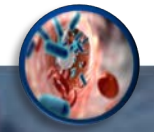
AER
ACTUALITÉS EN RÉANIMATION

ACCUEIL CONGRÈS 2022 INSCRIPTIONS INFORMATIONS EXPOSANTS 2022 PARTENAIRES ARCHIVES CONTACT


Congrès 2022

Evaluation des besoins en remplissage vasculaire

Philippe Vignon

Réanimation Polyvalente
Inserm CIC 1435
CHU Limoges

CONGRÈS FRANCOPHONE
ACTUALITÉS EN RÉANIMATION
MÉDECINE INTENSIVE, SURVEILLANCE CONTINUE ET URGENCES
GRAVES

CHU Centre hospitalier universitaire Limoges
Inserm La science pour la santé From science to health
CIC LIMOGES CENTRE INVESTIGATION CLINIQUE



Congrès 2022

Evaluation des besoins en remplissage vasculaire

Pas de conflits d'intérêt avec la présentation

Contexte

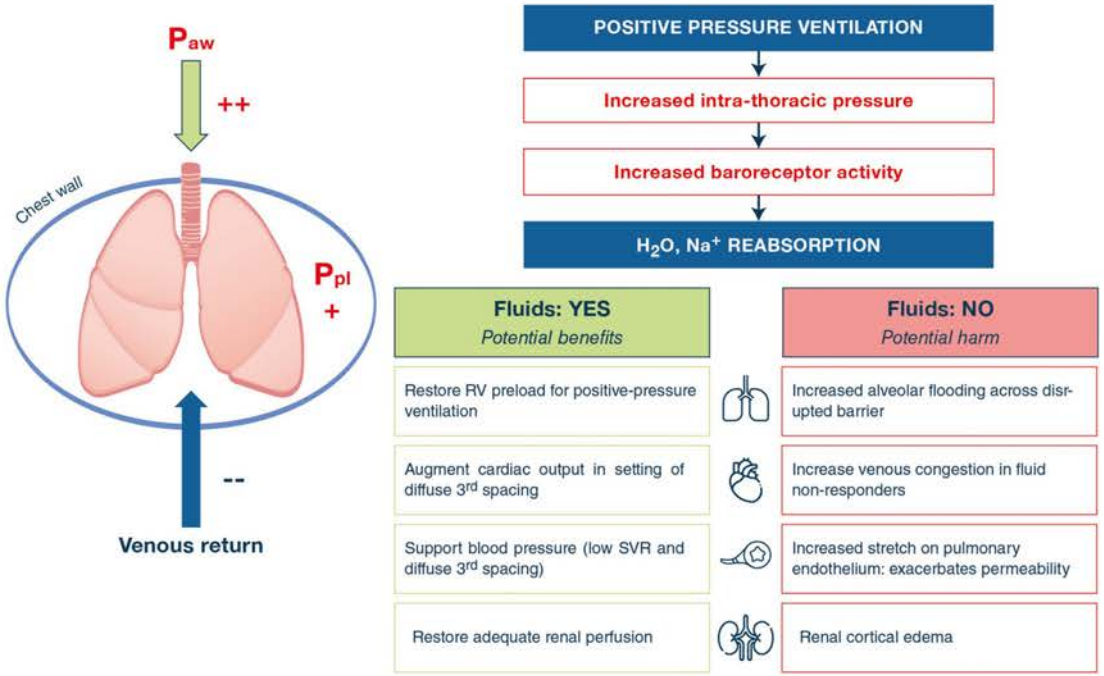
Fluid loading: benefits & risks

Intensive Care Med (2020) 46:2252–2264
https://doi.org/10.1007/s00134-020-06310-0

REVIEW

Fluid administration and monitoring in ARDS: which management?

Philippe Vignon[1,2,3,16*], Bruno Evrard[1,2,3], Pierre Asfar[4], Mattia Busana[5], Carolyn S. Calfee[6], Silvia Coppola[7,8,9], Julien Demiselle[4], Guillaume Geri[10,11,12], Mathieu Jozwiak[13,14], Greg S. Martin[15], Luciano Gattinoni[5] and Davide Chiumello[7,8,9]



Intensive Care Med (2018) 44:1138–1140
DOI 10.1007/s00134-017-4989-4

WHAT'S NEW IN INTENSIVE CARE

The dark sides of fluid administration in the critically ill patient

Daniel A. Reuter[1*], Daniel Chappell[2] and Azriel Perel[3]

Table 1 Prevalent iatrogenic 'dark sides' of fluid administration

Dark side	Pathophysiological mechanisms	Clinical consequence
Edema formation	Hydrostatic intravascular pressures ↑ Destruction of endothelial glykokalix	Oxygen delivery to end organs↓ End organ dysfunction (e.g. lungs, brain, kidney, gut) Risk for infections ↑ Risk for GI anastomotic breakdown ↑
Organ congestion	Hydrostatic intravascular pressures ↑ Intra-organ/capsular/compartmental pressures ↑	End organ dysfunction (e.g. kidney, liver, heart)
Dilutional coagulopathy	Relative decrease of thrombocytes and coagulation factors	Risk of bleeding ↑
Hypothermia	Application of cold infusions	Coagulopathy ↑
Dilutional anemia	Relative decrease of Hb: O2 transport capacity↓	Need for compensatory increase in CO ⇒ endogenous catecholamines ↑/exogenous application of catecholamines; need for transfusions
Electrolyte imbalance	Chloride-rich infusions induce hyperchloremic acidosis	End organ (kidney) dysfunction/damage

Contexte

Response to fluid challenge

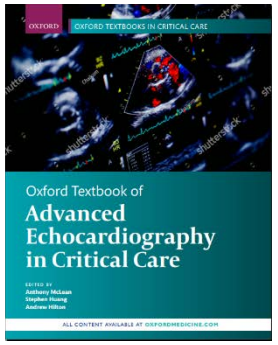
- Ability of the cardiovascular system to **significantly increase cardiac output** in response to increased venous return (usually without significant increase in filling pressures)
- Usual definition of « responders »:
  - ↑ cardiac output ≥ 15% after a fluid challenge (500 mL)
  - ↑ aortic blood flow ≥ 10% during PLR (1')

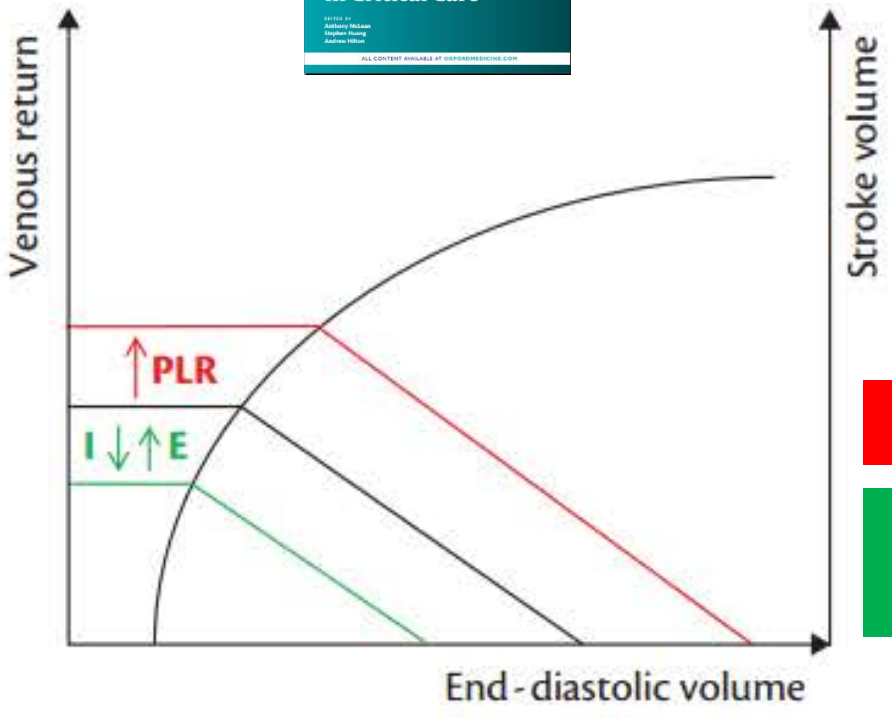
  when compared to baseline.

- "Static": measured at end-expiration, reflect preload
- **"Dynamic"**: use **heart-lung interactions**; measured at both end-expiration & insufflation (ventilated patients; by extension end-inspiration in SB patients)
- **Continuous** rather than yes/no physiological response: **no "magic" cut-off** value that fits for all clinical scenarios!
- Aim : to improve a **clearly defined clinical problem +++**

Contexte

Indices dynamiques





LJP

Ventilation mécanique

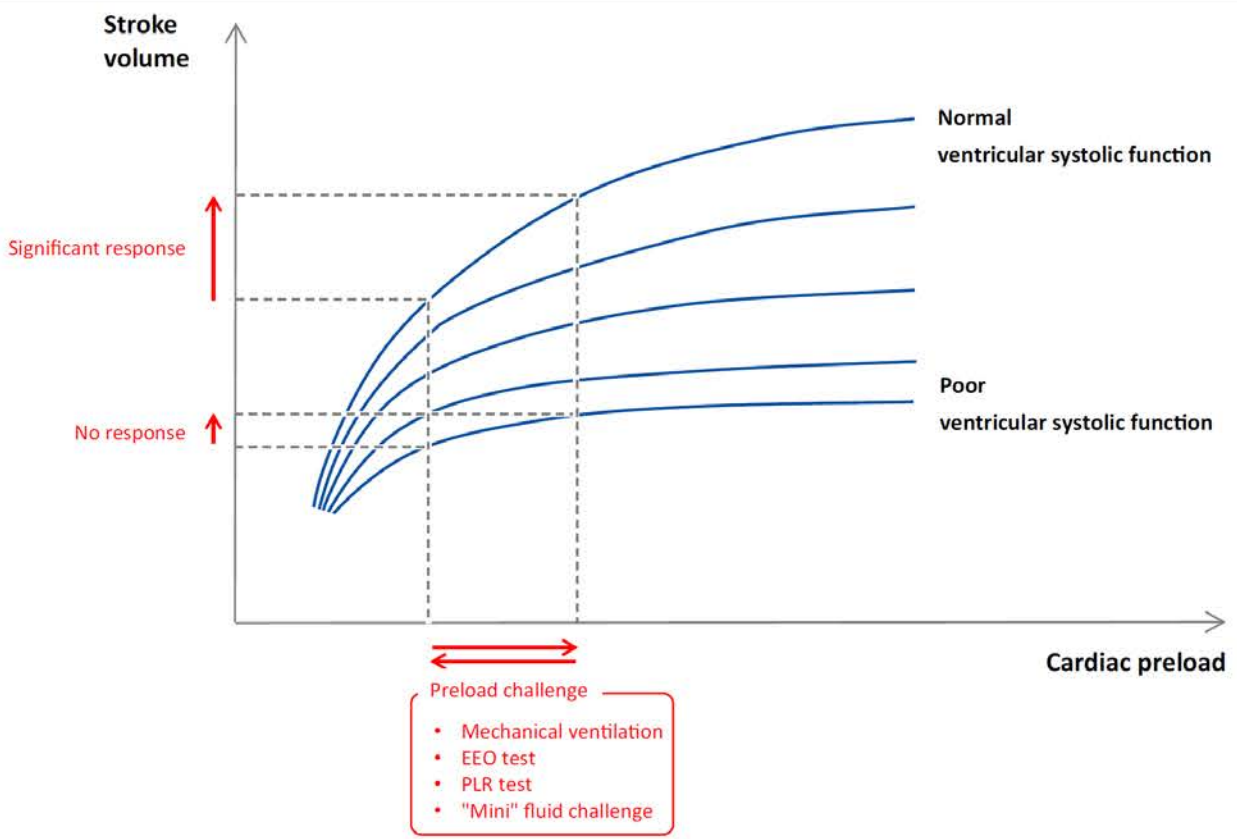
Monnet et al. Ann. Intensive Care (2016) 6:111
DOI 10.1186/s13613-016-0216-7

