic and pulse pressure **were associated with higher mortality**, acute kidney injury and myocardial injury

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5. DAP is the upstream  pressure for LV coronary perfusion
6. DAP is associated to outcome
7. **DAP may be used as a trigger when managing septic shock patients**

# Diastolic arterial pressure is important in septic shock: PRO

Olfa Hamzaoui  Jean-Louis Teboul

Journal of Critical Care 51 (2019) 238–240

Patient of **70** years old and history of **CAD**

with **tachycardia** (heart rate: 100 beats/min)

and clinical signs of **septic shock** in spite of initial fluid resuscitation

**Situation A**

**Situation B**

**DAP may be a trigger to start norepinephrine**

**Surviving Sepsis Campaign: International Guidelines for Management of Severe Sepsis and Septic Shock: 2012**

R. Phillip Dellinger, MD[1]; Mitchell M. Levy, MD[2]; Andrew Rhodes, MB BS[3]; Djillali Annane, MD[4]; Herwig Gerlach, MD, PhD[5]; Steven M. Opal, MD[6]; Jonathan E. Sevransky, MD[7]; Charles L. Sprung, MD[8]; Ivor S. Douglas, MD[9]; Roman Jaeschke, MD[10]; Tiffany M. Osborn, MD, MPH[11]; Mark E. Nunnally, MD[12]; Sean R. Townsend, MD[13]; Konrad Reinhart, MD[14]; Ruth M. Kleinpell, PhD, RN-CS[15]; Derek C. Angus, MD, MPH[16]; Clifford S. Deutschman, MD, MS[17]; Flavia R. Machado, MD, PhD[18]; Gordon D. Rubenfeld, MD[19]; Steven A. Webb, MB BS, PhD[20]; Richard J. Beale, MB BS[21]; Jean-Louis Vincent, MD, PhD[22]; Rui Moreno, MD, PhD[23]; and the Surviving Sepsis Campaign Guidelines Committee including the Pediatric Subgroup*

***Rationale.*** Vasopressor therapy is required to sustain life and maintain perfusion in the face of life-threatening hypotension, even when hypovolemia has not yet been resolved.

Adequate fluid resuscitation is a fundamental aspect of the hemodynamic management of patients with septic shock and should ideally be achieved before vasopressors and inotropes are used; however, using vasopressors early as an emergency measure in patients with severe shock is frequently necessary, as when diastolic blood pressure is too low.

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7. DAP may be used as a trigger when managing septic shock patients
8. **Development and use of markers of vascular hyporesponsiveness to NE:**

**VNERi = DAP / (HR x NE dose)**

RESEARCH Open Access

# Ability of diastolic arterial pressure to better characterize the severity of septic shock when adjusted for heart rate and norepinephrine dose

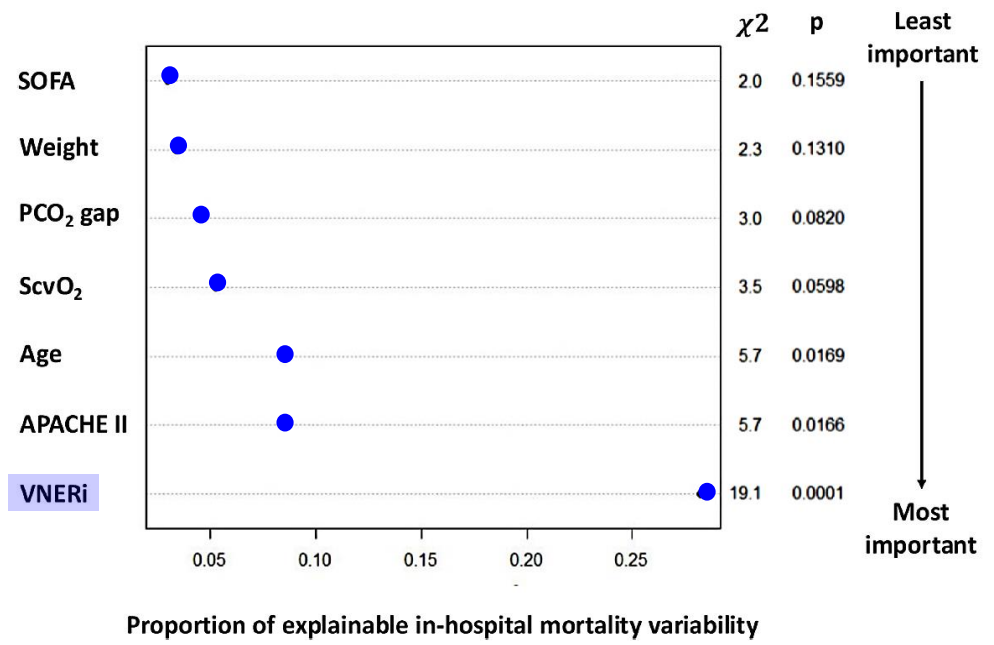
Antoine Goury[1,2*], Zoubir Djerada[2], Glenn Hernandez[3], Eduardo Kattan[3], Romain Griffon[1], Gustavo Ospina-Tascon[4,5], Jan Bakker[6,7], Jean-Louis Teboul[2,8] and Olfa Hamzaoui[1,2]

*Annals of Intensive Care* (2025) 15:43

**VNERi = DAP / (HR x NE dose)**

- **DAP**: marker of **vascular tone**
- **DAP/HR**: better **marker** of **vascular tone** than DAP

**DAP/(HR x NE dose)**: marker of **vascular responsiveness** to **NE**



RESEARCH Open Access

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*Annals of Intensive Care* (2025) 15:43

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- **DAP**: marker of **vascular tone**
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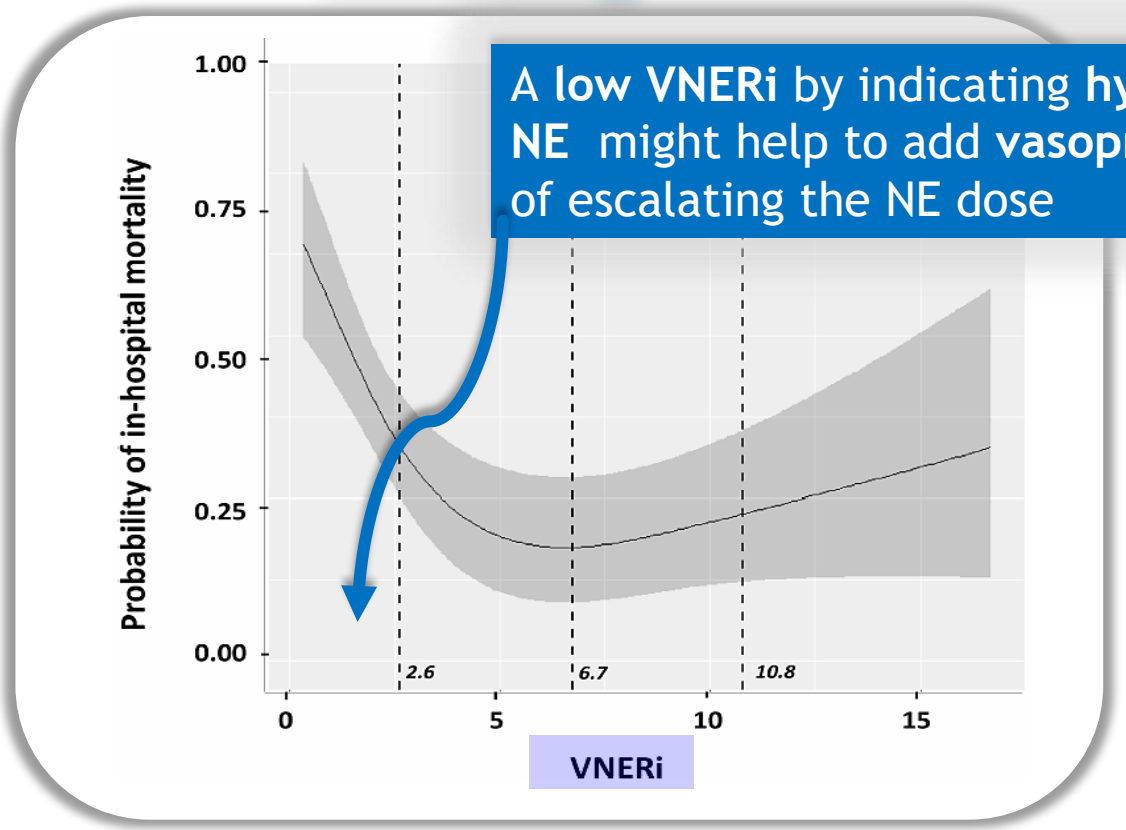
**DAP/(HR x NE dose)**: marker of **vascular responsiveness** to **NE**




A **low VNERi** by indicating **hyporesponsiveness to NE** might help to add **vasopressin earlier** instead of escalating the NE dose

# Is it important to consider DAP in septic shock ?

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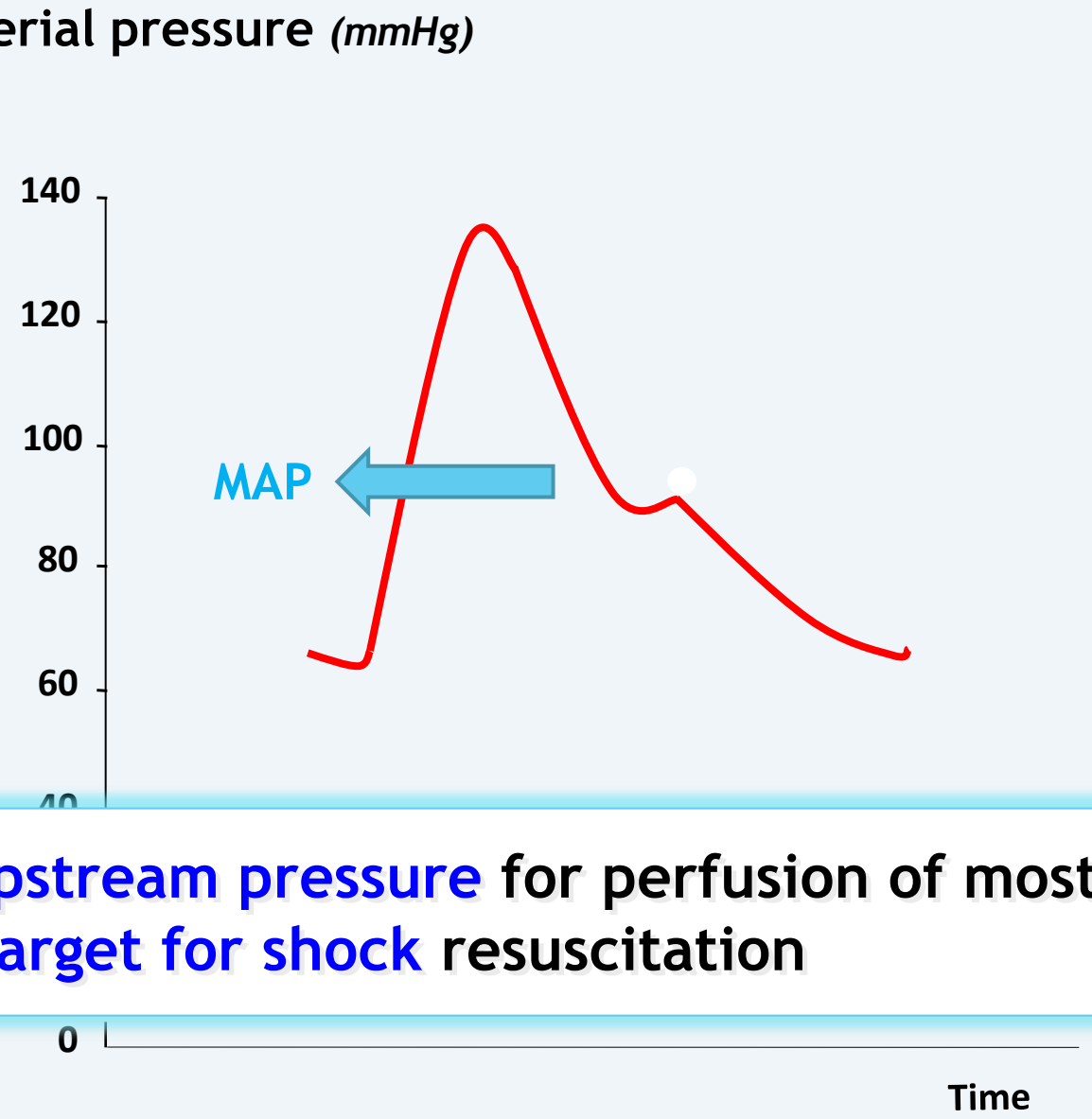
4. DAP is constant through the vascular tree
5. DAP is the upstream  pressure for LV coronary perfusion
6. DAP is associated to outcome
7. DAP may be used as a trigger when managing septic shock patients
8. **Development and use of markers of vascular hyporesponsiveness to NE:**

