Place de l'ECHOGRAPHIE cardiaque dans l'Insuffisance Cardiaque Aiguë

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CH Henri Duffaut
AVIGNON

DÉCLARATION DE RELATIONS PROFESSIONNELLES

Je n’ai pas de lien d’intérêt potentiel à déclarer

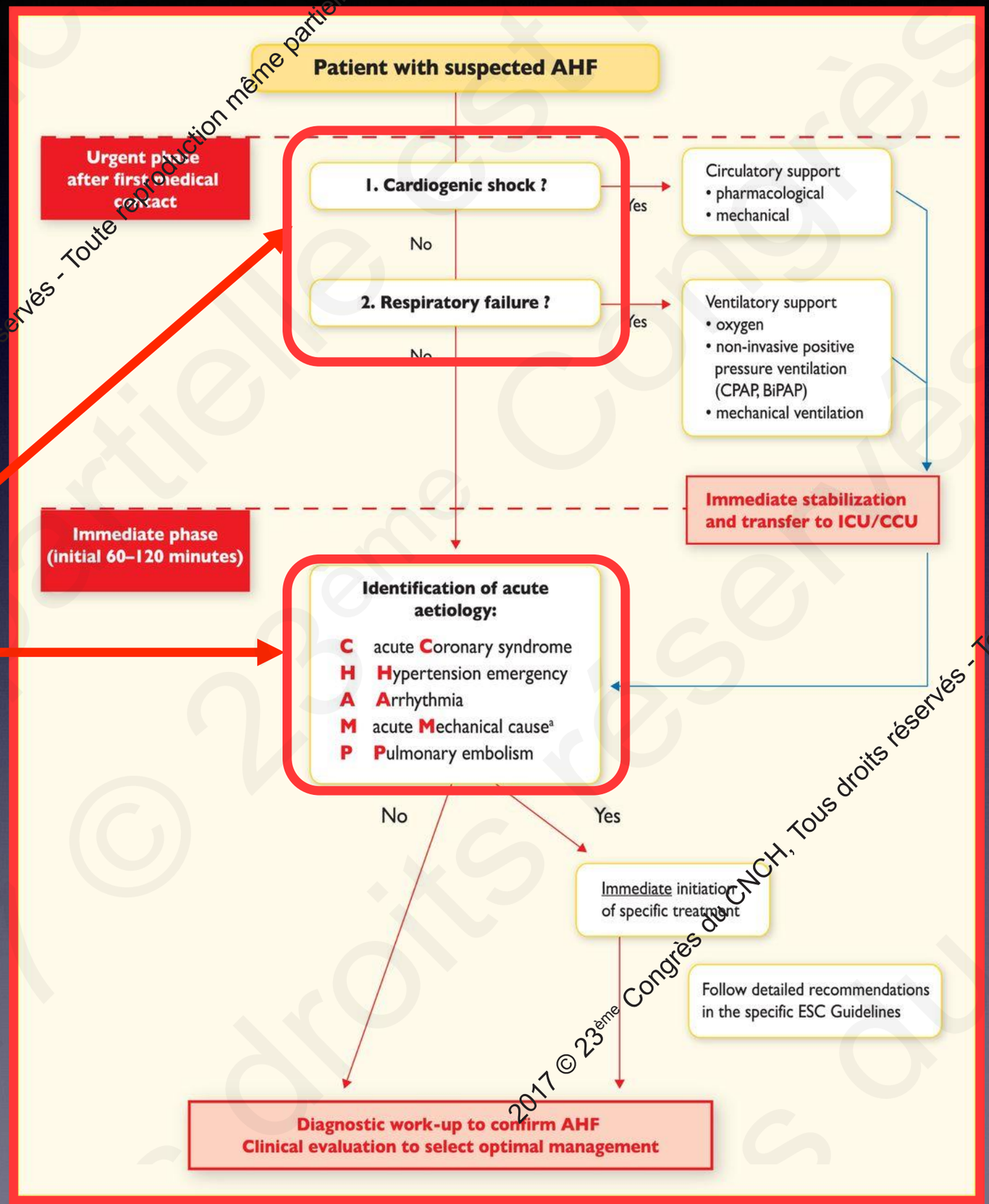
Insuffisance cardiaque

- **IC**=Syndrome clinique caractérisé par des symptômes typiques (dyspnée, OMI et fatigue) accompagnés de signes cliniques (crépitants, TJ) causé par une anomalie cardiaque structurelle ou fonctionnelle conduisant à une réduction du débit cardiaque et/ou à l'augmentation des pressions intra cardiaques au repos ou à l'effort

- **ICA**: Survenue rapide ou aggravation des symptômes d'une IC nécessitant une prise en charge rapide le plus souvent par une hospitalisation

ESC 2016 Guidelines for the diagnosis and treatment of acute and chronic heart failure

