Webinar Réanimation

14 Novembre 2017

Monitorage hémodynamique par échocardiographie : où en sommes nous en 2017?

P. Vignon

Réanimation Polyvalente ; CIC 1435 - CHU Limoges

CHU Centre hospitalier universitaire Limoges

CIC LIMOGES CENTRE INVESTIGATION CLINIQUE

Instituts thématiques Inserm Institut national de la santé et de la recherche médicale

Monitorage hémodynamique

MOYENS

- Baisse d'utilisation du cathétérisme droit
- Diffusion des méthodes moins invasives (débit cardiaque, index dynamique de réponse au remplissage vasculaire) : thermodilution transpulmonaire…
- Développement de l'échocardiographie en réanimation.

INDICATIONS

- S'adresse aux patients sévères et instables
- Identification du mécanisme (principal) de la défaillance circulatoire (évolutif)
- Suivi des effets et de la tolérance des interventions thérapeutiques
- (Détection précoce des événements hémodynamiques).

Vincent *et al. Critical Care* 2011, **15**:229
http://ccforum.com/content/15/4/229

CRITICAL CARE

REVIEW

Clinical review: Update on hemodynamic monitoring - a consensus of 16

Jean-Louis Vincent[1]*, Andrew Rhodes[2], Azriel Perel[3], Greg S Martin[4], Giorgio Della Rocca[5], Benoit Vallet[6], Michael R Pinsky[7], Christoph K Hofer[8], Jean-Louis Teboul[9], Willem-Pieter de Boode[10], Sabino Scolletta[11], Antoine Vieillard-Baron[12], Daniel De Backer[1], Keith R Walley[13], Marco Maggiorini[14] and Mervyn Singer[15]

Table 2. The key properties of an 'ideal' hemodynamic monitoring system

Provides measurement of relevant variables
Provides accurate and reproducible measurements
Provides interpretable data
Is easy to use
Is readily available
Is operator-independent
Has a rapid response-time
Causes no harm
Is cost-effective
Should provide information that is able to guide therapy

Echocardiographie : plus qu'un outil diagnostique ponctuel

Permet le monitorage hémodynamique (discontinu)

Critical Care Echocardiography (CCE)

CHEST Consensus Statement

American College of Chest Physicians/ La Société de Réanimation de Langue Française Statement on Competence in Critical Care Ultrasonography*

CCE

CCE is performed and interpreted by the intensivist at the bedside to establish diagnoses and to guide therapy of patients with cardiopulmonary compromise. This part of the document defines the elements of echocardiography that are required to achieve competence in CCE.

Chest 2009;135:1050-60

Critical care echocardiography	Conventional echocardiography
Main indications: cardiopulmonary compromise	Main indications: cardiopathies
Performed at the bedside by the ICU physician	Performed in the Cardiology laboratory by the sonographer
On-line interpretation by the ICU physician	Off-line interpretation by the Cardiologist
Interpretation in light of the Critical Care Medicine background of the physician	Interpretation in light of the Cardiology background of the physician
Guide diagnostic work-up and invasive procedures	Expertise allows identification and interpretation of complex findings
Around-the-clock availability	Daytime schedule
Ventilated patients (heart-lung interactions)	Spontaneously breathing (out)patients
TEE frequently required and easy to perform	TTE is most commonly performed
Frequently goal-oriented examination	State-of-the-art exhaustive examination
Qualitative or quantitative evaluation using simple yet robust parameters	Quantitative assessment using all existing imaging tools
Immediate diagnostic / therapeutic impact	Delayed diagnostic / therapeutic impact
Monitoring tool / short term follow-up	Diagnostic tool / long term follow-up

Vignon P. In: Critical Care Ultrasound. P Lumb and D Karakitsos (Eds). Elsevier 2014

Formation spécifique

2009

CHEST Consensus Statement

American College of Chest Physicians/ La Société de Réanimation de Langue Française Statement on Competence in Critical Care Ultrasonography*

Paul H. Mayo, MD; Yannick Beaulieu, MD; Peter Doelken, MD; David Feller-Kopman, MD; Christopher Harrod, MS; Adolfo Kaplan, MD; John Oropello, MD; Antoine Vieillard-Baron, MD; Olivier Axler, MD; Daniel Lichtenstein, MD; Eric Maury, MD; Michel Slama, MD; and Philippe Vignon, MD

Intensive Care Med (2011) 37:1077–1083
DOI 10.1007/s00134-011-2246-9

EXPERT PANEL

2011

Expert Round Table on Ultrasound in ICU

International expert statement on training standards for critical care ultrasonography

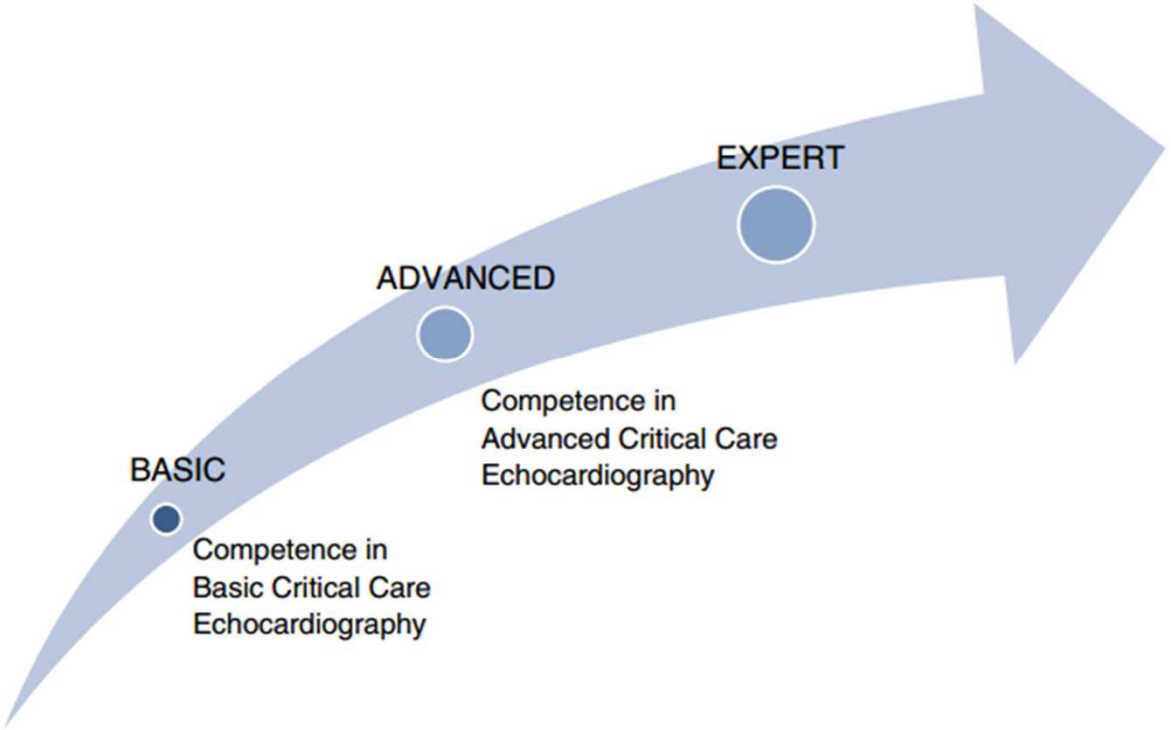
Intensive Care Med (2014) 40:654–666
DOI 10.1007/s00134-014-3228-5

CONFERENCE REPORTS AND EXPERT PANEL

2014

Expert Round Table on Echocardiography in ICU

International consensus statement on training standards for advanced critical care echocardiography



BASIQUE

- Privilégie la spécificité
- Appel référent « facile »
- Principalement transthoracique (ETT)

AVANCE

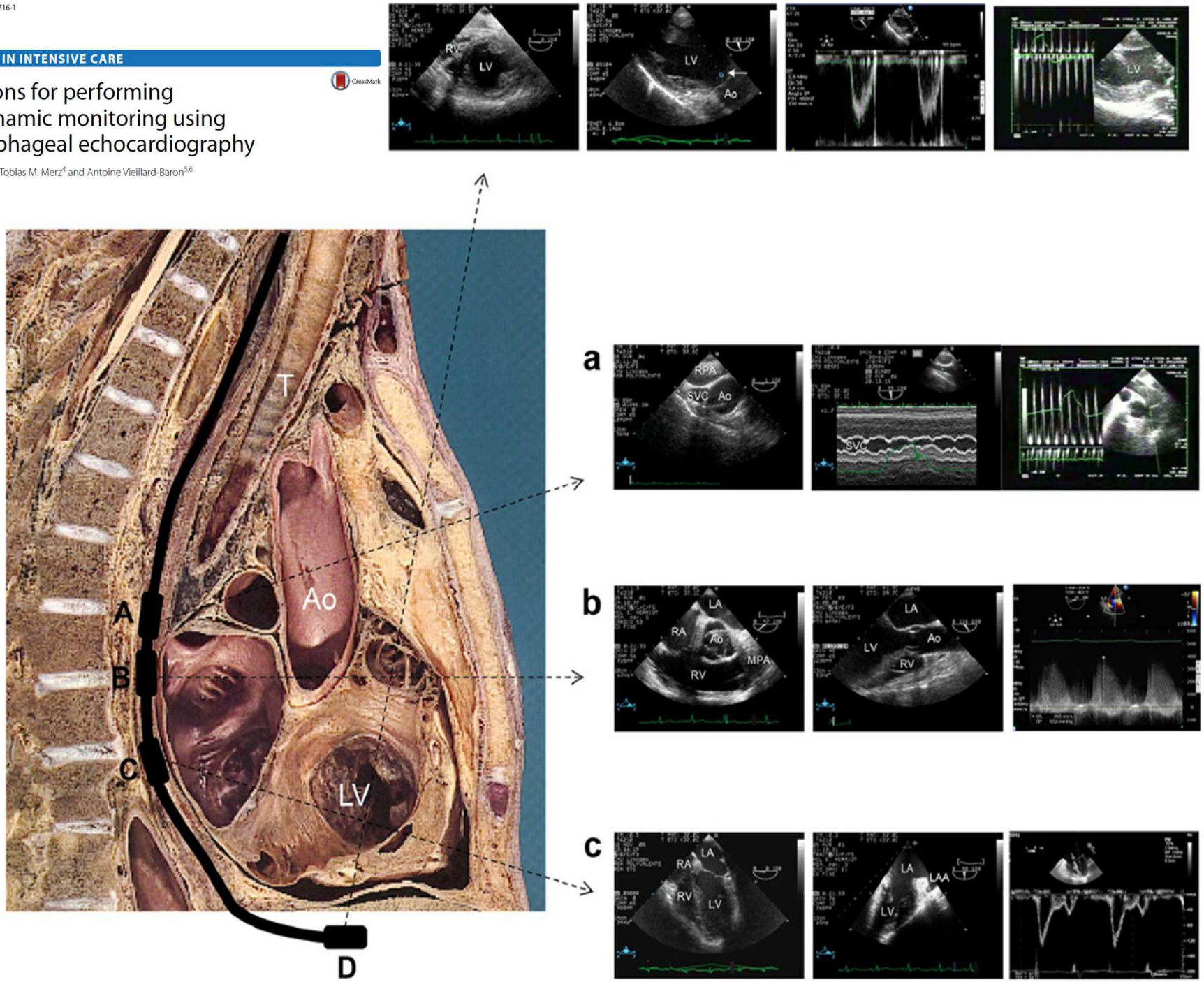
- Autonomie pour la gestion de la défaillance circulatoire et/ou respiratoire
- Toutes les modalités, y compris transoesophagienne (ETO)

Intensive Care Med
DOI 10.1007/s00134-017-4716-1

WHAT'S NEW IN INTENSIVE CARE

Ten reasons for performing hemodynamic monitoring using transesophageal echocardiography

Philippe Vignon[1,2,3*], Tobias M. Merz[4] and Antoine Vieillard-Baron[5,6]

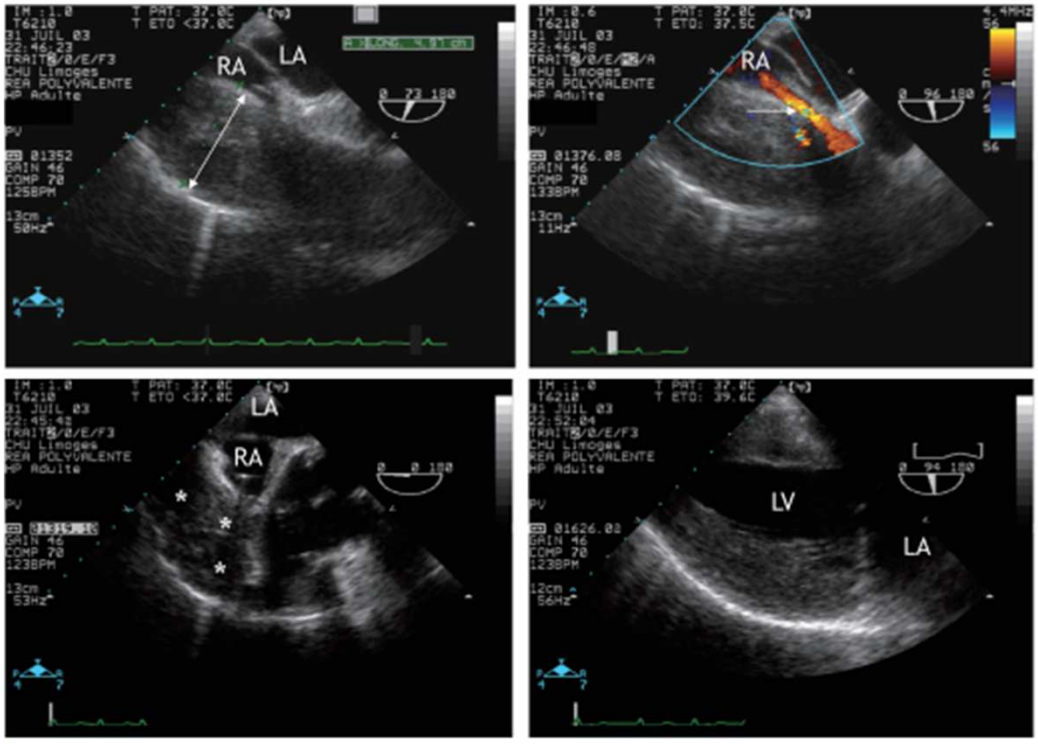


Ann Thorac Cardiovasc Surg 2012; 18: 524–529 doi: 10.5761/atcs.oa.11.01855

Original Article

Localized Cardiac Tamponade after Open-Heart Surgery

Anna Grumann,[1] Leonel Baretto,[1] Anthony Dugard,[1,2] Pierre Morera,[3,4] Elisabeth Cornu,[3,4] Jean-Bernard Amiel,[1,2] and Pr Philippe Vignon[1,2,3]