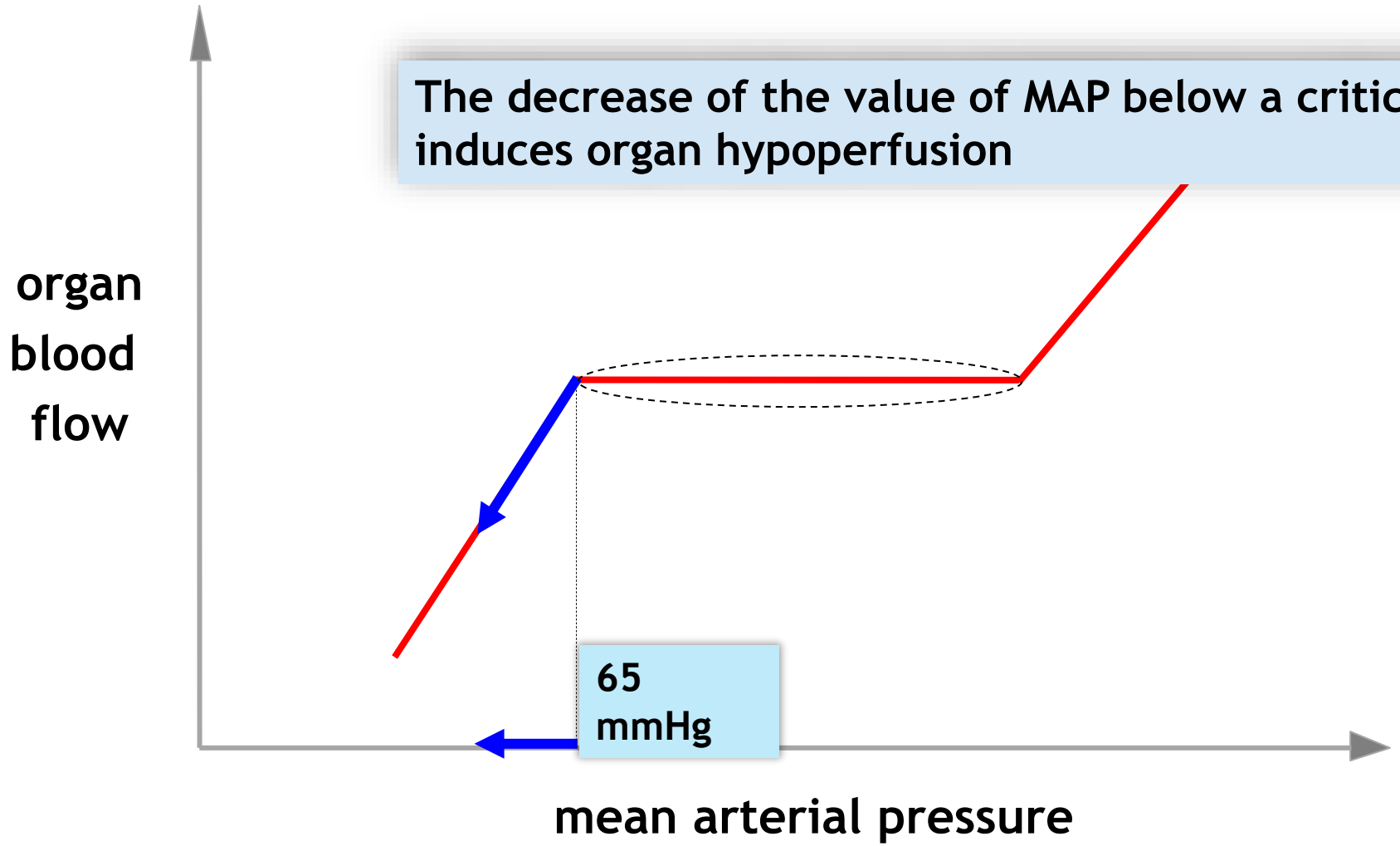
**VNERi = DAP / (HR x NE dose)<2.6** → **Add a second vasopressor: Vasopressin**




**MAP**: **upstream pressure** for perfusion of most vital organs
And a **target for shock** resuscitation

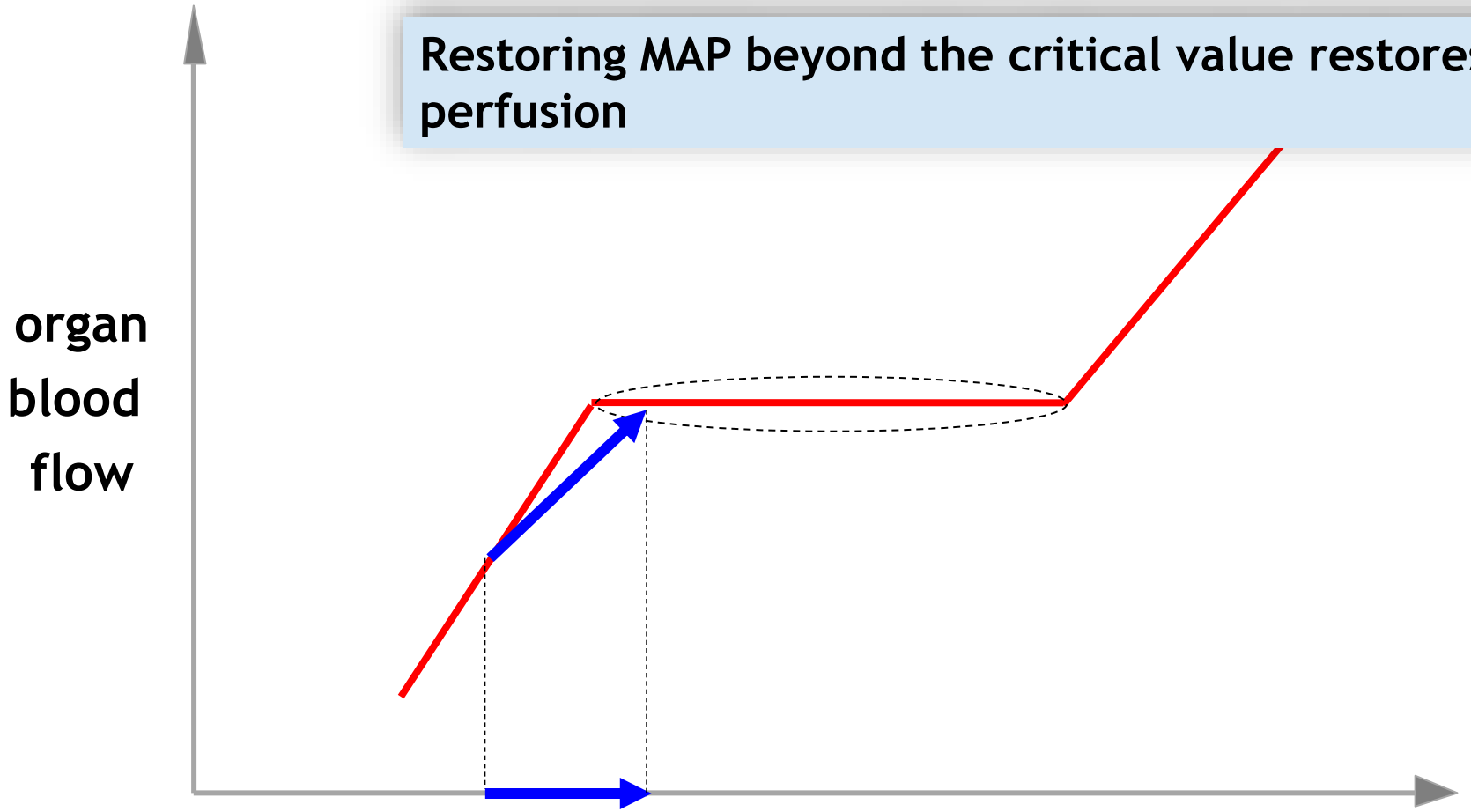
# Autoregulation of organ blood flow

The decrease of the value of MAP below a critical value induces organ hypoperfusion



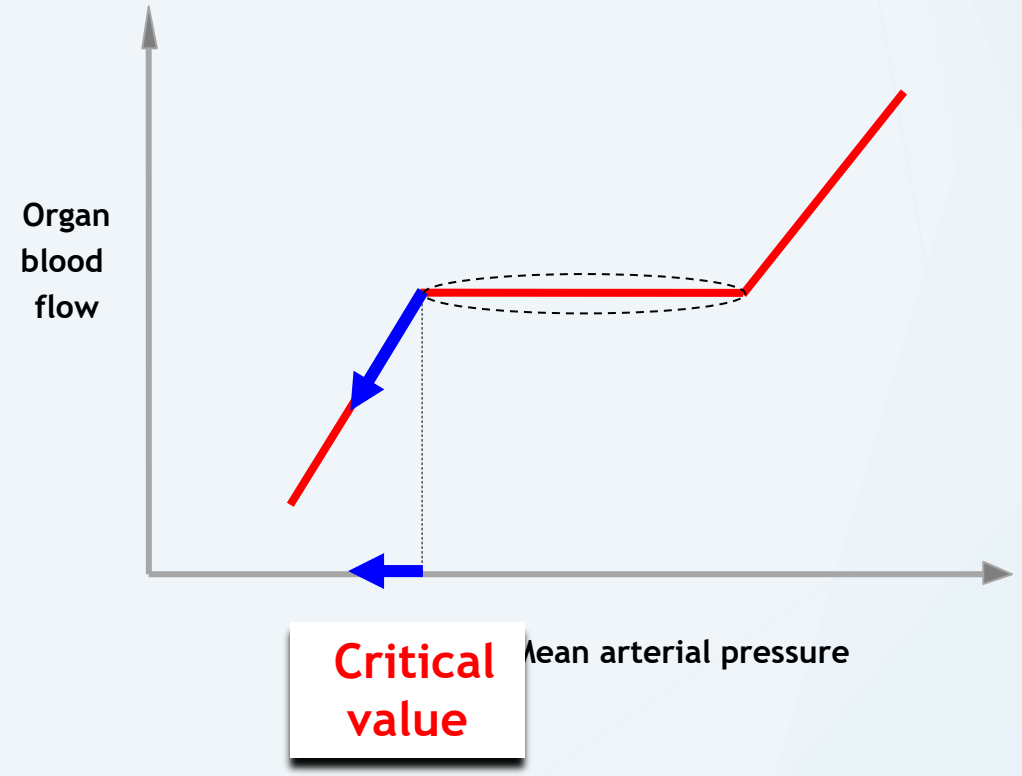
# Autoregulation of organ blood flow

Restoring MAP beyond the critical value restores organs perfusion



# MAP: Therapeutic goal

What is the cut off value?



GUIDELINES

# Surviving sepsis campaign: international guidelines for management of sepsis and septic shock 2021

*Intensive Care Med (2021) 47:1181–1247*

## MEAN ARTERIAL PRESSURE


9 For adults with septic shock on vasopressors, we **recommend** an initial target mean arterial pressure (MAP) of 65 mm Hg over higher MAP targets.

