

# Echographie cardiaque et pulmonaire aux urgences

B.Lambermont

Interniste - Intensiviste

CHU Sart Tilman

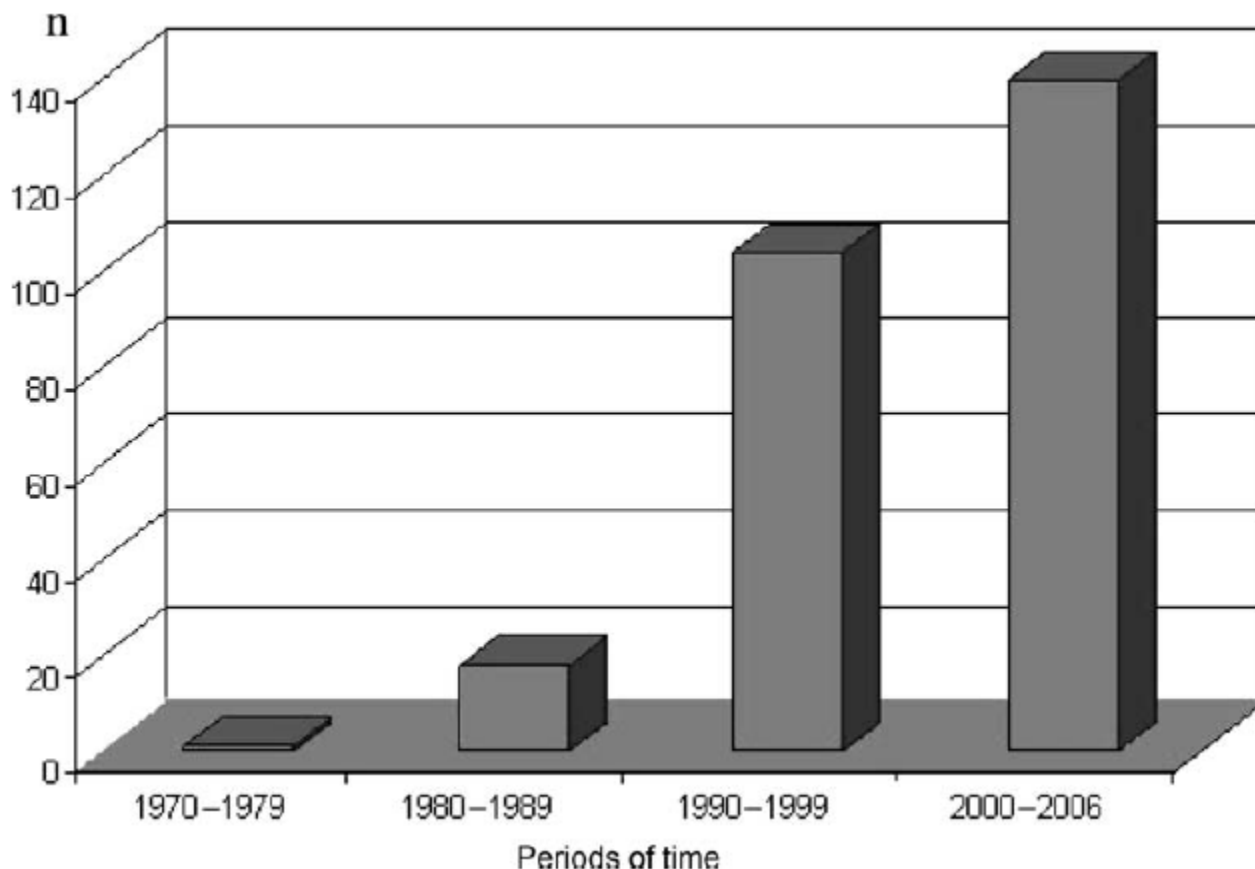
# Plan de l'exposé

- Echographie cardiaque:
  - Les différentes incidences de l'échographie cardiaque
  - Examens pathologiques de base: épanchement péricardique, dysfonction du VG, dilatation des cavités droites, diamètre de la veine cave inférieure
  - Les grands syndromes: douleur thoracique, dyspnée, choc
- Echographie pulmonaire:
  - Images anatomiques
  - Images basées sur les artefacts

