DIU TUSAR

Bordeaux – Lundi 15 décembre 2025

Formation à l'échocardiographie en réanimation & impact thérapeutique

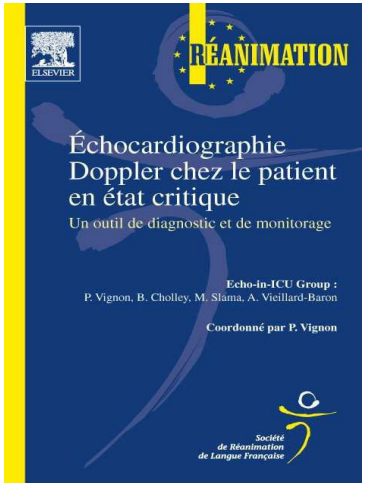
Philippe Vignon

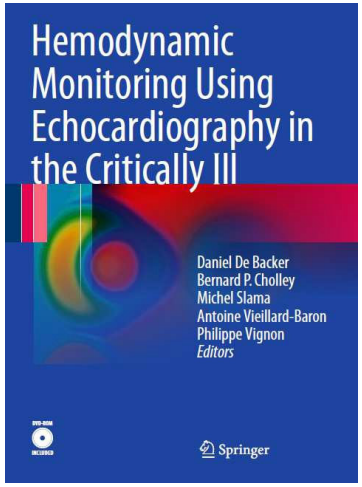
Réanimation Polyvalente
Inserm CIC 1435
CHU Limoges

DIU TUSAR

Bordeaux – Lundi 15 décembre 2025

Conflit d'intérêt





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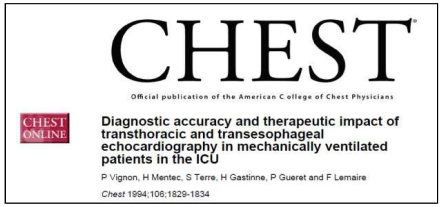
Historique

D'où vient-on ?

1990 — 2025


CHEST

Official publication of the American College of Chest Physicians

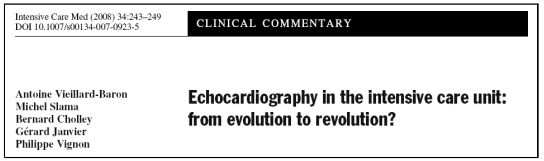
CHEST ONLINE

Diagnostic accuracy and therapeutic impact of transthoracic and transesophageal echocardiography in mechanically ventilated patients in the ICU

P Vignon, H Mentec, S Terre, H Gastinne, P Gueret and F Lemaire

Chest 1994;106:1829-1834

Etudes monocentriques descriptives

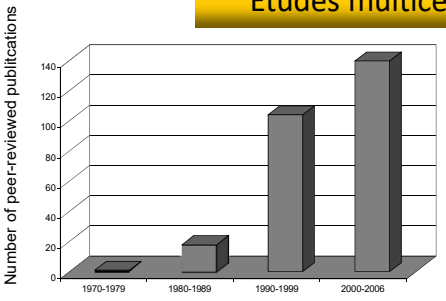

Intensive Care Med (2008) 34:243–249
DOI 10.1007/s00134-007-0923-5

CLINICAL COMMENTARY

Antoine Vieillard-Baron
Michel Slama
Bernard Cholley
Gérard Janvier
Philippe Vignon

Echocardiography in the intensive care unit: from evolution to revolution?

Etudes multicentriques descriptives

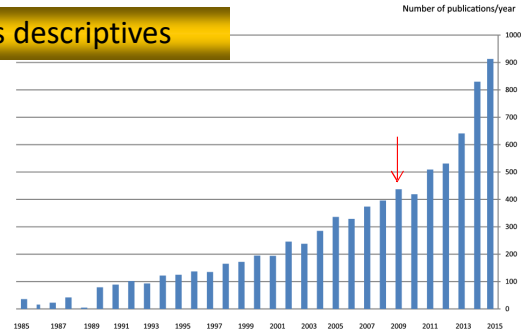



Intensive Care Med (2017) 43:1257–1269
DOI 10.1007/s00134-017-4734-z

RESEARCH AGENDA

The ICM research agenda on critical care ultrasonography

P. Mayo[1*], R. Arntfield[2], M. Balik[3], P. Kory[4], G. Mathis[5], G. Schmidt[6], M. Slama[7,8], G. Volpicelli[9], N. Xirouchaki[10], A. McLean[11] and A. Vieillard-Baron[12,13]