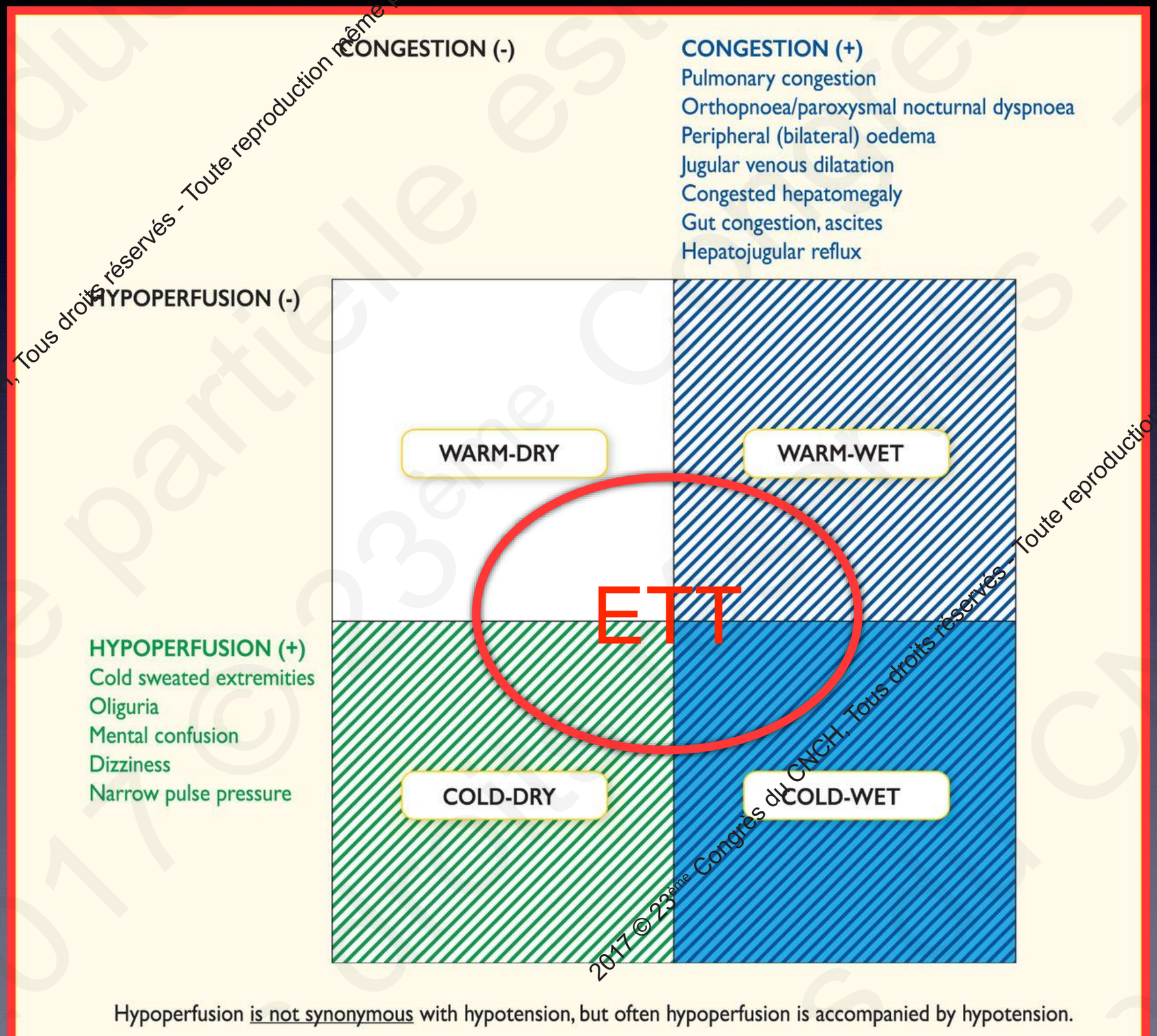
PRISE EN CHARGE INITIALE D'UN PATIENT SUSPECT D'INSUFFISANCE CARDIAQUE AIGUE



ETT

ESC 2016

Profil clinique des patients en ICA



L'ECHOCARDIOGRAPHIE

CONTRIBUE A

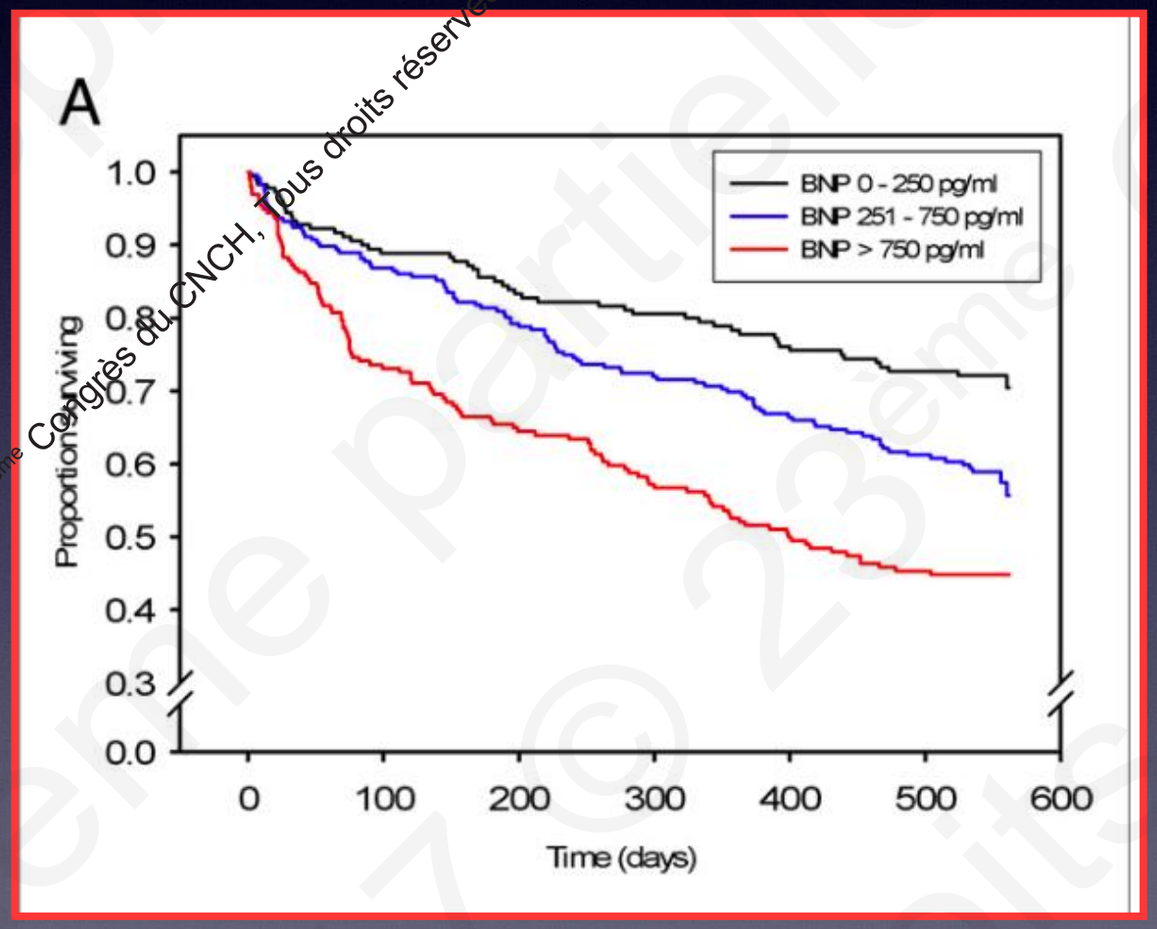
- ✓ Affirmer le diagnostic d'ICA, précisant l'atteinte myocardique (Systolique et/ou diastolique) , valvulaire, péricardique, endocardique
- ✓ Trouver la ou les causes
- ✓ Guider la thérapeutique
- ✓ Estimer le pronostic
- ✓ Evaluation dynamique de l'ICA