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

**Fig. 2** Search in PubMed ([www.ncbi.nlm.nih.gov/PubMed](http://www.ncbi.nlm.nih.gov/PubMed)) for published manuscripts in peer-reviewed journals related to the use of echocardiography in ICU settings during four consecutive periods. The following keywords were used for the Medline search: "Critical Care" [MeSH] AND "Echocardiography" [MeSH], and "Intensive Care" [MeSH] AND "Echocardiography" [MeSH].  
*n*, number



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## **Echocardiography in the ICU: time for widespread use!**

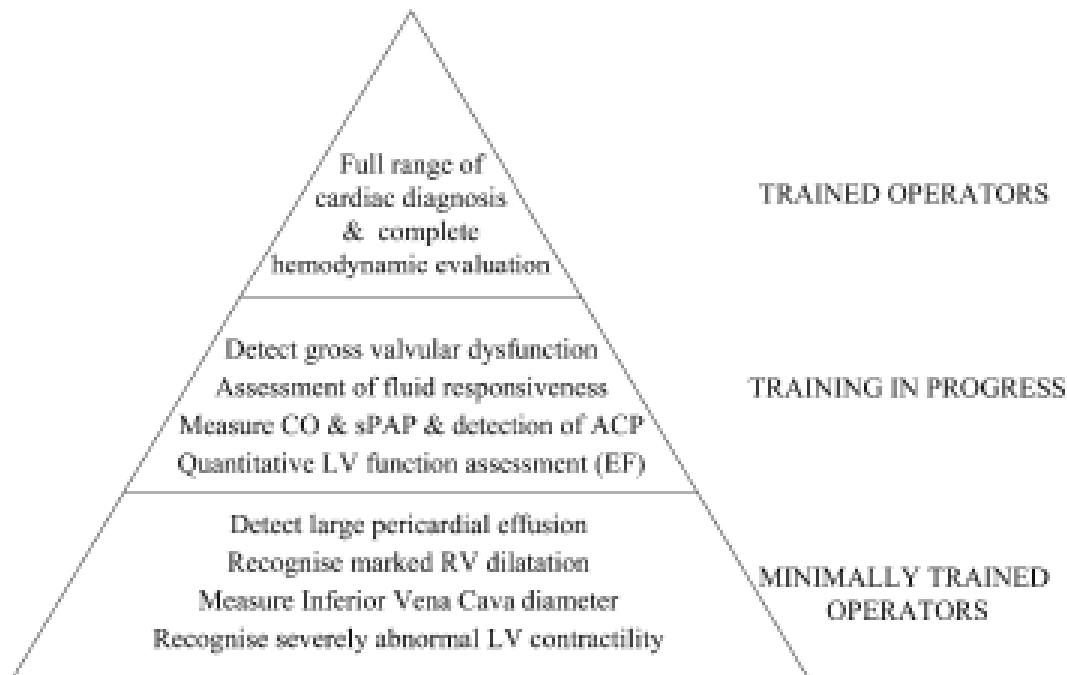
**Table 1** Potential clinical and echocardiographic findings on the intensive care unit. (HOCM hypertrophic obstructive cardiomyopathy, LVH left ventricular hypertrophy, LVOTO left ventricular outflow tract obstruction, VSD ventricular septal defect, ASD atrial septal defect, LV left ventricle, RV right ventricle, LA left atrium, RA right atrium, AS aortic stenosis, AR aortic regurgitation, MS mitral

stenosis, MR mitral regurgitation, TR tricuspid regurgitation, TEE trans-oesophageal echo, 2D two-dimensional echo, PW pulse-wave Doppler, CW continuous-wave Doppler, IVRT isovolumic relaxation time, RV LAX right ventricular long axis function, CABG coronary artery bypass graft, PE pulmonary embolus, CVA cerebrovascular accident, SIRS systemic inflammatory response syndrome)