Identité de la *Critical Care Echocardiography*

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

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

Echocardiographie en Réanimation	Echocardiographie en Cardiologie
Indication principale : insuffisance circulatoire et/ou respiratoire	Indication principale : cardiopathies
Réalisation au lit du patient par le réanimateur	Réalisation au laboration d'échocardiographie par le cardiologue ou l'infirmière formée
Interprétation en temps réel par le médecin réanimateur	Interprétation en temps réel ou à distance par le cardiologue
Guide immédiatement la démarche diagnostique de pathologie aiguë ou chroniques décompensées	Evaluation de pathologies cardiovasculaires chroniques parfois complexes
Disponibilité permanente 24/7	Réalisation programmée aux heures ouvrables
Patients fréquemment ventilés (interactions cardiopulmonaires)	Patients en ventilation spontanée et parfois ambulatoires
Echocardiographie transoesophagienne fréquemment requise et facile à réaliser sous sédation (ventilation mécanique)	Echocardiographie transthoracique le plus souvent pratiquée car qualité d'images souvent suffisante
Utilisation fréquente d'une évaluation ciblée	Examen exhaustif répondant à l'état de l'art
Evaluation qualitative, semi-quantitative ou quantitative utilisant des paramètres simples et reproductibles	Evaluation quantitative utilisant en routine l'ensemble des outils disponibles (ex, strain, imagerie tridimensionnelle)
Impact thérapeutique immédiat (y compris indication chirurgicale)	Impact thérapeutique en règle retardé (modification du traitement au long cours)
Evaluations répétées voire monitoring, suivi à court terme	Evaluation ponctuelle, suivi à long terme

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

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*

2014

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

CONFERENCE REPORTS AND EXPERT PANEL

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

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

2025

Intensive Care Med (2025) 51:1971–2012
https://doi.org/10.1007/s00134-025-08137-z

CONFERENCE REPORTS AND EXPERT PANEL

ESICM guidelines on circulatory shock and hemodynamic monitoring 2025

Xavier Monnet[1*], Antonio Messina[2,3], Massimiliano Greco[2,3], Jan Bakker[5,6], Nadia Aissaoui[4], Maurizio Cecconi[2,3], Giacomo Coppalini[2], Daniel De Backer[7], Vanina Kanoore Edul[8], Laura Evans[9], Glenn Hernández[6], Oliver Hunsicker[10], Can Ince[5], Thomas Kaufmann[11], Bruno Levy[12], Manu L. N. G. Malbrain[13,14], Alexandre Mebazaa[15], Sheila Nainan Myatra[16], Marlies Ostermann[17], Michael R. Pinsky[18], Bernd Saugel[19], Marzia Savi[2], Mervyn Singer[20], Jean-Louis Teboul[21], Antoine Vieillard-Baron[22], Jean-Louis Vincent[23] and Michelle S. Chew[24]

HAEMODYNAMIC MONITORING — SUMMARY OF CLINICAL QUESTIONS AND RECOMMENDATIONS

Recommendation strength: S suggest against; W weak recommendation; S strong recommendation; D ungraded definition; ungraded good practice statement; unable to provide recommendation
Certainty of evidence: VL very low; L low; M moderate; H high; ? ungraded
Agreement strength: weak; moderate; strong
[2014] Statement of recommendation: ungraded, best practice statement; ungraded, statement of fact
[2014] Certainty of evidence: level 1, QoE B; level 1, QoE C; level 2, QoE B; level 2, QoE C

	Recommendation strength	Certainty of evidence	Agreement strength
→ We suggest using echocardiography as the first line imaging modality to assess the type of shock and hemodynamic status.	R	L	
2014 — *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 B]			
2014 — *Serial echocardiographic evaluations should be performed to provide additional information on cardiac function, even when CO is monitored.* [ungraded, best practice statement]			
2014 — *Echocardiography can be used for the sequential evaluation of cardiac function in shock.* [ungraded, statement of fact]			
→ Serial echocardiographic evaluations should be performed to provide additional information on cardiac function, even when CO is monitored.		?	