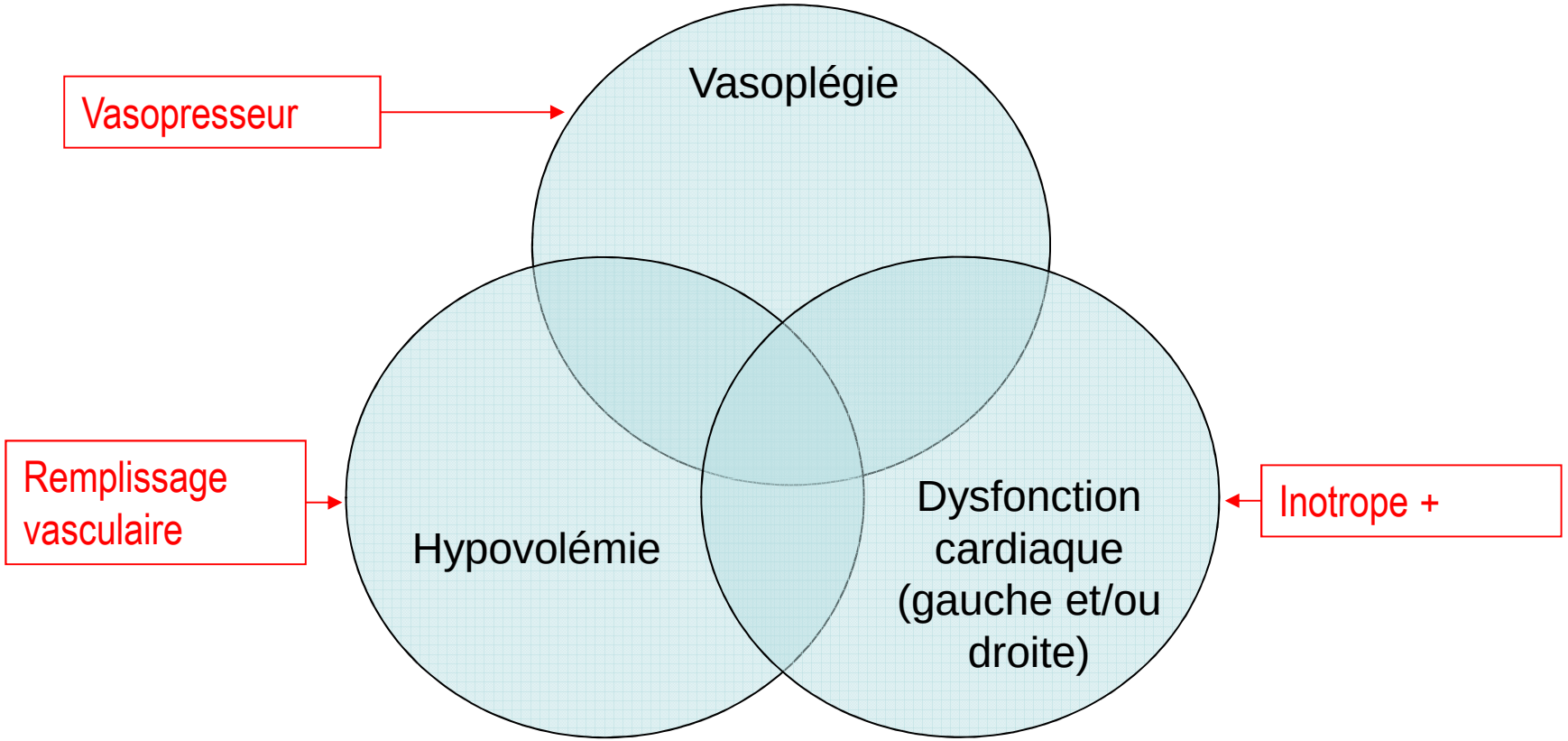
Mécanisme prédominant ?

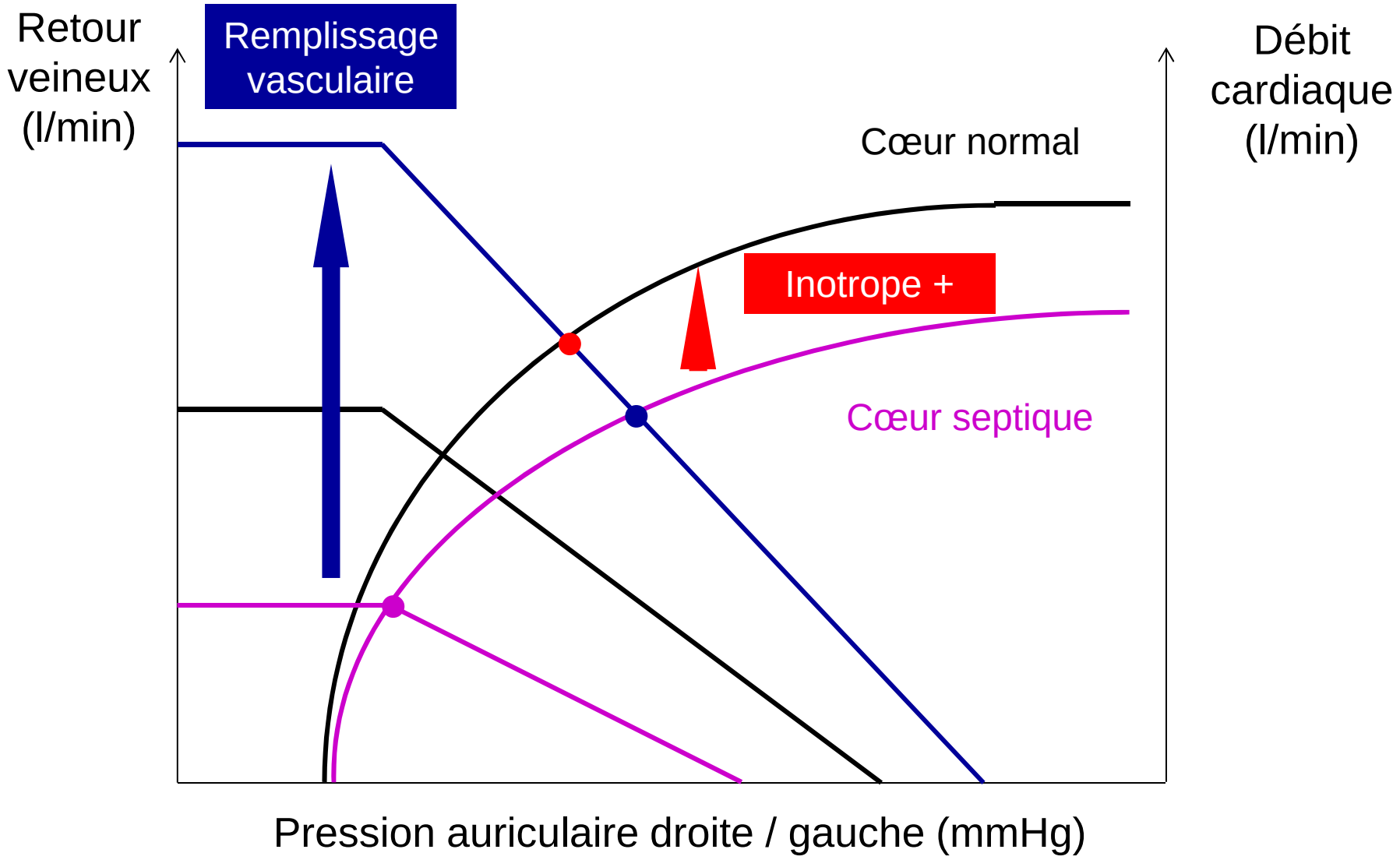
Evolution au cours du temps ?

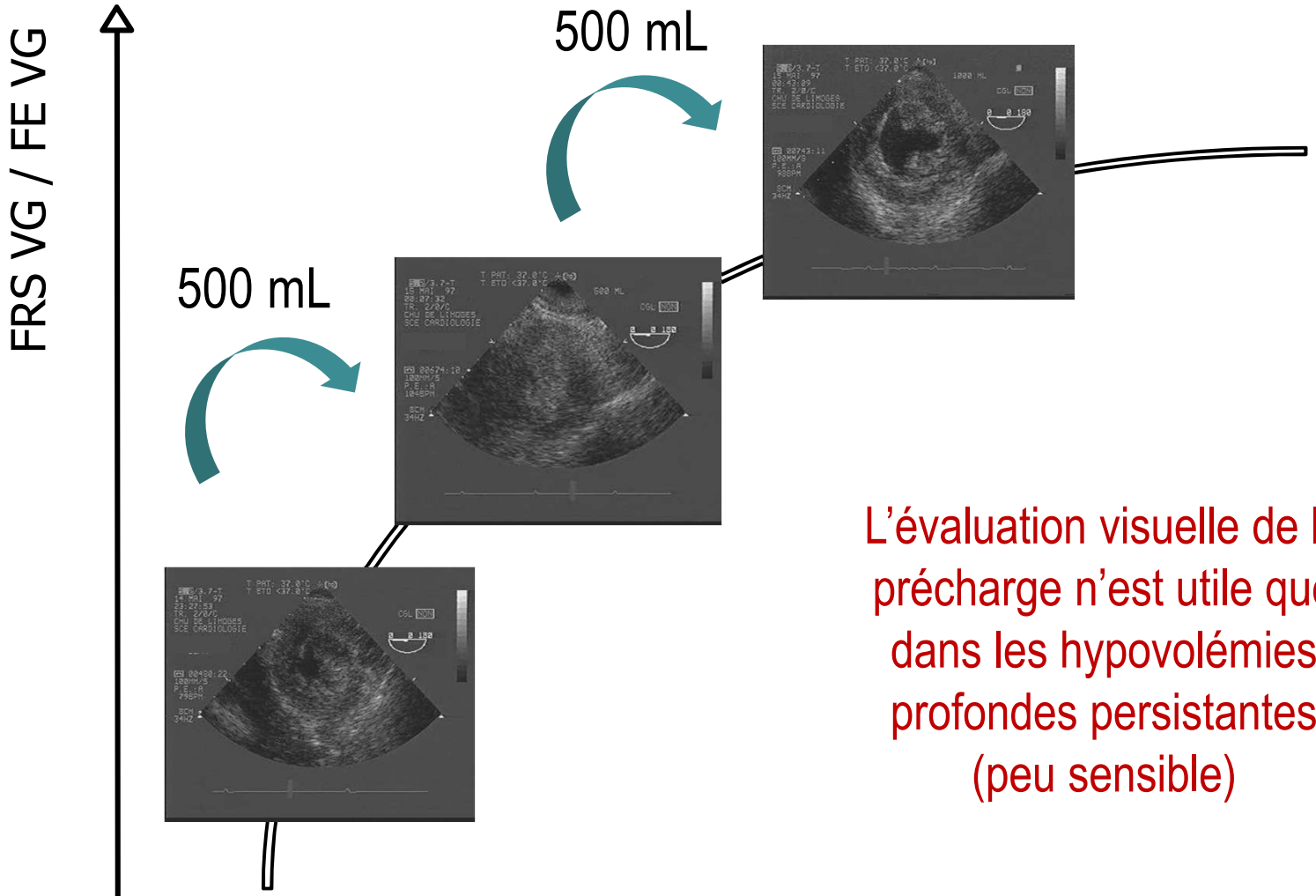
→

Quelle évaluation ?

Quel monitoring ?

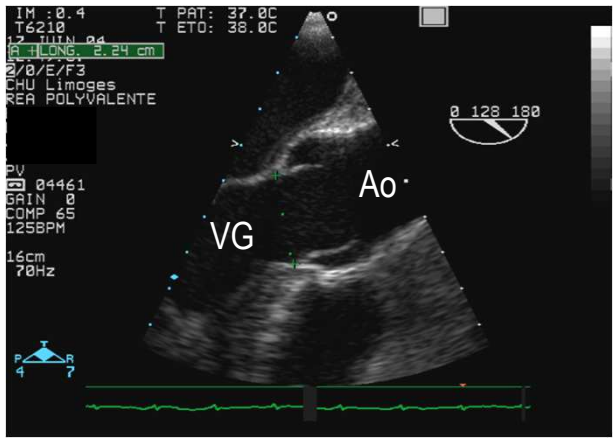


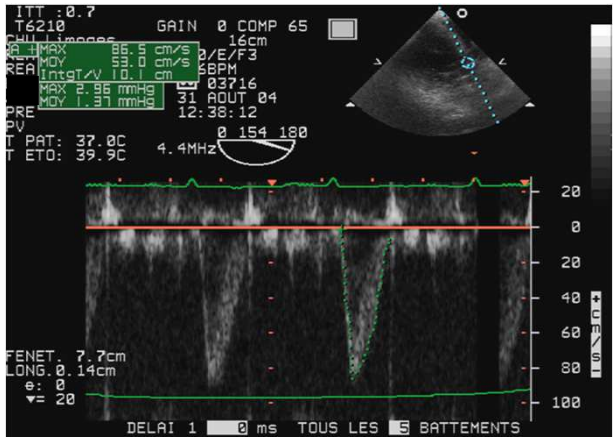

Retour veineux (l/min)
Remplissage vasculaire
Débit cardiaque (l/min)
Cœur normal
Inotrope +
Cœur septique
Pression auriculaire droite / gauche (mmHg)



L'évaluation visuelle de la précharge n'est utile que dans les hypovolémies profondes persistantes (peu sensible)