Intensive Care Med (2005) 31:1066–1071
DOI 10.1007/s00134-005-2688-z

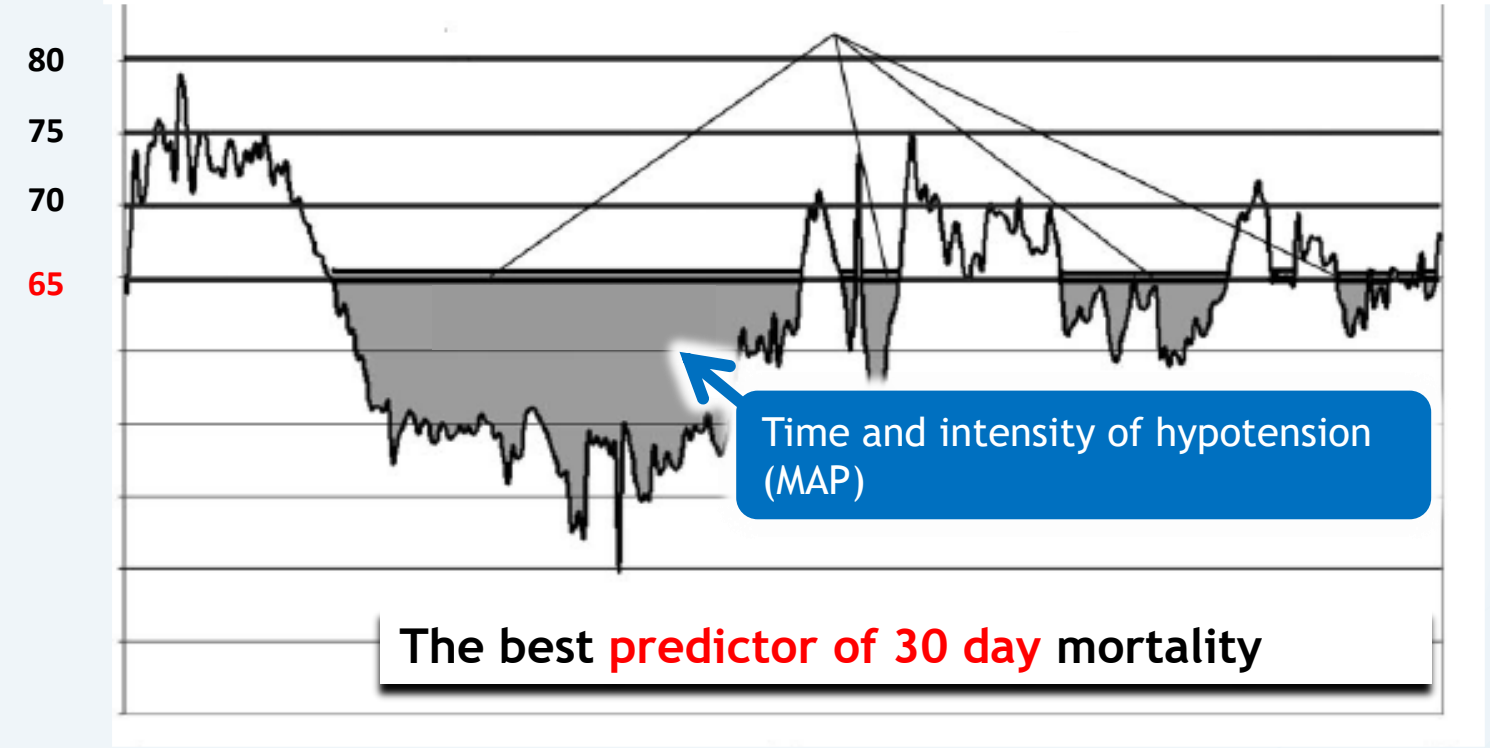
ORIGINAL

Marjut Varpula
Minna Tallgren
Katri Saukkonen
Liisa-Maria Voipio-Pulkki
Ville Pettilä

# Hemodynamic variables related to outcome in septic shock

Retrospective cohort
111 septic shock patients
30-day mortality

## Time under the value of MAP 65 mmHg

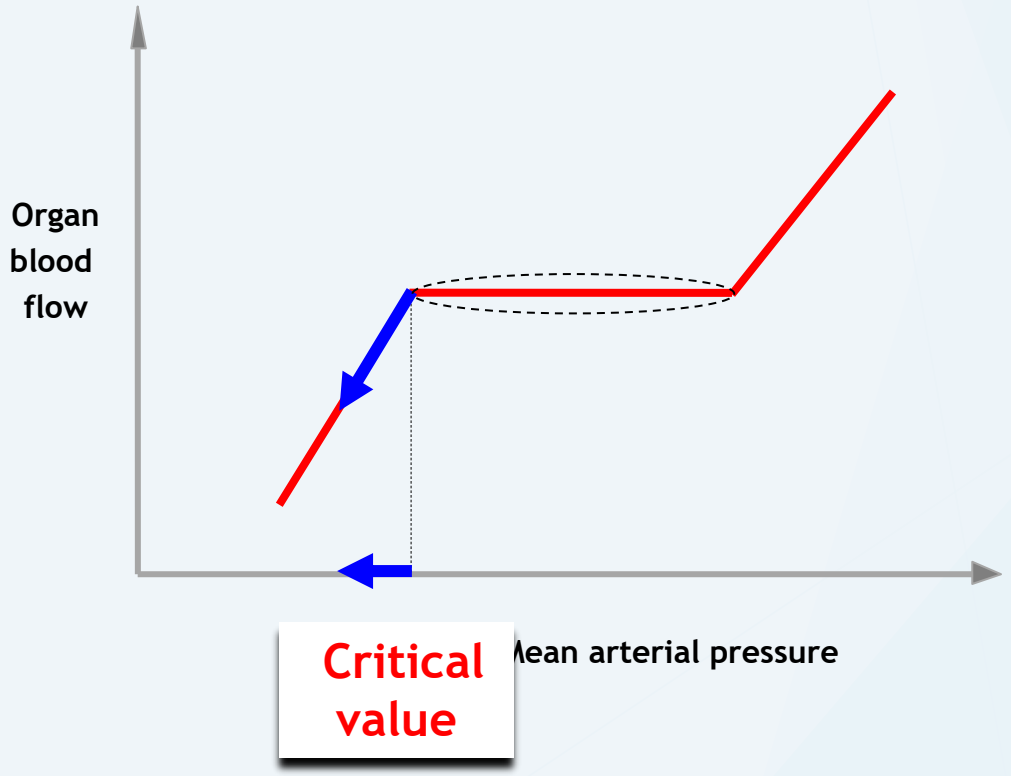



## The best predictor of 30 day mortality

# MAP: Treatment goal

What is the cut off value?

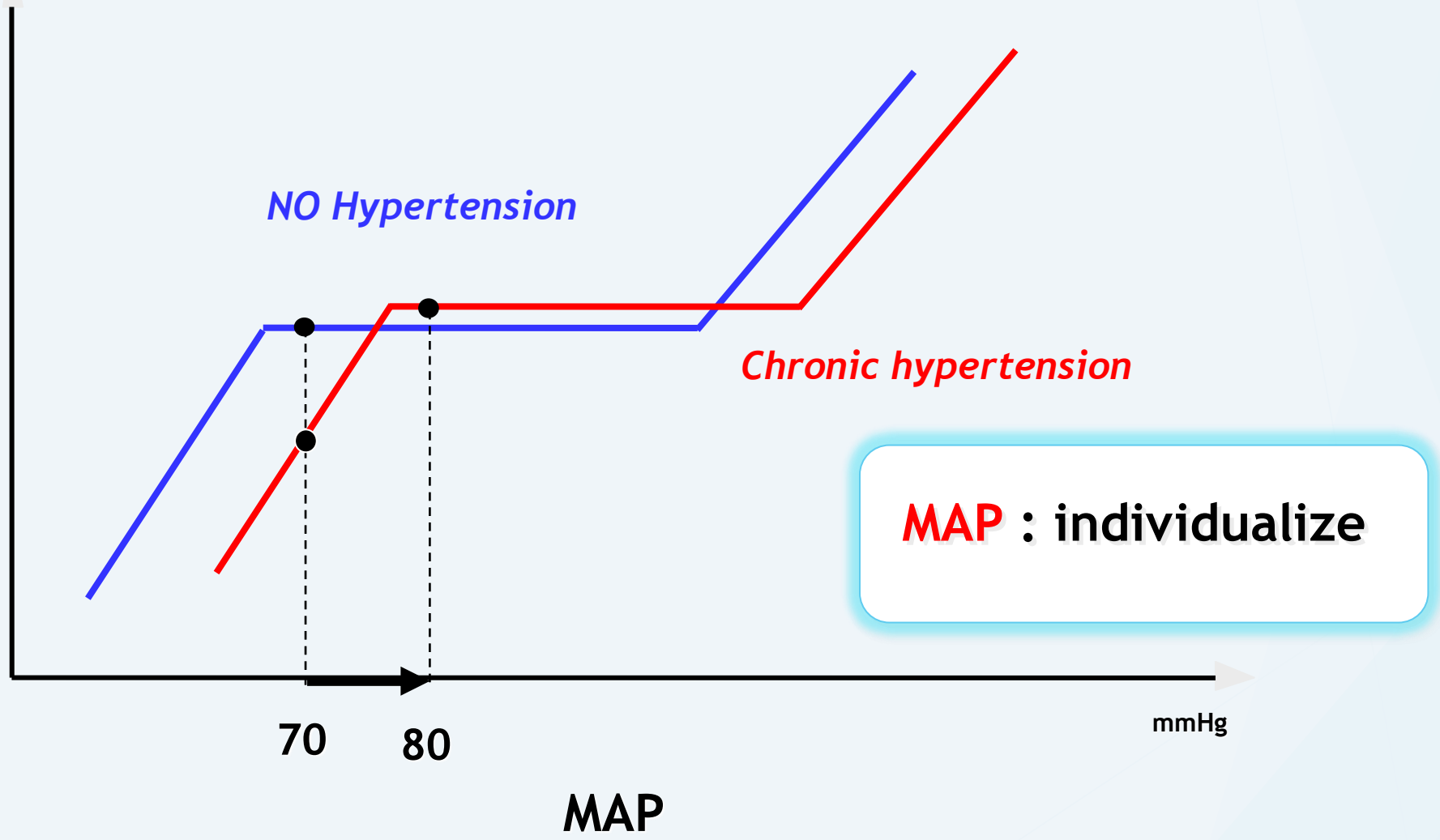
**Is it the same for all the patients ?**



**Autoregulation of Brain Circulation in Severe Arterial Hypertension**

S. STRANDGAARD, J. OLESEN, E. SKINHØJ, N. A. LASSEN

*British Medical Journal*, 1973, 1, 507–510




**MAP : individualize**

The NEW ENGLAND JOURNAL of MEDICINE

ISHED IN 1812 APRIL 24, 2014 VOL. 370 NO

80-85 mmHg

65-70 mmHg

# High versus Low Blood-Pressure Target in Patients with Septic Shock

Pierre Asfar, M.D., Ph.D., Ferhat Meziani, M.D., Ph.D., Jean-François Hamel, M.D., Fabien Grelon, M.D., Bruno Megarbane, M.D., Ph.D., Nadia Anguel, M.D., Jean-Paul Mira, M.D., Ph.D., Pierre-François Dequin, M.D., Ph.D., Soizic Gergaud, M.D., Nicolas Weiss, M.D., Ph.D., François Legay, M.D., Yves Le Tulzo, M.D., Ph.D., Marie Conrad, M.D., René Robert, M.D., Ph.D., Frédéric Gonzalez, M.D., Christophe Guitton, M.D., Ph.D., Fabienne Tamion, M.D., Ph.D., Jean-Marie Tonnelier, M.D., Pierre Guezennec, M.D., Thierry Van Der Linden, M.D., Antoine Vieillard-Baron, M.D., Ph.D., Eric Mariotte, M.D., Gaël Pradel, M.D., Olivier Lesieur, M.D., Jean-Damien Ricard, M.D., Ph.D., Fabien Hervé, M.D., Damien du Cheyron, M.D., Ph.D., Claude Guerin, M.D., Ph.D., Alain Mercat, M.D., Ph.D., Jean-Louis Teboul, M.D., Ph.D., and Peter Radermacher, M.D., Ph.D.,

**388** pts

**388** pts

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 APRIL 24, 2014 VOL. 370 NO. 17