ECHOCARDIOGRAPHY — SUMMARY OF CLINICAL QUESTIONS AND RECOMMENDATIONS

Recommendation strength: S suggest against; W weak recommendation; S strong recommendation; D ungraded definition; ungraded good practice statement; unable to provide recommendation
Certainty of evidence: VL very low; L low; M moderate; H high; ? ungraded
Agreement strength: weak; moderate; strong
[2014] Statement of recommendation: ungraded, best practice statement; ungraded, statement of fact
[2014] Certainty of evidence: level 1, QoE B; level 1, QoE C; level 2, QoE B; level 2, QoE C

	Recommendation strength	Certainty of evidence	Agreement strength
IN PATIENTS WITH SHOCK, DOES PERFORMING ECHOCARDIOGRAPHY IMPROVE CLINICAL OUTCOMES?			
→ We suggest performing one or more echocardiograms in patients with circulatory shock.	R	L	
2014 — *Echocardiography can be used for the sequential evaluation of cardiac function in shock.* [ungraded, best practice statement]			
IN PATIENTS WITH SHOCK, DOES THE PRESENCE OF ECHOCARDIOGRAPHIC ABNORMALITIES PROVIDE ADDITIONAL PROGNOSTIC INFORMATION FOR CLINICAL OUTCOMES?			
→ In patients with shock, echocardiographically defined phenotypes of left and RV systolic function may be of prognostic significance.	R	VL	
IN PATIENTS WITH SHOCK, WHAT IS THE IMMEDIATE THERAPEUTIC IMPACT OF ECHOCARDIOGRAPHY?			
→ In patients with circulatory shock, echocardiography leads to changes in management and supports therapeutic impact.		?	

Historique

Formation

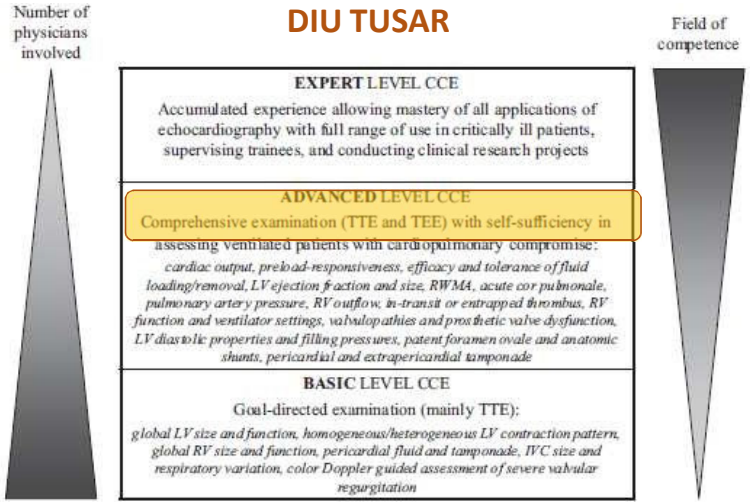
EDITORIAL

PRO: Physician-Performed Ultrasound: The Time Has Come for Routine Use in Acute Care Medicine

P. Vignon, MD, PhD

Anesth Analgesia 2012

DIU TUSAR



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

CONFERENCE REPORTS AND EXPERT PANEL

Expert Round Table on Echocardiography in ICU

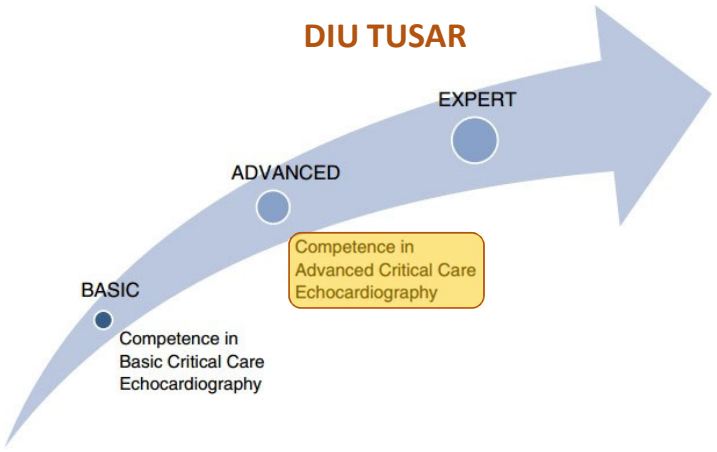
International consensus statement on training standards for advanced critical care echocardiography