Annals of Intensive Care

REVIEW Open Access

Prediction of fluid responsiveness: an update

Xavier Monnet[1*], Paul E. Marik[2] and Jean-Louis Teboul[1]



Intensive Care Med (2015) 41:1529–1537
DOI 10.1007/s00134-015-3850-x

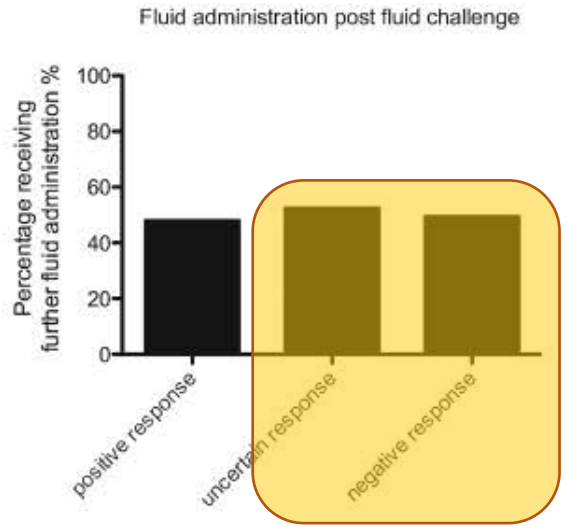
SEVEN-DAY PROFILE PUBLICATION

Maurizio Cecconi
Christoph Hofer
Jean-Louis Teboul
Ville Pettila
Erika Wilkman
Zsolt Molnar
Giorgio Della Rocca
Cesar Aldecoa
Antonio Artigas
Sameer Jog
Michael Sander
Claudia Spies
Jean-Yves Lefrant
Daniel De Backer
on behalf of the FENICE Investigators
and the ESICM Trial Group

Fluid challenges in intensive care: the FENICE study

A global inception cohort study

2015



Further fluid administration – n (%)	1050 (47.4 ± 2.5)	
with an initial positive response n (%) OR	739 (47.9 ± 2.5)	Ref
with an initial negative response n (%) OR	212 (49.4 ± 6.6)	OR 0.94 (0.76-1.16)
with an initial uncertain response n (%) OR	99 (52.4 ± 7.1)	OR 0.83 (0.62-1.13)

Intensive Care Med (2015) 41:248–256
DOI 10.1007/s00134-014-3576-1

ORIGINAL

Thierry Boulain
Julie Boisrame-Helms
Stephan Ehrmann
Jean-Baptiste Lascarrou
Adrien Bouglé
Arnaud Chiche
Karim Lakhal
Stéphane Gaudry
Sébastien Perbet
Arnaud Desachy
Séverin Cabasson
Isabelle Geneau
Patricia Courouble
Noémie Clavieras
Pablo L. Massanet
Frédéric Bellec
Yoan Falquet
François Réminiac
Philippe Vignon
Pierre-François Dequin
Ferhat Meziani

Volume expansion in the first 4 days of shock: a prospective multicentre study in 19 French intensive care units

Table 3 Indications and variables used to predict fluid responsiveness ($N = 2213$)

Indication			*n* (%)
Hypotension			1211 (58.7 [56.7–60.8])
Weaning vasopressor			146 (7.1 [6.0–8.2])
Cardiac output			62 (3.0) [2.3–3.7]
Oliguria			372 (18.0 [16.4–19.6])
Skin mottling			36 (1.7 [1.2–2.2])
Lactate			128 (6.2 [5.2–7.2])
$SvO_2/ScvO_2$			10 (0.5 [0.2–0.8])
SVV/PPV			37 (1.8 [1.3–2.4])
CVP/PAOP			60 (2.9 [2.2–3.6])
Hemodynamic variable used to predict fluid responsiveness	***n***	**% Of category**	**% All**
No variable used	945		42.7 [40.6–44.8]
Any variable used	1268		57.3 [55.2–59.4]
Static	785		35.5 [33.5–37.5]
CVP	572	89.9 [87.8–92.0]	25.8 [24.0–27.6]
PAOP	31	4.9 [3.4–6.4]	1.4 [0.9–1.9]
GEDVI	33	5.2 [3.6–6.8]	1.5 [1.0–2.0]
Other	149	23.4 [20.4–26.4]	6.7 [5.7–7.8]
Dynamic	483		21.9 [20.2–23.6]
PPV	88	18.2 [14.8–21.6]	4.0 [3.2–4.8]
SVV	88	18.2 [14.8–21.6]	4.0 [3.2–4.8]
PPV + SVV	24	5.0 [3.1–6.9]	1.1 [0.7–1.5]
PLR	238	49.3 [44.8–53.8]	10.7 [9.4–12.0]
Echo variables	45	9.3 [6.7–11.9]	2.0 [1.4–2.6]

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.

Phase Focus	Salvage	Optimization	Stabilization	De-escalation
	Obtain a minimal acceptable blood pressure	Provide adequate oxygen availability	Provide organ support	Wean from vasoactive agents
	Perform lifesaving measures	Optimize cardiac output, SvO_2, lactate	Minimize complications	Achieve a negative fluid balance

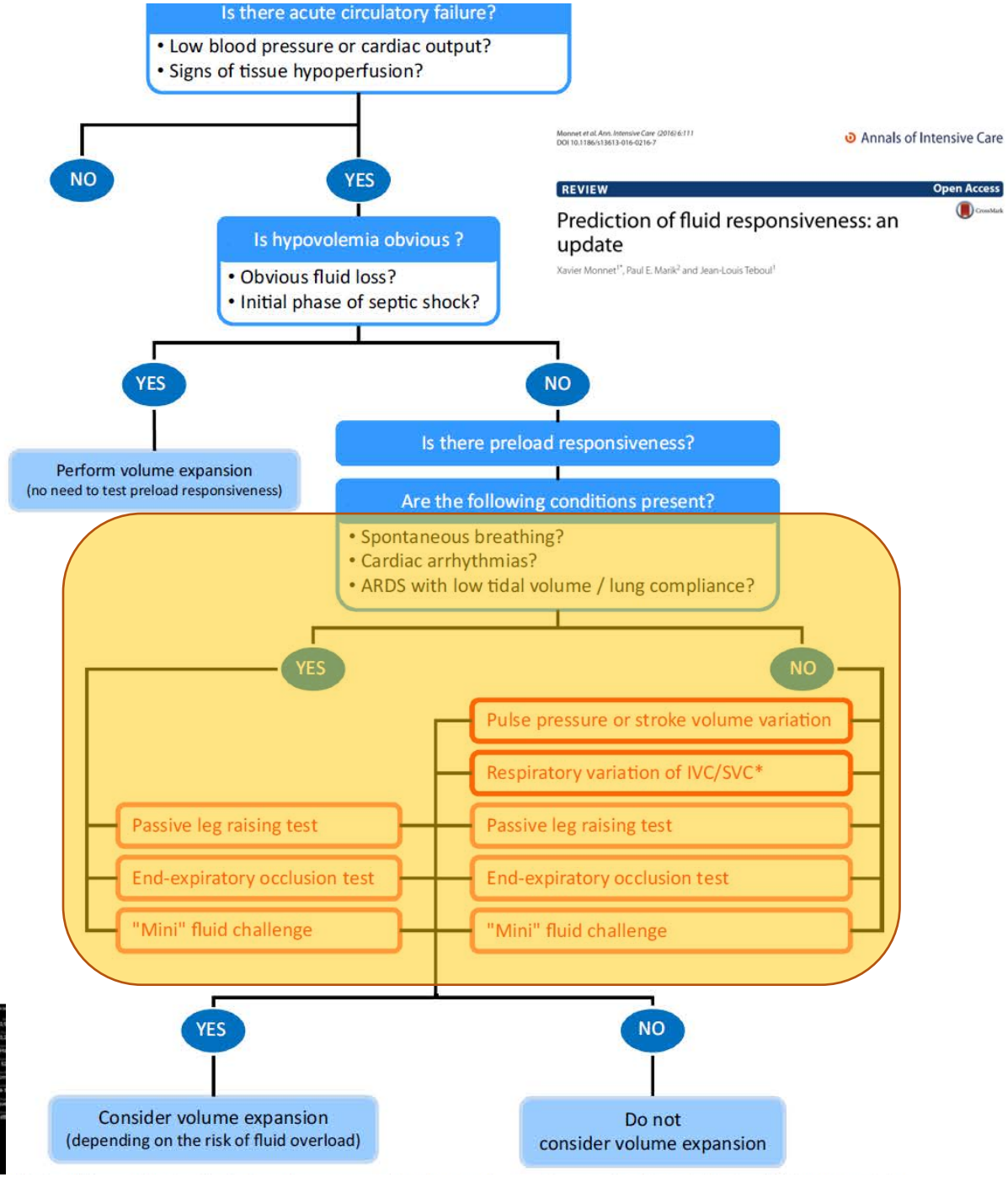
Monnet et al. Ann. Intensive Care (2016) 6:111
DOI 10.1186/s13613-016-0216-7

Annals of Intensive Care

REVIEW Open Access

Prediction of fluid responsiveness: an update

Xavier Monnet[1*], Paul E. Marik[2] and Jean-Louis Teboul[1]