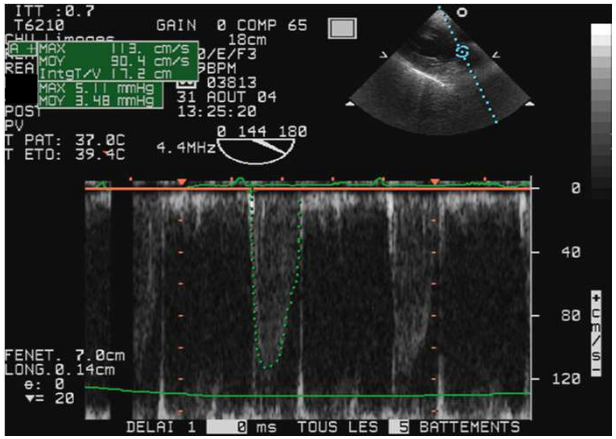
Situation basale





VES du VG : 40 mL

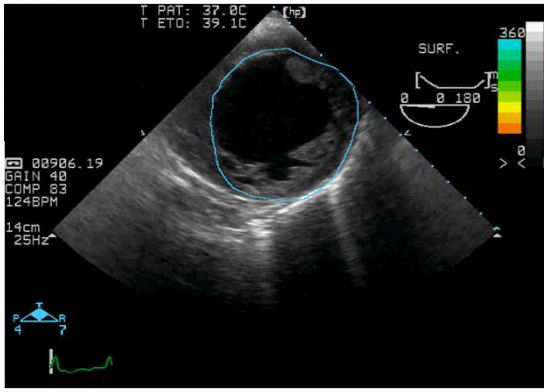
Après épreuve de remplissage

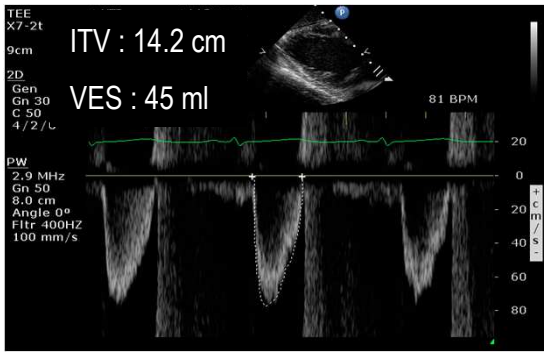


VES du VG : 68 mL

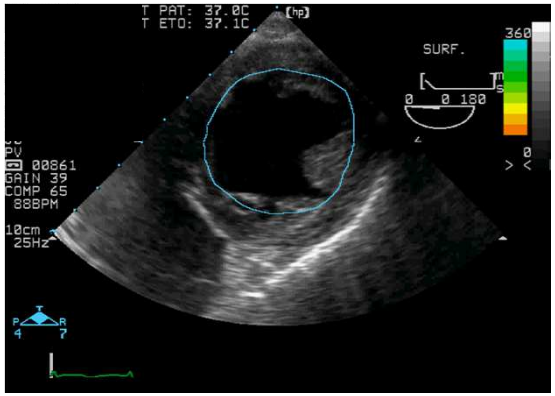
Répondeur : augmentation du débit cardiaque (ITV aortique) > 10 à 15% après remplissage vasculaire

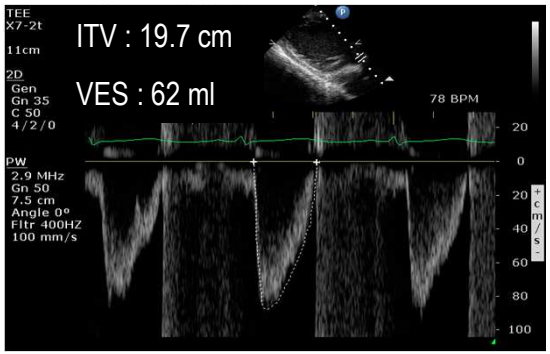
Monitorage débit cardiaque / VES





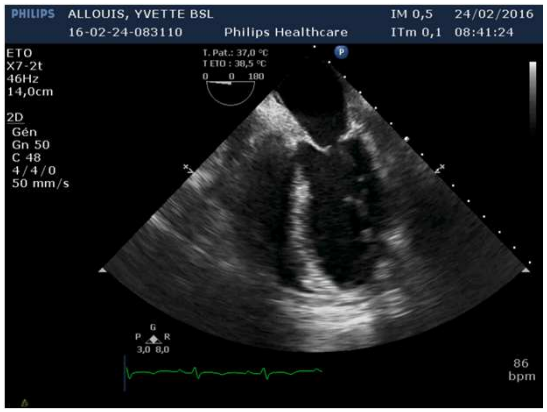
Inotrope +



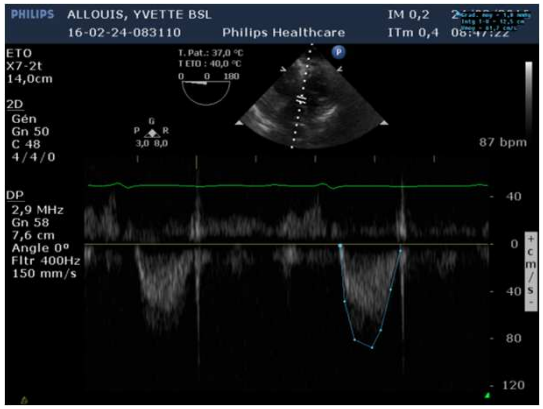


H0

BSL 8:41

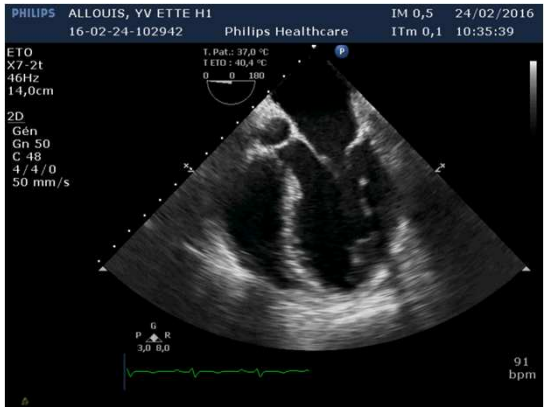


VES = 40 mL

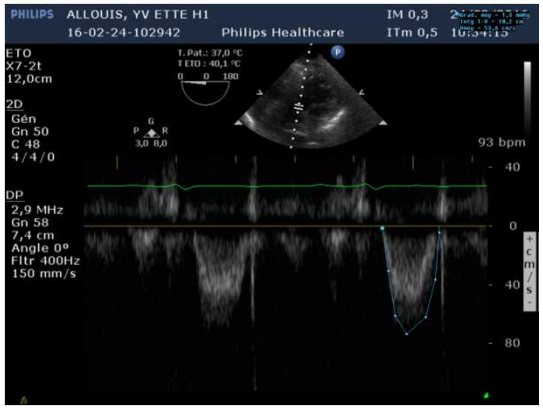


H2

NAD 10:35

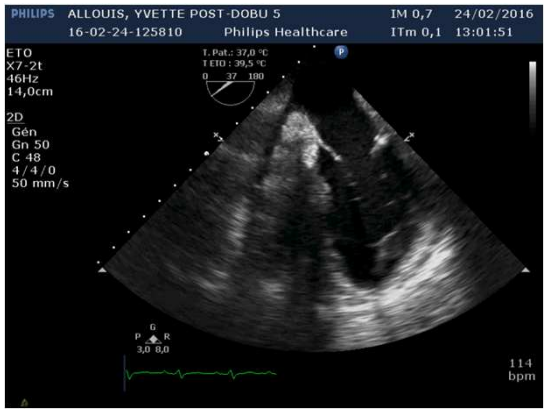


VES = 33 mL

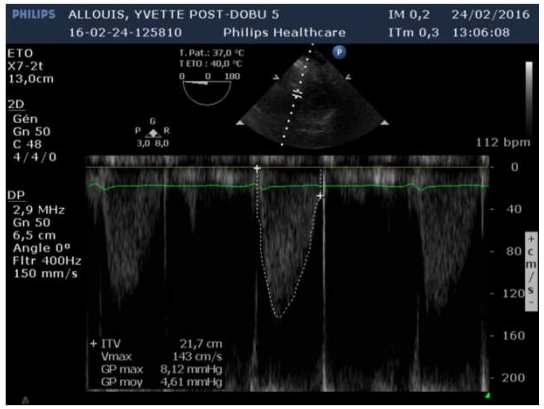


H4-5

NAD + DOBU 5µ 13:01



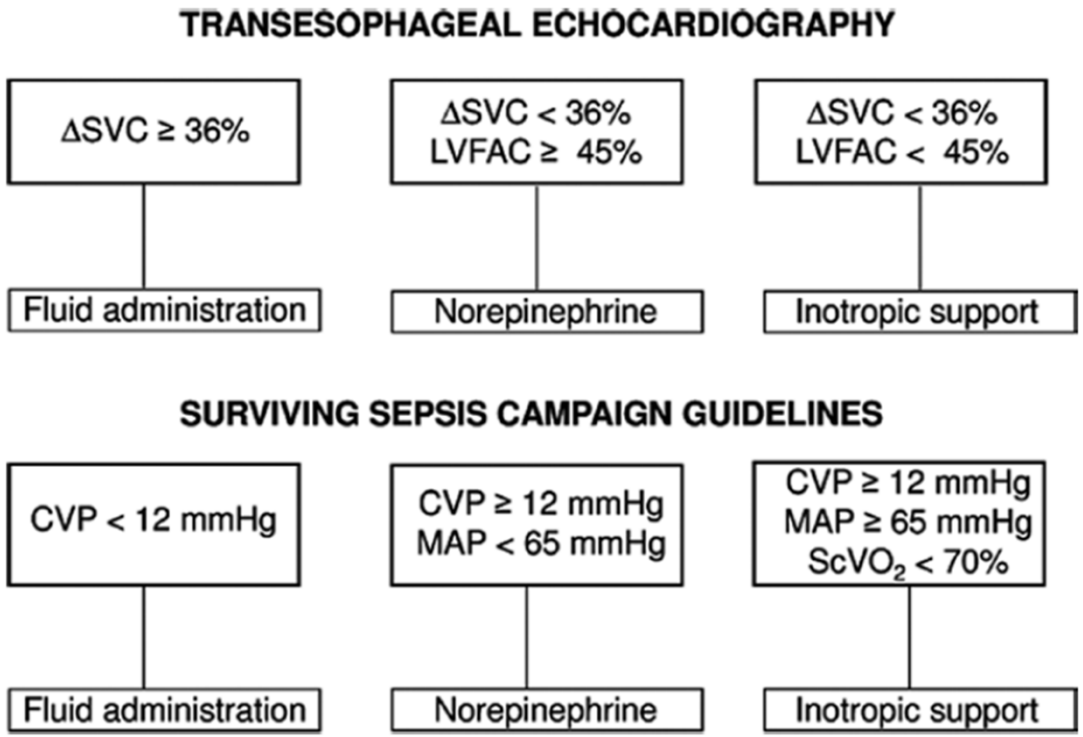
VES = 68 mL



Initial resuscitation guided by the Surviving Sepsis Campaign recommendations and early echocardiographic assessment of hemodynamics in intensive care unit septic patients: A pilot study

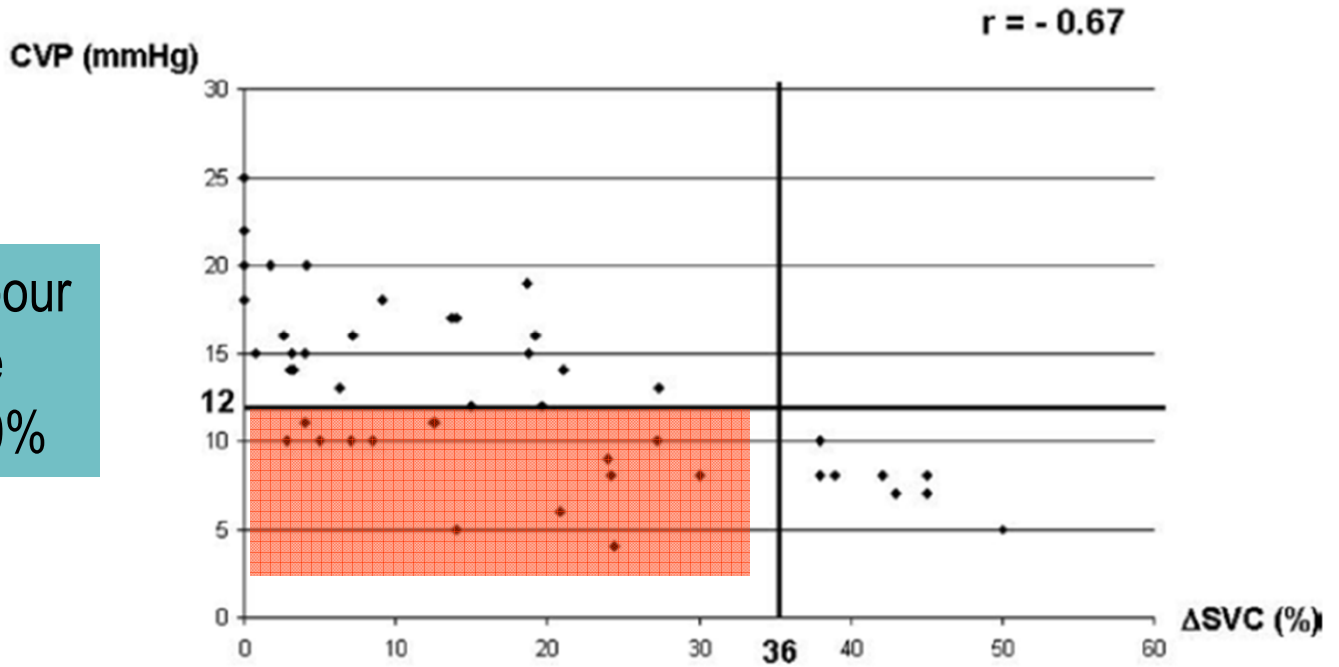
Koceila Bouferrache, MD; Jean-Bernard Amiel, MD; Loïc Chimot, MD; Vincent Caille, MD; Cyril Charron, MD; Philippe Vignon, MD, PhD: Antoine Vieillard-Baron, MD, PhD

- 46 patients ventilés en choc septique
- Prise en charge initiale (6 h)
- ETO vs SSC