Table 4 Clinical applications of advanced critical care echocardiography

Clinical settings
1. Circulatory failure (sustained hypotension, shock)
2. Cardiac arrest
a. During resuscitation
b. After successful resuscitation
3. Acute respiratory failure
a. Severe hypoxemia with bilateral radiological infiltrates
b. ARDS
c. Decompensated chronic respiratory failure
d. Weaning failure from the ventilator
e. Unexplained sustained hypoxemia
4. Specific clinical settings
a. Suspected systemic embolism
b. Suspected acute infective endocarditis
c. Acute aortic syndrome
d. Severe chest trauma
e. Circulatory assistance
f. Brain dead donor

Historique

Formation



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

2011

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

EXPERT PANEL

Expert Round Table on Ultrasound in ICU

International expert statement on training standards for critical care ultrasonography

2014

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

CONFERENCE REPORTS AND EXPERT PANEL

Expert Round Table on Echocardiography in ICU

International consensus statement on training standards for advanced critical care echocardiography

Historique

Formation

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

EXPERT PANEL

Expert Round Table
on Ultrasound in ICU

International expert statement on training standards for critical care ultrasonography

Statements

Preliminary general statements

All experts (100%) agreed upon the facts that:

- Basic-level critical care echocardiography and general critical care ultrasound should be a required part of the training of every ICU physician.
- Advanced-level critical care echocardiography is an optional component of the training of the ICU physician.

Intensivists who want to achieve competence in advanced CCE must be trained to basic-level CCE as a prerequisite (100% agreement).

DIU TUSAR :
100 ETT
50 ETO vues
(25 ETO réalisées)

1. Theoretical program:

Course design should include specific learning goals as described in the ACCP/SRLF competence statement [14]. The minimum number of hours for course design required to teach advanced CCE is 40 h, to be divided between lectures and didactic cases with image-based training (100% agreement).

3. What is the required number of examinations to be performed by the trainee?

Trainees must acquire competencies in TTE and TEE (100% agreement). There was a consensus that TEE is mandatory for advanced CCE. Review of the literature suggests that 150 fully supervised TTE studies and 50 fully supervised TEE studies are a reasonable training target to achieve competence in image acquisition and interpretation [24, 25]. Trainees should learn advanced CCE with a locally qualified physician supervisor. Using validated scoring system to evaluate acquisition of competencies at bedside has been proposed [23]. A maximum period of 2 years is recommended to collect the appropriate number of echocardiographic studies.

5. What should be the format for documenting practical training in image acquisition and interpretation?

Each trainee must maintain a logbook of their scanning activity that includes reports of studies performed and/or interpreted. Trainees should write reports of their image interpretation, and the reports be cosigned by trainee and supervisor to attest that the findings have been verified by a physician who is qualified in advanced CCE.

Historique

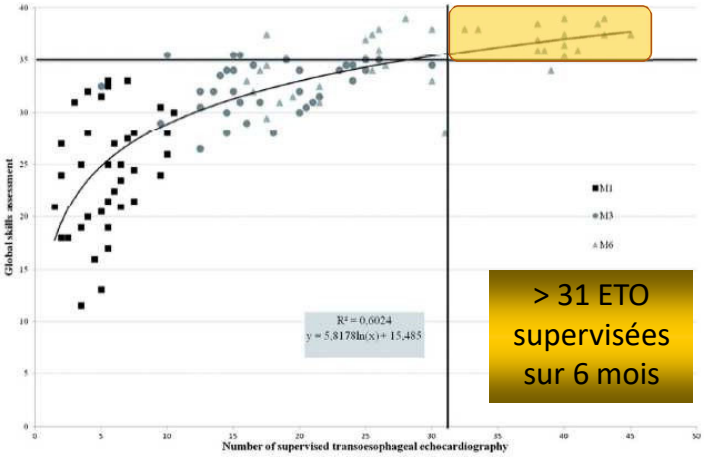
Formation

Intensive Care Med (2013) 39:1019–1024
DOI 10.1007/s00134-013-2838-7

ORIGINAL

Cyril Charron
Philippe Vignon
Gwenaël Prat
Alexandre Tonnelier
Philippe Aegerter
Jean-Michel Boles
Jean-Bernard Amiel
Antoine Vieillard-Baron