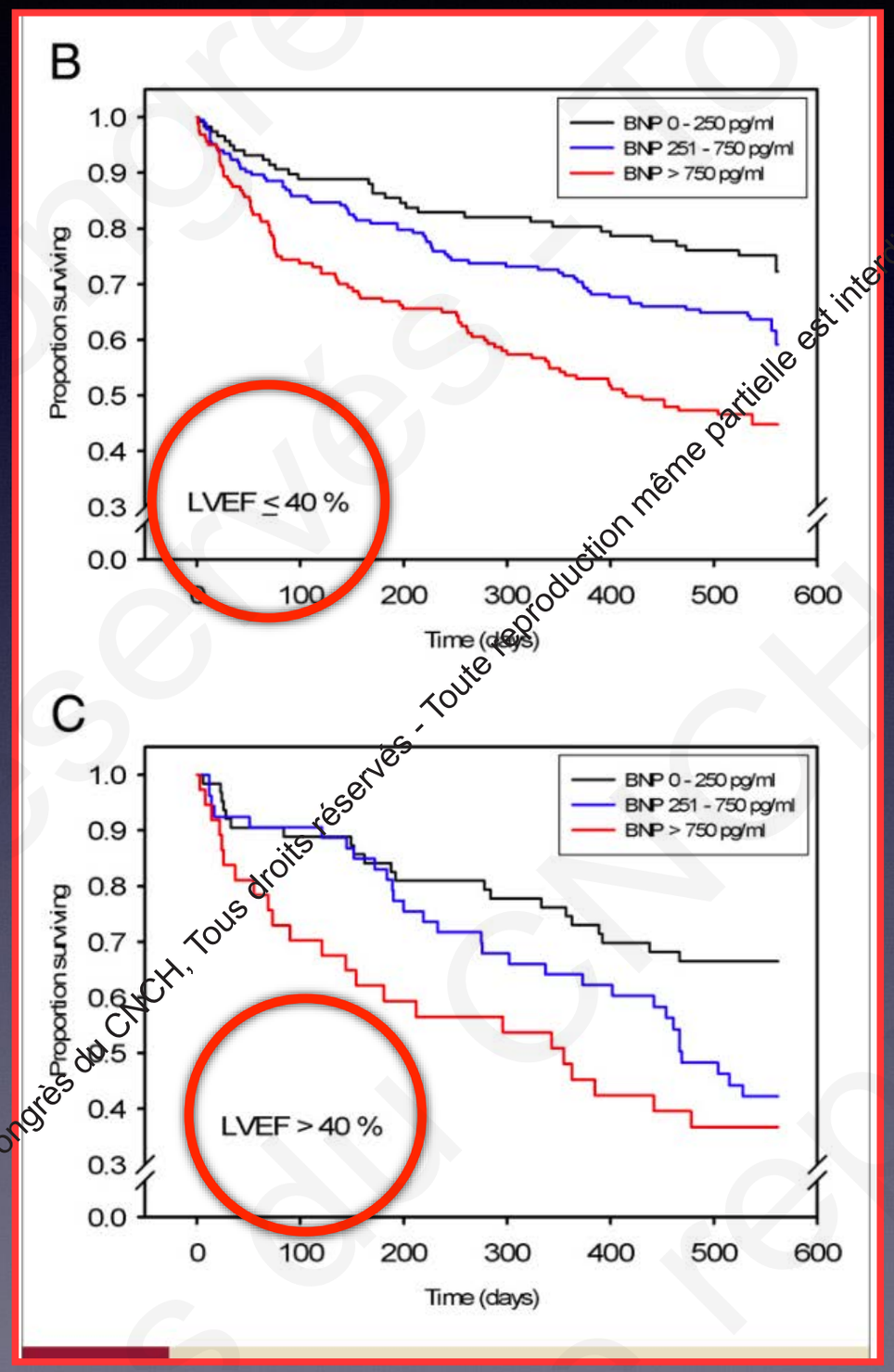
CAR

- ✓ Facilité d'accès,
- ✓ Mobilité,
- ✓ Safe,
- ✓ Reproductible,
- ✓ Non Invasif

Lancellotti et al. Use of Echocardiography in ACC: Recommendations of the EIACCA 2014

Le taux de BNP ou NT Pro-BNP ne suffit-il pas ?





Van Veldhuisen JACC 2013

Le taux de BNP ou NT Pro-BNP ne suffit-il pas ?

Table 12.3 Causes of elevated concentrations of natriuretic peptides[522–524]

Cardiac	Heart failure Acute coronary syndromes Pulmonary embolism Myocarditis Left ventricular hypertrophy Hypertrophic or restrictive cardiomyopathy Valvular heart disease Congenital heart disease Atrial and ventricular tachyarrhythmias Heart contusion Cardioversion, ICD shock Surgical procedures involving the heart Pulmonary hypertension
Non-cardiac	Advanced age Ischaemic stroke Subarachnoid haemorrhage Renal dysfunction Liver dysfunction (mainly liver cirrhosis with ascites) Paraneoplastic syndrome Chronic obstructive pulmonary disease Severe infections (including pneumonia and sepsis) Severe burns Anaemia Severe metabolic and hormone abnormalities (e.g. thyrotoxicosis, diabetic ketosis)

HFpEF = heart failure with preserved ejection fraction; HFrEF = heart failure with reduced ejection fraction; ICD = implantable cardioverter defibrillator.

NON HELAS

ESC 2016

Immediate echocardiography is mandatory only in patients with haemodynamic instability (particularly in cardiogenic shock) and in patients suspected of acute life-threatening structural or functional cardiac abnormalities (mechanical complications, acute valvular regurgitation, aortic dissection).

Early echocardiography should be considered in all patients with *de novo* AHF and in those with unknown cardiac function; however, the optimal timing is unknown (preferably within 48 h from admission, if the expertise is available).

Efficacité d'une stratégie écho-guidée

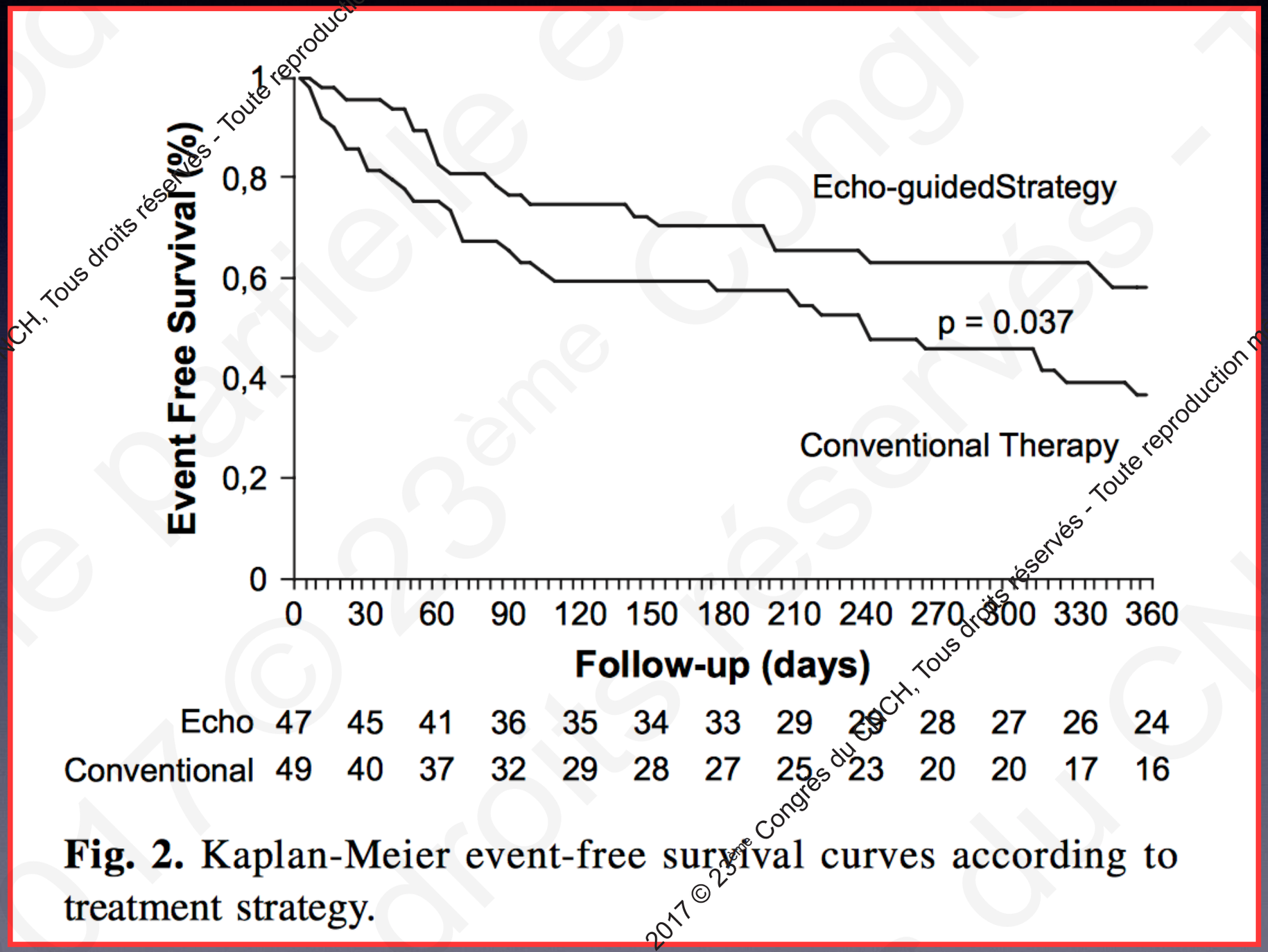


Fig. 2. Kaplan-Meier event-free survival curves according to treatment strategy.