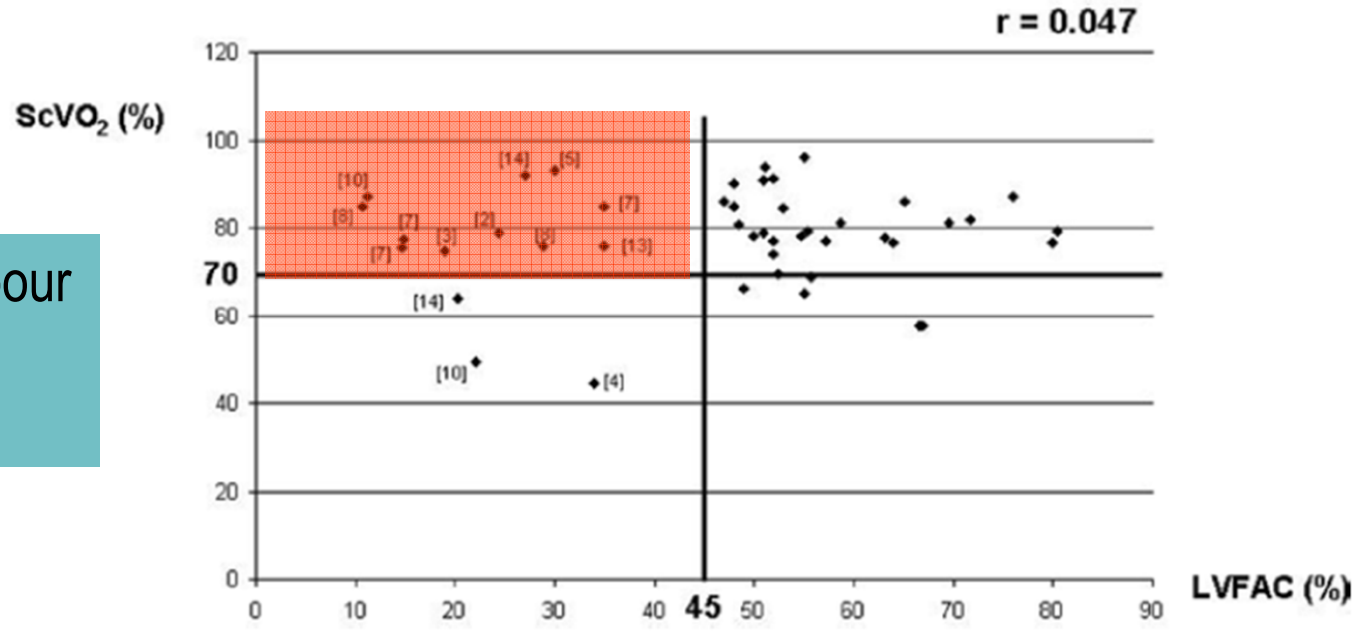


Crit Care Med 2012 ; 40 : 2821-7

Discordance pour le remplissage vasculaire : 70%



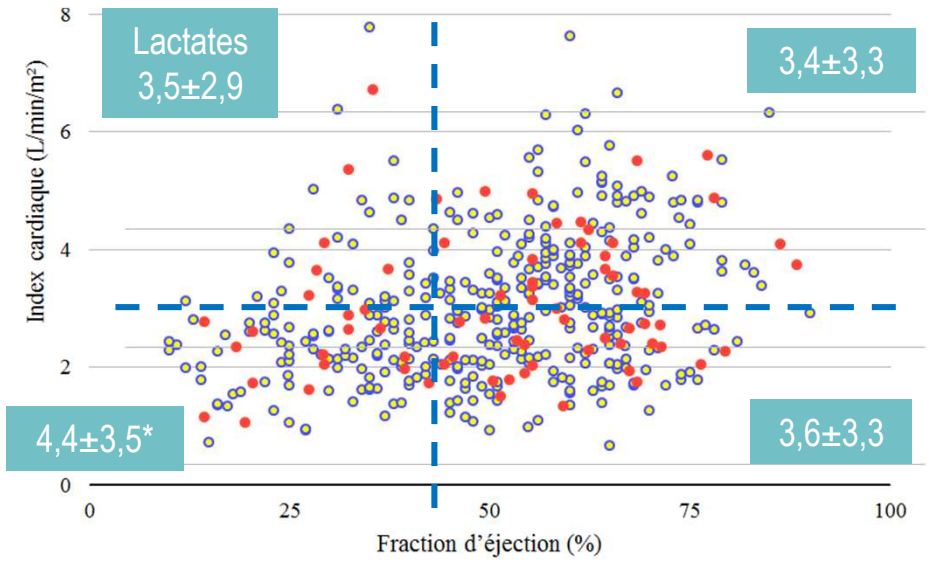
Discordance pour les inotropes positifs : 29%



Profil hémodynamique : ETO vs. monitorage 1ère ligne

465 patients ventilés en choc septique évalués par ETO

- $ScvO_2$ < 70%



		FE < 40%	FE ≥ 40%
IC ≥ 3 L/min/m²	n (%)	27 (7%)	146 (38%)
	PAm (mmHg) / FC (bpm)	82 ± 15 / 119 ± 26	76 ± 16 / 114 ± 20
	PVC (mmHg) / ScvO2 (%)	10 ± 4 / 76 ± 13	10 ± 4 / 80 ± 10
IC < 3 L/min/m²	n (%)	74 (19%)	141 (36%)
	PAm (mmHg) / FC (bpm)	78 ± 16 / 108 ± 26	77 ± 17 / 96 ± 23
	PVC (mmHg) / ScvO2 (%)	11 ± 5 / 76 ± 11	10 ± 5 / 76 ± 11

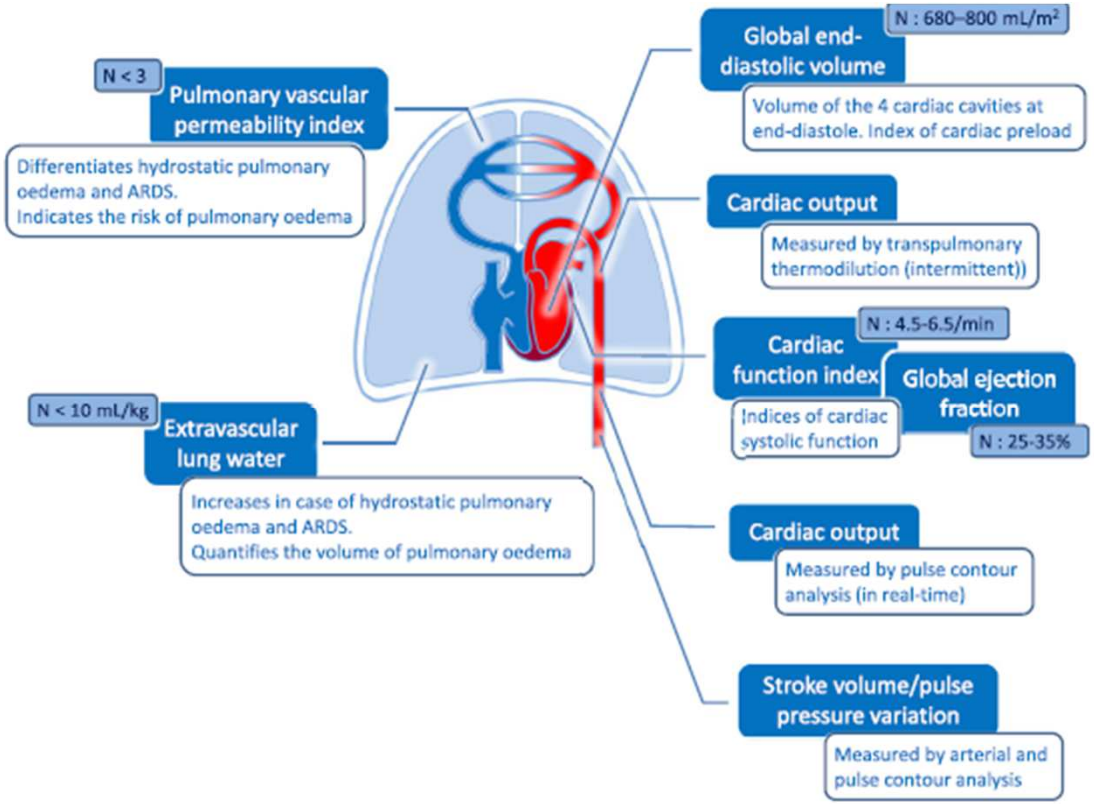
Monnet and Teboul *Critical Care* (2017) 21:147
DOI 10.1186/s13054-017-1739-5

Critical Care

REVIEW Open Access

Transpulmonary thermodilution: advantages and limits

Xavier Monnet[1,2,3*] and Jean-Louis Teboul[1,2]



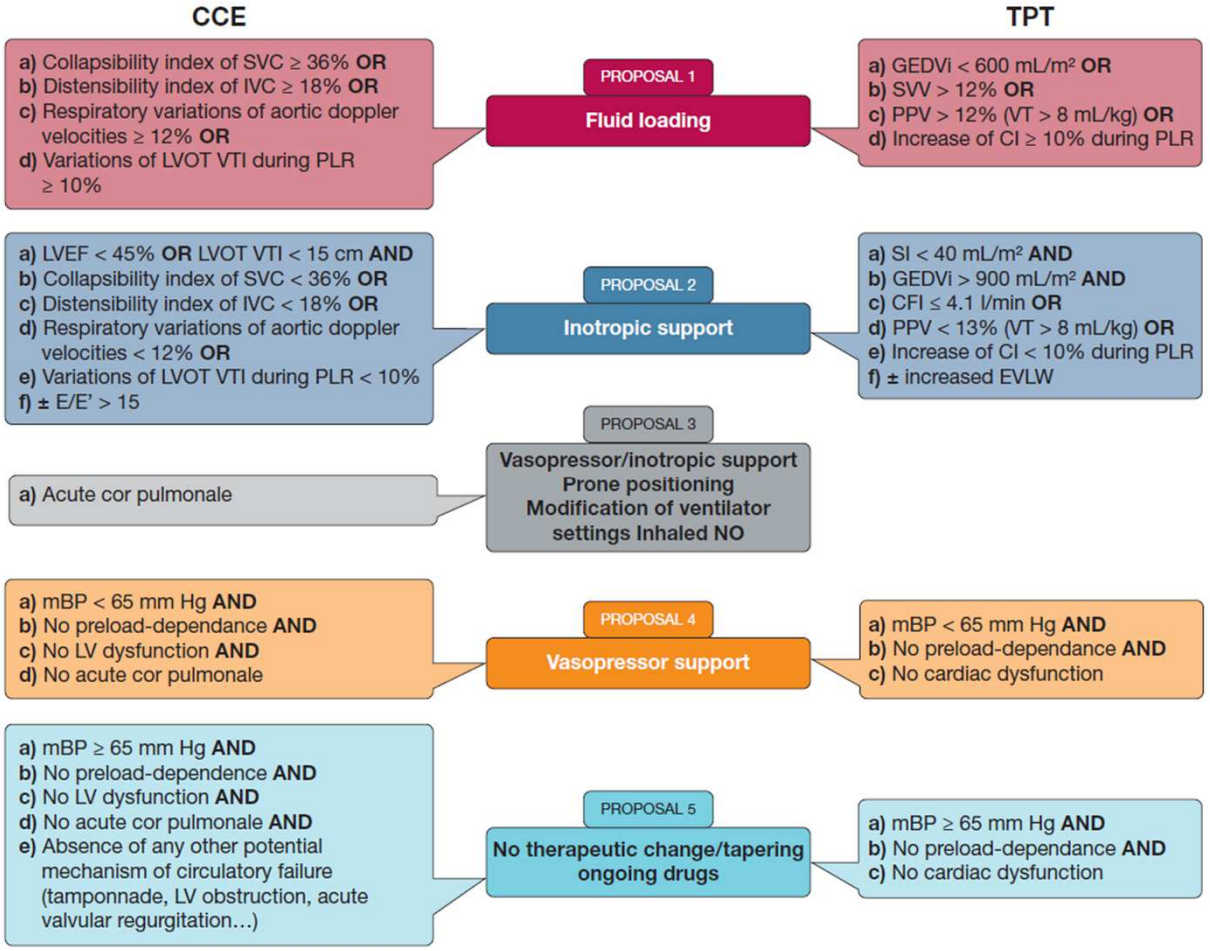
- Pas opérateur-dépendant
- Mesures du DC en continu (recalibrations)
- Peu invasif
- Utilise les voies d'abord en place (KTA spécifique)

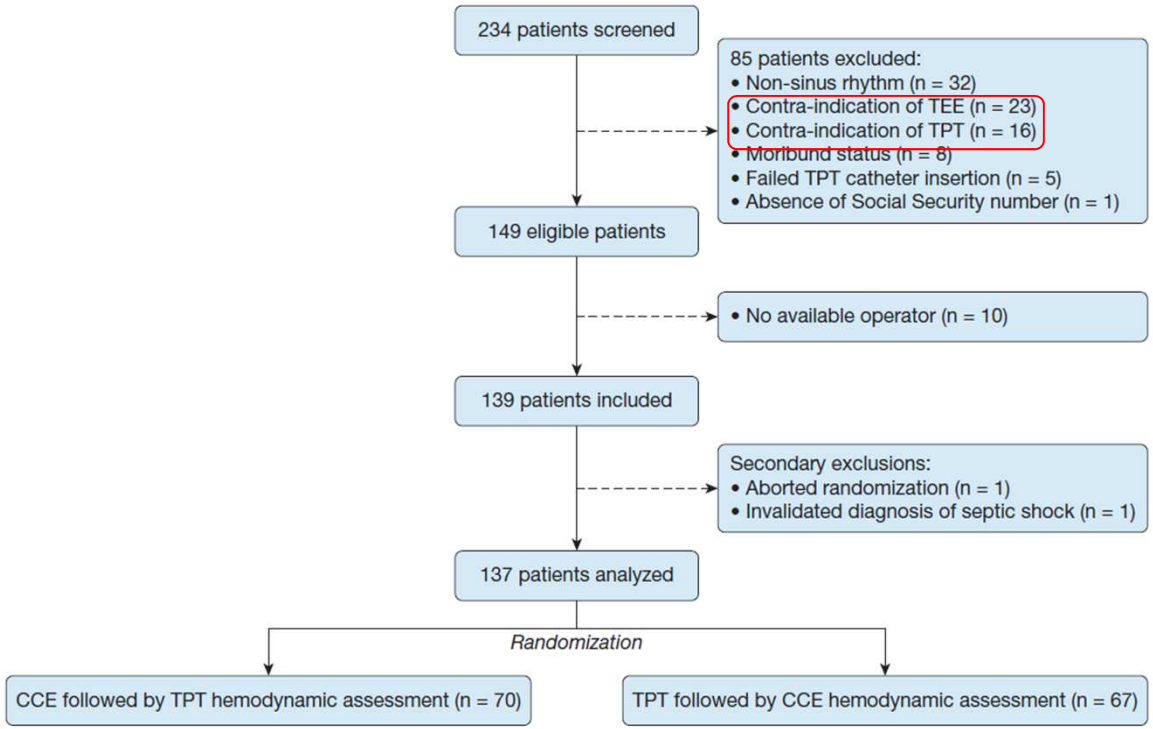
CHEST

Hemodynamic Assessment of Patients With Septic Shock Using Transpulmonary Thermodilution and Critical Care Echocardiography

A Comparative Study

Philippe Vignon, MD, PhD; Emmanuelle Begot, MD; Arnaud Mari, MD; Stein Silva, MD; Loïc Chimot, MD; Pierre Delour, MD; Frédéric Vargas, MD, PhD; Bruno Filloux, MD; David Vandroux, MD; Julien Jabot, MD; Bruno François, MD; Nicolas Pichon, MD; Marc Clavel, MD; Bruno Levy, MD, PhD; Michel Slama, MD, PhD; and Béatrice Riu-Poulenc, MD