Number of supervised studies required to reach competence in advanced critical care transesophageal echocardiography



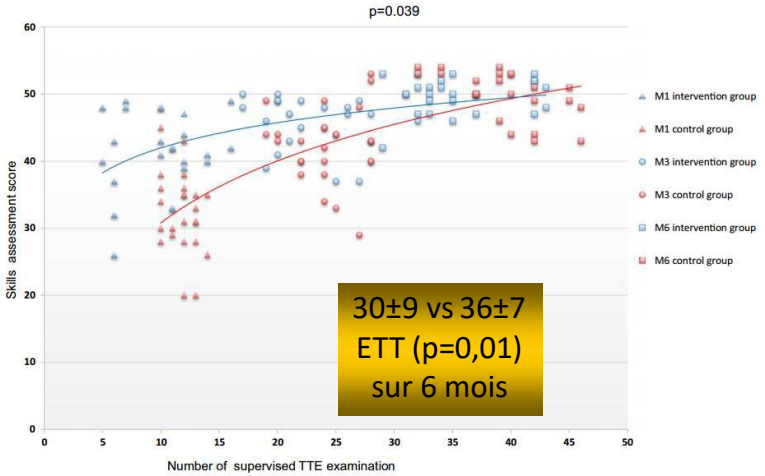
> 31 ETO supervisées sur 6 mois

Intensive Care Med (2018) 44:1097–1105
https://doi.org/10.1007/s00134-018-5248-z

ORIGINAL

Acceleration of the learning curve for mastering basic critical care echocardiography using computerized simulation

Philippe Vignon[1,2,3,9*], Benjamin Pegot[1], François Dalmay[4], Vanessa Jean-Michel[5], Simon Bocher[5], Erwan L'her[5,6,7], Jérôme Cros[8], Gwenaël Prat[5] and EchoSimu Group

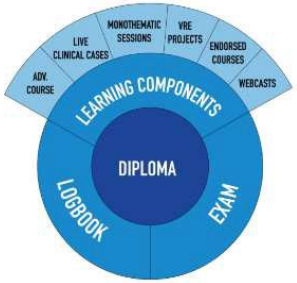


30±9 vs 36±7 ETT (p=0,01) sur 6 mois

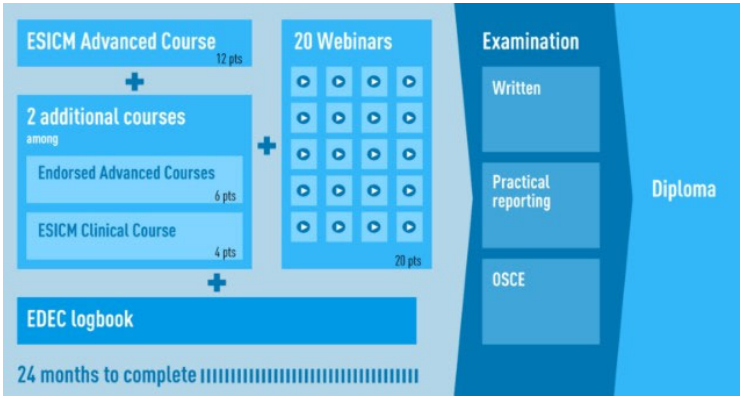
Historique

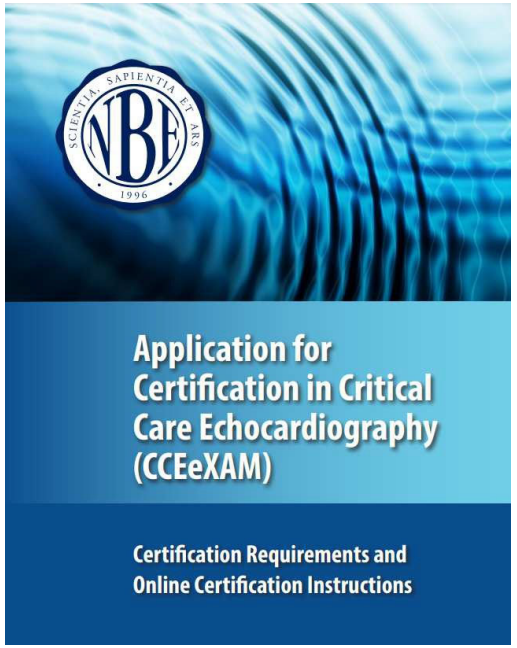
Formation

European Diploma in advanced critical care EchoCardiography (EDEC)