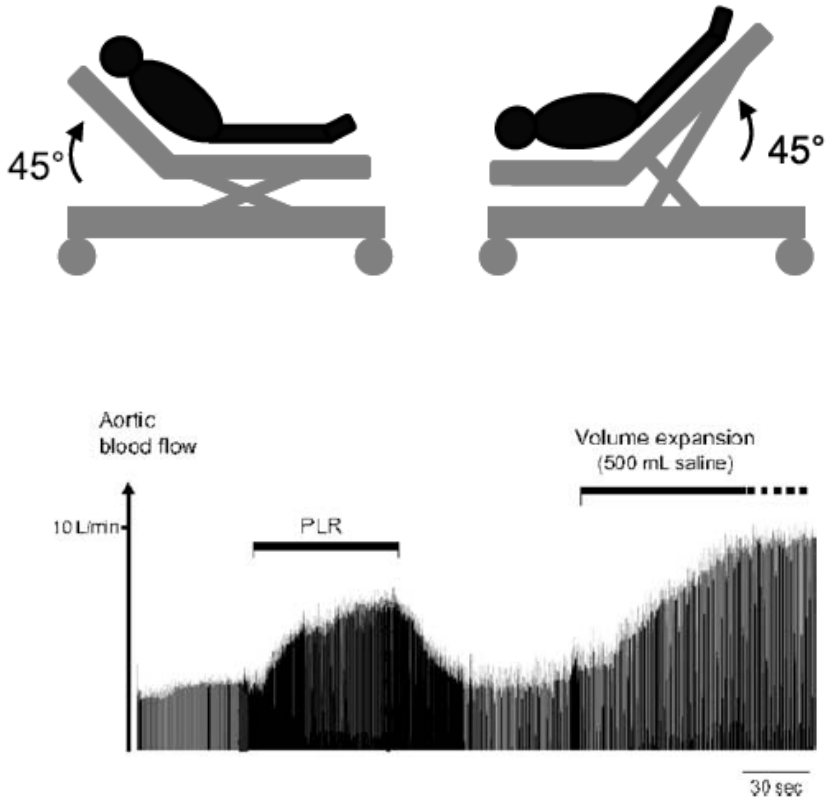


Intensive Care Med (2008) 34:659–663
DOI 10.1007/s00134-008-0994-y

CLINICAL COMMENTARY

Xavier Monnet
Jean-Louis Teboul

Passive leg raising

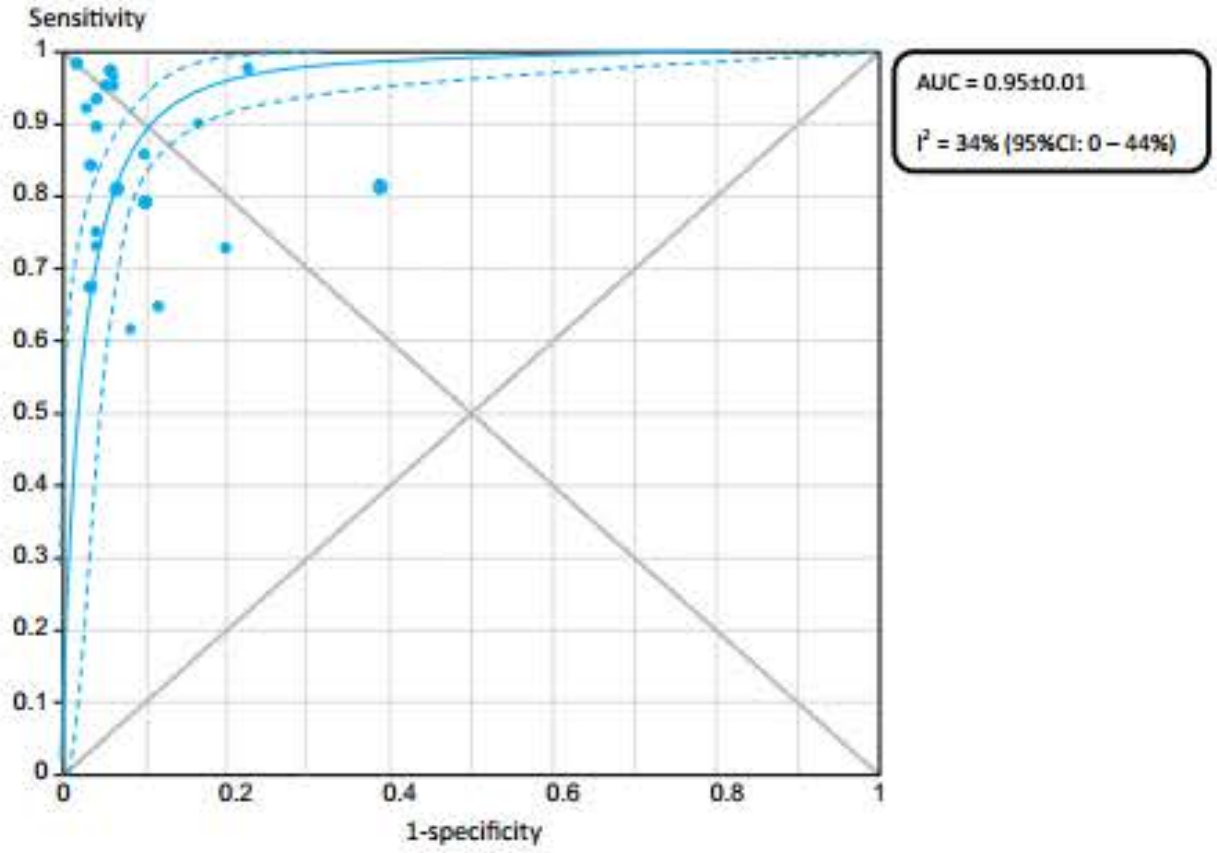


Intensive Care Med
DOI 10.1007/s00134-015-4134-1

ORIGINAL

Xavier Monnet
Paul Marik
Jean-Louis Teboul

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



PLR-induced changes in aortic blood flow (esophageal Doppler) ≥ 10%:
Sensitivity: 97%, Specificity: 94%

Dynamic indices in ventilated patients

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

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

CHEST 2001; 119:867–873

n=19; ΔVmax > 12%; Se: 100%, Sp: 89%

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

n=66; ΔSVC > 36%; Se: 90%, Sp: 100%

Intensive Care Med (2004) 30:1740–1746
DOI 10.1007/s00134-004-2259-8

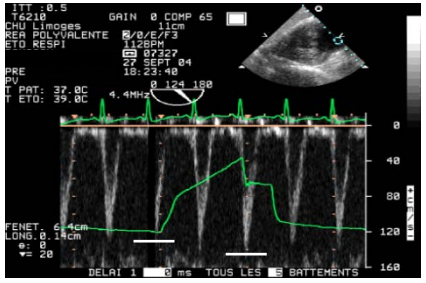
ORIGINAL

Christophe Barbier
Yann Loubières
Christophe Schmit
Jan Hayon
Jean-Louis Ricôme
François Jardin
Antoine Vieillard-Baron

Respiratory changes in inferior vena cava diameter are helpful in predicting fluid responsiveness in ventilated septic patients

n=20; ΔIVC > 18%; Se: 90%, Sp: 90%

R



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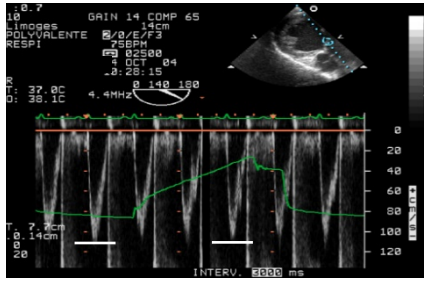

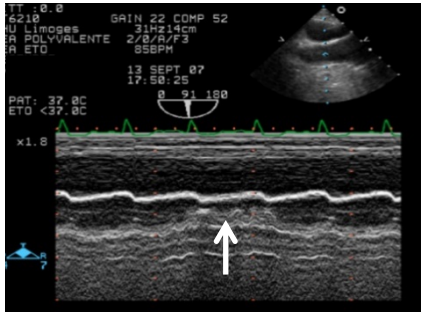

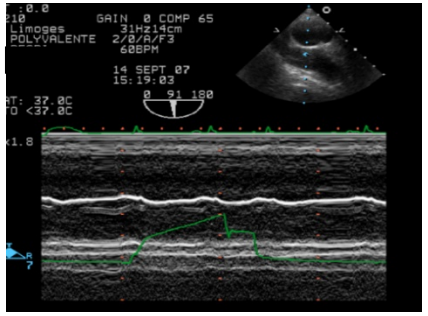

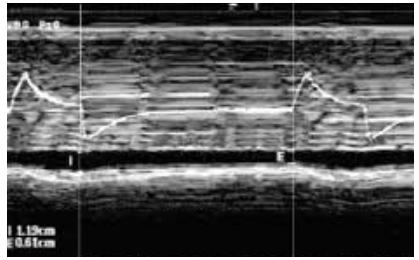

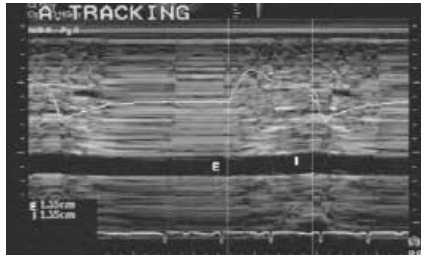

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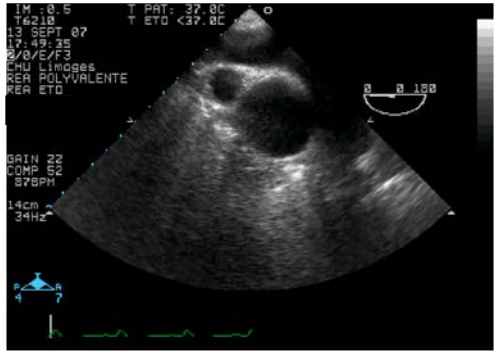

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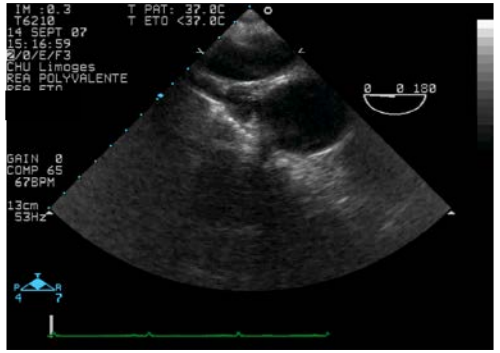


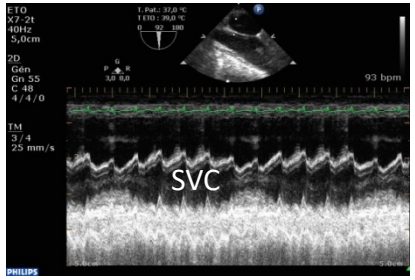
ORIGINAL ARTICLE

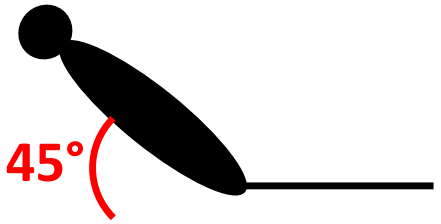
Comparison of Echocardiographic Indices Used to Predict Fluid Responsiveness in Ventilated Patients

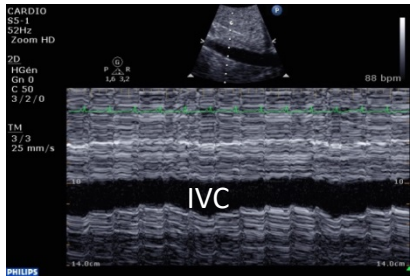
Philippe Vignon[1,2,3], Xavier Repessé[4*], Emmanuelle Bégot[1,2*], Julie Léger[5], Christophe Jacob[6], Koceila Bouferrache[7], Michel Slama[8], Gwenaël Prat[6], and Antoine Vieillard-Baron[4,9,10]