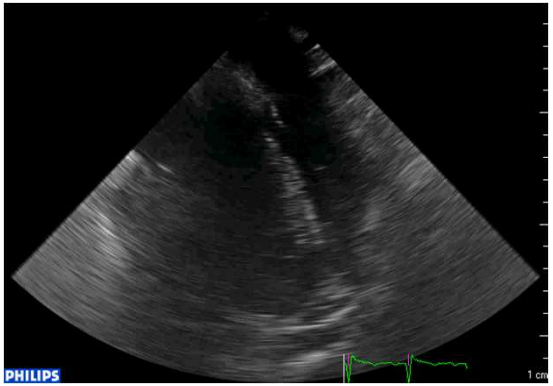
Agrément entre CCE et TDTP :

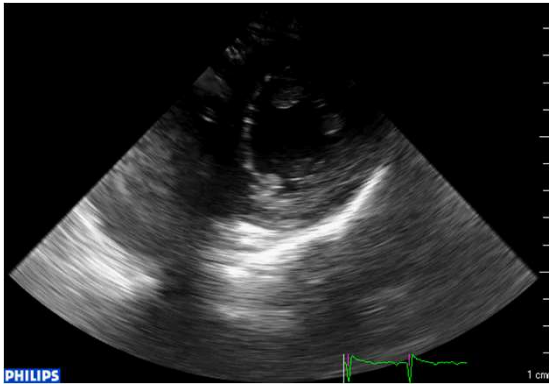
Temps réel : K = 0,48 (ICs 95% : 0,37-0,60)

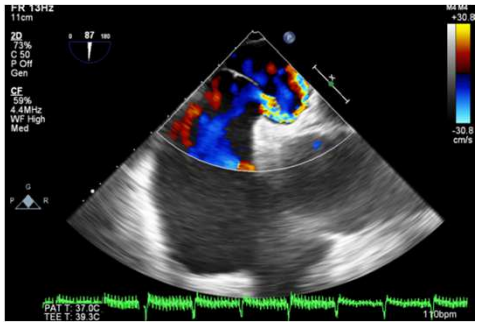
Experts : K = 0,66 (ICs 95% : 0,55-0,77)

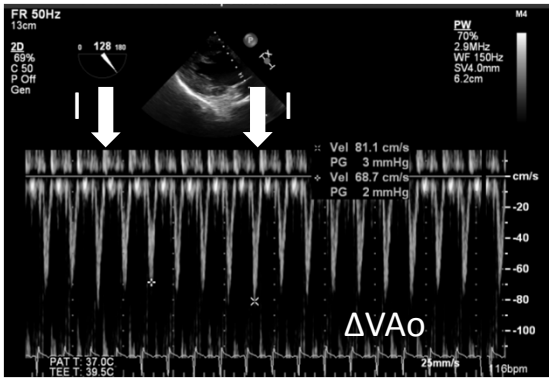
- ~ 10% de contre-indication
- Concordance : 2/3 cas
  - Fluides ~ 50%
  - Inotropes ~ 25%
- 22,5% de discordances persistantes avec experts
- CCE : source discordance chez 16 / 37 patients (dont 8 : cœur pulmonaire aigu).

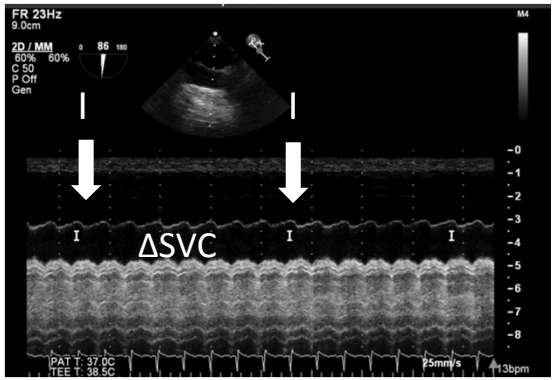
Faux positif de ΔPP : coeur pulmonaire aigu











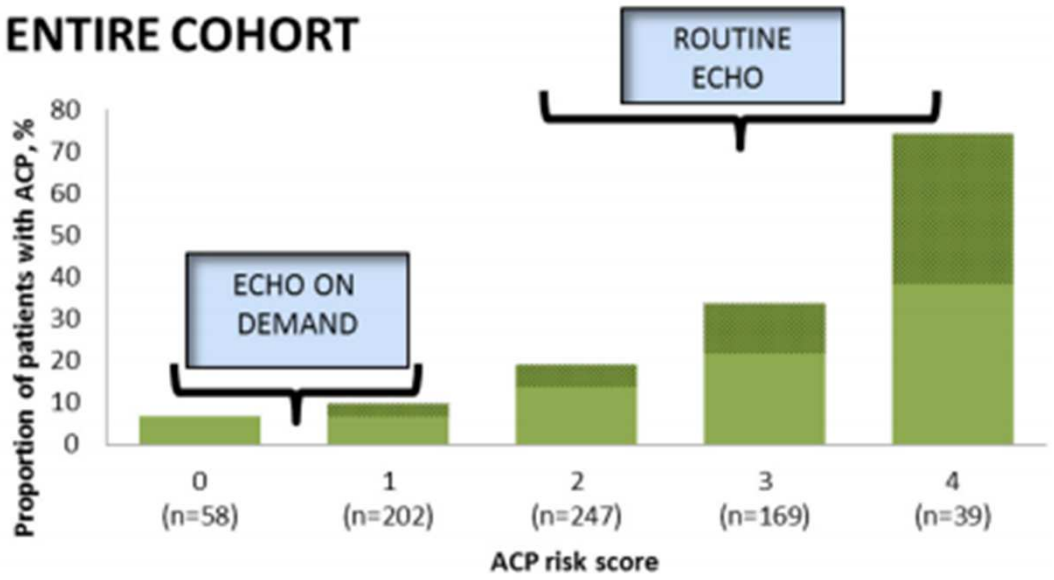
NO inhalé &
décubitus ventral

Intensive Care Med (2016) 42:862–870
DOI 10.1007/s00134-015-4141-2

SEVEN-DAY PROFILE PUBLICATION

Armand Mekontso Dessap
Florence Boissier
Cyril Charron
Emmanuelle Bégot
Xavier Repessé
Annick Legras
Christian Brun-Buisson
Philippe Vignon
Antoine Vieillard-Baron

Acute cor pulmonale during protective ventilation for acute respiratory distress syndrome: prevalence, predictors, and clinical impact



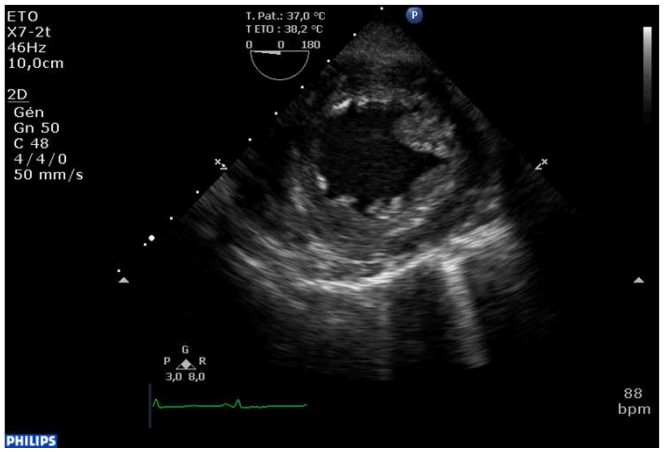
- 752 patients
- SDRA modéré à sévère (Berlin)
- 22% de cœur pulmonaire aigu (CPA)
- CPA sévère : facteur de risque de mortalité
- Score pour prédire CPA.

Table 3 The acute cor pulmonale risk score

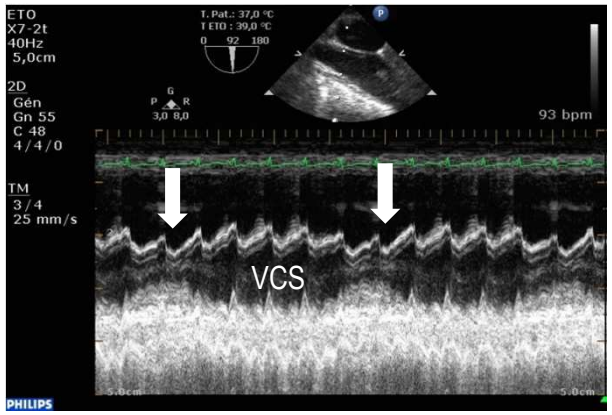
Parameter	Score
Pneumonia as cause of ARDS	1
Driving pressure ≥18 cmH_2O[a]	1
PaO_2/FiO_2 ratio <150 mmHg	1
$PaCO_2$ ≥48 mmHg	1
Total score	0–4

Cas clinique 1

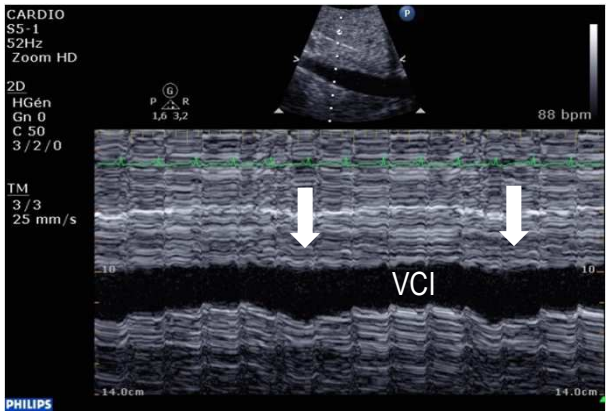
- Patiente de 58 ans ventilée pour choc septique sur pyélonéphrite avec obstacle
- HTA sous bêta-bloquant
- Remplissage vasculaire : 2 L ; Noradrénaline : 2,1 mg/h
- PAm : 70 mmHg ; FC : 90 bpm ; PVC : 11 mmHg
- Lactates : 4,3 mmol/L ; $ScvO_2$: 68%



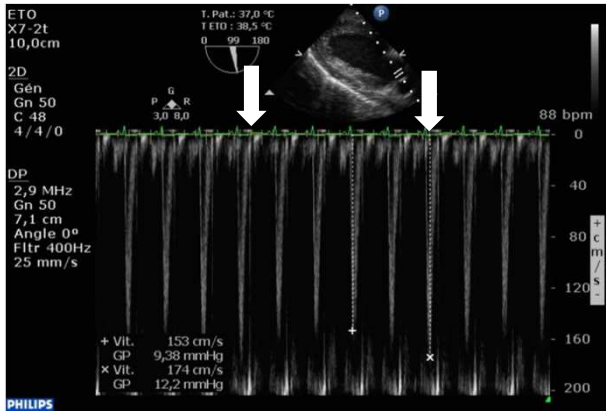
Veine cave supérieure



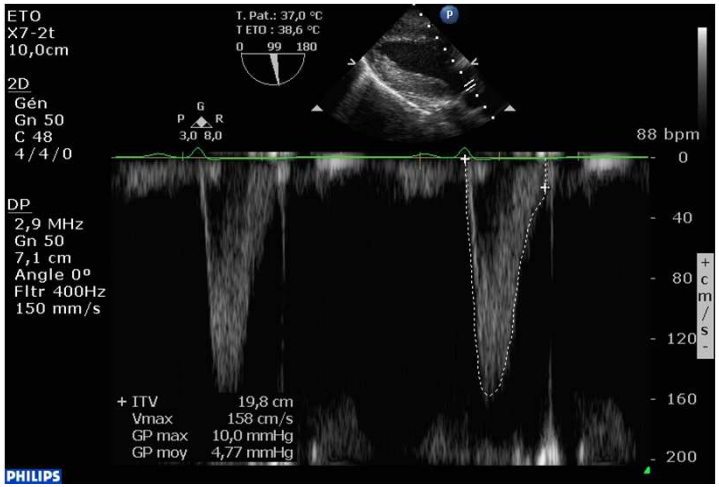
Veine cave inférieure



ITV aortique (CCVG)

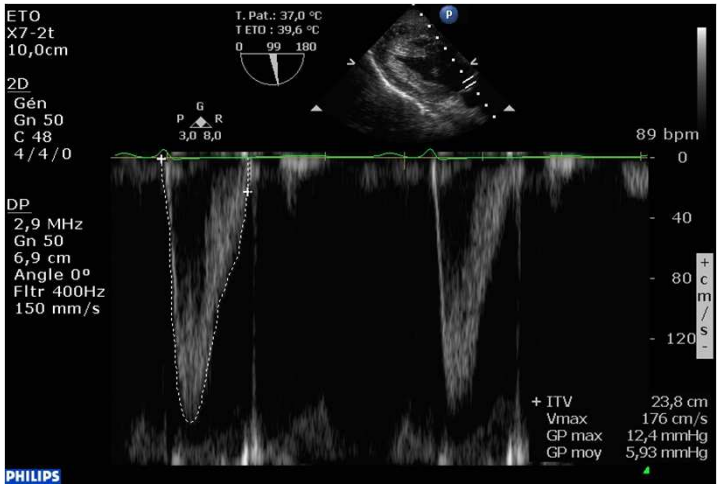


ITV : 19,8 cm



500 mL

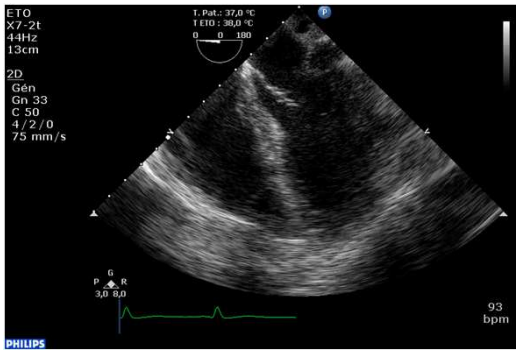
ITV : 23,8 cm

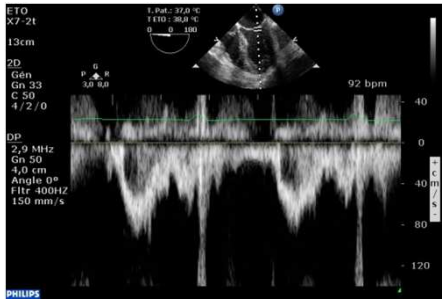


+ 20%

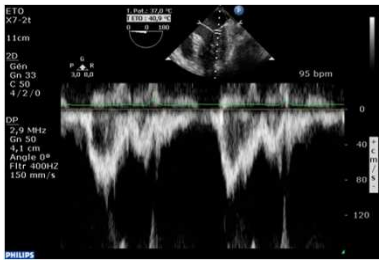
Cas clinique 2

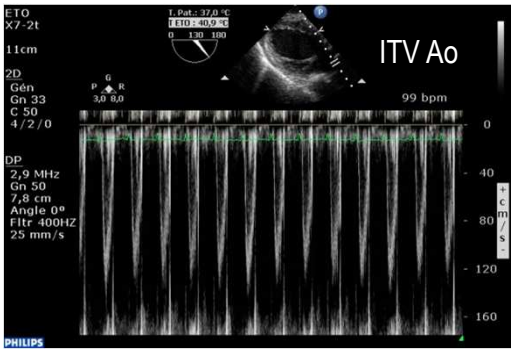
- Patiente de 36 ans sans ATCD ventilée pour choc septique sur abcès pelviens opérés
- Remplissage vasculaire : 2,5 L ; Noradrénaline : 2,8 mg/h
- Oligurie ; lactates : 4,6 mmol/L ; $ScvO_2$: 74% ; P/F : 340