# High versus Low Blood-Pressure Target in Patients with Septic Shock

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| Variable | Low-Target Group (N=388) | High-Target Group (N=388) | P Value |
|---|---|---|---|
| Primary outcome: death at day 28 — no. (%)* | 132 (34.0) | 142 (36.6) | 0.57 |
| Secondary outcomes — no./total no. (%) | | | |
| Death at day 90† | 164 (42.3) | 170 (43.8) | 0.74 |
| Survival at day 28 without organ support‡ | 241 (62.1) | 235 (60.6) | 0.66 |
| Doubling of plasma creatinine | 161 (41.5) | 150 (38.7) | 0.42 |
| No chronic hypertension | 71/215 (33.0) | 85/221 (38.5) | 0.32 |
| Chronic hypertension | 90/173 (52.0) | 65/167 (38.9) | 0.02 |
| Renal-replacement therapy from day 1 to day 7 | 139 (35.8) | 130 (33.5) | 0.50 |
| No chronic hypertension | 66/215 (30.7) | 77/221 (34.8) | 0.36 |
| Chronic hypertension | 73/173 (42.2) | 53/167 (31.7) | 0.046 |
| Atrial fibrillation | 11 (2.8) | 26 (6.7) | 0.02 |
| Ventricular fibrillation or tachycardia | 15 (3.9) | 22 (5.7) | 0.24 |
| Digital ischemia | 9 (2.3) | 10 (2.6) | 0.82 |
| Mesenteric ischemia | 9 (2.3) | 9 (2.3) | 1.00 |
| Bleeding | 42 (10.8) | 31 (8.0) | 0.22 |

EDITORIAL Open Access

# Equilibrating SSC guidelines with individualized care

Jean-Louis Vincent[1*], Mervyn Singer[2], Sharon Einav[3], Rui Moreno[4], Julia Wendon[5], Jean-Louis Teboul[6], Jan Bakker[7,8,9,10], Glenn Hernandez[11], Djillali Annane[12], Angélique M. E. de Man[13], Xavier Monnet[14], V. Marco Ranieri[15], Olfa Hamzaoui[16], Jukka Takala[17], Nicole Juffermans[18,19], Jean-Daniel Chiche[20], Sheila N. Myatra[21] and Daniel De Backer[22]

*Critical Care* (2021) 25:397

We recommend **individualizing** arterial **blood pressure levels.**

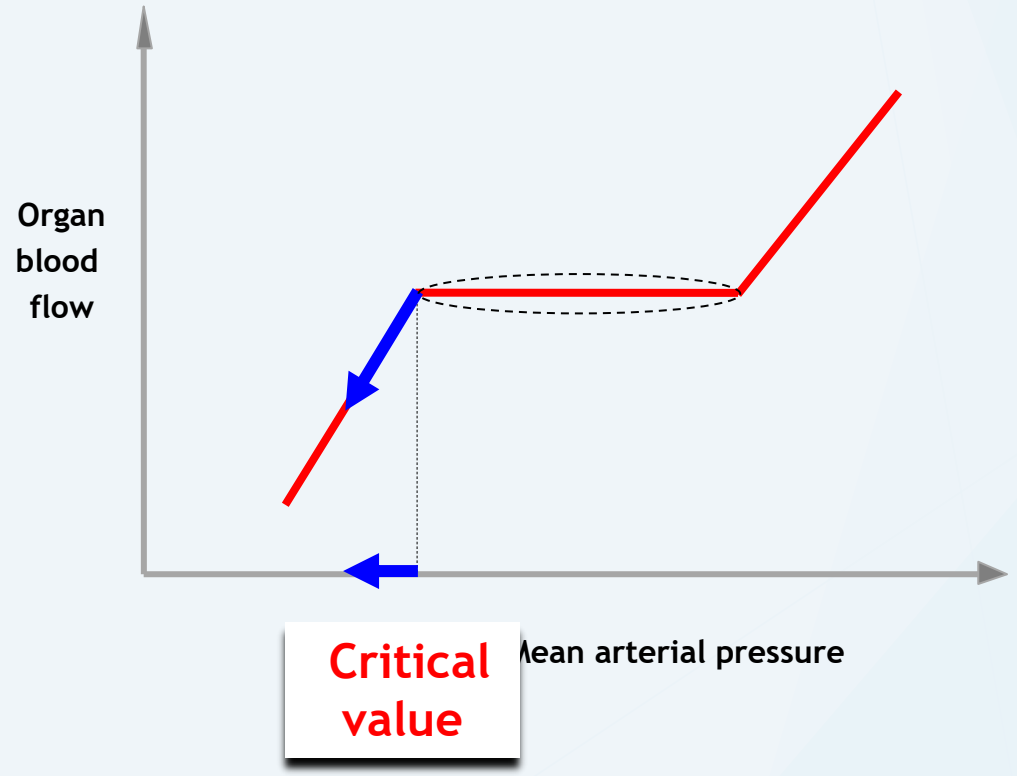
Although a mean value of **65 mmHg** may be recommended as an **initial goal**, the optimal level may be **higher** in patients with a history of **hypertension**, atherosclerosis or chronic kidney disease

# MAP: Treatment goal

What is the cut off value?

Is it the same for all the patients ?

**Is it the same in all the situations ?**



SPECIAL ISSUE INSIGHT

# Central venous pressure (CVP)

Olfa Hamzaoui[1*] and Jean-Louis Teboul[2,3]

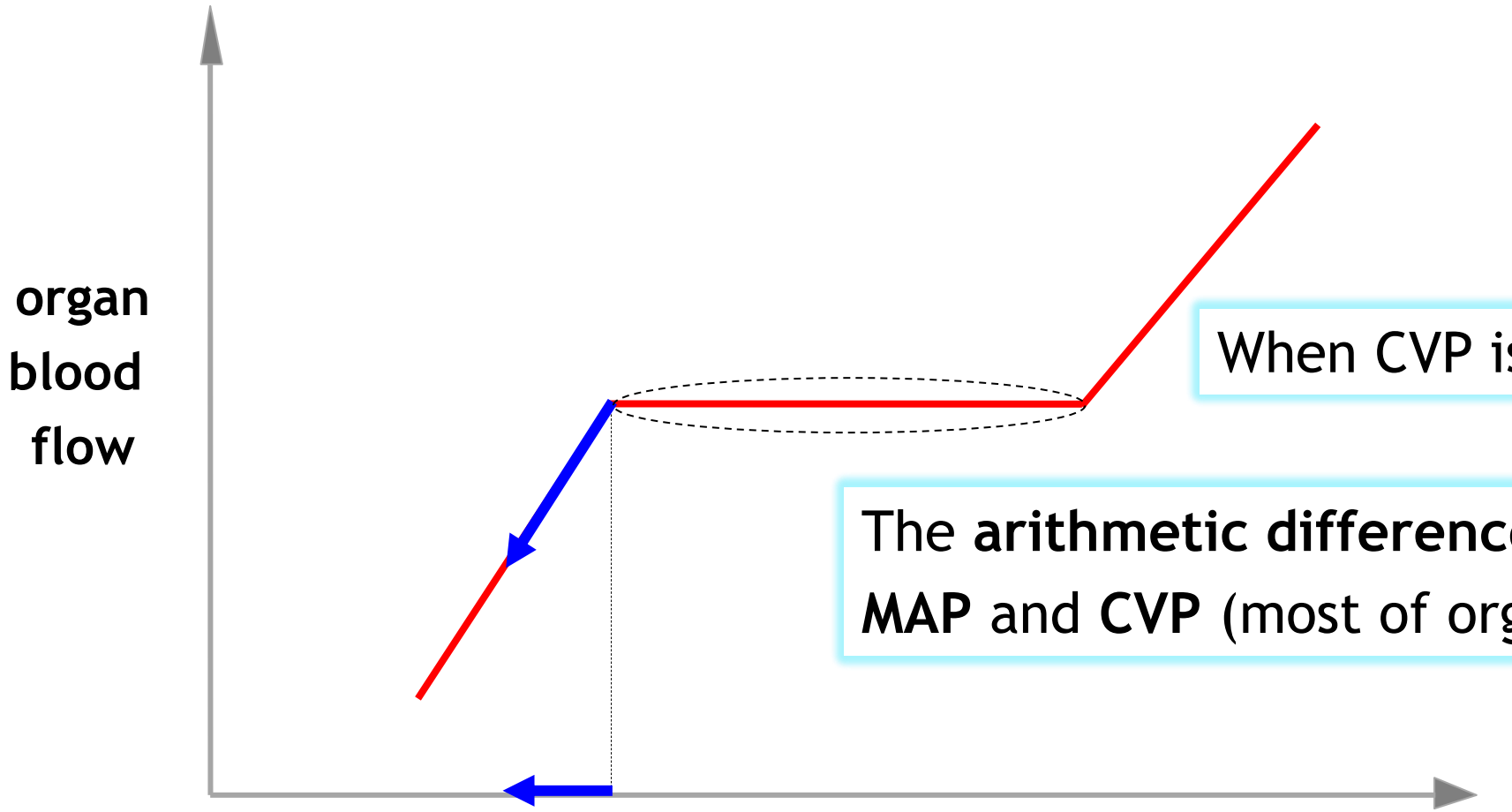
*Intensive Care Med (2022) 48:1498–1500*

## CVP as the downstream pressure for organ perfusion

The CVP also reflects the downstream pressure for perfusion of most vital organs (e.g., brain and kidney). The mean perfusion pressure (MPP) of such organs is the difference between mean arterial pressure (MAP) and CVP.

**MPP = MAP - CVP** ⇒ **MAP** may be a surrogate of **MPP when CVP is low**

# Autoregulation of organ blood flow




When CVP is high

The **arithmetic difference** between **MAP** and **CVP** (most of organs)

**Mean perfusion pressure: MAP - CVP**

# Low mean perfusion pressure is a risk factor for progression of acute kidney injury in critically ill patients – A retrospective analysis

Marlies Ostermann[1*], Anna Hall[2] and Siobhan Crichton[3]

*BMC Nephrology* (2017) 18:151

- Retrospective analysis
- **2118 patients: 790 patients** (37%) who developped **AKI**
- **205 equipped with advanced hemodynamic** monitoring.

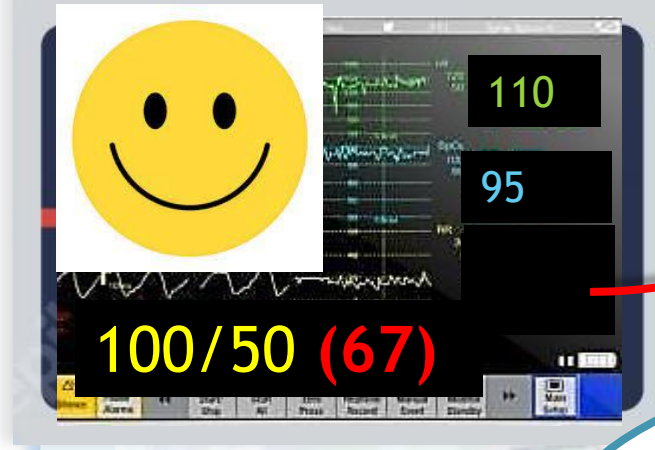
**Table 2** Multivariable analysis: Risk factors for progression from AKI I to AKI III

| Parameter | OR (95% CI)[a] | *p*-value |
|---|---|---|
| First arterial lactate following diagnosis of AKI I [mmol/L] | 1.45 (1.12–1.89) | 0.005 |
| SOFA score on day of AKI I | 1.20 (1.05–1.37) | 0.01 |
| First $DO_2I$ in 12 h period after diagnosis of AKI I [ml/min/$m^2$] | 0.997 (0.994–0.99) | 0.01 |
| First calculated MPP | 0.995 (0.92–0.99) | 0.03 |
| Age [years] | 1.02 (0.997–1.05) | 0.09 |
| Cumulative fluid balance on day of AKI I [ml] | 1.00 (0.99–1.00) | 0.98 |
| MAP <65 mmHg for >1 h in first 12 h after diagnosis of AKI I | 0.97 (0.48–1.96) | 0.93 |

Mean perfusion pressure (MPP = MAP-CVP) but not MAP was an independent factor associated with AKI progression. A value of **MPP of 60 mmHg** was found as a cutoff.