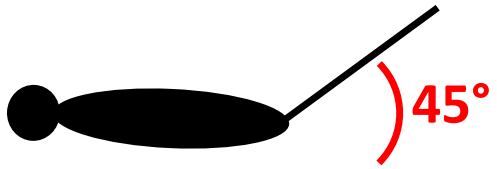
Am J Respir Crit Care Med Vol 195, Iss 8, pp 1022–1032, Apr 15, 2017

Cause of circulatory failure:	n=540
Septic shock (n)	295 (55%)
Cardiogenic shock (n)	100 (18%)
Hypovolemic shock (n)	81 (15%)
Obstructive shock (n)	10 (2%)
Anaphylactic shock (n)	4 (1%)
Other causes (n)	50 (9%)









- 540 patients
- Lactate: 3.89±3.72 mmol/l
- Shock of any origin
- Ventilated patients without respiratory activity (sinus)

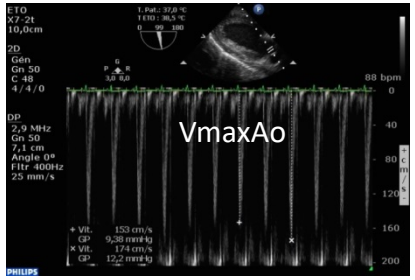
Responders :
ΔAoVTI ≥ 10% 1 min PLR

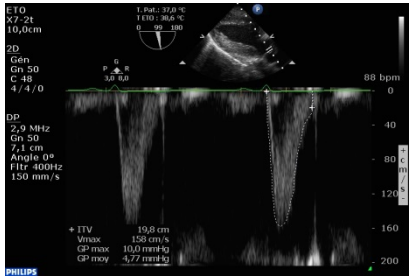
Feasibility:

ΔVmaxAo: 78%

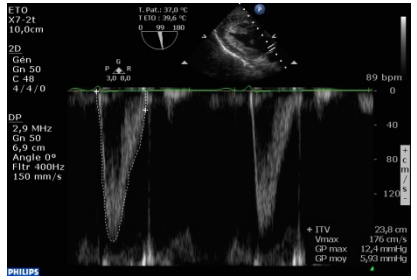
ΔSVC: 99%

ΔIVC: 78%



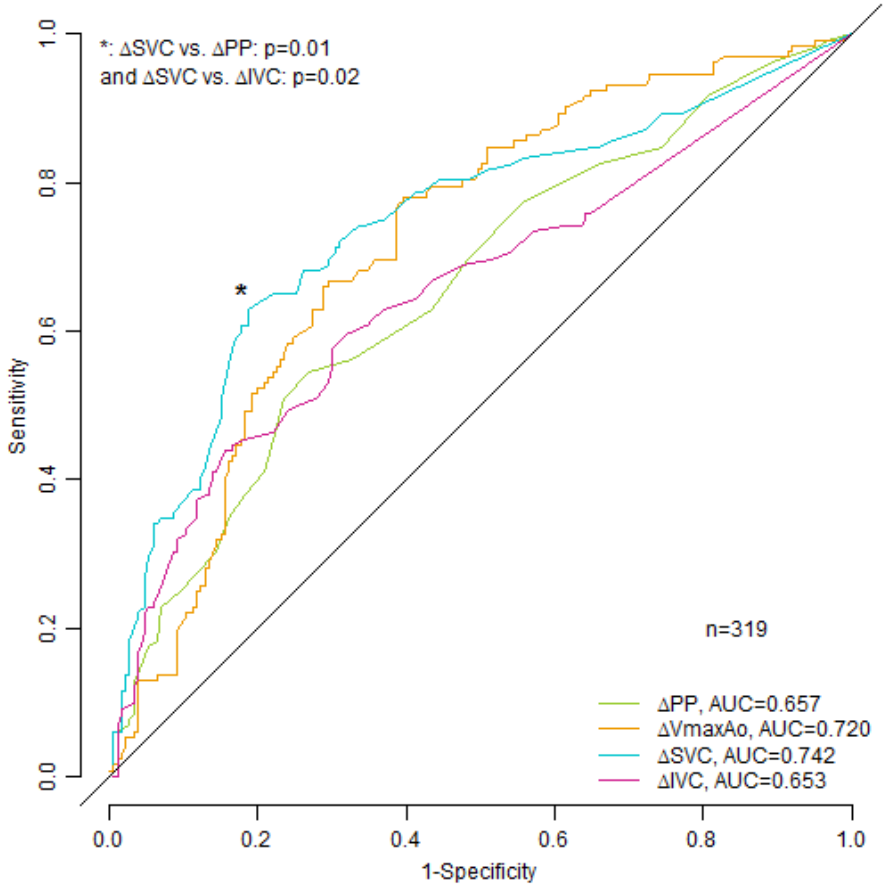


LJP 1 min



229 Répondeurs (42%)

Diagnostic accuracy of dynamic indices

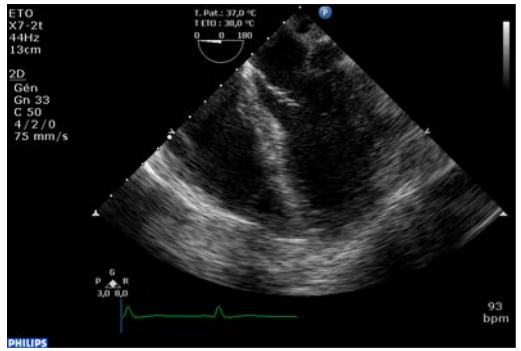


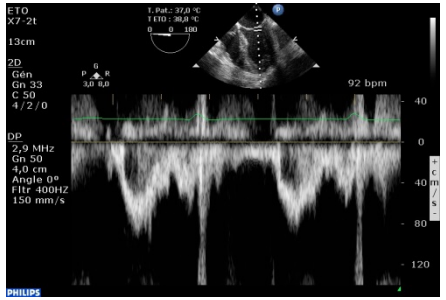
Dynamic parameters	Threshold value for **optimized sensitivity**	Optimized sensitivity (associated specificity)	Threshold value for **optimized specificity**	Optimized specificity (associated sensitivity)
ΔVmaxAo (n=421)	7%	90% (39%)	18%	90% (29%)
ΔSVC (n=538)	4%	89% (25%)	31%	90% (43%)
ΔIVC (n=422)	3%	74% (36%)	18%	90% (28%)

(mini) Fluid challenge

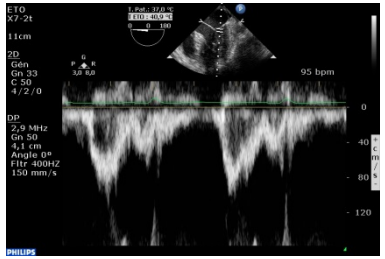
Close to initial cut-offs

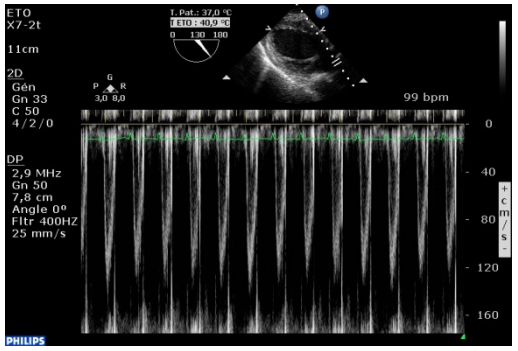
Concordant dynamic indices *for* fluid responsiveness

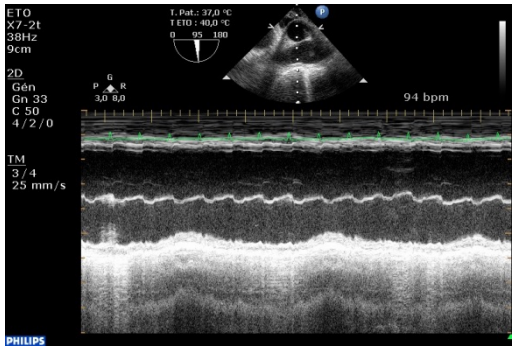


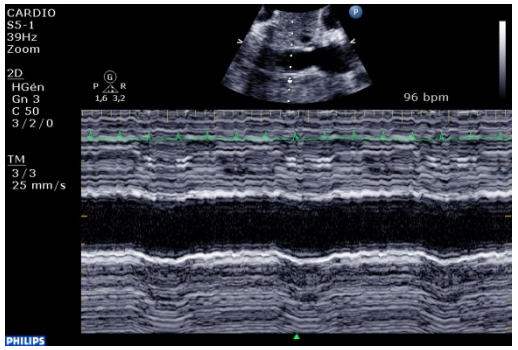


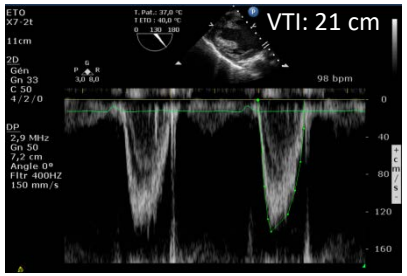
After fluids

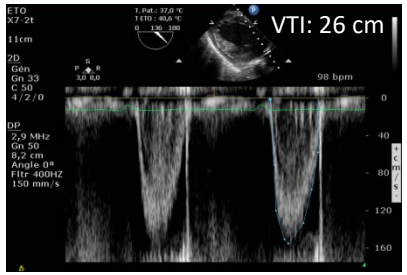








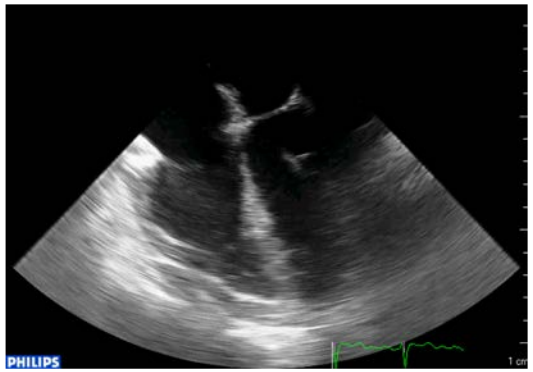


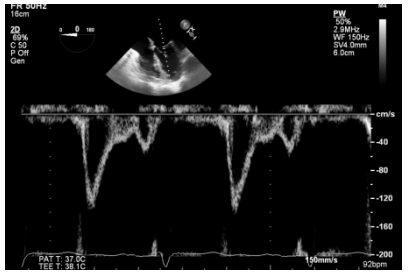


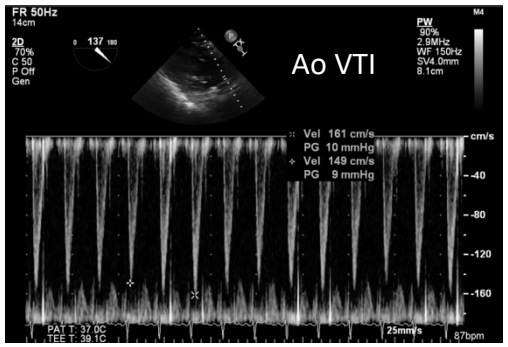
500 mL

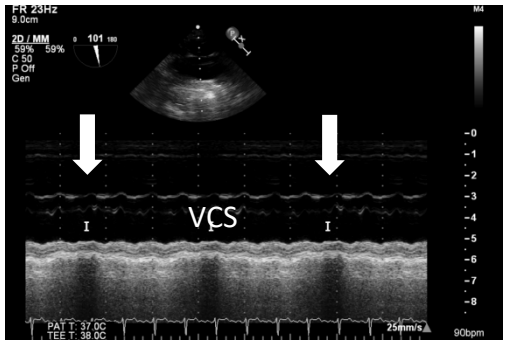
+24%

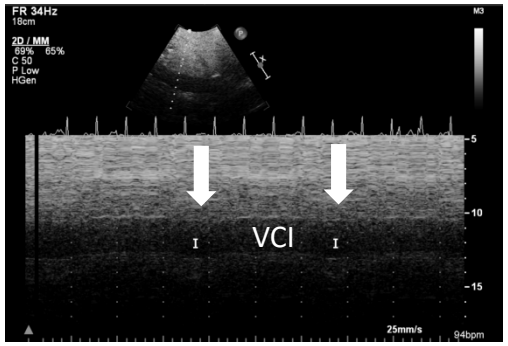
Concordant dynamic indices *against* fluid responsiveness