Rhode J of Card Fail 2007

ETIOLOGIES DES INSUFFISANCES CARDIAQUES

DISEASED MYOCARDIUM		
Ischaemic heart disease	Myocardial scar	
	Myocardial stunning/hibernation	
	Epicardial coronary artery disease	
	Abnormal coronary microcirculation	
	Endothelial dysfunction	
Toxic damage	Recreational substance abuse	Alcohol, cocaine, amphetamine, anabolic steroids.
	Heavy metals	Copper, iron, lead, cobalt.
	Medications	Cytostatic drugs (e.g. anthracyclines), immunomodulating drugs (e.g. interferons monoclonal antibodies such as trastuzumab, cetuximab), antidepressant drugs, antiarrhythmics, non-steroidal anti-Inflammatory drugs, anaesthetics.
	Radiation	
Immune-mediated and inflammatory damage	Related to infection	Bacteria, spirochaetes, fungi, protozoa, parasites (Chagas disease), rickettsiae, viruses (HIV/AIDS).
	Not related to infection	Lymphocytic/giant cell myocarditis, autoimmune diseases (e.g. Graves' disease, rheumatoid arthritis, connective tissue disorders, mainly systemic lupus erythematosus), hypersensitivity and eosinophilic myocarditis (Churg–Strauss).
Infiltration	Related to malignancy	Direct infiltrations and metastases.
	Not related to malignancy	Amyloidosis, sarcoidosis, haemochromatosis (iron), glycogen storage diseases (e.g. Pompe disease), lysosomal storage diseases (e.g. Fabry disease).
Metabolic derangements	Hormonal	Thyroid diseases, parathyroid diseases, acromegaly, GH deficiency, hypercortisolaemia, Conn's disease, Addison disease, diabetes, metabolic syndrome, phaeochromocytoma, pathologies related to pregnancy and peripartum.
	Nutritional	Deficiencies in thiamine, L-carnitine, selenium, iron, phosphates, calcium, complex malnutrition (e.g. malignancy, AIDS, anorexia nervosa), obesity.
Genetic abnormalities	Diverse forms	HCM, DCM, LV non-compaction, ARVC, restrictive cardiomyopathy (for details see respective expert documents), muscular dystrophies and laminopathies.
ABNORMAL LOADING CONDITIONS		
Hypertension		
Valve and myocardium structural defects	Acquired	Mitral, aortic, tricuspid and pulmonary valve diseases.
	Congenital	Atrial and ventricular septum defects and others (for details see a respective expert document).
Pericardial and endomyocardial pathologies	Pericardial	Constrictive pericarditis Pericardial effusion
	Endomyocardial	HES, EMF, endocardial fibroelastosis.
High output states		Severe anaemia, sepsis, thyrotoxicosis, Paget's disease, arteriovenous fistula, pregnancy.
Volume overload		Renal failure, iatrogenic fluid overload.
ARRHYTHMIAS		
Tachyarrhythmias		Atrial, ventricular arrhythmias.
Bradyarrhythmias		Sinus node dysfunctions, conduction disorders.