Patient with pneumonia ARDS and under mechanical ventilation

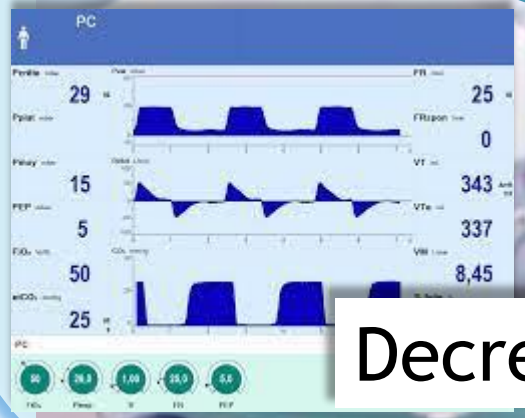
- Under **NE:0.4microg/Kg/min**
- **Acute renal failure**




MPP= MAP-CVP

MPP= 67-25

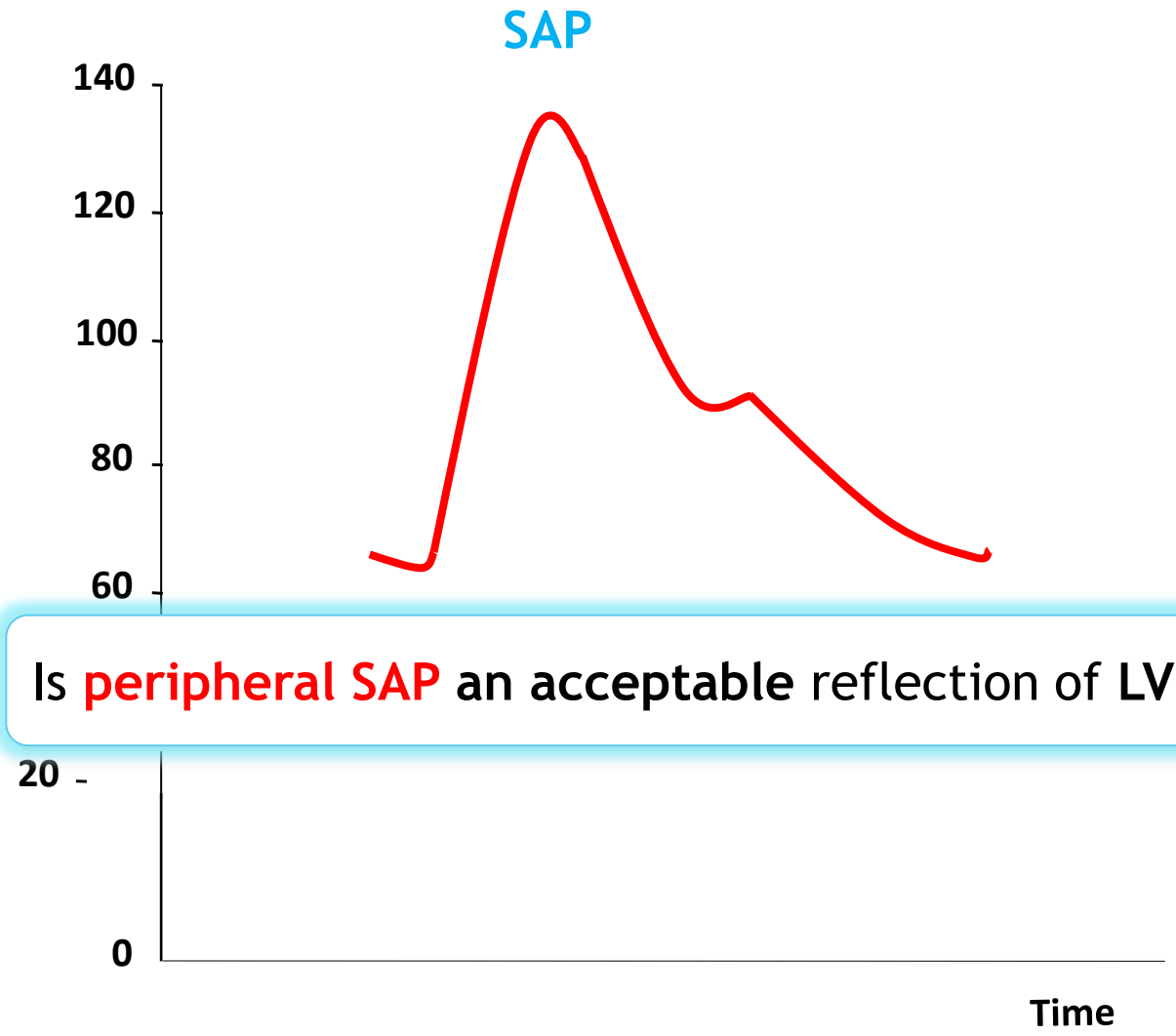
MPP= 42 mmHg




Decrease PEEP

Increase NE

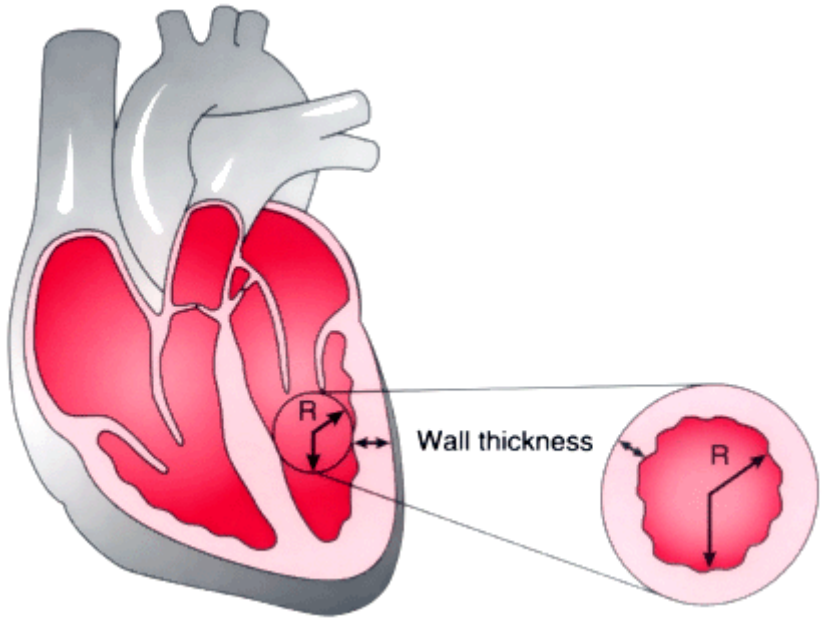

## Arterial pressure *(mmHg)*




Is **peripheral SAP** an **acceptable** reflection of **LV afterload**?