100 ETT et 35 ETO supervisées





Historique — Formation — **Impact thérapeutique**

Diagnostic accuracy and therapeutic impact of transthoracic and transesophageal echocardiography in mechanically ventilated patients in the ICU

P Vignon, H Mentec, S Terre, H Gastinne, P Gueret and F Lemaire

Chest 1994;106;1829-1834

Table 2—*Therapeutic Impact of Transthoracic (TTE) and Transesophageal Echocardiography (TEE)**

Therapeutic Changes		TEE (n=128)	TEE (n=96)
Catecholamines infusion	(n=21)	10	11 (1)
Fluid challenge	(n=18)	6	12 (4)
Rapid cardiovascular surgery	(n=10)	2	8
Anticoagulation or fibrinolytic agents	(n=2)	1	1
Antibiotics for endocarditis	(n=2)	0	2
β-blockers	(n=1)	0	1
Pericardiocentesis	(n=1)	1	0
Total	(n=55)	20	35

137 patients ventilés

Concordance : ¾ cas (experts)

Discordance identifiée par ETO : 16/37 pts (43%)

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

CHEST 2018; 153(1):55-64

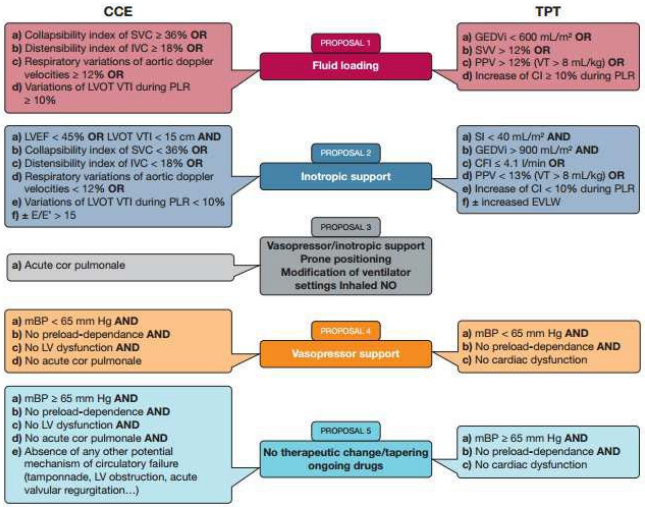


TABLE I.—*Studies evaluating impact of TEE on patient management in the ICU. With permission from Hüttemann et al.*[10]