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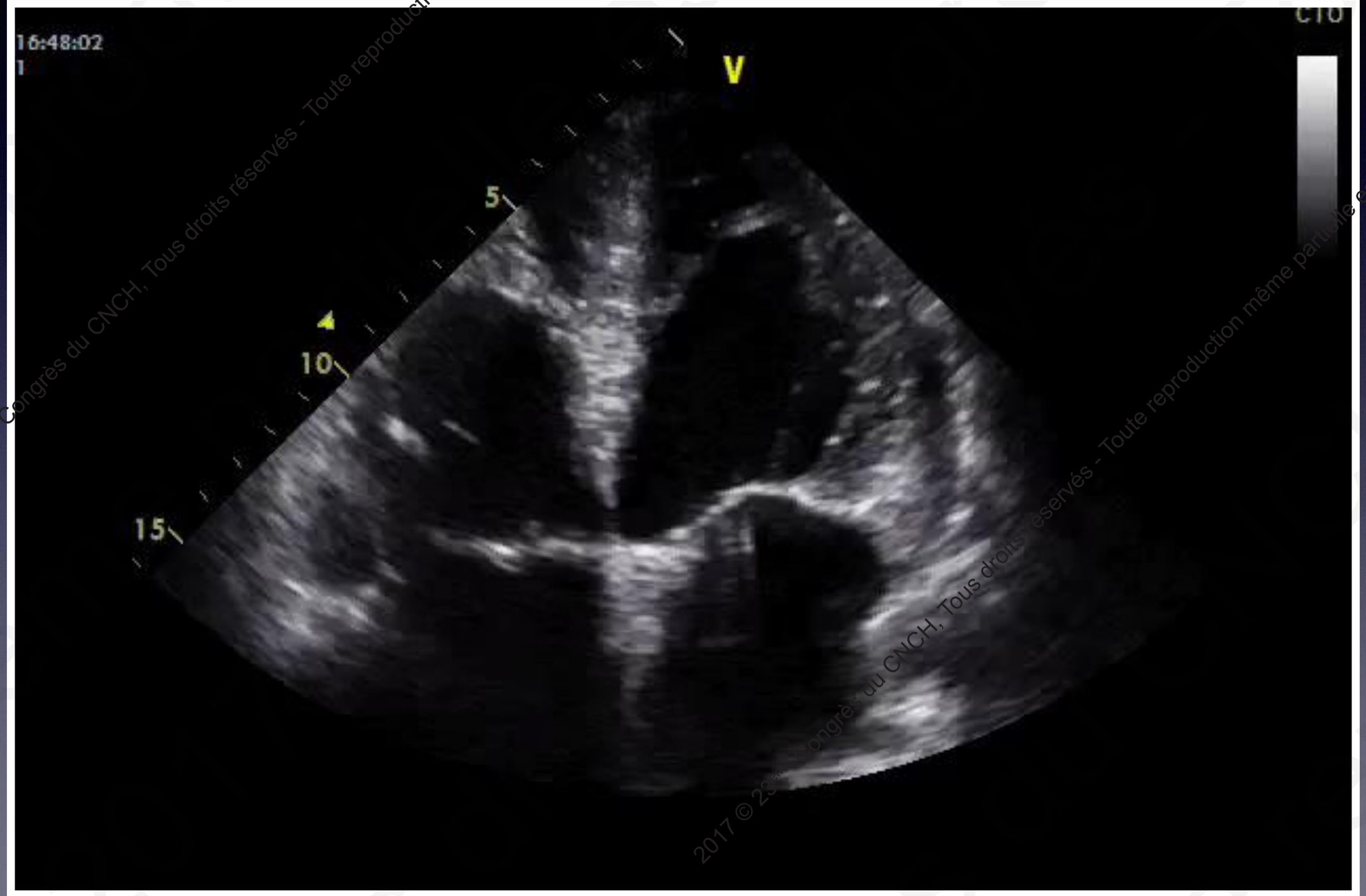
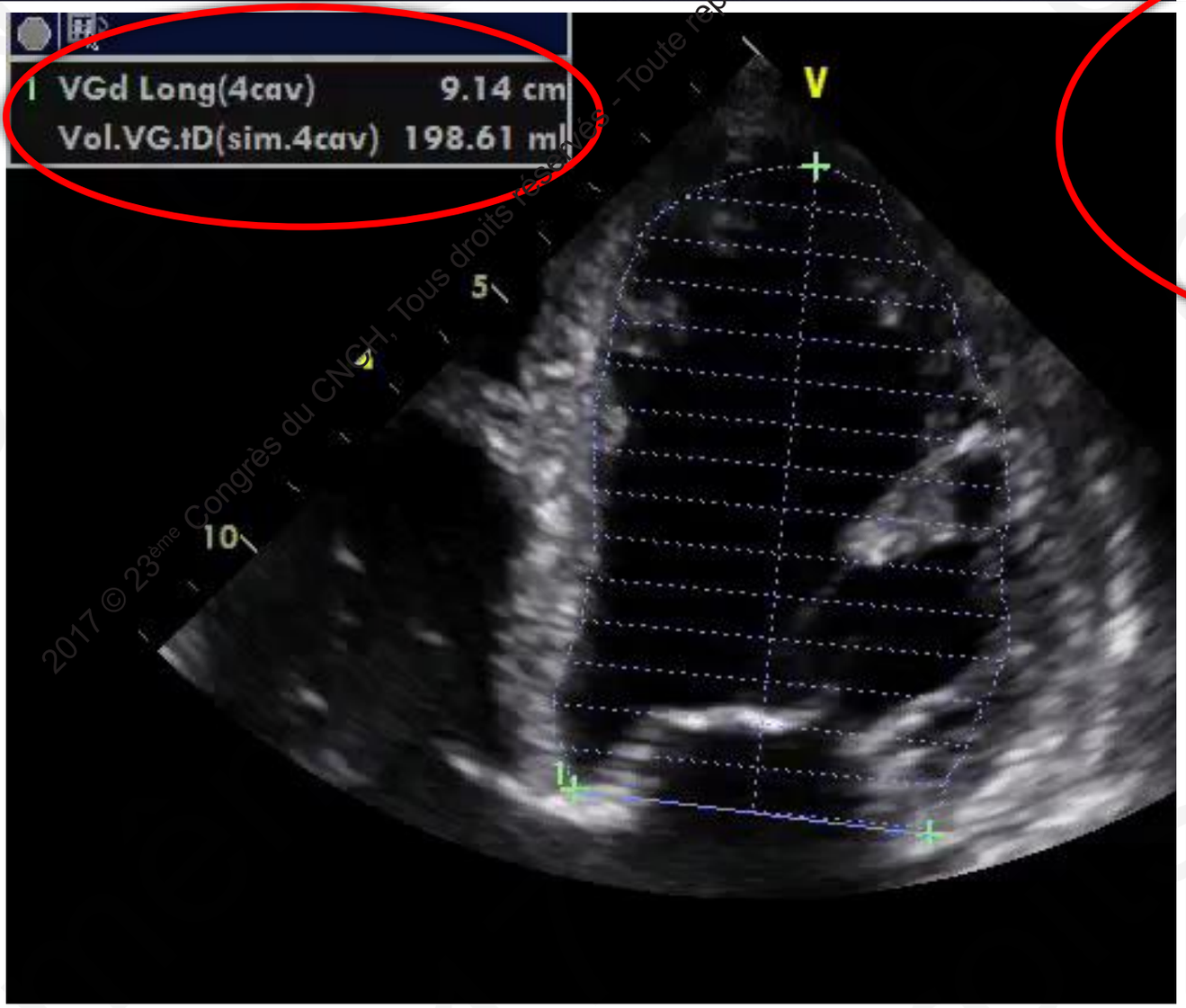