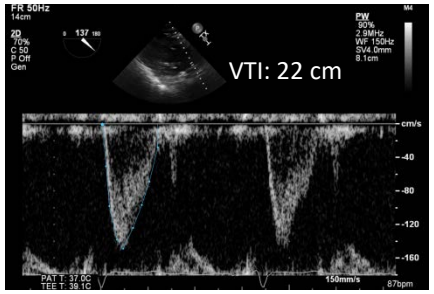


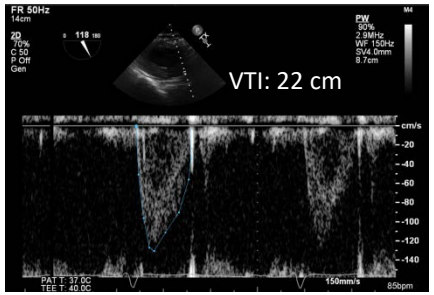








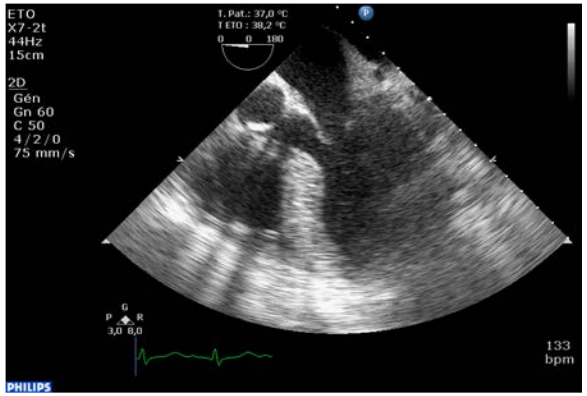


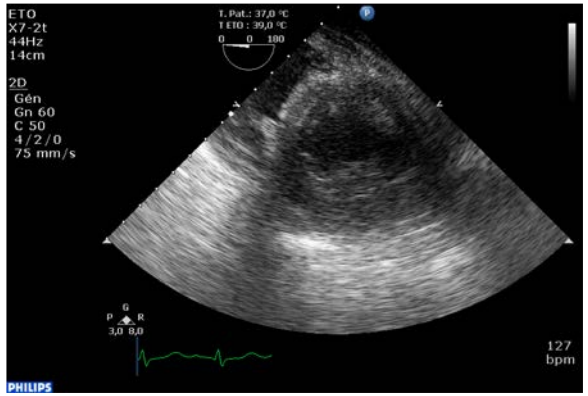


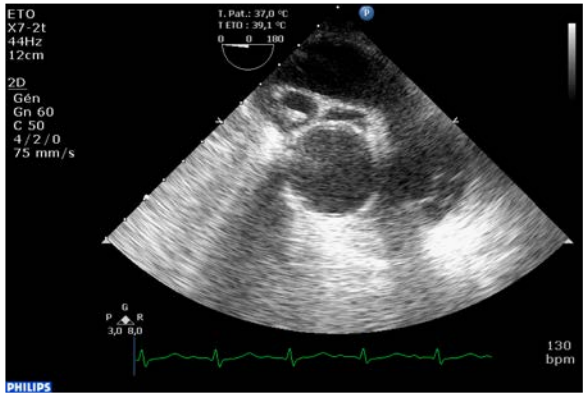
PLR 90°

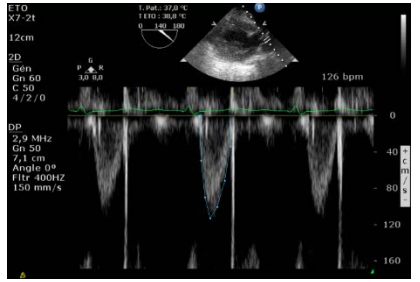
No fluids

“Borderline” dynamic indices: perform PLR



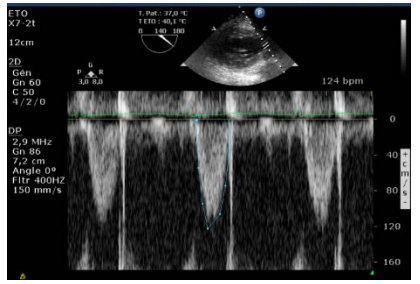






VTI:
11.4 cm

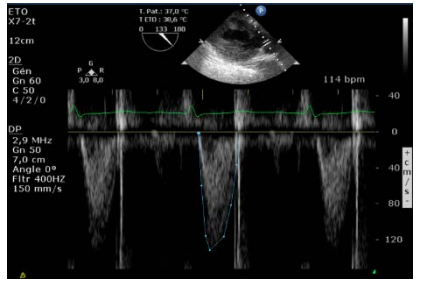
PLR



VTI:
13.4 cm

+18%

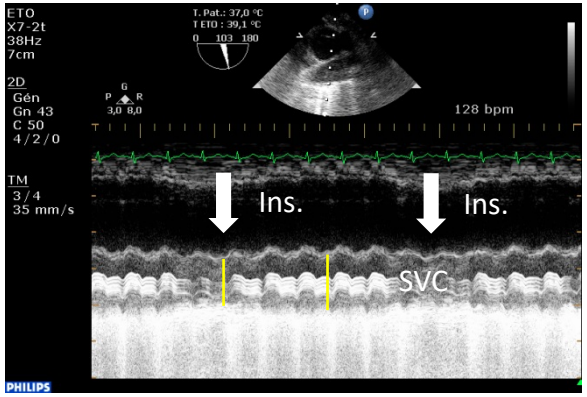
500 mL



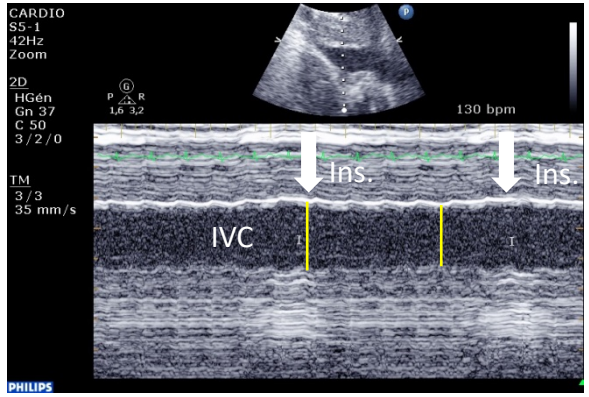
VTI:
16.7 cm

+46%

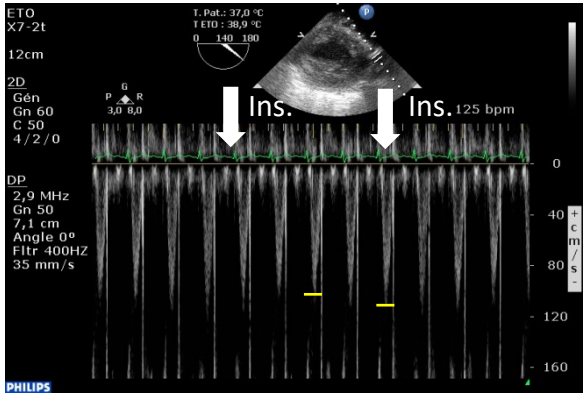
Superior vena cava



Inferior vena cava



Aortic VTI (LVOT)



PLR-induced changes in AoVTI

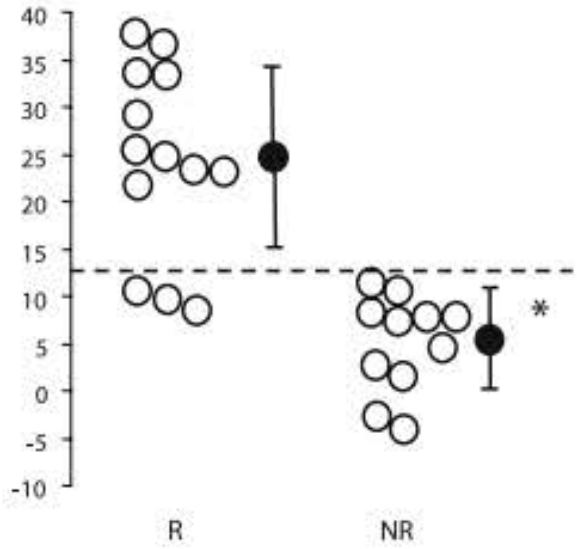
Intensive Care Med (2007) 33:1125–1132
DOI 10.1007/s00134-007-0646-7

ORIGINAL

Bouchra Lamia
Ana Ochagavia
Xavier Monnet
Denis Chemla
Christian Richard
Jean-Louis Teboul

Echocardiographic prediction of volume responsiveness in critically ill patients with spontaneously breathing activity

12.5%



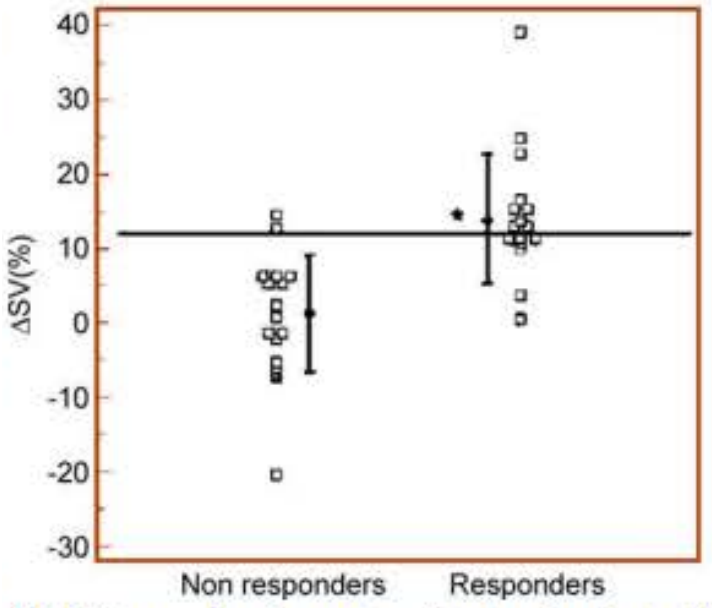
Se: 77%; Spe: 100%

Intensive Care Med (2007) 33:1133–1138
DOI 10.1007/s00134-007-0642-y

ORIGINAL

Julien Maizel
Norair Airapetian
Emmanuel Lorne
Christophe Tribouilloy
Ziad Massy
Michel Slama