Author	Design	Year	Study period (month)	TEE (N)	ICU-type (%)	Mortality (%)	Patients studied (% of ICU admissions)	Ventilated patients (%)	Feasibility	Complications (%)	Impact			
											Diagnostic	Overall therapeutic	Non-surgical*	Surgical
Alam [2]	R	1996	48	121	CICU	N/A	N/A	22	98 [1]	0	58	25	7	19
Bruch [3]	R	2003	12	117	M (52%) CT-SICU (48%)	N/A	N/A	N/A	100	2	43	43	33	10
Chenzbrraun [4]	R	1994	39	113	CT-SICU (52%) MICU (34%) CCU (13%)	N/A	N/A	65	N/A [2]	7	45	26	8	18
Colreavy [5]	R	2002	48	308	MICU (68%) CT-SICU (32%)	38	4.2	99	99 [3]	2	55	33	20	13
Font [6]	R	1991	26	112	CICU	N/A	N/A	40	N/A	0	99	16	4	12
Foster [7]	R	1992	30	83	GICU (50%) CCU (47%) M (3%)	N/A	N/A	N/A	N/A	0	77	32	13	19
Harris [8]	R	1999	18	206	CICU	23	N/A	N/A	N/A	N/A	47	32	19	13
Heidenreich [9]	P	1995	14	61	CICU	48	N/A	91	97 [4]	5	97	61	41	20
Hüttemann [10]	R	2004	42	216	SICU	44	6,6	98	100	6	88	69	63	6
Hwang [11]	R	1993	24	78	GICU (60%) ER (40%)	N/A	N/A	21	98 [5]	0	85	N/A	N/A	26
Khoury [12]	R	1994	41	77	SICU (48%) CCU (24%) MICU (19%) NICU (7%)	N/A	N/A	47	100 [6]	3	64	48	19	29
McLean [13]	R	1998	24	53	GICU	N/A	3,2	N/A	100	N/A	45	10	8	2
Oh [14]	R	1990	12	51	CCU (49%) SICU (29,4%) MICU (21,5%)	N/A	N/A	59	98	4	59	N/A	N/A	24
Pearson [15]	R	1990	10	62	CCU (45%) CT-SICU (21%) MICU (19%) SICU (11%)	N/A	N/A	36	98 [7]	5	44	N/A	N/A	8
Poelaert [16]	R	1995	7	103	GICU	51	11	56	N/A	1	74	44	30	14
Puybasset [17]	P	1993	10	32	MICU (53%) CT-SICU (34%) SICU (13%)	61	N/A	100	100	0	78	N/A	N/A	N/A
Schmidlin [18]	R	2001	48	301	CT-SICU	22	8,2	100	100	4	73	60	46	14
Slama [19]	R	1996	18	61 127	MICU (52%) CT-SICU (48%)	39	9,1	66	100	20	45	20	12	8
Sohn [20]	R	1995 1994	78 12	96 130	MICU (56%) CT-SICU (44%)	51 N/A	N/A N/A	81 86	98 100	2	52	N/A	N/A	21
Vignon [21]	P R	2001	36		MICU (57%) CT-SICU (43%)	24	2,1	100	100	0	97	41	33	8
Wake [22]					CT-SICU					0	91	58	43	15
Total				2508					(weighted mean)	(weighted mean)	67.2	36		14.1

Miniaturisation des appareils

2011

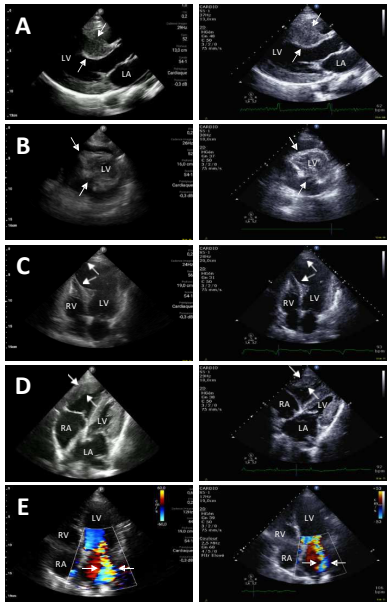
Intensive Care Med (2018) 44:1579–1581
https://doi.org/10.1007/s00134-018-5225-6

LETTER

Diagnostic capability of a next-generation, ultra-miniaturized ultrasound system in patients with cardiopulmonary compromise assessed using basic critical care echocardiography

Marine Goudelin[1,2], Bruno Evrard[1,2], François Dalmay[3], Ana Hernandez Padilla[1,4], Céline Gonzalez[1,2], Thomas Lafon[2,4,5], Thomas Daix[1,4], Anne-Laure Fedou[1,4], Bruno François[1,4] and Philippe Vignon[1,2,4*]