# LV afterload is defined by systolic wall stress

**LV afterload** is defined
by the load that
the LV must eject blood against
and expressed as **systolic wall stress**



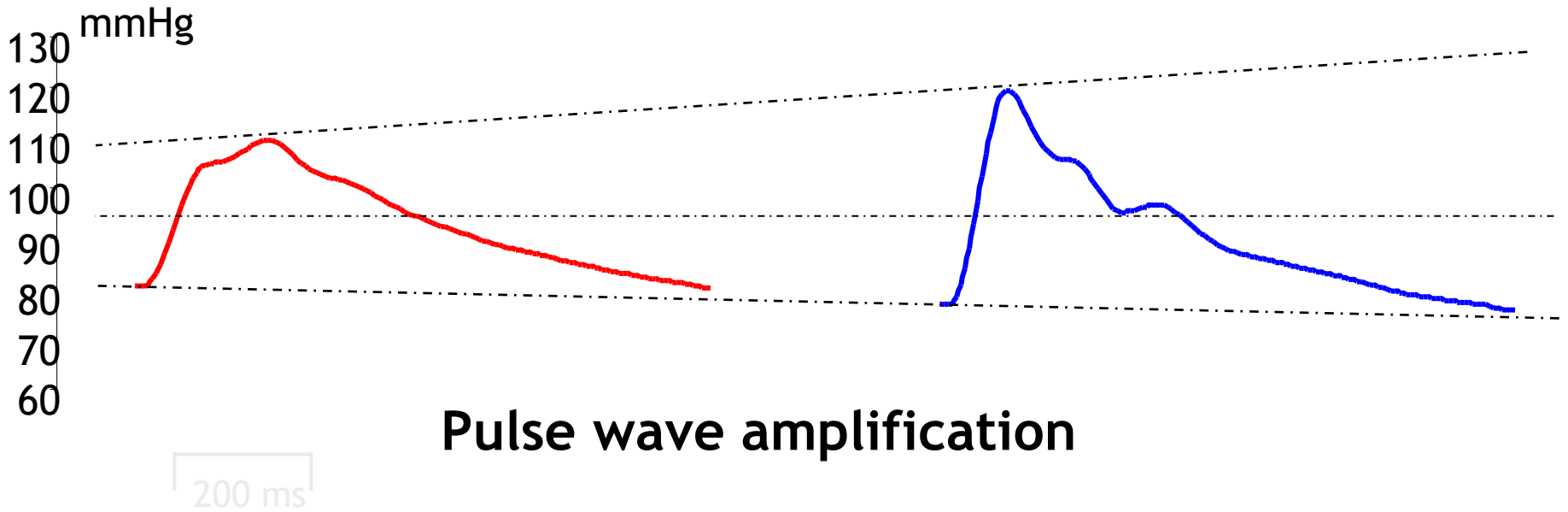

**Laplace law**

**Systolic wall stress = ventricular systolic pressure x LV radius / 2 x LV wall thickness**

**Ventricular end-systolic pressure = 0.9 x aortic SAP**

**Central** pressure wave

**Peripheral** pressure wave

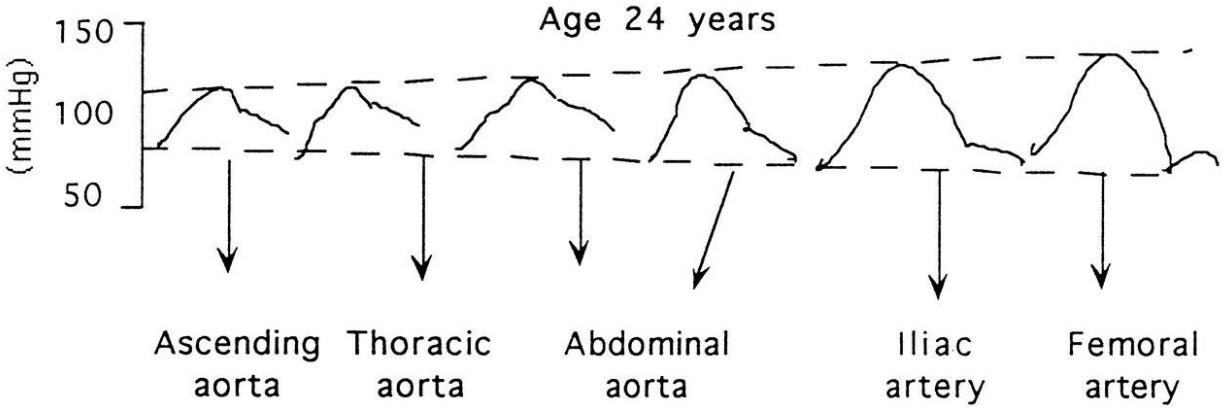



**Pulse wave amplification**

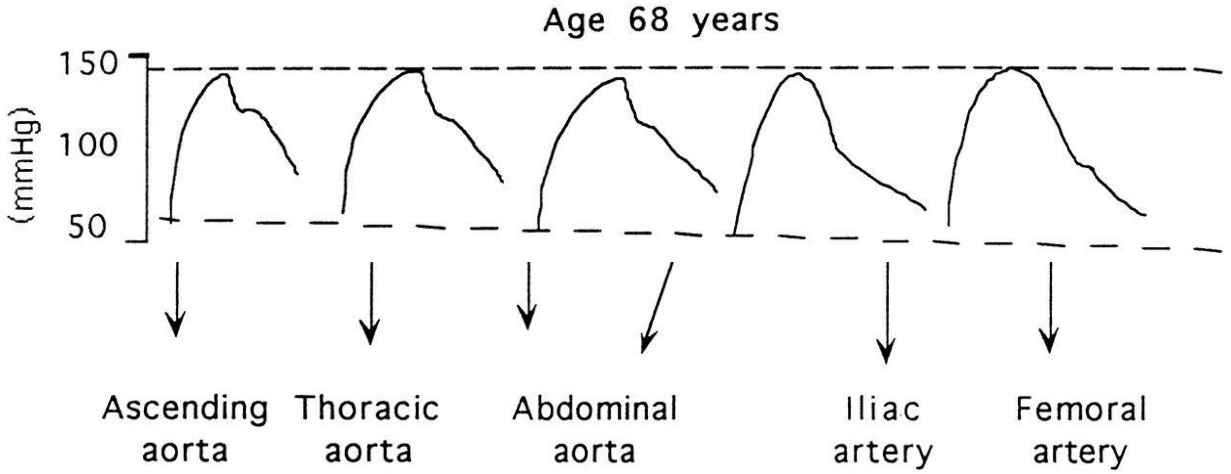
**aortic SAP < femoral SAP**

**femoral SAP < radial SAP**

## **Pulse wave amplification** depends on **age** and arterial **stiffness**

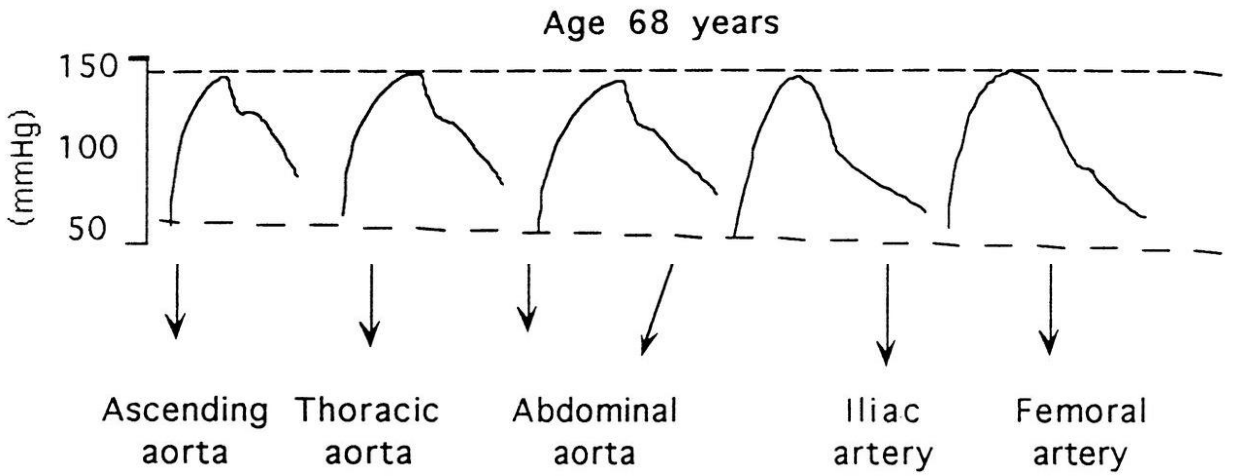



If you measure a **peripheral SAP** of **150** mmHg
the **aortic SAP** is **lower**
… and **LV afterload not** so much **increased**




If you measure a **peripheral SAP** of **150** mmHg
the **aortic SAP** is **150** and **LV afterload** is high

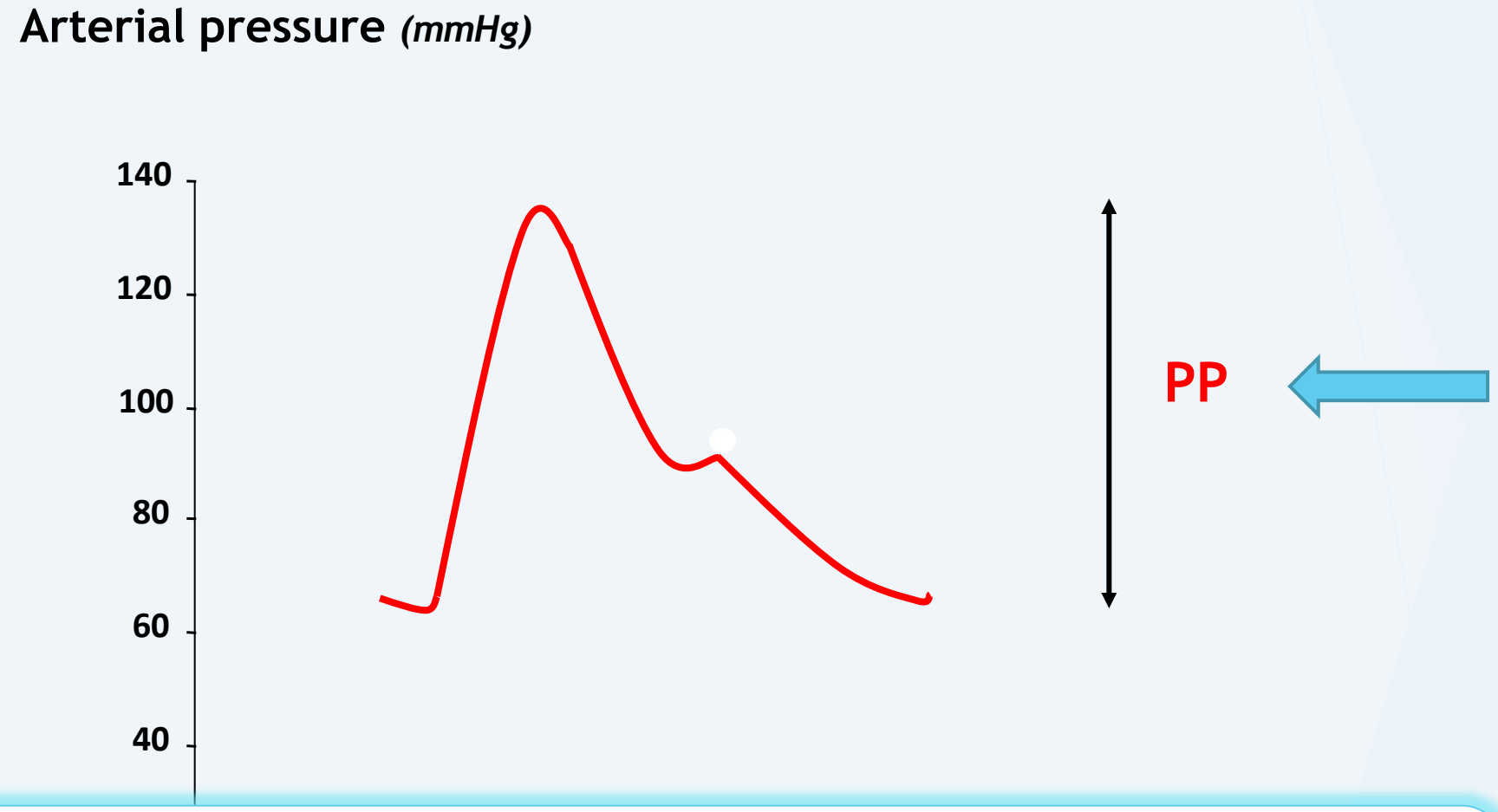
**Pulse wave amplification** depends on **age** and arterial **stiffness**




If you measure a **peripheral SAP** of **150** mmHg the **aortic SAP** is **150** and **LV afterload** is high

- Is **peripheral SAP** **an acceptable** reflection of **LV afterload ?**

- Yes, if **low pulse wave amplification**
- (**elderly**, **hypertensive**, **vasoconstricted**, etc)




**Aortic pulse pressure = SV / aortic compliance**

*Chemla et al AJP 1998*

Intensive Care Med (2011) 37:942–949

ORIGINAL

Nicolas Dufour
Denis Chemla
Jean-Louis Teboul
Xavier Monnet
Christian Richard
David Osman

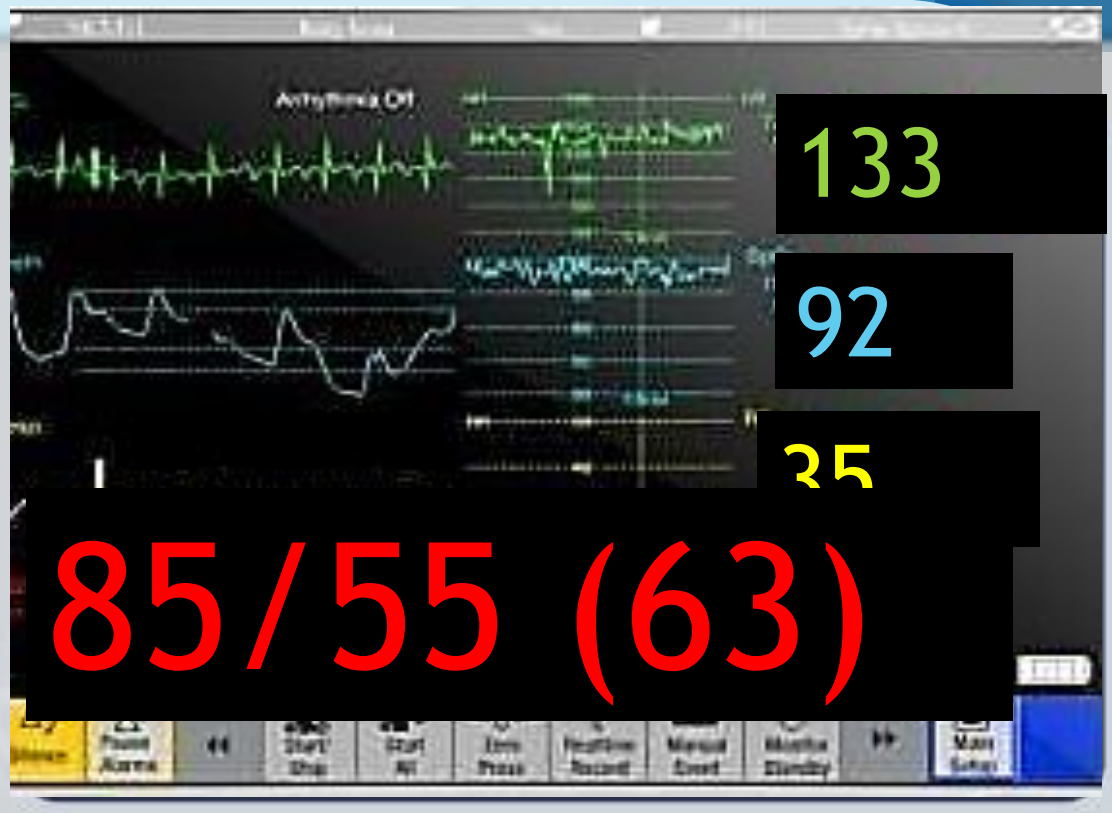
# Changes in pulse pressure following fluid loading: a comparison between aortic root (non-invasive tonometry) and femoral artery (invasive recordings)

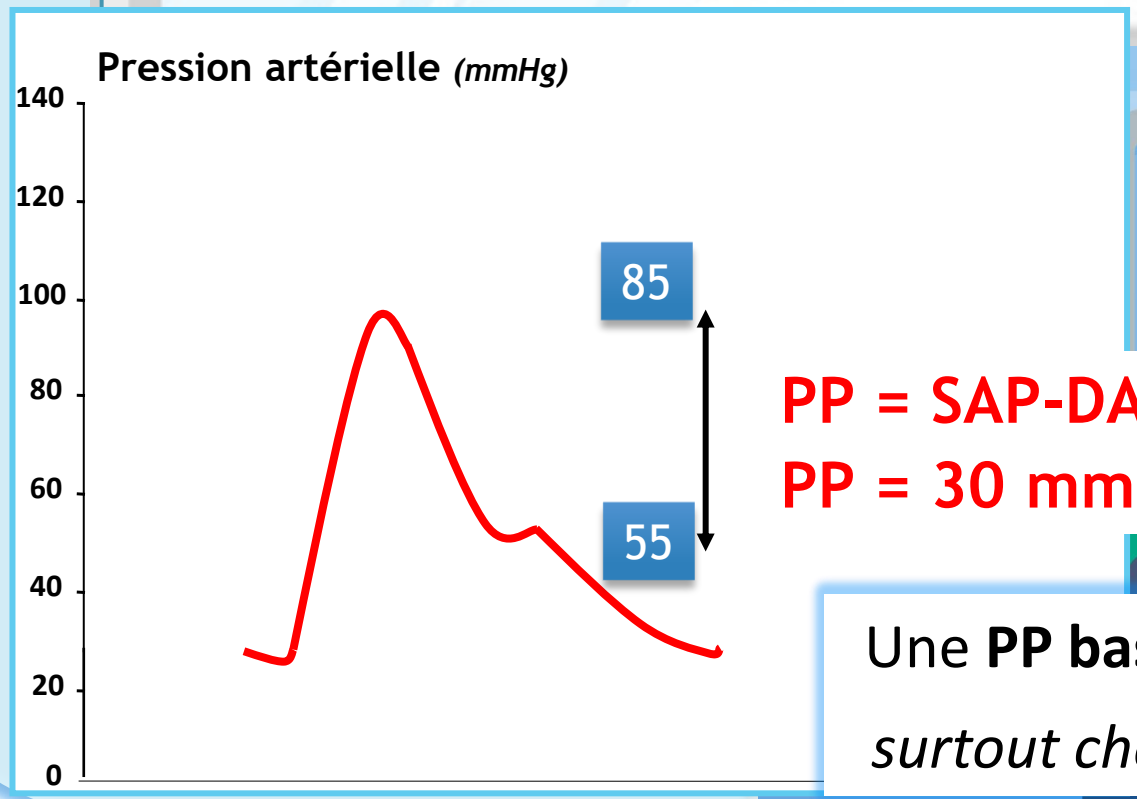
**Easy** bedside **tool** to identify **low stroke volume**