Diagnosis of central hypovolemia by using passive leg raising



12%

Se: 69%; Spe: 89%

Inspiratory collapse of IVC

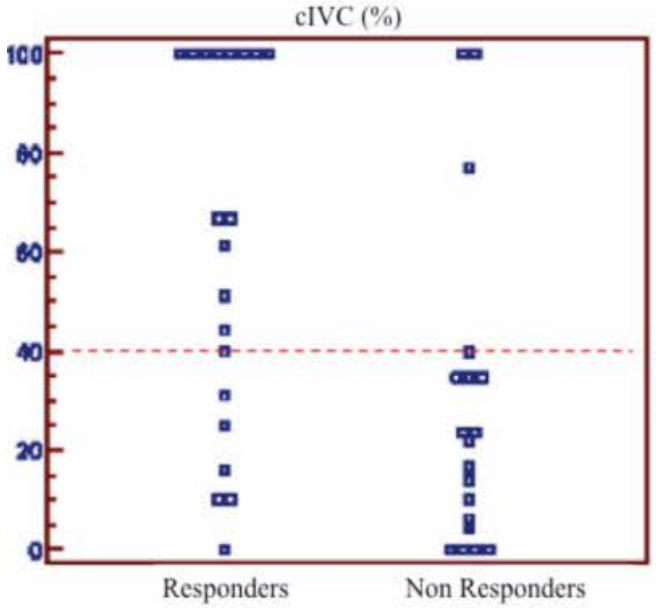
Muller et al. Critical Care 2012, 16:R188
http://ccforum.com/content/16/5/R188

CRITICAL CARE

RESEARCH Open Access

Respiratory variations of inferior vena cava diameter to predict fluid responsiveness in spontaneously breathing patients with acute circulatory failure: need for a cautious use

Laurent Muller[1*], Xavier Bobbia[1], Mehdi Toumi[1], Guillaume Louart[1], Nicolas Molinari[2], Benoit Ragonnet[3], Hervé Quintard[4], Marc Leone[3], Lana Zoric[1], Jean Yves Lefrant[1] and the AzuRea group



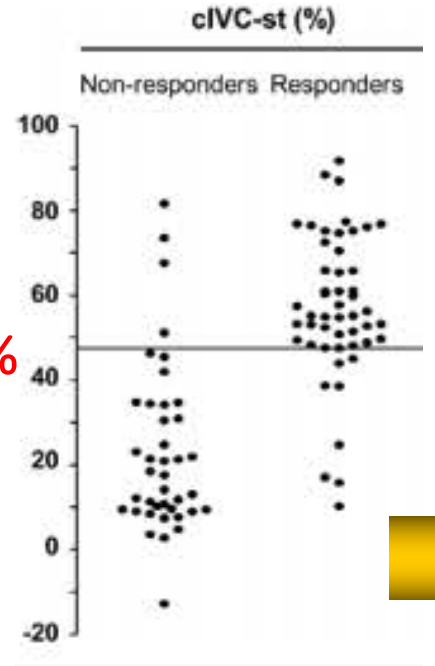
40%

Se: 70%; Spe: 80%

Diagnostic Accuracy of the Inferior Vena Cava Collapsibility to Predict Fluid Responsiveness in Spontaneously Breathing Patients With Sepsis and Acute Circulatory Failure

Sebastien Preau, MD, PhD[1]; Perrine Bortolotti, MD[2,3]; Delphine Colling, MD[2,3]; Florent Dewavrin, MD[3]; Vincent Colas, MD[3]; Benoit Voisin, MD[2]; Thierry Onimus, MD[2]; Elodie Drumez, BST[2]; Alain Durocher, MD[2]; Alban Redheuil, MD, PhD[4]; Fabienne Saulnier, MD[2]

(*Crit Care Med* 2017 45:e290–e297)



48%

Se: 84%; Spe: 90%

Monnet et al. Ann. Intensive Care (2016) 6:111
DOI 10.1186/s13613-016-0216-7

Annals of Intensive Care

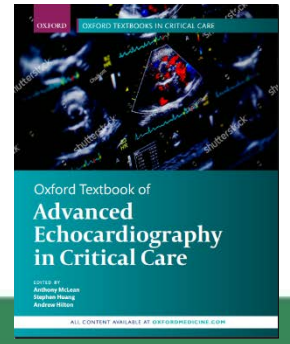
REVIEW Open Access

Prediction of fluid responsiveness: an update

Xavier Monnet[1*], Paul E. Marik[2] and Jean-Louis Teboul[1]

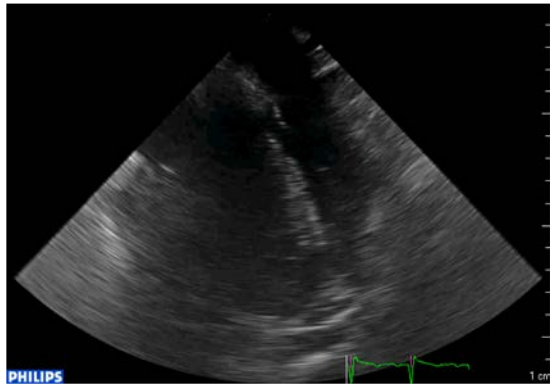
Table 2 Conditions where pulse pressure and stroke volume variations are less reliable

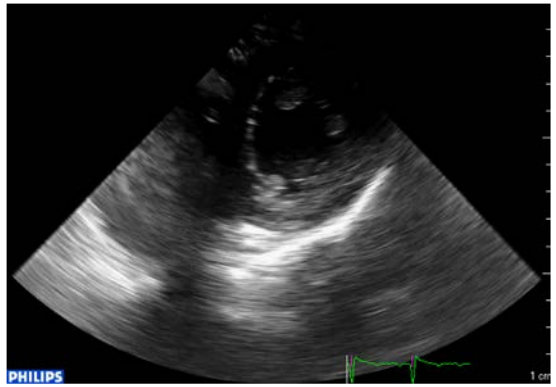
Spontaneous breathing	False+
Cardiac arrhythmias	False+
Low Vt/low lung compliance	False−
Open chest	False−
Increased intra-abdominal pressure	False+
Very high respiratory rate (HR/RR < 3.6)	False−
Right heart failure*	False+

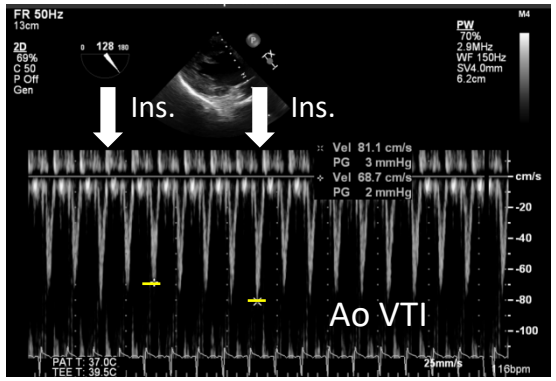


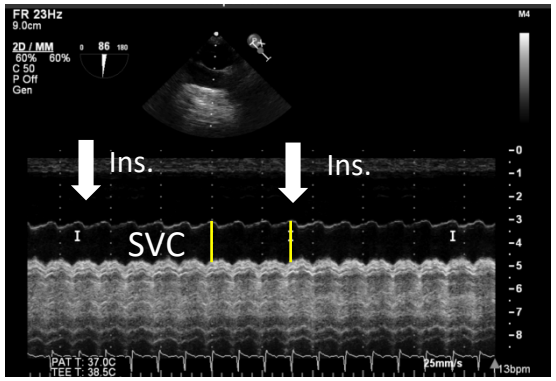
Parameters	Limitations
Dynamic parameters	
ΔV_{peak}	Non-sinus rhythm Inspiratory efforts and high respiratory rates Low tidal volume (<7–8 ml/kg) Right ventricular failure, acute cor pulmonale
ΔSVC	Requires transoesophageal echocardiography
ΔIVC	Increased IAP Spontaneous breathing with orthopnoea (deep breaths)
PLR-induced increase of LVOT VTI	PLR contraindicated (e.g. intracranial hypertension) or not feasible (e.g. pelvic or limb fractures, surgery) Severe atrophy or limb amputation Increased IAP (≥16 mmHg)

RV injury: false-positive of PPV / SVV / ΔVmaxAo









PPV: 14%

Vieillard-Baron et al. Crit Care (2020) 24:630
https://doi.org/10.1186/s13054-020-03345-z

Critical Care

RESEARCH Open Access

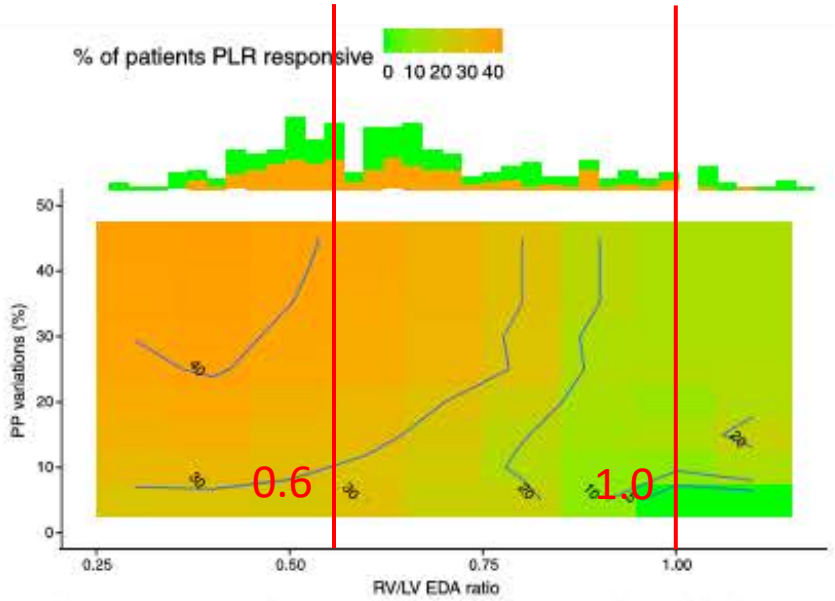
Right ventricular failure in septic shock: characterization, incidence and impact on fluid responsiveness

Antoine Vieillard-Baron[1,2,3*], Amélie Prigent[1,2], Xavier Repessé[1], Marine Goudelin[1], Gwenaël Prat[4], Bruno Evrard[5], Cyril Charron[1], Philippe Vignon[5,6,7] and Guillaume Geri[1,2,3]