| Clinical finding                                      | Cardiac cause  | Echocardiographic finding   | Notes  |
|---|--|---|--|
| Low cardiac output (unresponsive to inotropes)        | Valvular disease   | Any severe stenotic or regurgitant lesion   | Difficult to assess in ICU; sequential stenotic lesions may mask severity of individual lesions<br>See text  |
|   | Intrinsic cardiac disease  | HOCM/IVH with LVOTO<br>Large VSD/ASD<br>Severe LV/RV dysfunction  |  |
| Oliguria  | Extrinsic cardiac disease  | Tamponade, pericardial effusion, pericardial disease  | NB: Post-operative cardiac surgical patients (see text)  |
|   | Underfilling   | Low trans-mitral/tricuspid velocities<br>Small ventricular volumes<br>Apposition of LV papillary muscles in systole | If severe LVH papillary apposition may be unreliable sign  |
|   | Intrinsic cardiac disease  | Poor LV function, severe AS   | High LA pressure demonstrated  |
|   | Pericardial disease  | Pericardial effusion, pericardial tamponade, pericardial constriction   | NB: Post-operative cardiac surgical patients (see text)  |
| Increased filling pressures (left-sided)              | Impaired LV  | Increased E>A ratio (corrected for age), short IVRT   | See text for detailed explanation  |
|   | Mitral valve disease   | Significant MS or MR  | MR <sup>a</sup> : dynamic ventricle, increased forward velocities (>1m/s), short duration and low velocity (<3m/s) regurgitant jet                                       |
| Increased filling pressures (right-sided)             | Secondary to left-sided disease  | Significant AS, AR, MS, MR or LV disease  |  |
|   | Impaired RV  | Reduced RV LAX function   | Any reduction in association with pulmonary hypertension is significant; mild impairment after CABG is normal  |
| Sepsis/SIRS   | Tricuspid regurgitation  | Annular dilatation or endocarditis  | If severe, RV dynamic with increased forward velocities (>1m/s), short duration and low velocity regurgitant jet<br>Changes controversial and may be masked by inotropes |
|   | LV/RV dysfunction  | Systolic/diastolic dysfunction  |  |
| Endocarditis  | Source of sepsis   | Endocarditis  |  |
|   | Native/prosthetic valve, pacemaker wires, extra-cardiac "endocarditis" | Vegetations, paraprosthetic leaks, aortic root abscess  | Vegetations rare in prosthetic valve endocarditis  |
| Pulmonary hypertension                                | Acute PE   | Dilated RV, severe TR   | May rarely demonstrate intra-cardiac thrombus<br>Views often difficult even with TEE   |
|   | Post-pneumonectomy   | Displaced heart, Increased pulmonary acceleration time  |  |
|   | Mitral valve disease   | Significant MS or MR (2D, PW, CW and colour Doppler)  | Severe MR in ICU may be difficult to diagnose (see text and superscript a, above)  |
| Failure to wean from ventilator<br>CVA, embolic event | Intrinsic cardiac disease  | Ischaemia, severe MR, HOCM, LV/RV dysfunction   | Stress echo may be necessary to make diagnosis   |
|   | Intra-cardiac thrombus   | LA appendage, RA, apical LV thrombus<br>Endocarditis  | Exclude intra-cardiac shunt with contrast study  |
| Cyanosis  | Intra-cardiac shunting   | Positive contrast study   | Use agitated blood/saline; perform Valsalva manoeuvre  |

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# Echographie cardiaque: pyramide d'apprentissage



**Fig. 1** The “pyramid” of echocardiography skills in the intensive care unit (ICU). At the *top* are trained operators who have gone through formal training and board certification. They are in charge of teaching all other ICU physicians, especially those who are minimally trained to obtain “vital” information (*base of the pyramid*). In the *middle* are the physicians who are in the process of preparing their echocardiography certification and who are usually able to acquire additional relevant information using echocardiography. (*CO* cardiac output, *PAP* systolic pulmonary artery pressure, *ACP* acute cor pulmonale, *LV* left ventricle, *EF* ejection fraction)

# Programme d'apprentissage spécifique adapté aux intensivistes: exemple.

**Table 1** Specific educational program for intensivists and anesthesiologists during the second year of certification in echocardiography

- 
1. Heart–lung interactions
  2. Why and how to measure cardiac output using echocardiography?
  3. Echocardiographic assessment of fluid requirement: “static parameters”
  4. Echocardiographic assessment of fluid requirement: “dynamic parameters”
  5. Cardiovascular diseases in the ICU; myocardial infarction and its complications, aortic injuries, cardiac tamponade
  6. Hemodynamic evaluation using echocardiography in ARDS
  7. Hemodynamic evaluation using echocardiography in sepsis
  8. Echocardiographic diagnosis of a cardiogenic pulmonary edema
  9. Patent foramen ovale and intrapulmonary shunts
  10. Echocardiography in pulmonary embolism. Diagnostic and prognostic impact
  11. Perioperative evaluation of mitral valve repair
  12. Perioperative hemodynamic management
  13. Specific patterns of shock after cardiac surgery
  14. Respective indications of TTE and TEE; tolerance and pitfalls of TEE
  15. Case presentations
- 