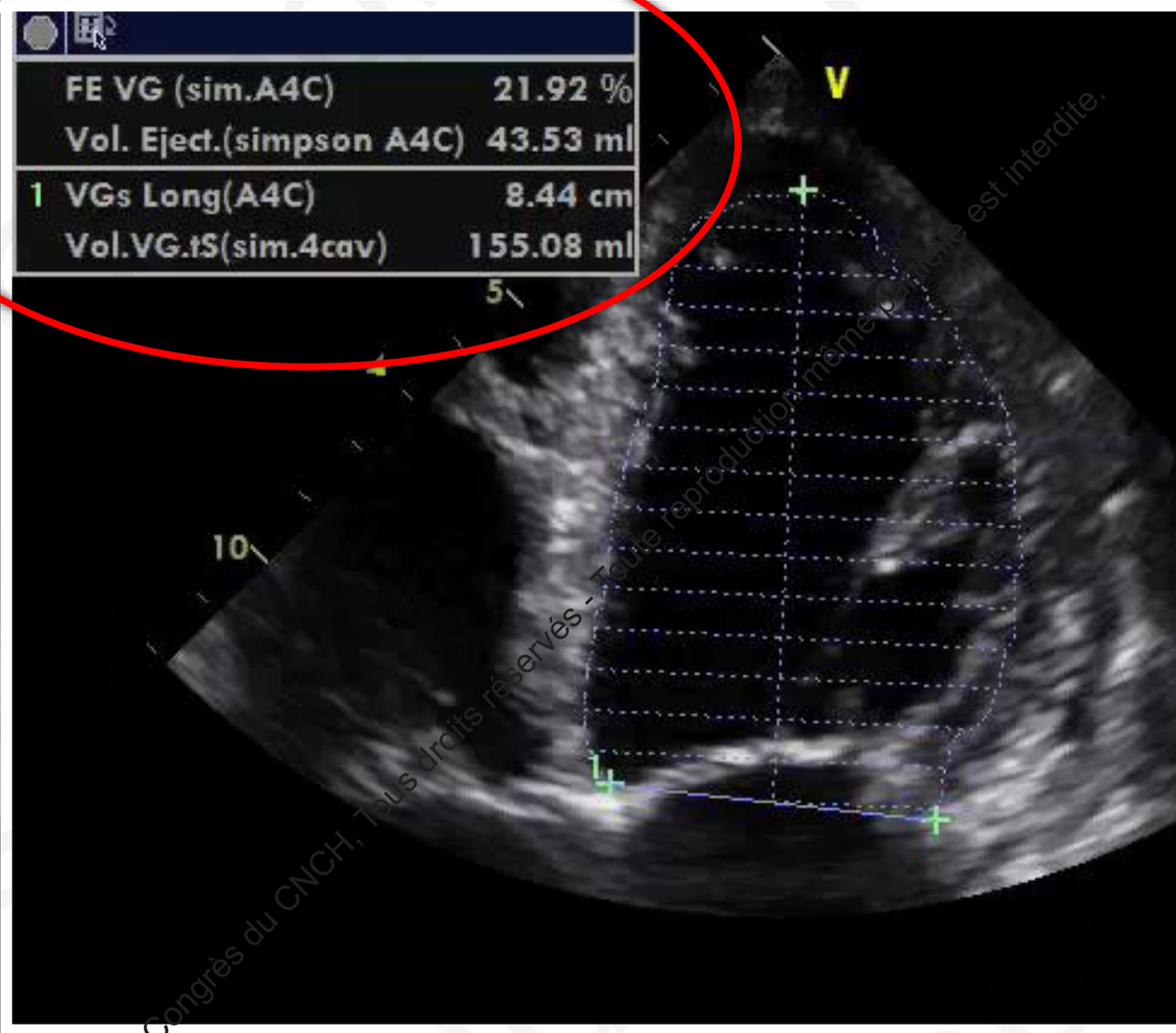
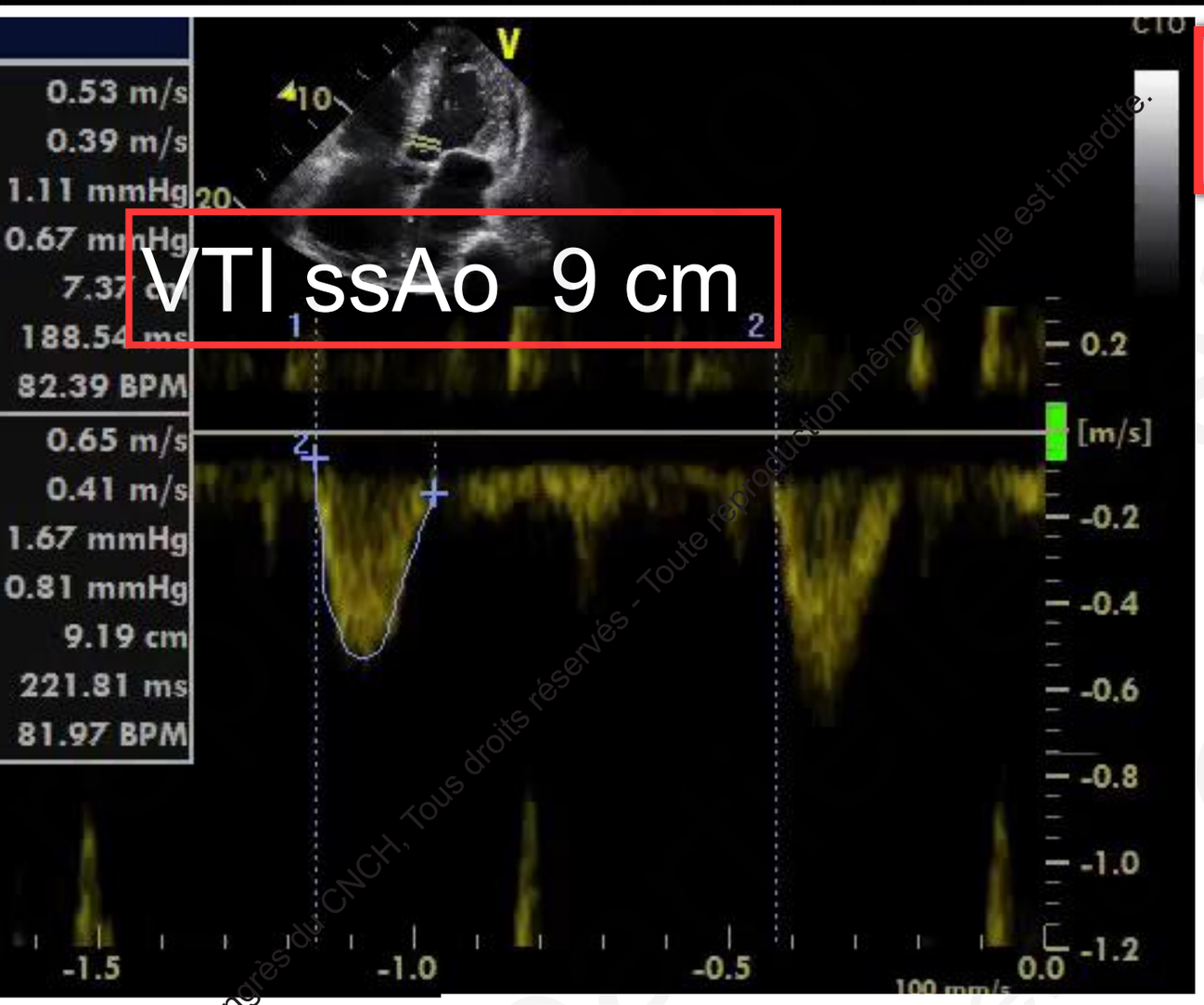
DYSPNEE aigue