282 ventilated patients in septic shock

Responders

Non Responders



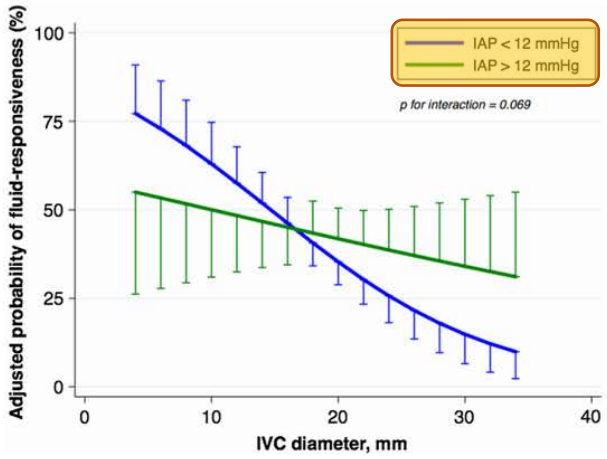
Respirophasic variations of IVC diameter & IAH

Intensive Care Med (2018) 44:197–203
https://doi.org/10.1007/s00134-018-5067-2

ORIGINAL

Limited value of end-expiratory inferior vena cava diameter to predict fluid responsiveness impact of intra-abdominal pressure

Antoine Vieillard-Baron[1,2,3*], Bruno Evrard[4,5], Xavier Repessé[1], Julien Maizel[6], Christophe Jacob[7], Marine Goudelin[4,5], Cyril Charron[1], Gwenaël Prat[7], Michel Slama[6], Guillaume Geri[1,2,3] and Philippe Vignon[4,5,8]



Intra-abdominal hypertension alters IVC / FR relationship

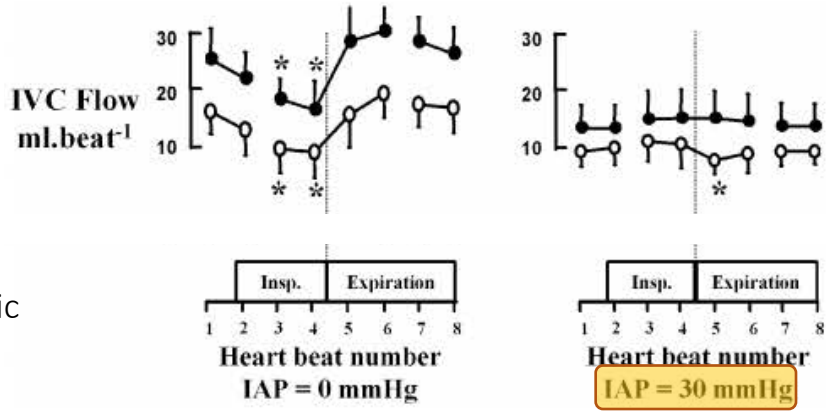
Intensive Care Med (2007) 33:163–171
DOI 10.1007/s00134-006-0412-2

EXPERIMENTAL

Serge Duperret
Franck Lhuillier
Vincent Piriou
Emmanuel Vivier
Olivier Metton
Patricia Branche
Guy Annat
Karim Bendjelid
Jean Paul Viale

Increased intra-abdominal pressure affects respiratory variations in arterial pressure in normovolaemic and hypovolaemic mechanically ventilated healthy pigs

- Controls
- Hypovolemic



Intra-abdominal hypertension blurs respiratory variations of IVC blood flow

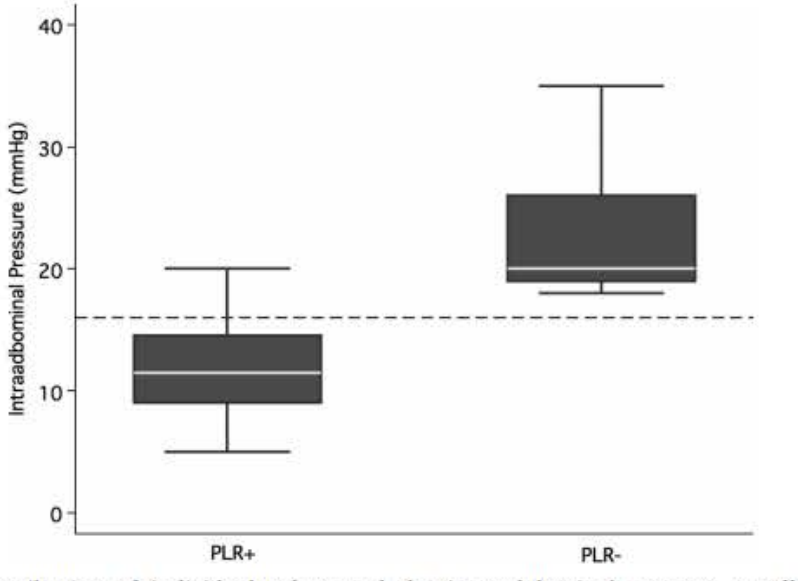
PLR & high intra-abdominal pressure

The passive leg-raising maneuver cannot accurately predict fluid responsiveness in patients with intra-abdominal hypertension*

Yazine Mahjoub, MD; Jérémie Touzeau, MD; Norair Airapetian, MD; Emmanuel Lorne, MD; Mustapha Hijazi, MD; Elie Zogheib, MD; François Tinturier, MD; Michel Slama, MD, PhD; Hervé Dupont, MD, PhD

Crit Care Med 2010 Vol. 38, No. 9

All patients with PPV ≥ 12% and who responded to fluid loading after a PLR

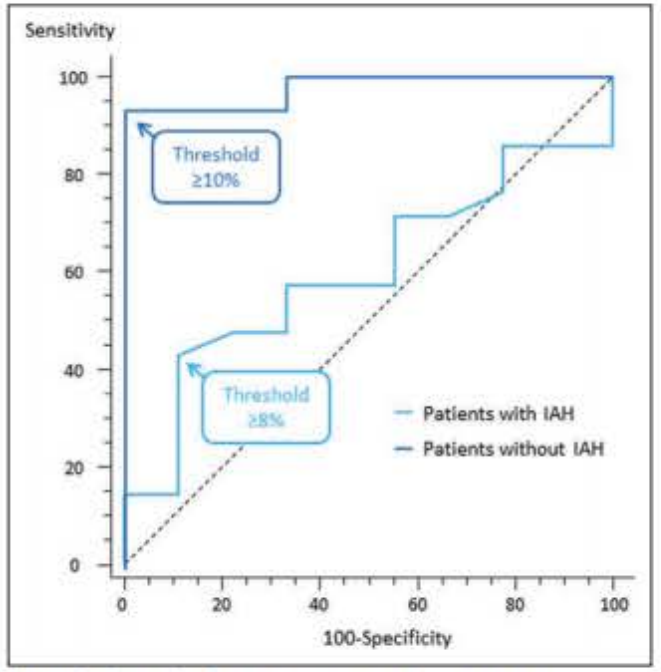


Intra-Abdominal Hypertension Is Responsible for False Negatives to the Passive Leg Raising Test

Alexandra Beurton, MD[1,2]; Jean-Louis Teboul, MD, PhD[1,2]; Valentina Girotto, MD[1]; Laura Galarza, MD[1]; Nadia Anguel, MD[1]; Christian Richard, MD[1]; Xavier Monnet, MD, PhD[1,2]

Crit Care Med 2019; 47:e639–e647

IAP ≥ 12 mmHg



Fluid challenge

New Concepts in the Diagnosis and Fluid Treatment of Circulatory Shock

Thirteenth Annual Becton, Dickinson and Company Oscar Schwidetsky Memorial Lecture

Max H. Weil, MD, PhD., and Robert J. Henning, MD

1979

Continuing Medical Education Article

Fluid challenge revisited

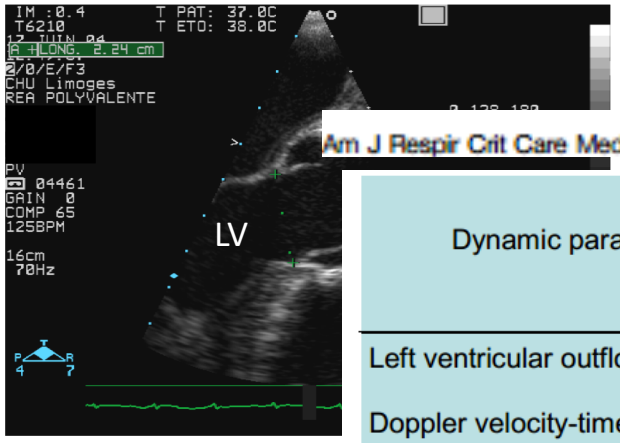
Jean-Louis Vincent, MD, PhD, FCCM; Max Harry Weil, MD, PhD, ScD (Hon), FCCM

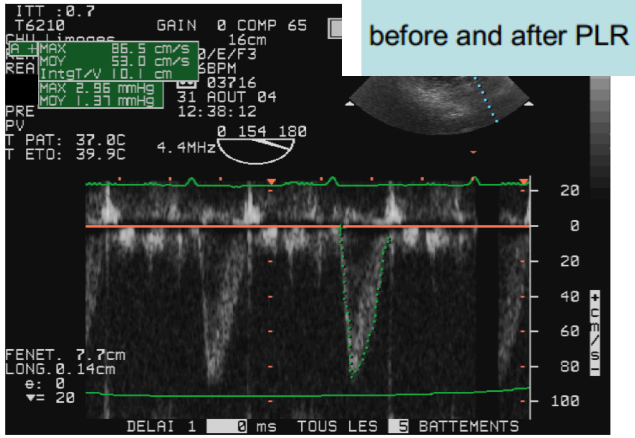
2006

- Remains valuable in case of **undetermined / discrepant dynamic indices**
- Prompt correction of volume deficit while minimizing the risk of volume overload
- Quantify the cardiovascular response to fluid infusion
- **Speed** of administration > **volume** infused (“mini” fluid challenge)
- Close monitoring of both efficacy (responder vs not) and tolerance (↑ filling pressures).