**Table 5** Relationship between changes in PP and SV after volume expansion in young and elderly patients

| PP versus SV relationship | Age <60 years | | Age ≥60 years | |
|---|---|---|---|---|
| | *r* | *p* | *r* | *p* |
| Femoral | 0.46 | 0.03 | 0.75 | <0.01 |

- Male (Mr Z)
- **75 years old**
- Medical history: **Hypertension**




**PP = SAP-DAP**

**PP = 30 mmHg**

Une **PP basse** reflète un **bas volume d'éjection systolique**

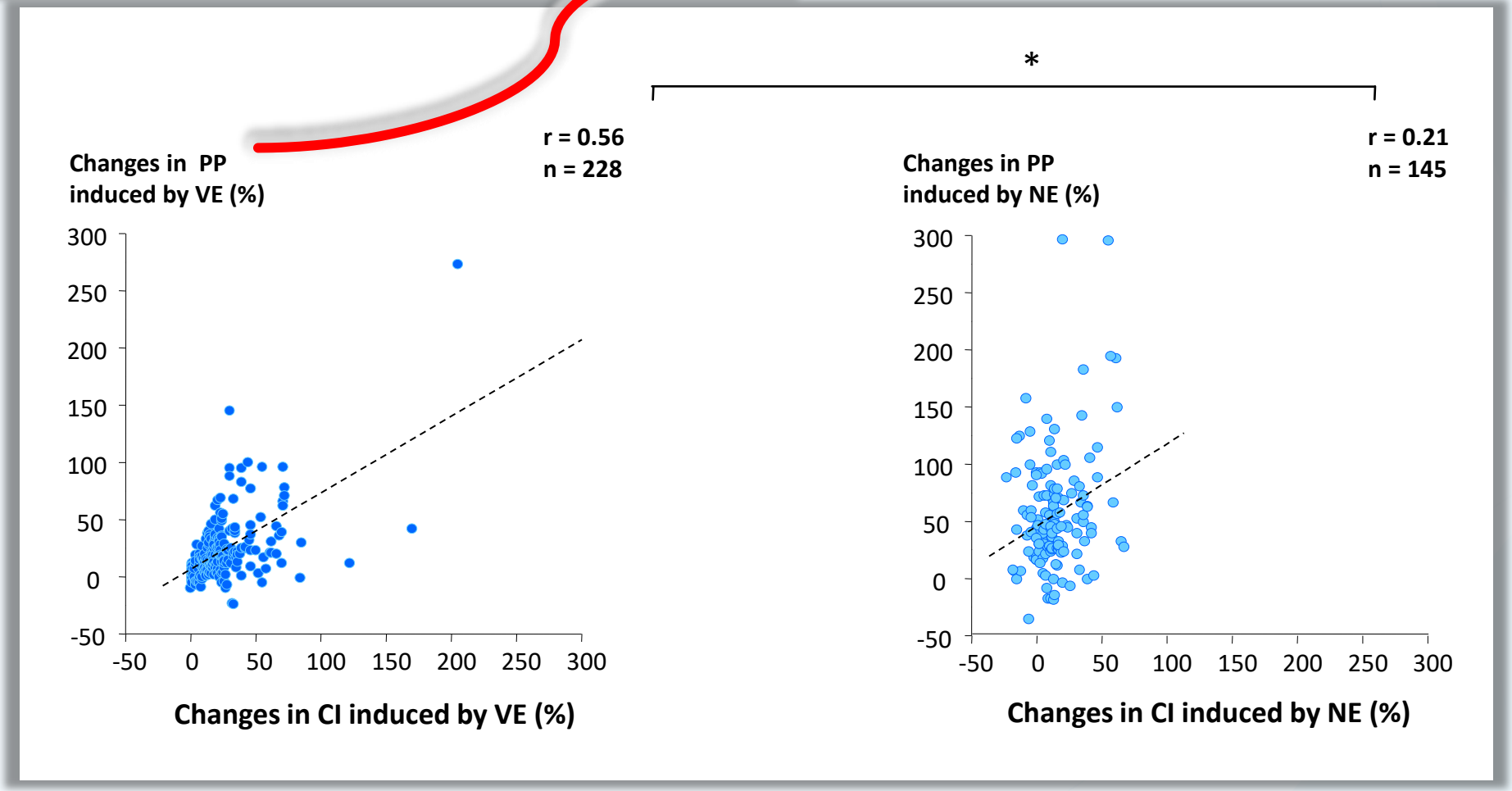
*surtout chez les patients avec artères (supposées) rigides*

# Arterial pressure allows monitoring the changes in cardiac output induced by volume expansion but not by norepinephrine*

Xavier Monnet, MD, PhD; Alexia Letierce, PhD; Olfa Hamzaoui, MD; Denis Chemla, MD, PhD; Nadia Anguel, MD; David Osman, MD; Christian Richard, MD; Jean-Louis Teboul, MD, PhD

Crit Care Med 2011; 39:1394–1399

**Easy** bedside **tool** to test changes in **low stroke volume**



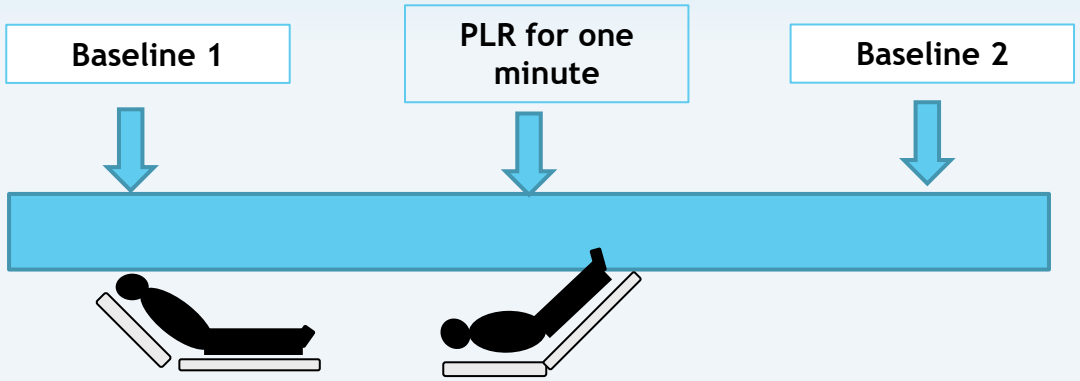
Dynamic changes of pulse pressure but not of pulse pressure variation during passive leg raising predict preload responsiveness in critically ill patients with spontaneous breathing activity

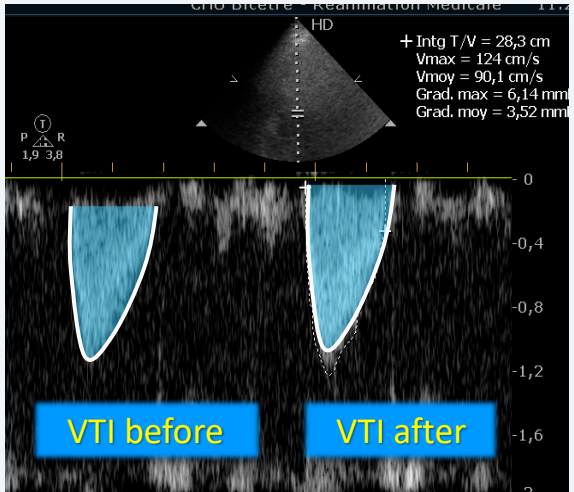
Rui Shi, MD, PhD [a,b], Francesca Moretto, MD [a], Dominique Prat, MD [c], Frederic Jacobs, MD [c], Jean-Louis Teboul, MD, PhD [a,b], Olfa Hamzaoui, MD [c,*]

Journal of Critical Care 72 (2022) 154141

33 Patients ventilated with **pressure support** mode **or totally spontaneously breathing**

To **evaluate** whether **changes** in **pulse pressure (PP)** or in **pulse pressure variation (PPV)** during (PLR) can be used to evaluate preload responsiveness



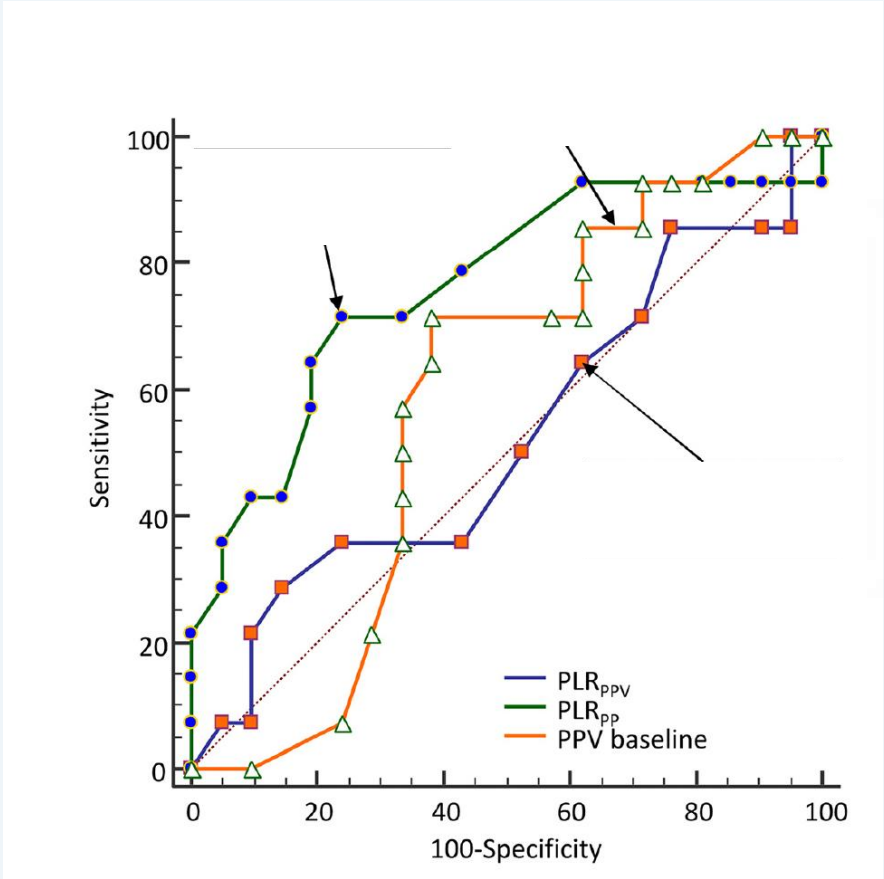

**VTI >12%:** PLR +

Dynamic changes of pulse pressure but not of pulse pressure variation during passive leg raising predict preload responsiveness in critically ill patients with spontaneous breathing activity

Rui Shi, MD, PhD [a,b], Francesca Moretto, MD [a], Dominique Prat, MD [c], Frederic Jacobs, MD [c], Jean-Louis Teboul, MD, PhD [a,b], Olfa Hamzaoui, MD [c,*]