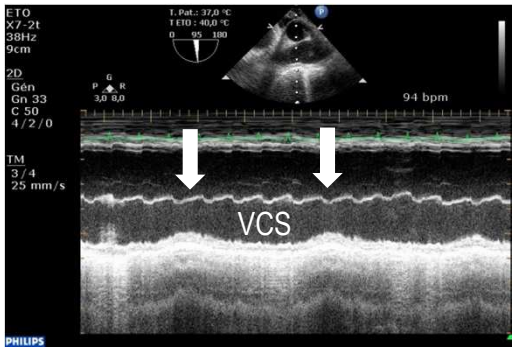


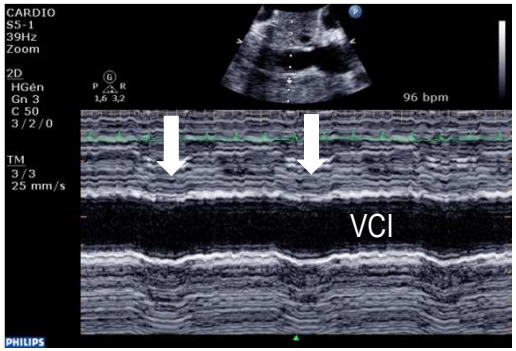


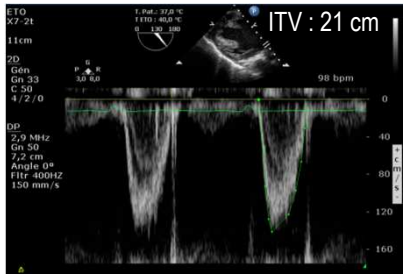
Post RV



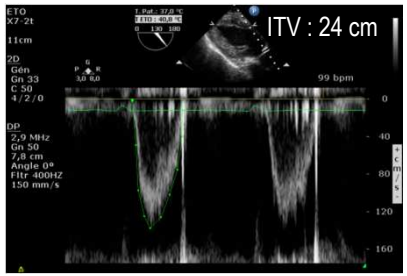




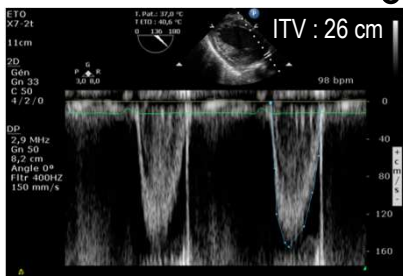




LJP 90°



500 mL

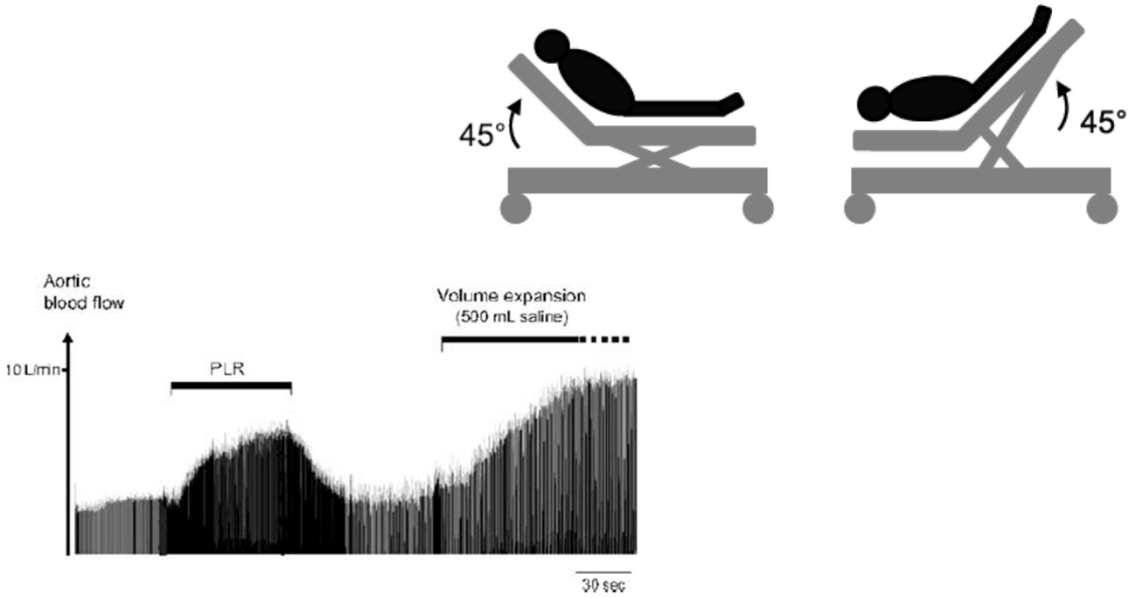


Intensive Care Med (2008) 34:659–663
DOI 10.1007/s00134-008-0994-y

CLINICAL COMMENTARY

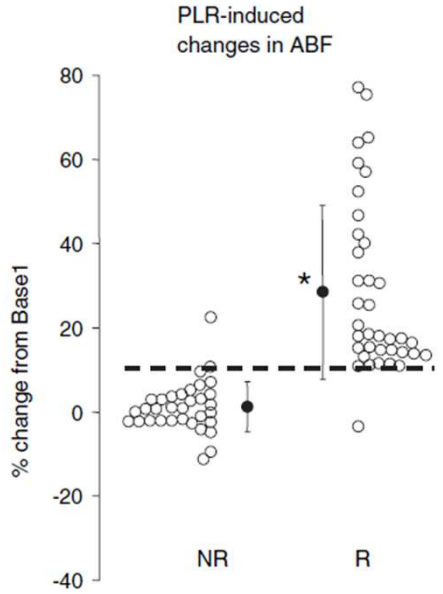
Xavier Monnet
Jean-Louis Teboul

Passive leg raising



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

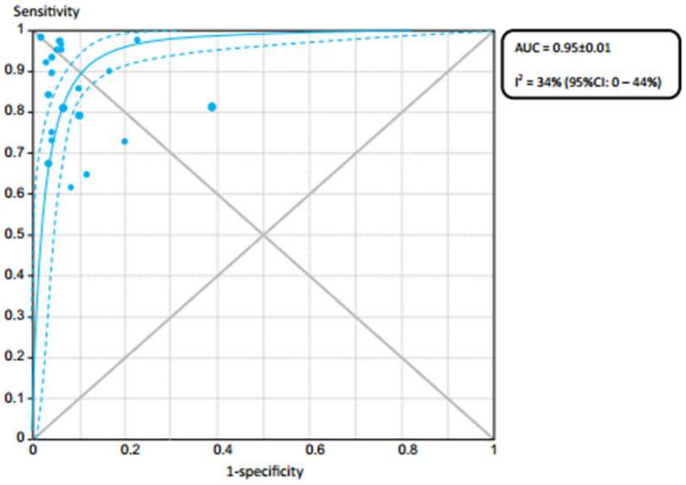


Intensive Care Med
DOI 10.1007/s00134-015-4134-1

ORIGINAL

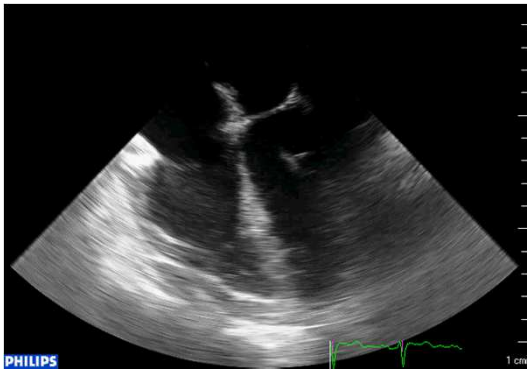
Xavier Monnet
Paul Marik
Jean-Louis Teboul

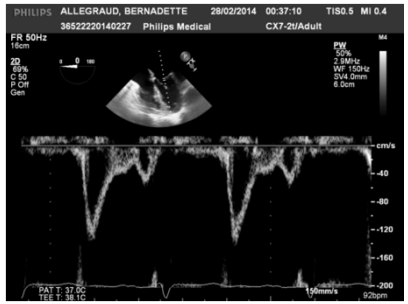
Passive leg raising for predicting fluid responsiveness: a systematic review and meta-analysis

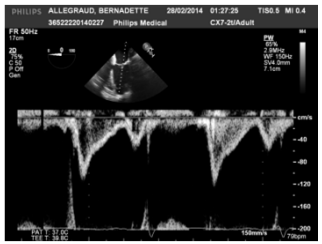


Cas clinique 3

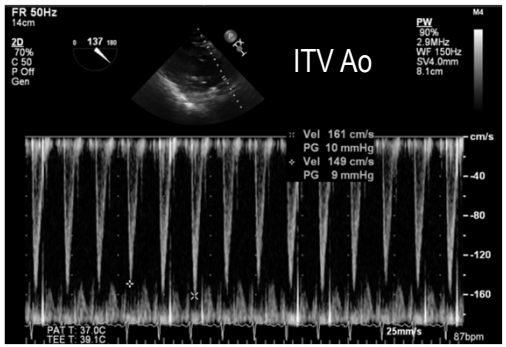
- Patient de 76 ans ventilé pour choc septique sur péritonite stercorale opérée
- Cardiopathie ischémique
- Remplissage vasculaire : 1,5 L ; Noradrénaline : 2,1 mg/h
- Oligurie ; lactates : 3,6 mmol/L ; $ScvO_2$: 66% ; P/F : 140

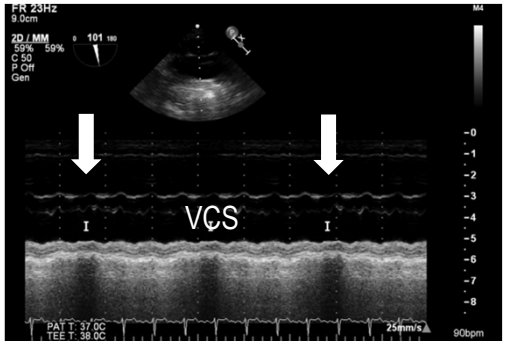


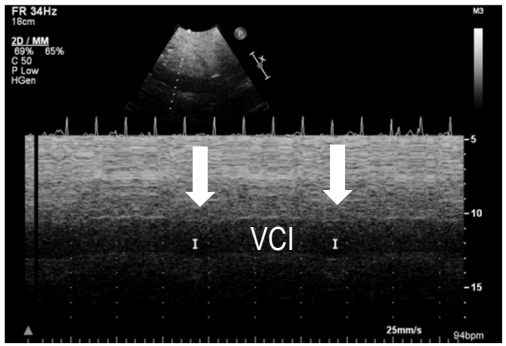


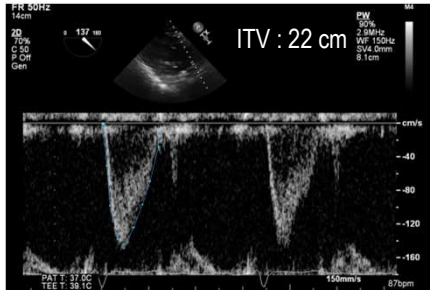


Post RV

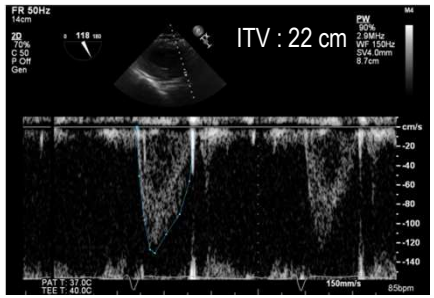




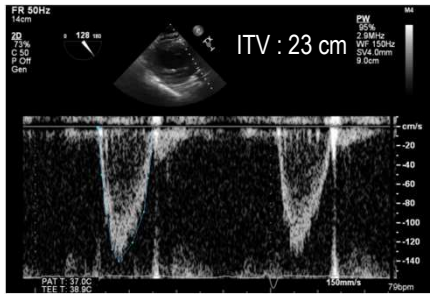




LJP 90°

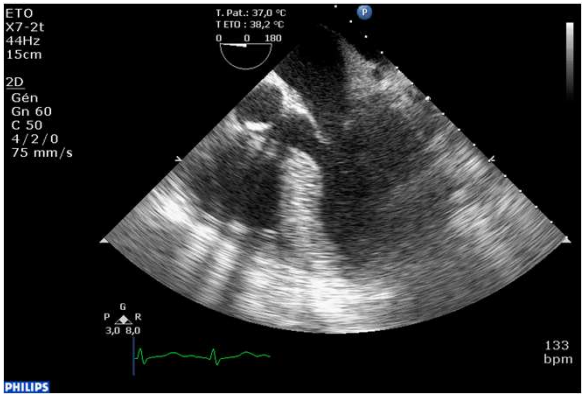


500 mL

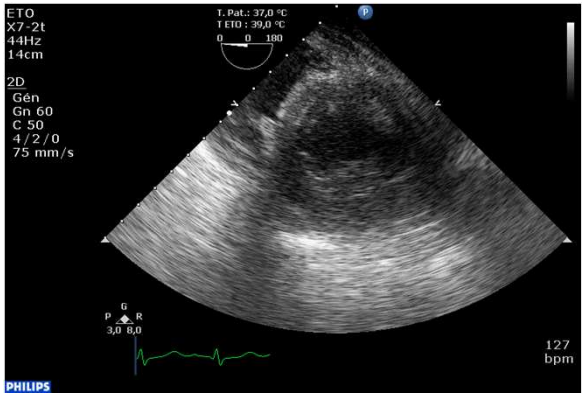


Cas clinique 4

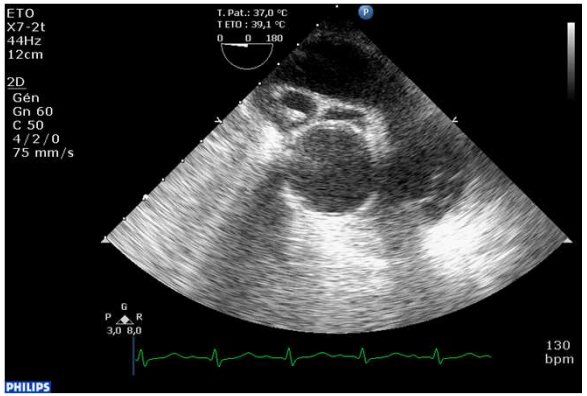
- Patiente de 72 ans ventilée pour choc septique sur angiocholite
- HTA
- Admise en Réanimation à la sortie du bloc opératoire
- Remplissage vasculaire : 2,5 L ; Noradrénaline : 3,1 mg/h
- Marbrures persistantes ; lactates : 5,6 mmol/L ; $ScvO_2$: 65% ; P/F : 260