Stroke volume changes

Baseline LVSV: 40 mL



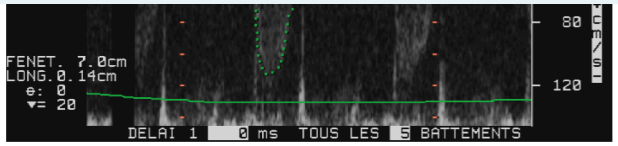


Am J Respir Crit Care Med Vol 195, Iss 8, pp 1022–1032, Apr 15, 2017

After fluid challenge

LVSV: 68 mL

Dynamic parameters	Inter-observer	Intra-observer
Left ventricular outflow tract Doppler velocity-time integral before and after PLR	0.932 (0.886-0.960)	0.978 (0.972-0.987)



LV outflow tract & aortic annulus areas are fixed: ΔVTI ~ ΔSV

Jozwiak et al. Critical Care (2019) 23:116
https://doi.org/10.1186/s13054-019-2413-x

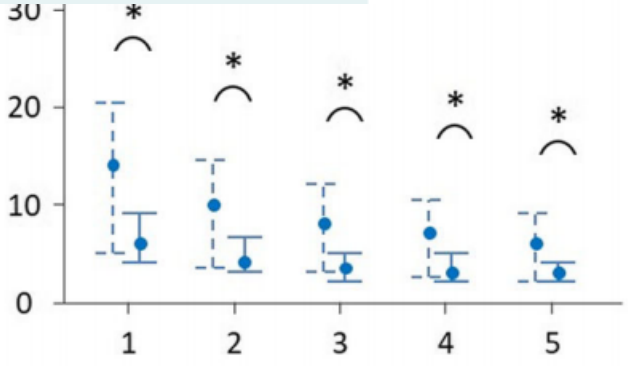
Critical Care

RESEARCH Open Access

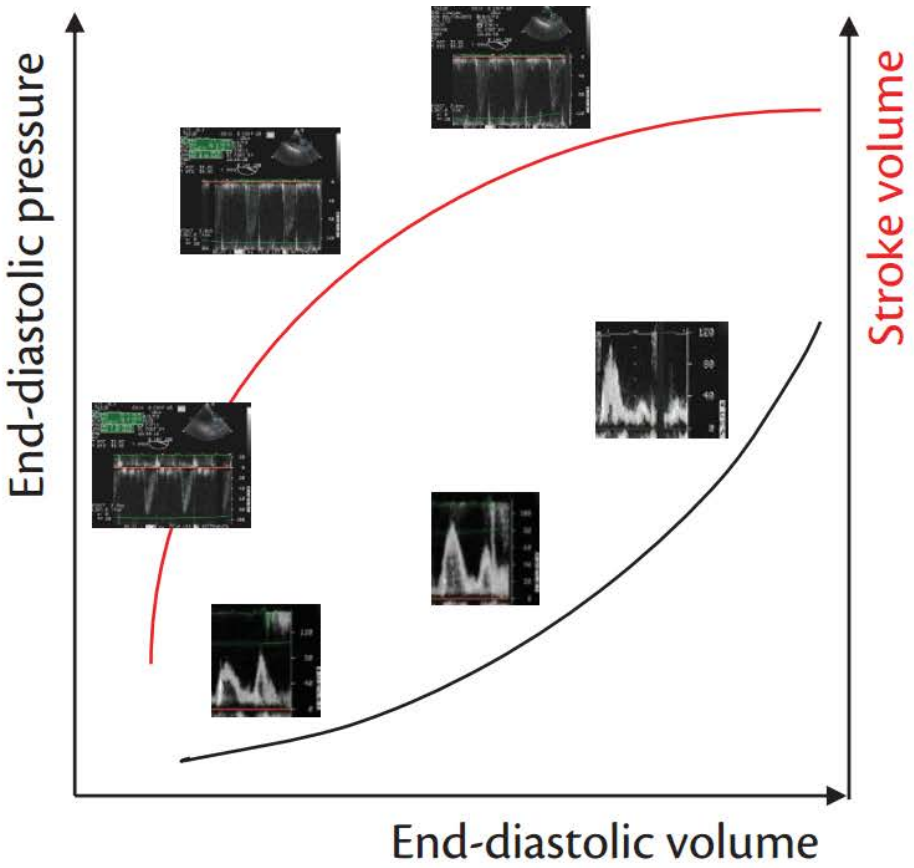
What is the lowest change in cardiac output that transthoracic echocardiography can detect?

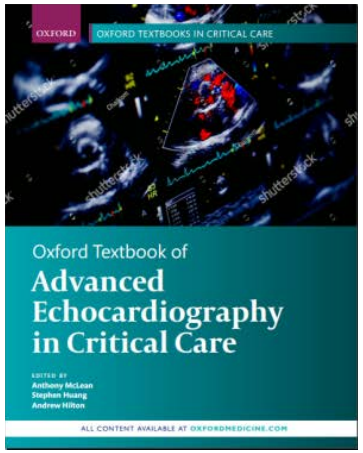
ar Benmalek[3], Julia Gimenez[1,2],

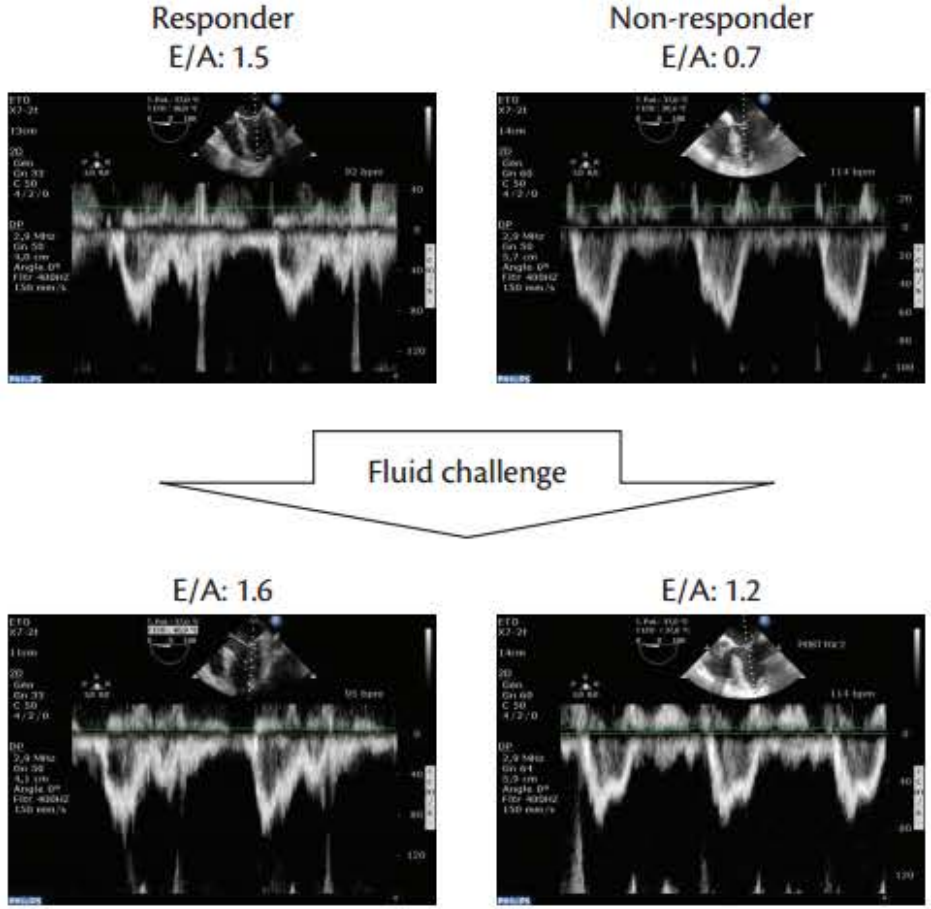
rythm fibrillation



Hemodynamic tolerance







"Mini" fluid challenge

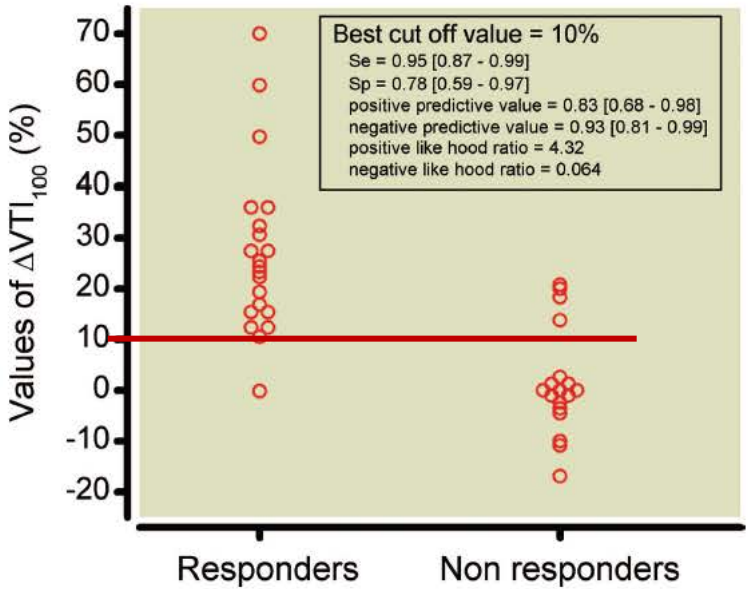
An Increase in Aortic Blood Flow after an Infusion of 100 ml Colloid over 1 Minute Can Predict Fluid Responsiveness

The Mini-fluid Challenge Study

Laurent Muller, M.D., M.Sc.,* Medhi Toumi, M.D.,* Philippe-Jean Bousquet, M.D.,† Béatrice Riu-Poulenc, M.D.,‡ Guillaume Louart, M.D.,* Damien Candela, M.D.,* Lana Zoric, M.D.,* Carey Suehs, Ph.D.,† Jean-Emmanuel de La Coussaye, M.D., Ph.D.,§ Nicolas Molinari, Ph.D.,† Jean-Yves Lefrant, M.D., Ph.D.,§ in the AzuRéa Group

Anesthesiology 2011 ; 115 : 541-7

An increase of VTI > 10% after a 1-min infusion of 100 mL predicts an increase of cardiac output > 15% after a 20-min fluid challenge of 500 mL

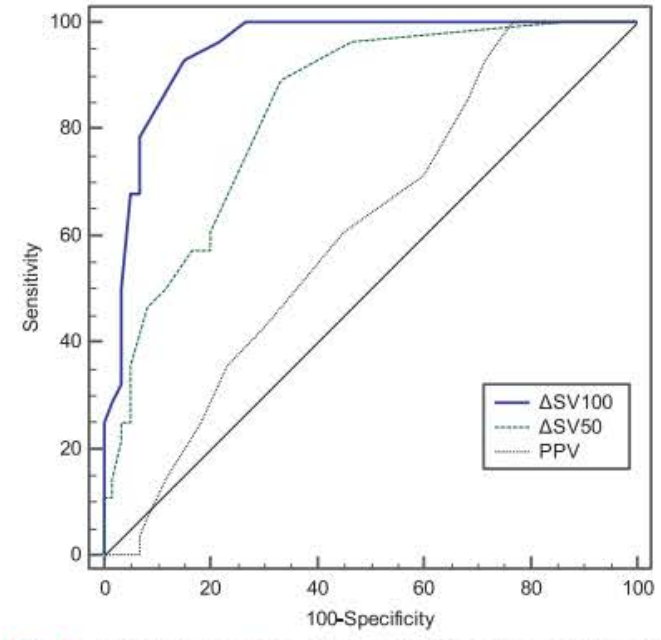


Mini-fluid Challenge of 100 ml of Crystalloid Predicts Fluid Responsiveness in the Operating Room

Matthieu Biais, M.D., Ph.D., Hugues de Courson, M.D., Romain Lanchon, M.D., Bruno Pereira, Ph.D., Guillaume Bardonneau, M.D., Marion Griton, M.D., Musa Sesay, M.D., Karine Nouette-Gaulain, M.D., Ph.D.

(ANESTHESIOLOGY 2017; 127:450-6)

An increase of VTI > 6% after a 2-min infusion of 100 mL predicts an increase of cardiac output > 10% after a 5-min fluid challenge of 250 mL



Evaluation des besoins en remplissage vasculaire

- **Optimization phase** of acute circulatory failure
- Use of **dynamic indices** to **predict** fluid responsiveness
- Choice of **adapted** indices according to **clinical settings**
- Require **concordant** indices / **PLR** if discordant or “borderline” indices
- Each index has its **own limitations**
- Fluid challenge: **prefer speed vs. volume** of infusion (“mini” fluid challenge)
- Monitor **efficacy** (predefine clinical target) **& tolerance** (semi-quantitative filling pressures).