*ICU*, intensive care unit; *ARDS*, acute respiratory distress syndrome; *TTE*, transthoracic echocardiography; *TEE*, transesophageal echocardiography



# Echographie cardiaque: examen de base

- Les différentes coupes:
  - Parasternal: grand axe et petit axe
  - Apicale: 4 cavités, 5 cavités
  - Sous-xyphoïdienne
- Les différents mode:
  - 2D
  - TM
  - Couleur
  - Doppler pulsé ou continu

Parasternale grand axe et petit axe

Apicale 2, 4 et 5 cavités

Sous xyphoide

Les différents mode:  
2D TM doppler

# Les pathologies de base

- Epanchement péricardique et tamponnade
- Dysfonction du VG
- Dilatation des cavités droites et mesure des pressions d'artère pulmonaire
- La veine cave inférieure

# Epanchement péricardique

# La tamponnade



# La dysfonction du VG

# Les cavités droites

## La mesure des PAP

# La veine cave inférieure

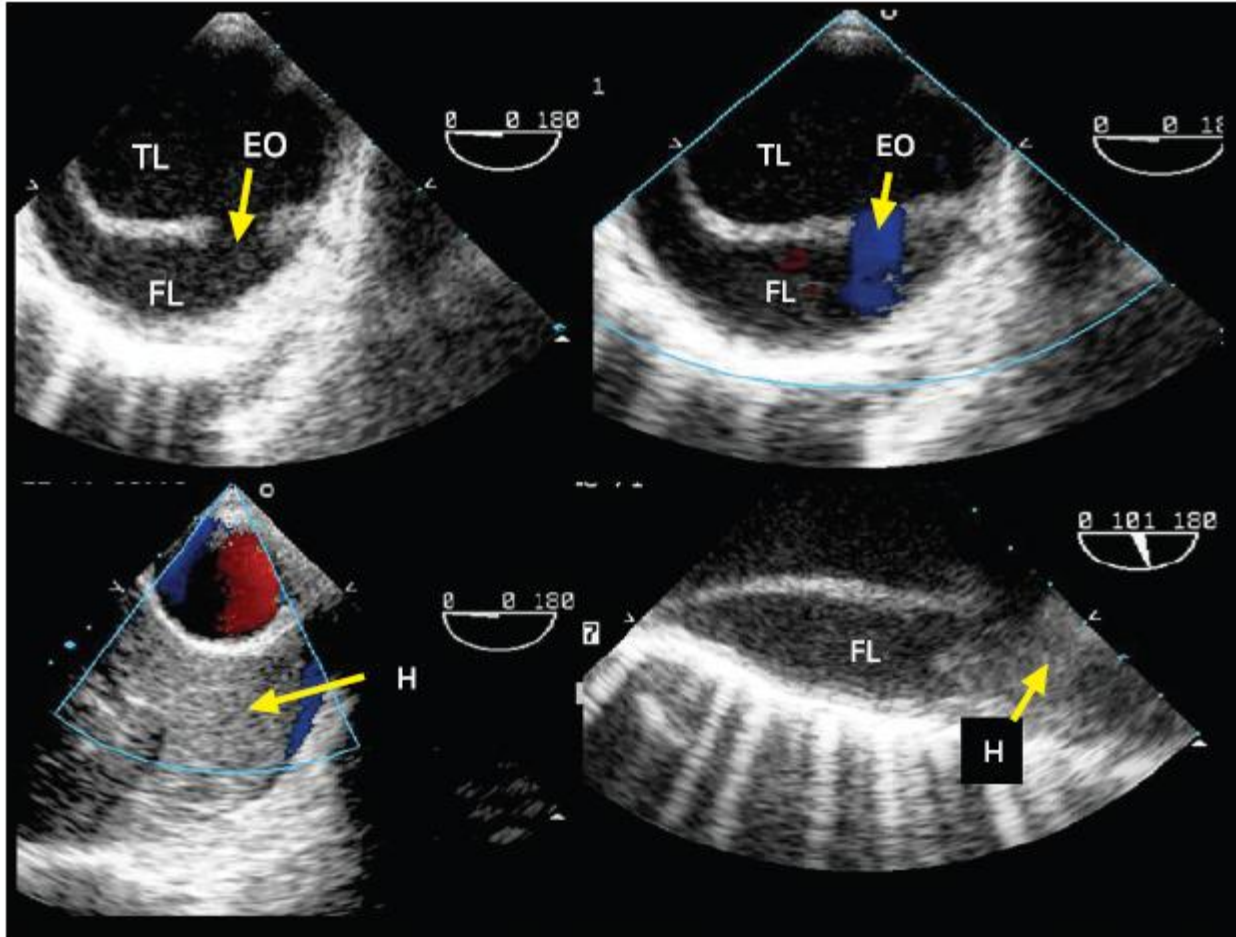
# Les syndromes

- La douleur thoracique
- Le choc
- La dyspnée

# La douleur thoracique: les causes décelables en échographie cardiaque

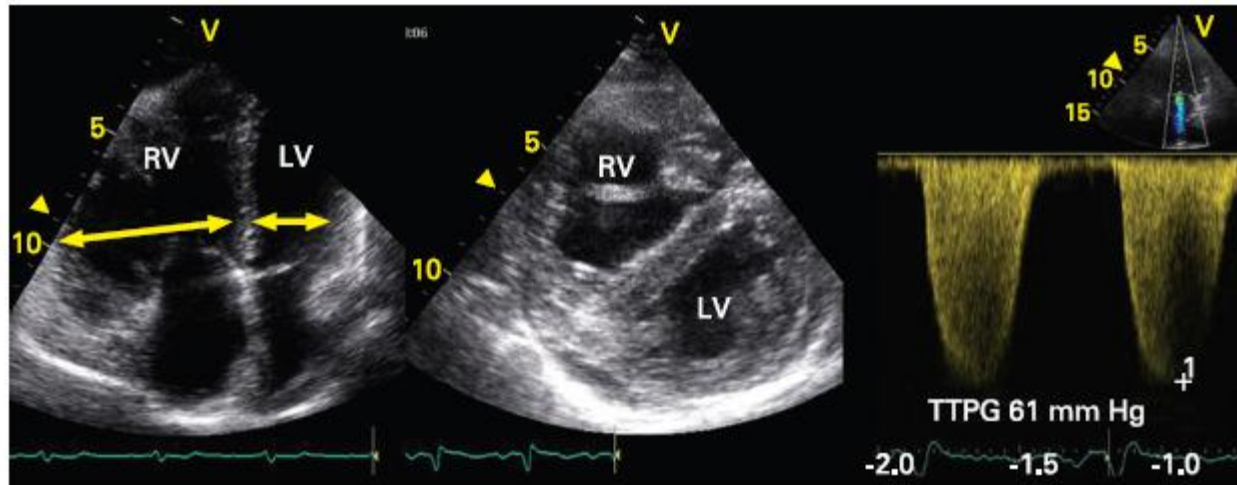
- Syndrome coronarien aigu
- Péricardite
- Dissection aortique (mauvaise sensibilité de l'ETT)
- Cardiomyopathie hypertrophique
- Sténose aortique
- Prolapsus valvulaire mitral