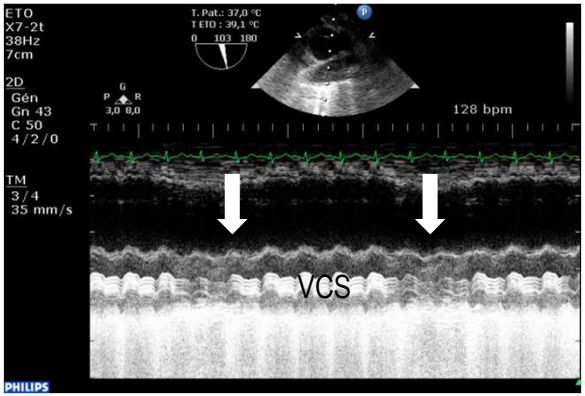
Veine cave supérieure

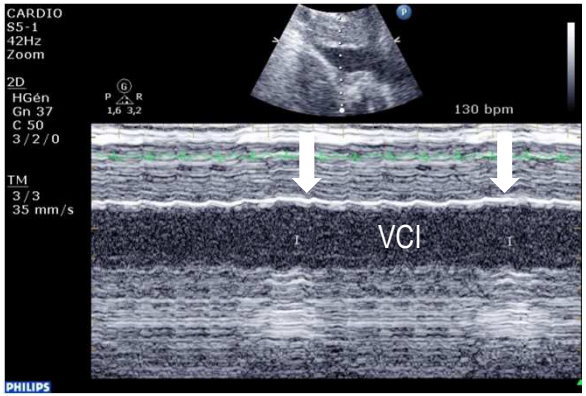


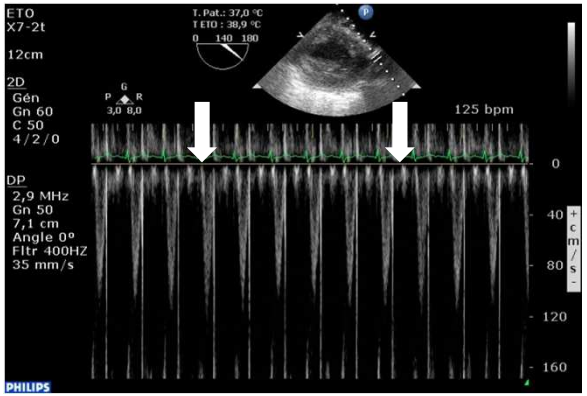
Veine cave inférieure



ITV aortique (CCVG)







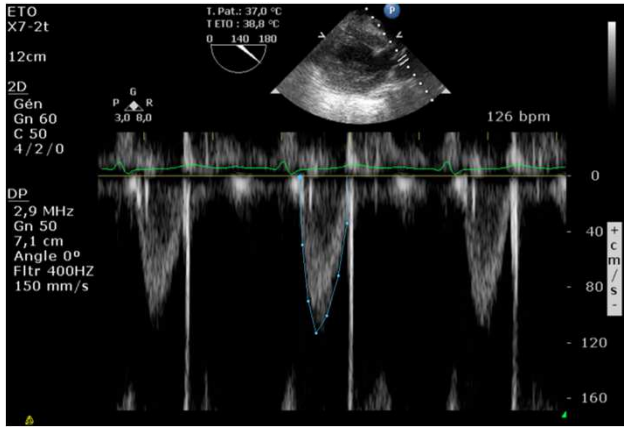
LJP

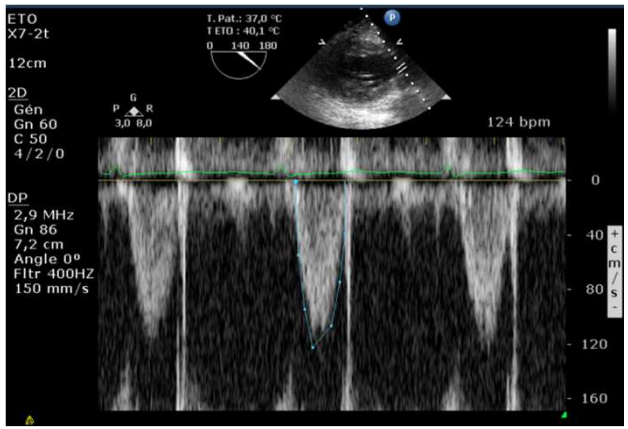
500 mL

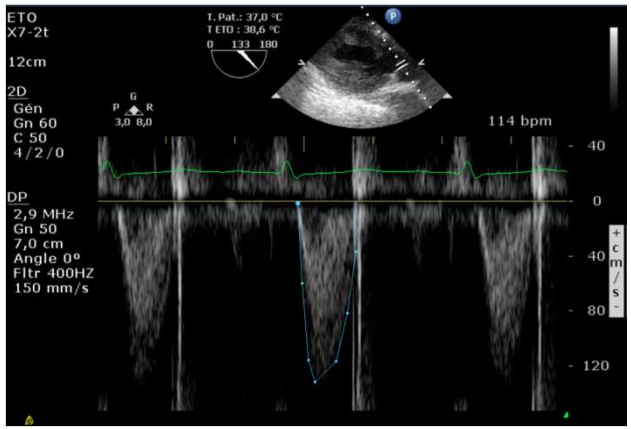
ITV : 11,4 cm

ITV : 13,4 cm

ITV : 16,7 cm





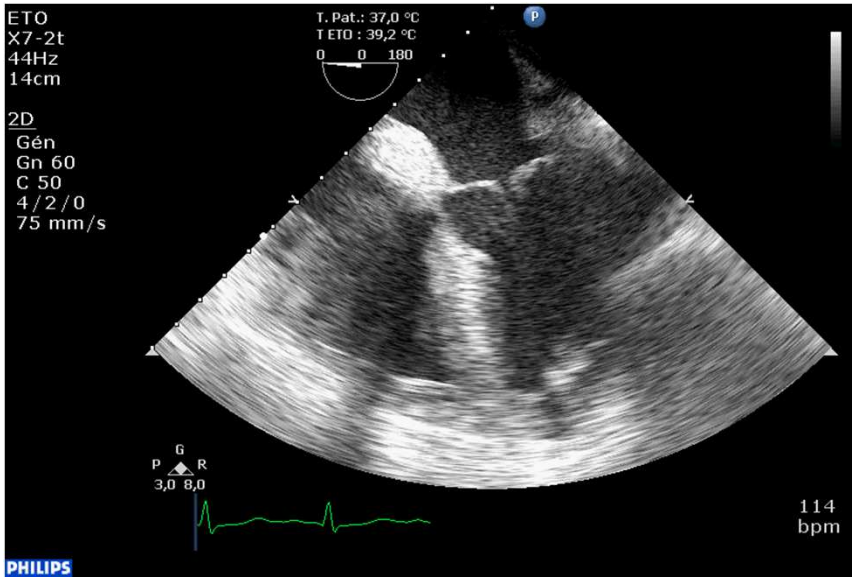


+ 18%

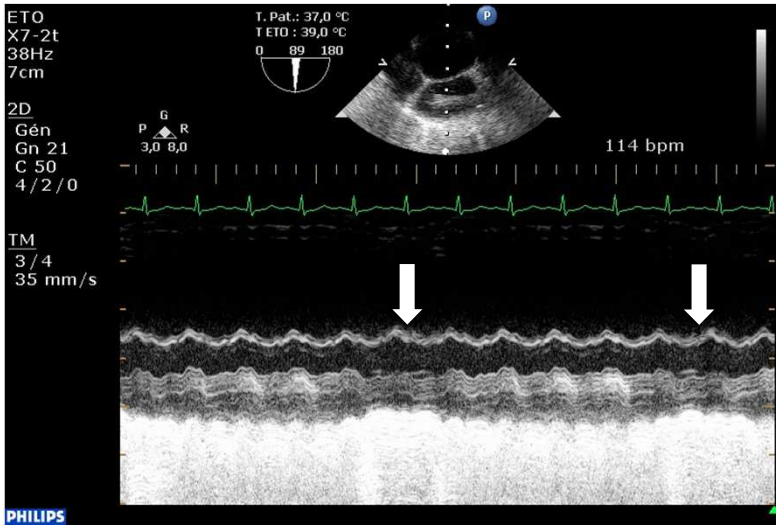
+ 46%

Cas clinique 4 (suite)

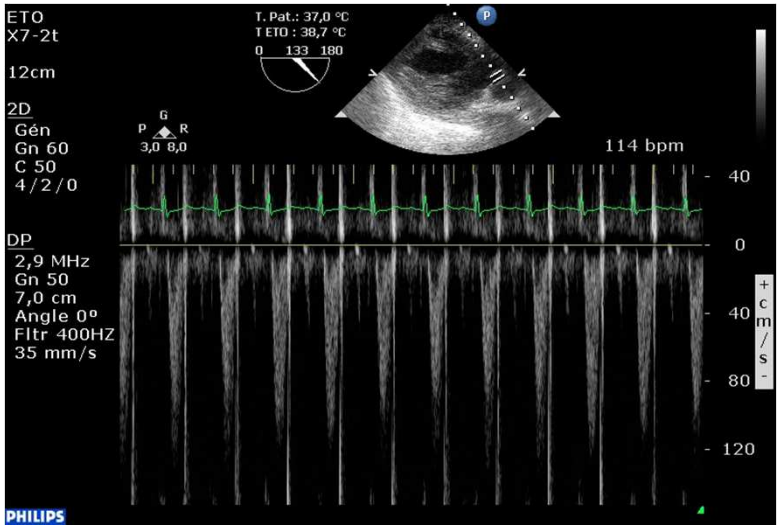
- Après 500 mL de remplissage vasculaire : PAm à 70 mmHg, PVC : 14 mmHg
- Marbrures persistantes ; pas de nouvelle biologie

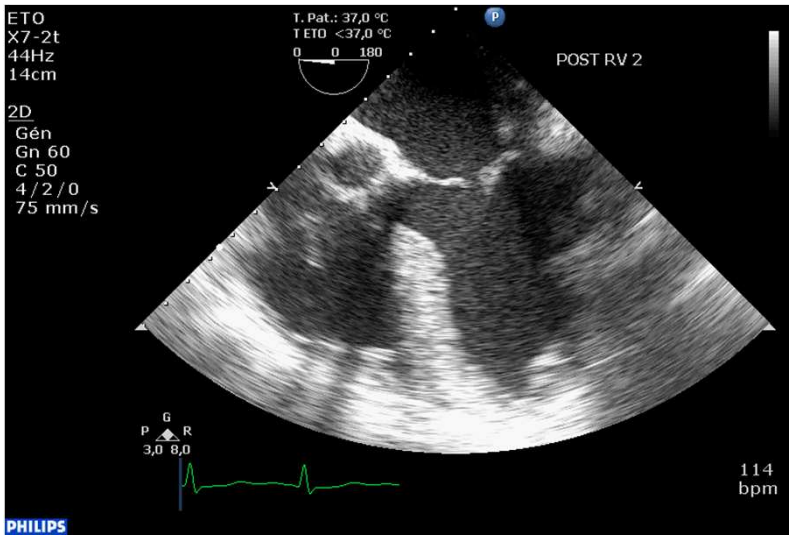


Veine cave supérieure



ITV aortique (CCVG)