Journal of Critical Care 72 (2022) 154141

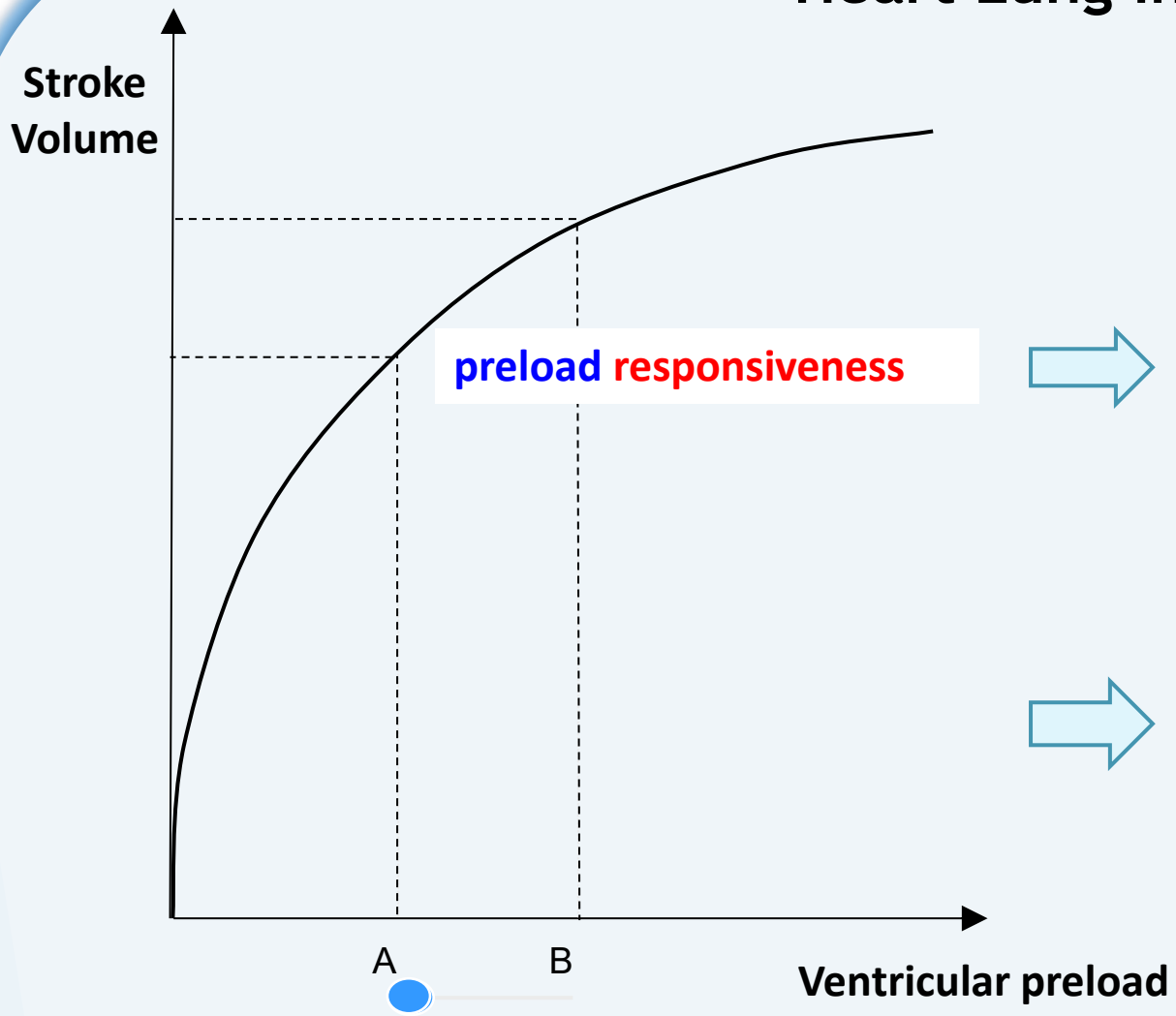
33 Patients ventilated with **pressure support** mode **or totally spontaneously breathing**




in patients **with spontaneous breathing activity**, **the increase in PP of equal to or higher than 2 mmHg during PLR** may be **helpful to discriminate** preload **responders** from **non-responders** with fair accuracy

- Analysis of the static values
- **Analysis of the dynamic variation of AP values**

# Heart Lung interaction during MV



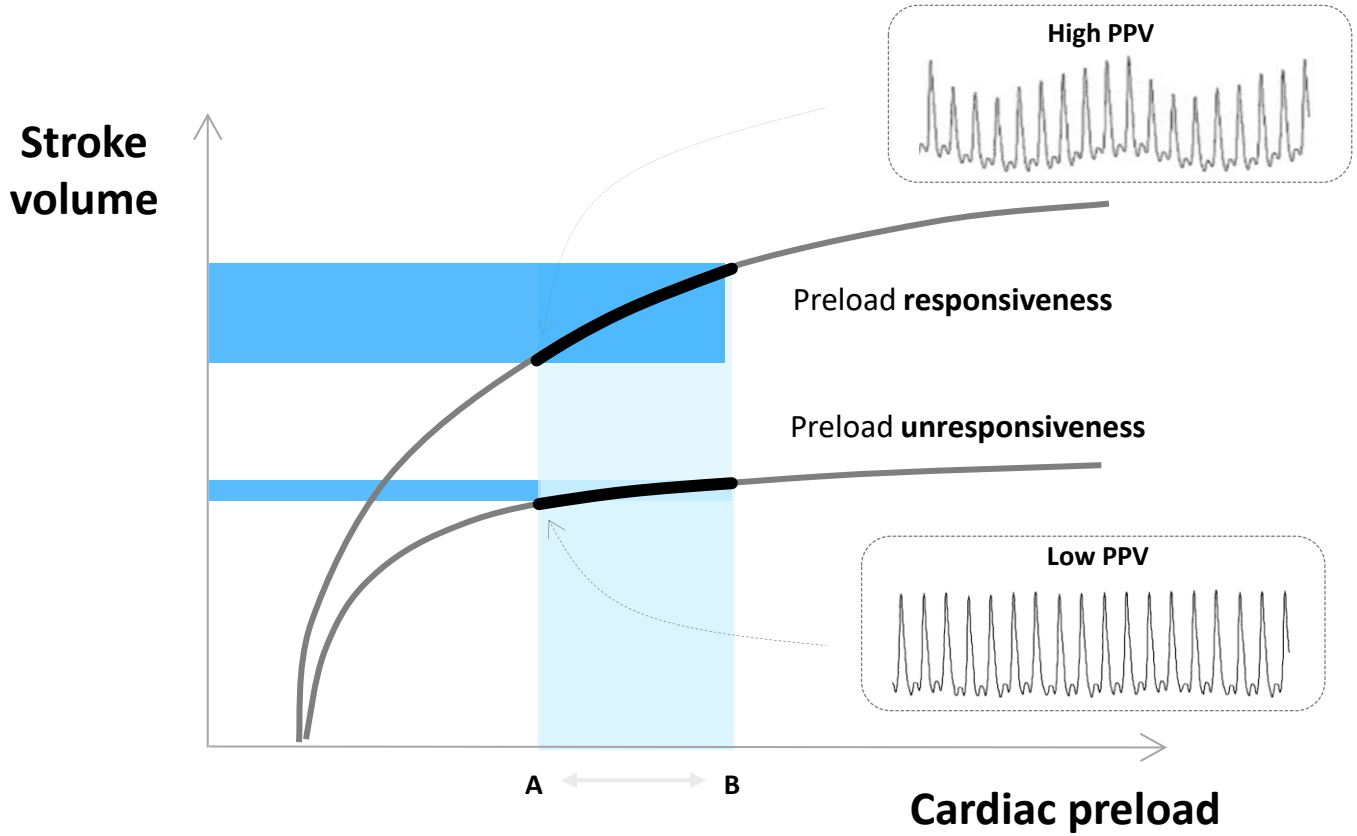

MV can induce cyclic changes in preload and …. in SV in cases of biventricular preload responsiveness

As aortic compliance does not change over the respiratory cycle, changes in PP (PPV) reflect changes in SV (SVV)

## Arterial Pulse Pressure Variation with Mechanical Ventilation

Jean-Louis Teboul[1], Xavier Monnet[1], Denis Chemla[2], and Frédéric Michard[3]

Am J Respir Crit Care Med Vol 199, Iss 1, pp 22–31, Jan 1, 2019

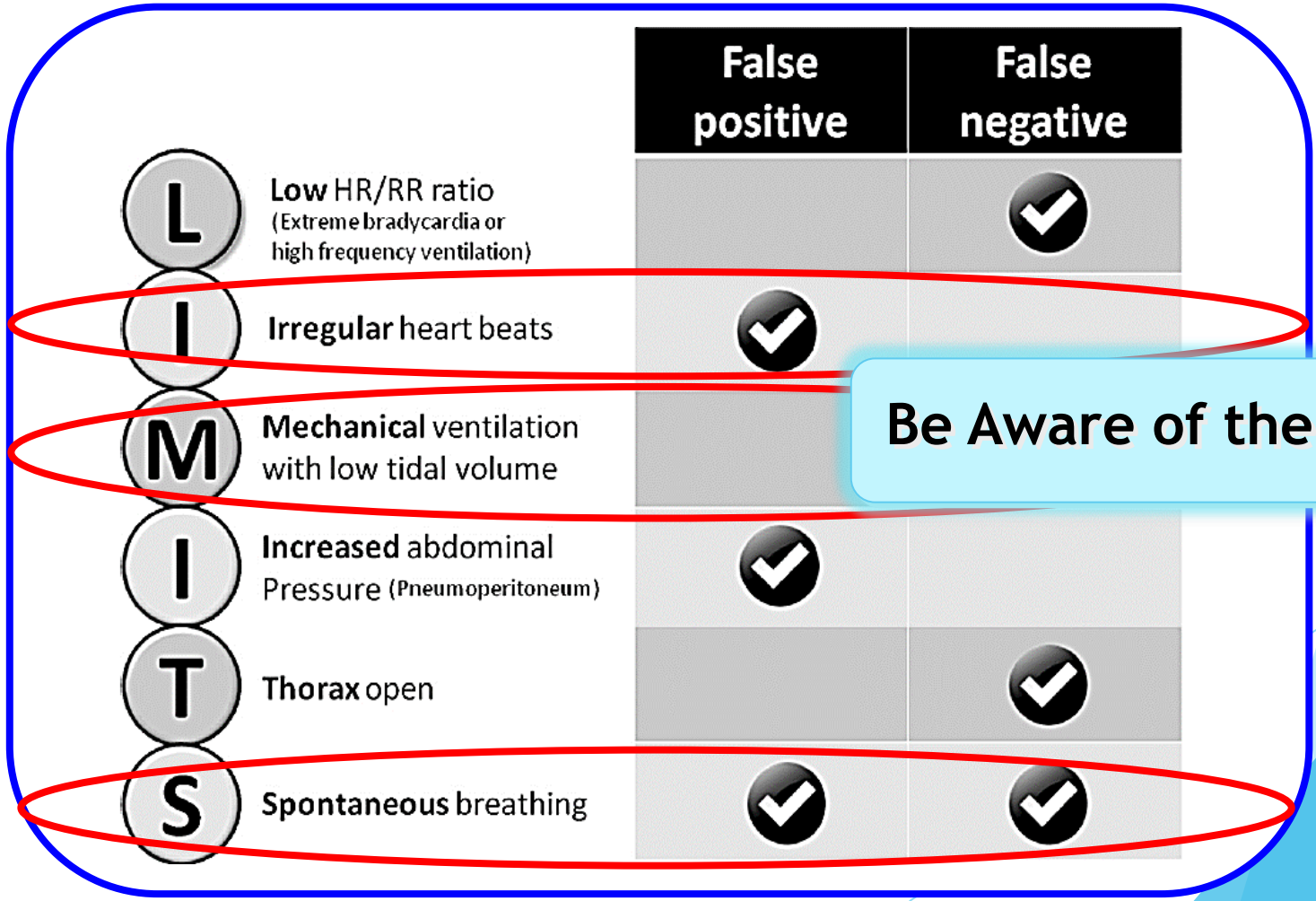




# Applied physiology

# Applicability of pulse pressure variation: how many shades of grey?

Frederic Michard[1*], Denis Chemla[2] and Jean-Louis Teboul[3]

*Critical Care* (2015) 19:144




**Be Aware of the Limitations !**

# Take home messages?

## Arterial pressure is a real time monitoring tool

- All the **static components** of arterial pressure (**SAP**, **DAP, MAP, PP**) are **important to consider** when managing critically ill patients

  - **SAP** : reflects **LV afterload**
  - **DAP :** may be used **as a « trigger » to introduce vasopressors**
  - **VNERi =DAP/HRxDose de NAD:** may be used **as a « trigger » to add a second vasopressor**
  - **MAP** : **Therapeutic target**
  - **PP** : may be used as **surrogate of stroke volume**

**Merci !**

- The **variation of PP(delta PP) under MV** may be used as a marker **of preload dependancy**

# DU Hemodynamic management and monitoring of patients with shock (OPENING SOON)

Professor Olfa HAMZAOUI

# Merci !



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