2017

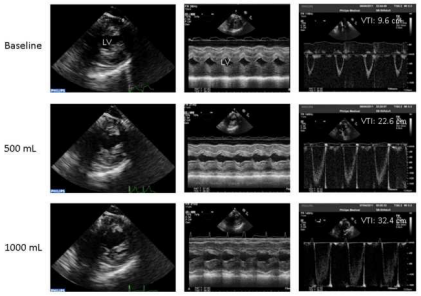


Intensive Care Med (2015) 41:1886–1894
DOI 10.1007/s00134-015-3998-4

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



Sondes ETO à usage unique

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

ORIGINAL

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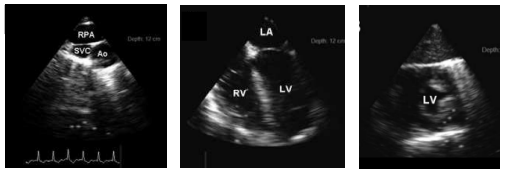
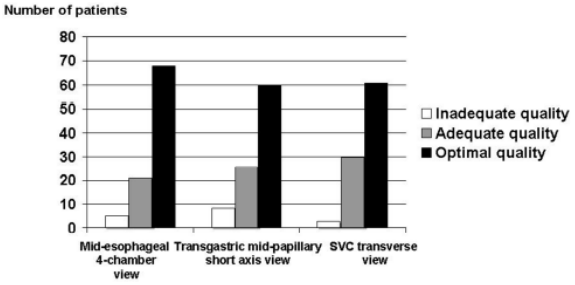
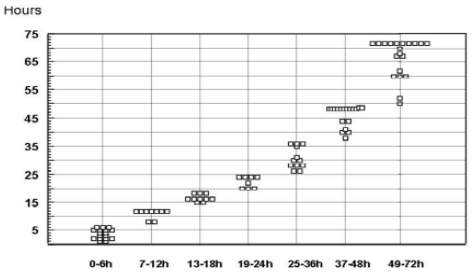
A pilot study on safety and clinical utility of a single-use 72-hour indwelling transesophageal echocardiography probe

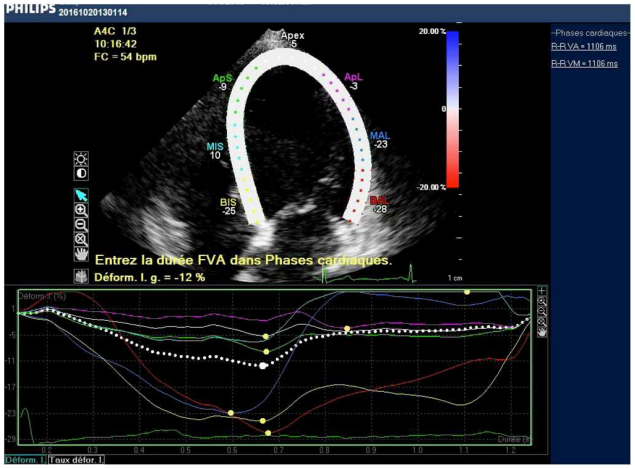
94 patients ventilés dans 4 centres

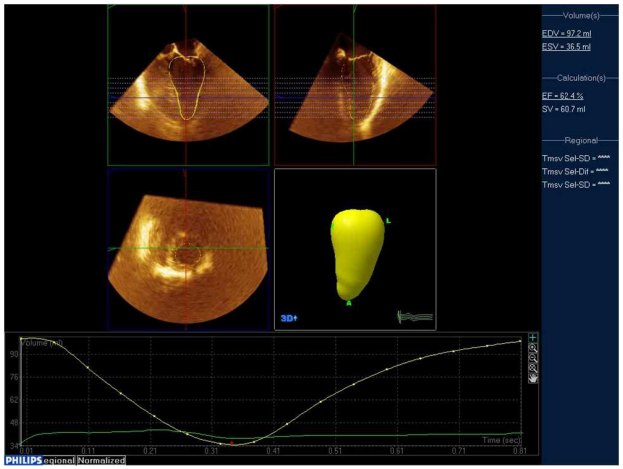






Strain & échocardiographie tridimensionnelle temps réel





Formation & impact thérapeutique



- L'échocardiographie en réanimation est **reconnue** avec ses **spécificités**
- Elle doit être **réalisée et interprétée par le réanimateur** pour l'intégrer dans la prise en charge
- Elle est recommandée en **1ère intention pour l'évaluation hémodynamique** du patientchoqué
- Elle est utilisée de manière **répétée** (monitoring) **plus que ponctuelle** (diagnostic)
- Elle évalue **l'efficacité** et la **tolérance** de l'intervention thérapeutique (ex, remplissage vasculaire)
- Elle identifie les limites de techniques de monitoring aveugles (thermodilution transpulmonaire)
- L'ETO est fondamentale en post-opératoire de chirurgie cardiaque et en cas d'ECMO.