- Embolie pulmonaire

# Dissection aortique



**Figure 1** Transoesophageal echocardiographic examination obtained in a patient with acute aortic dissection. EO, entry orifice; FL, false lumen; H, intense spontaneous contrast + thrombus; TL, true lumen.

# Embolie pulmonaire



**Figure 2** Echocardiographic examination of a patient admitted for a recurrent episode of pulmonary embolism. The right ventricle (RV) was enlarged compared with the left ventricle (LV) and the ratio between end diastolic RV to LV diameter was  $>0.6$ . The trans-tricuspid pressure gradient (TTPG) was notably increased, indicating severe pulmonary hypertension.

# Les états de choc

- Choc hypovolémique: collapsus de la veine cave inférieure en inspiration spontanée, cavités cardiaques collabées
- Choc cardiogénique: dysfonction sévère du VG
- Choc obstructif: embolie pulmonaire, tamponnade
- Choc distributif: parfois association d'une hypovolémie, d'une dysfonction droite et / ou gauche (parfois démasquée par le remplissage et/ou le levophed), parfois présence d'un haut débit.



# La dyspnée

- Embolie pulmonaire
- Œdème aigu du poumon
- Exacerbation de BPCO
- Infection pulmonaire
- Epanchement pleural



**Echographie  
pulmonaire**

# L'échographie pulmonaire