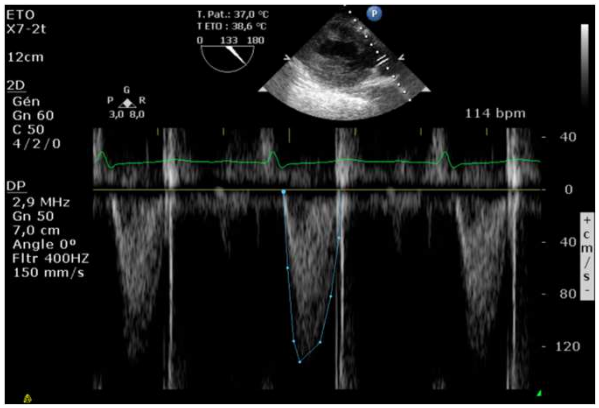


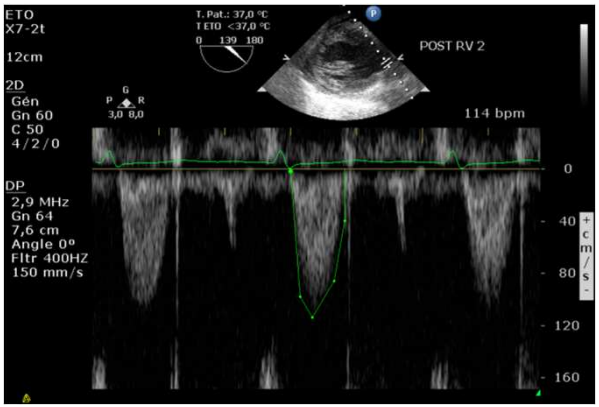


ITV : 16,7 cm

500 mL

ITV : 14 cm





Inotrope +

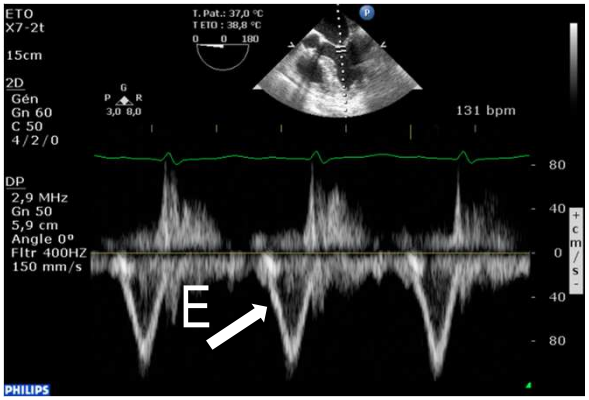
Baseline

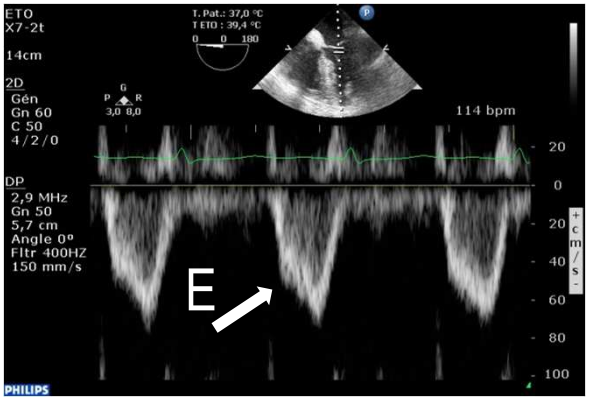
Tolérance

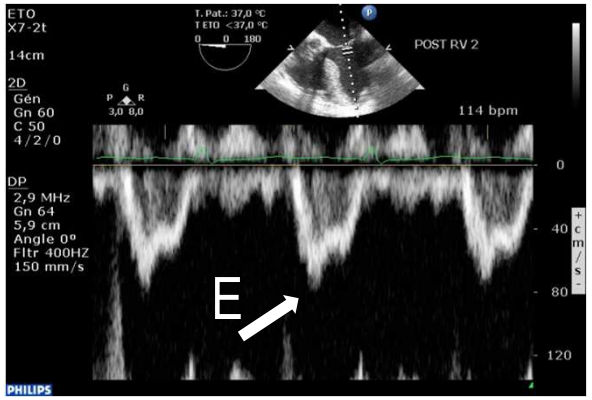
500 mL

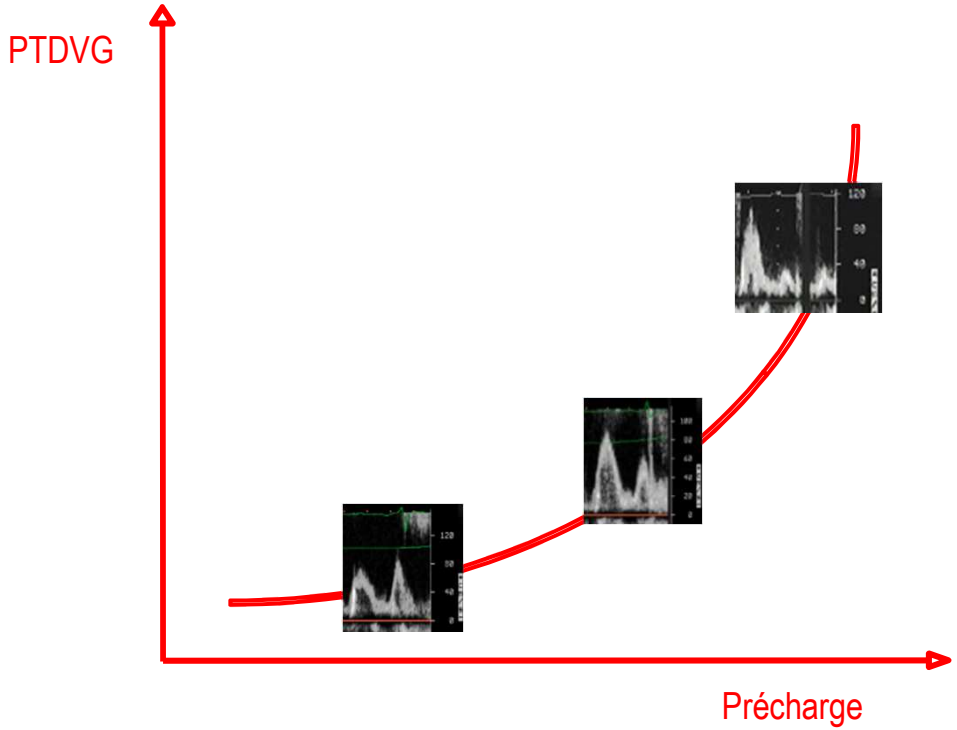
Intolérance

1000 mL









Microsondes d'ETO : monitorage

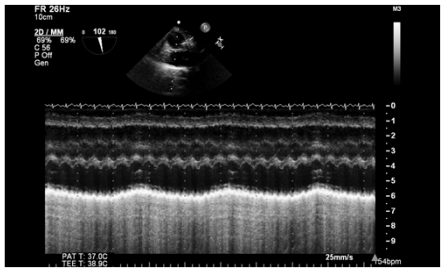
Microsonde multiplan avec Doppler

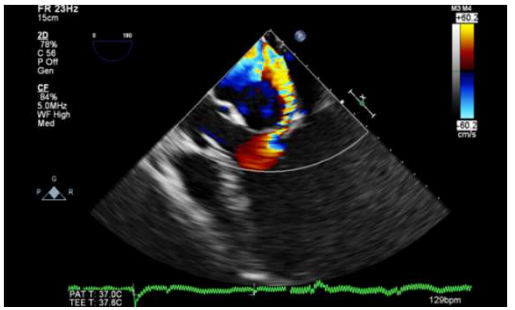
Intensive Care Med (2015) 41:1886–1894
DOI 10.1007/s00134-015-3998-4

ORIGINAL

Emmanuelle Begot
François Dalmay
Caroline Etchecopar
Marc Clavel
Nicolas Pichon
Bruno Francois
Roberto Lang
Philippe Vignon

Hemodynamic assessment of ventilated ICU patients with cardiorespiratory failure using a miniaturized multiplane transesophageal echocardiography probe

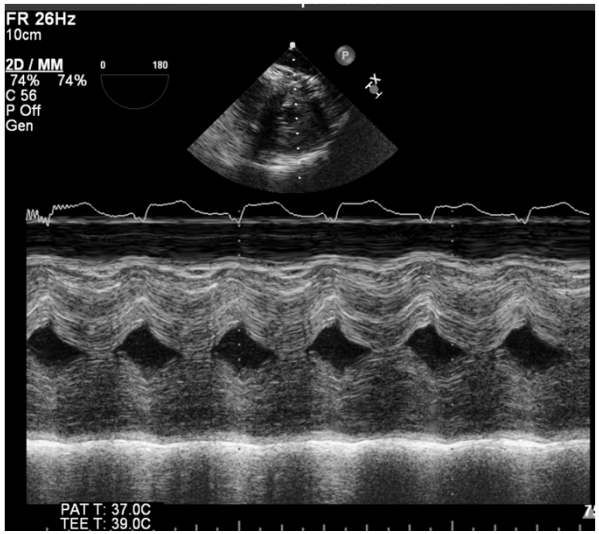


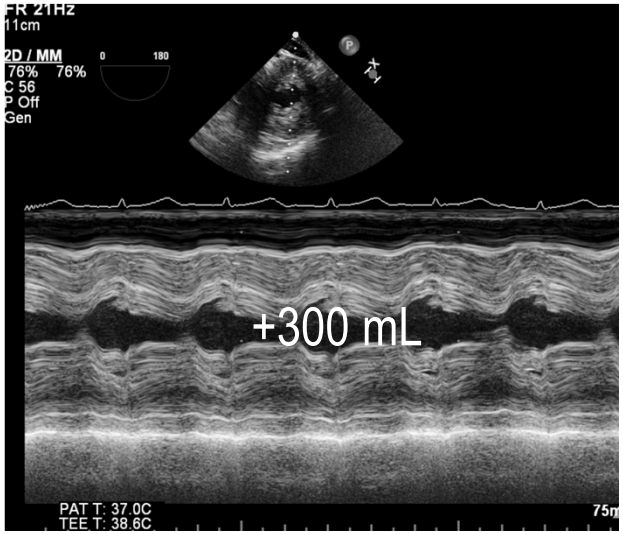


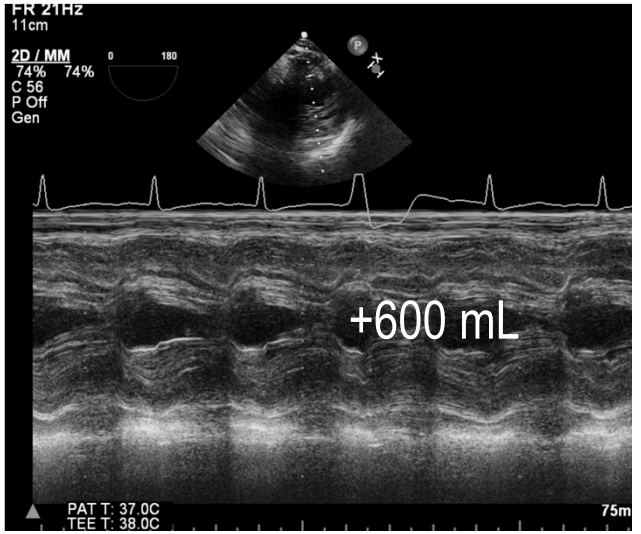
- 56 patients ventilés en défaillance cardiorespiratoire
- Excellent agrément diagnostique (Kappa : 0,95 ; IC95% : 0,85 - 1) et thérapeutique (Kappa : 1 ; IC95% : 1 - 1) avec l'ETO standard

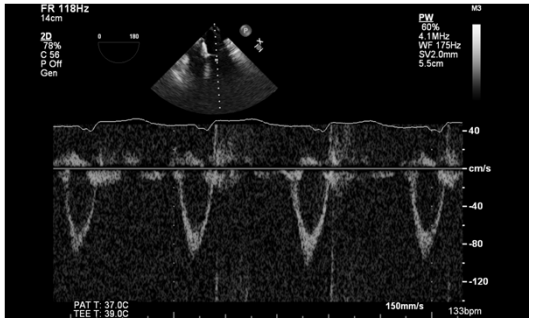
RV1

RV2


FR 26Hz
10cm
2D / MM
74% 74%
C 56
P Off
Gen
PAT T: 37.0C
TEE T: 39.0C


FR 21Hz
11cm
2D / MM
76% 76%
C 56
P Off
Gen
+300 mL
PAT T: 37.0C
TEE T: 38.6C


FR 21Hz
11cm
2D / MM
74% 74%
C 56
P Off
Gen
+600 mL
PAT T: 37.0C
TEE T: 38.0C


FR 118Hz
14cm
PW
-40
cm/s
-40
-80
-120
150mm/s
133bpm

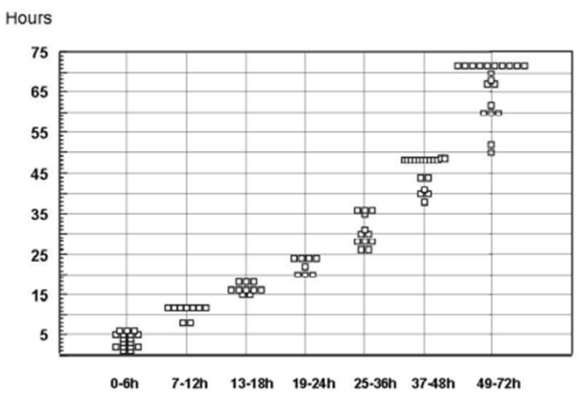
Intensive Care Med (2013) 39:629–635
DOI 10.1007/s00134-012-2797-4

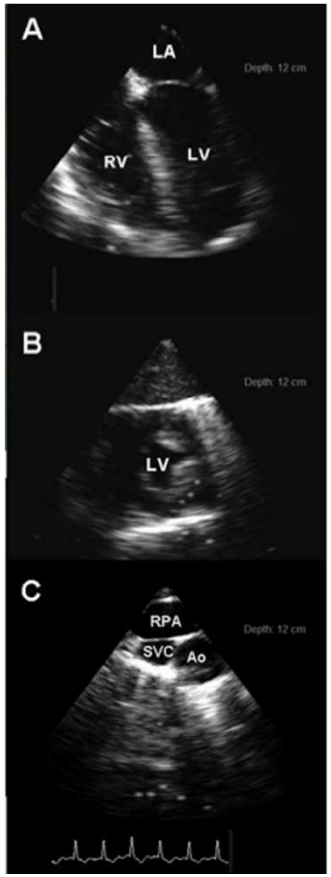
ORIGINAL

Antoine Vieillard-Baron
Michel Slama
Paul Mayo
Cyril Charron
Jean-Bernard Amiel
Cédric Esterez
François Leleu
Xavier Repesse
Philippe Vignon

A pilot study on safety and clinical utility of a single-use 72-hour indwelling transesophageal echocardiography probe

Microsonde monoplan à usage unique (72h) sans Doppler spectral





Intensive Care Med (2014) 40:1795–1815
DOI 10.1007/s00134-014-3525-z

Consensus on circulatory shock and hemodynamic monitoring. Task force of the European Society of Intensive Care Medicine

Maurizio Cecconi
Daniel De Backer
Massimo Antonelli
Richard Beale
Jan Bakker
Christoph Hofer
Roman Jaeschke
Alexandre Mebazaa
Michael R. Pinsky
Jean Louis Teboul
Jean Louis Vincent
Andrew Rhodes

Topic	ICM Antonelli 2007	ICM Cecconi 2014
Hemodynamic monitoring	–We do not recommend routine measurement of CO for patients with shock. Level 1; QoE moderate (B) –We suggest considering echocardiography or measurement of CO for diagnosis in patients with clinical evidence of ventricular failure and persistent shock with adequate fluid resuscitation. Level 2 (weak); QoE moderate (B) –We do not recommend the routine use of the pulmonary artery catheter for patients in shock. Level 1; QoE high (A)	–We recommend further hemodynamic assessment (such as assessing cardiac function) to determine the type of shock if the clinical examination does not lead to a clear diagnosis. *Ungraded best practice* –We suggest that, when further hemodynamic assessment is needed, echocardiography is the preferred modality to initially evaluate the type of shock as opposed to more invasive technologies. Level 2; QoE moderate (B) –In complex patients we suggest to additionally use pulmonary artery catheterization or transpulmonary thermodilution to determine the type of shock. Level 2; QoE low (C) –We do not recommend routine measurement of cardiac output for patients with shock responding to the initial therapy. Level 1; QoE low (C) –We recommend measurements of cardiac output and stroke volume to evaluate the response to fluids or inotropes in patients that are not responding to initial therapy. Level 1; QoE low (C) –We suggest sequential evaluation of hemodynamic status during shock. Level 1; QoE low (C) –Echocardiography can be used for the sequential evaluation of cardiac function in shock. *Statement of fact* –We do not recommend the routine use of the pulmonary artery catheter for patients in shock. Level 1; QoE high (A) –We suggest pulmonary artery catheterization in patients with refractory shock and right ventricular dysfunction. Level 2; QoE low (C) –We suggest the use of transpulmonary thermodilution or pulmonary artery catheterization in patients with severe shock especially in the case of associated acute respiratory distress syndrome. Level 2; QoE low (C) –We recommend that less invasive devices are used, instead of more invasive devices, only when they have been validated in the context of patients with shock. *Ungraded best practice*

Conclusions

- Echocardiographie : opérateur dépendant (formation spécifique)
- Monitorage hémodynamique plus que diagnostic ponctuel
- Avantage sur les méthodes de monitorage peu invasive (thermodilution)
- Examen de première ligne (défaillance hémodynamique et respiratoire) : recommandations européennes récentes.