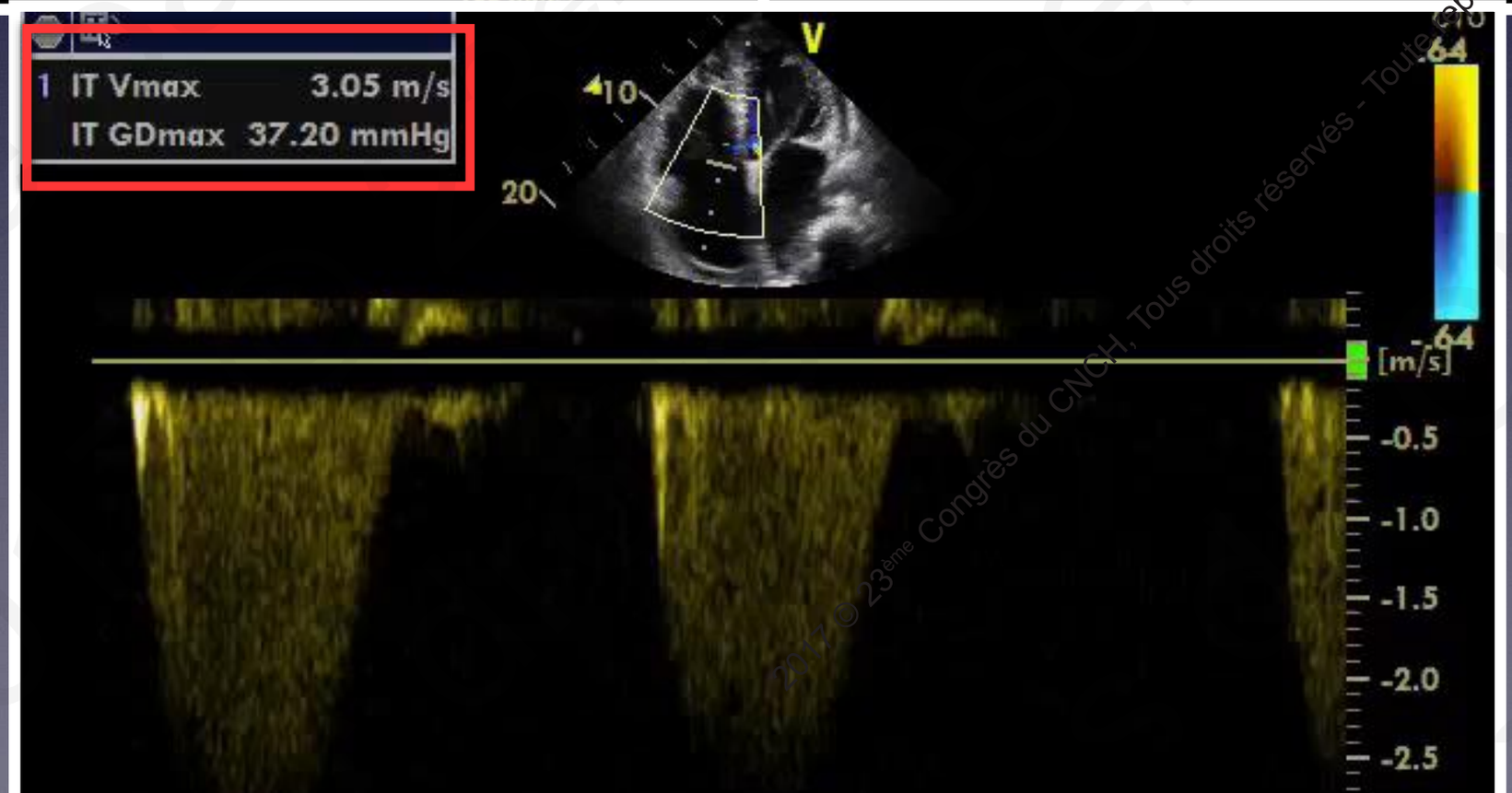


DYSPNEE aigue







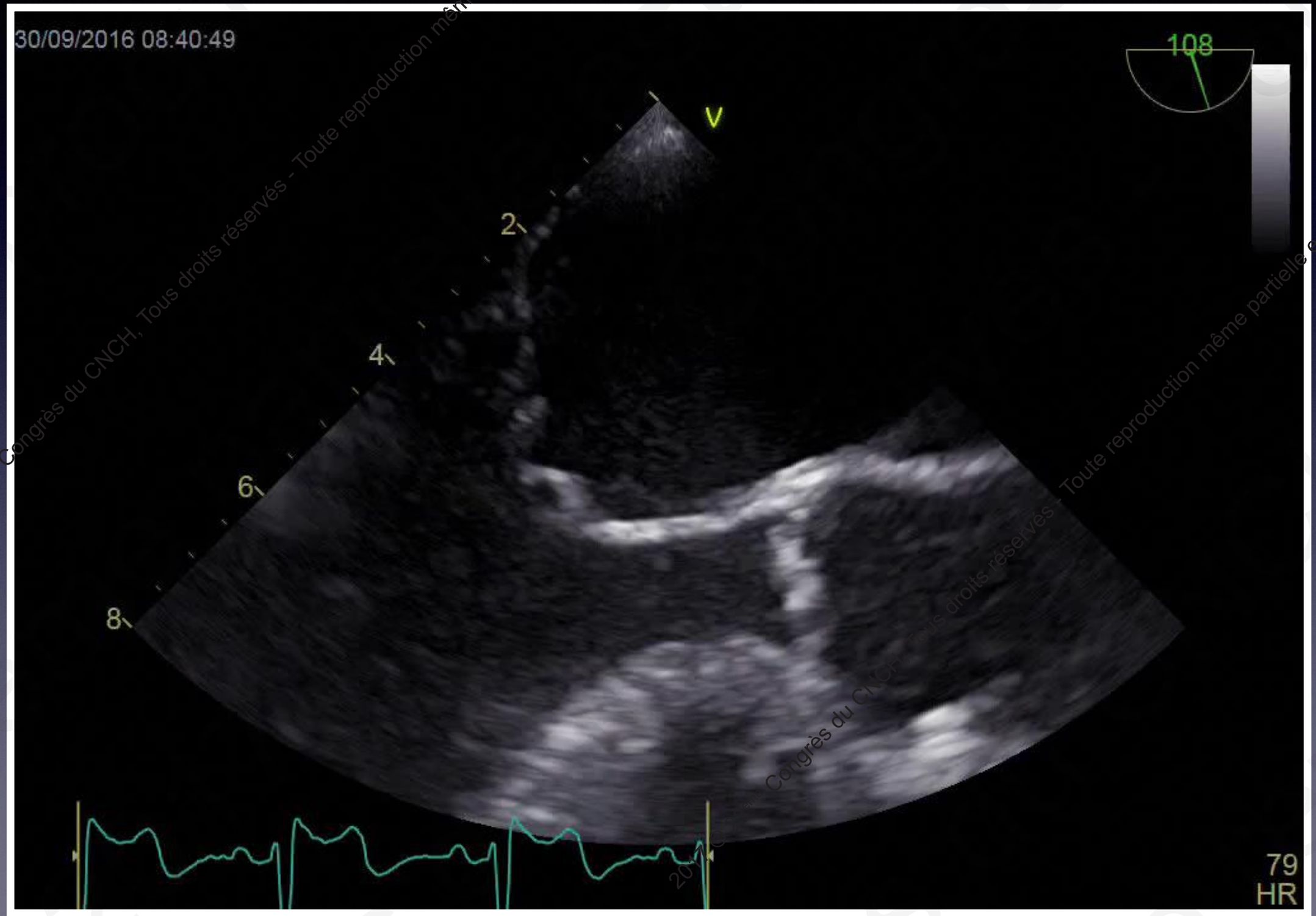


DYSPNEE aigue

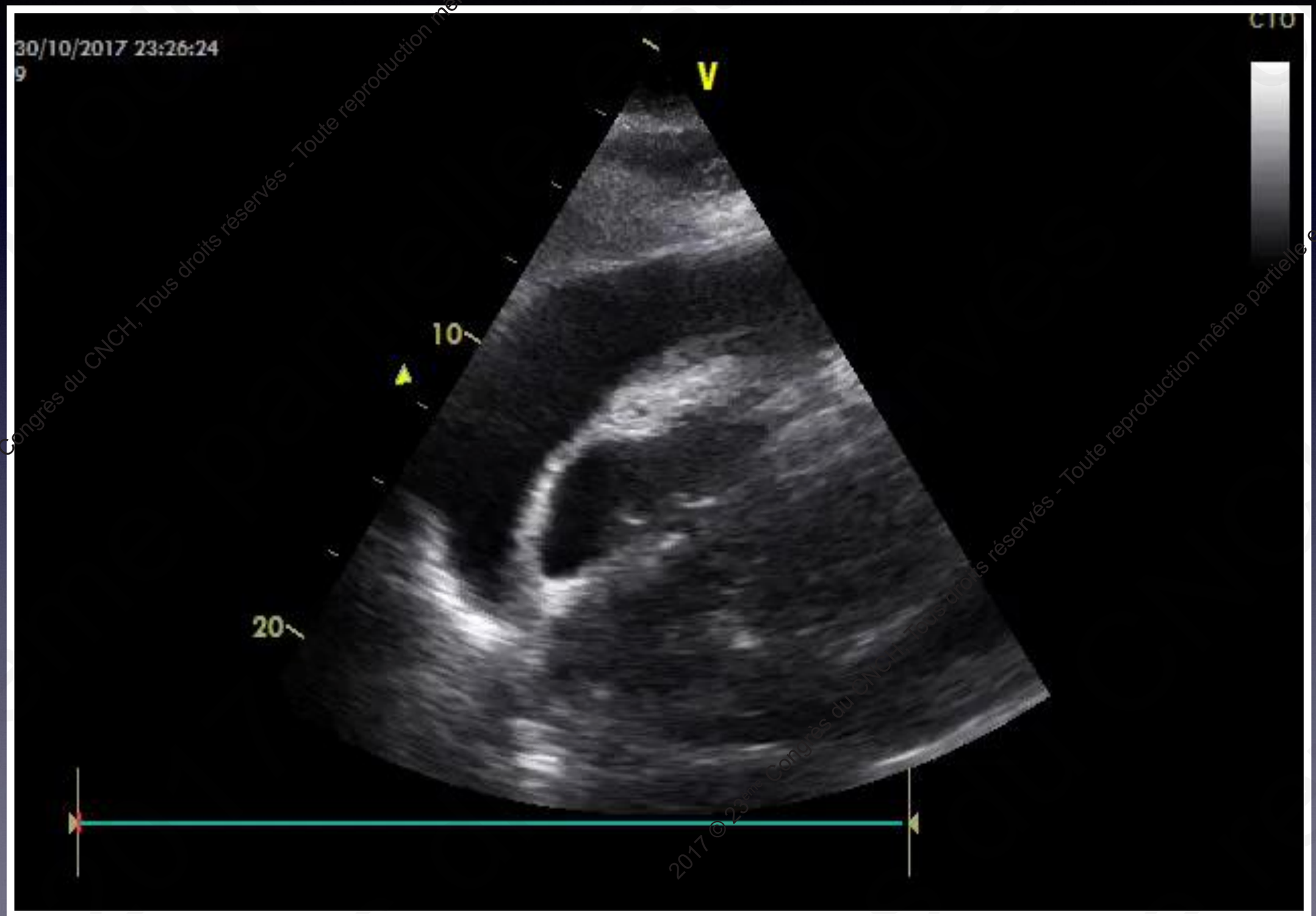
Dysfonction systolique majeure avec baisse du débit cardiaque:

Diagnostic facile

L’ECHO c’est facile

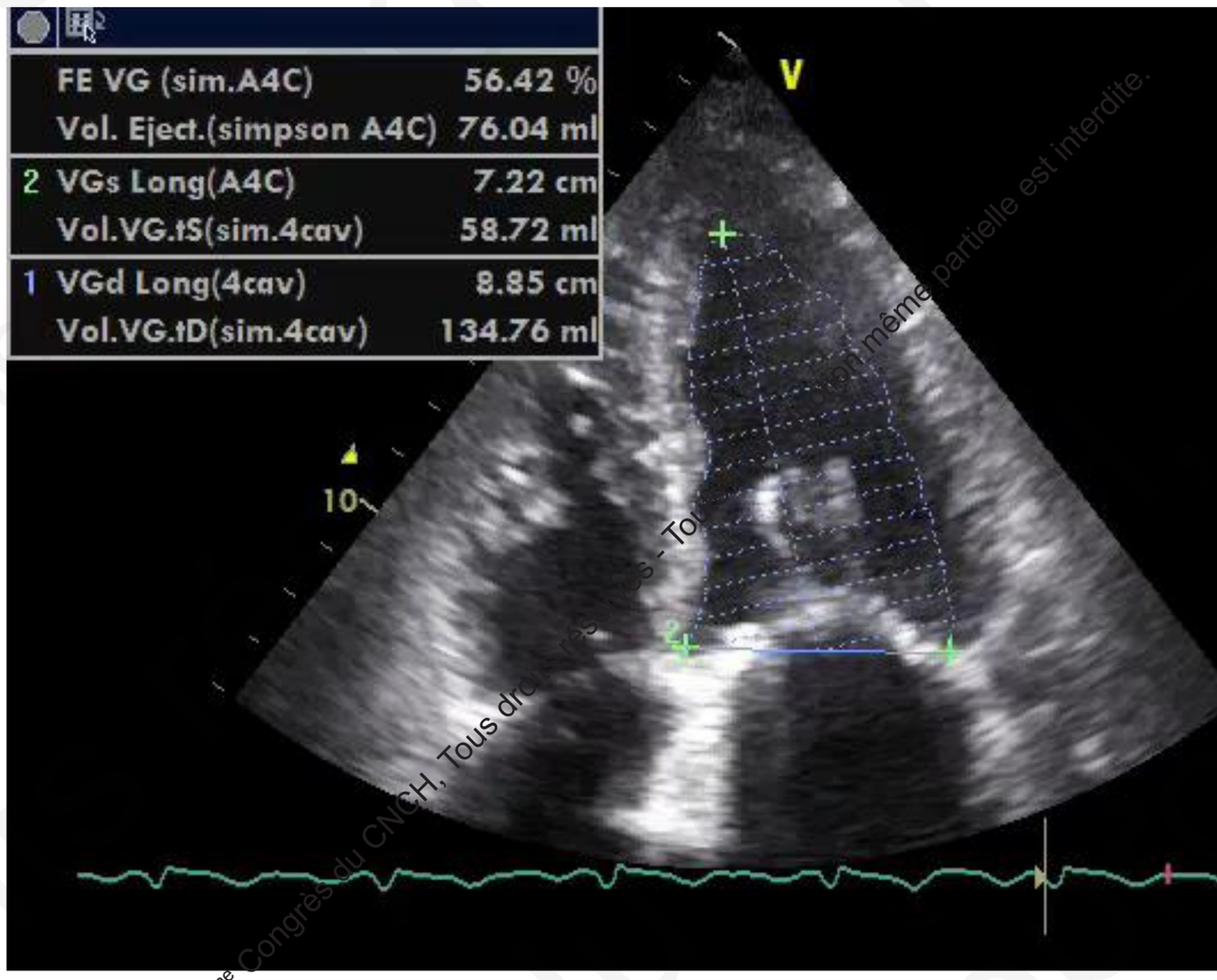


L’ECHO c’est facile

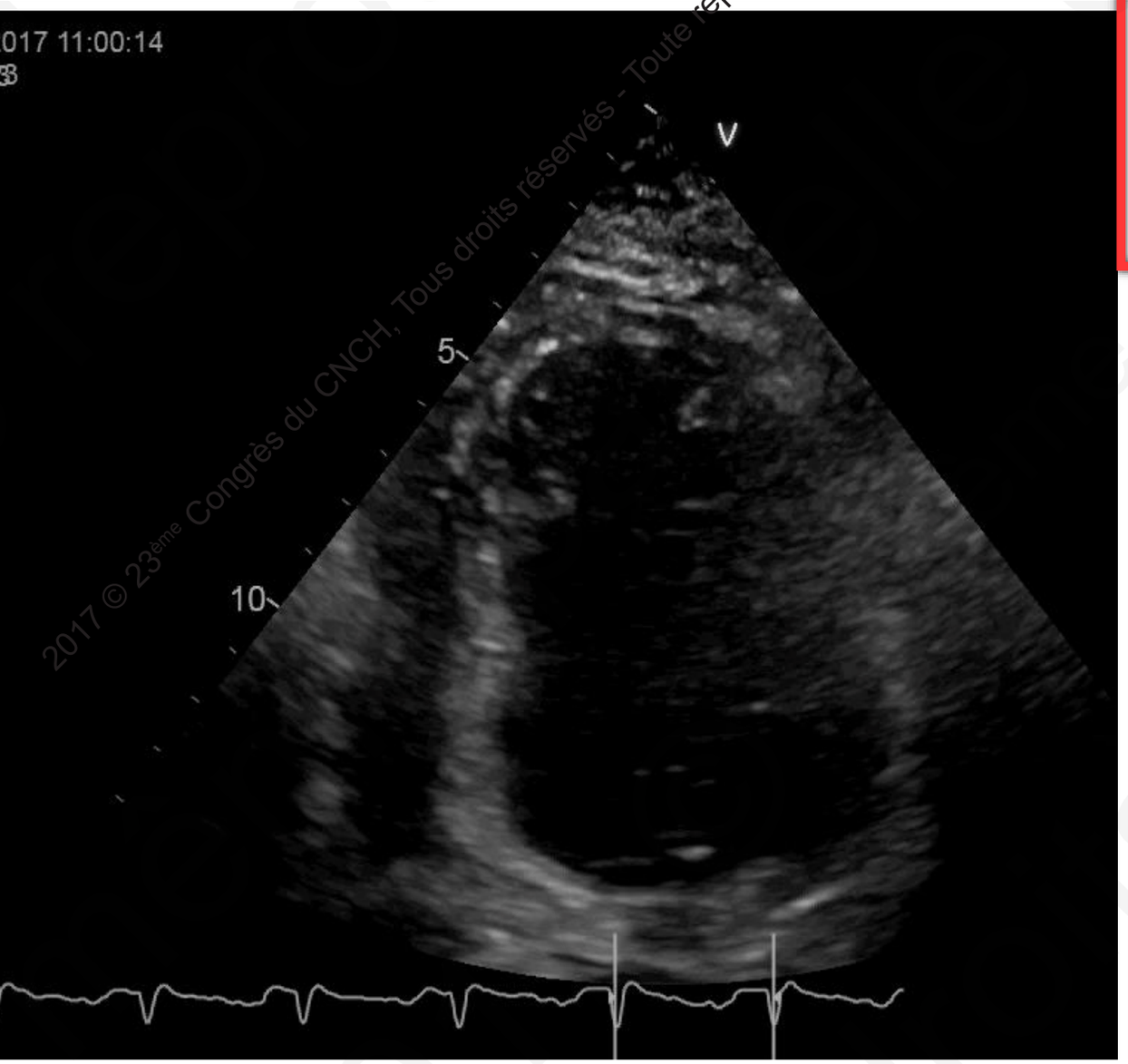


Mais pas toujours.

Patiente n°1



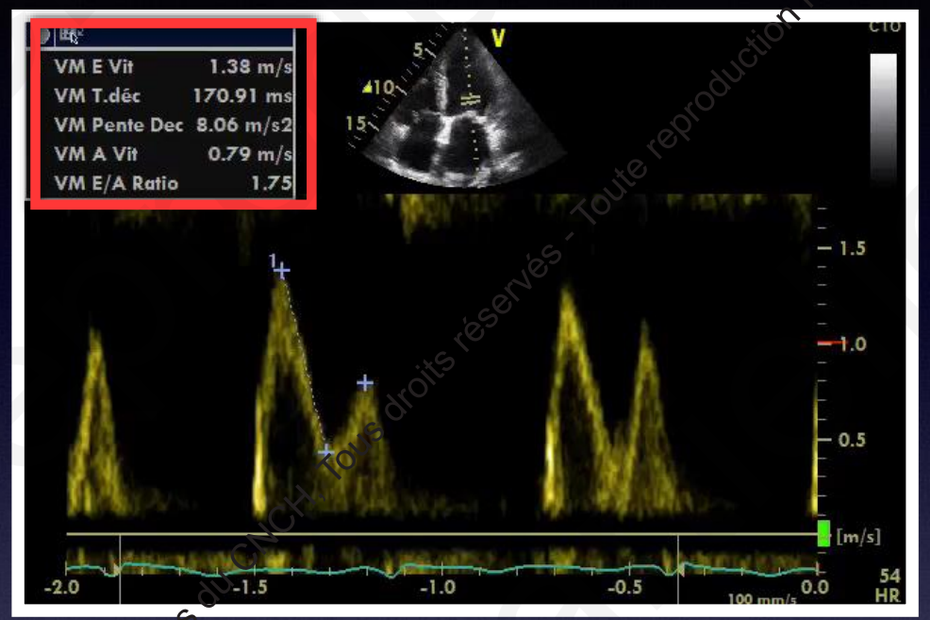
Patient n°2

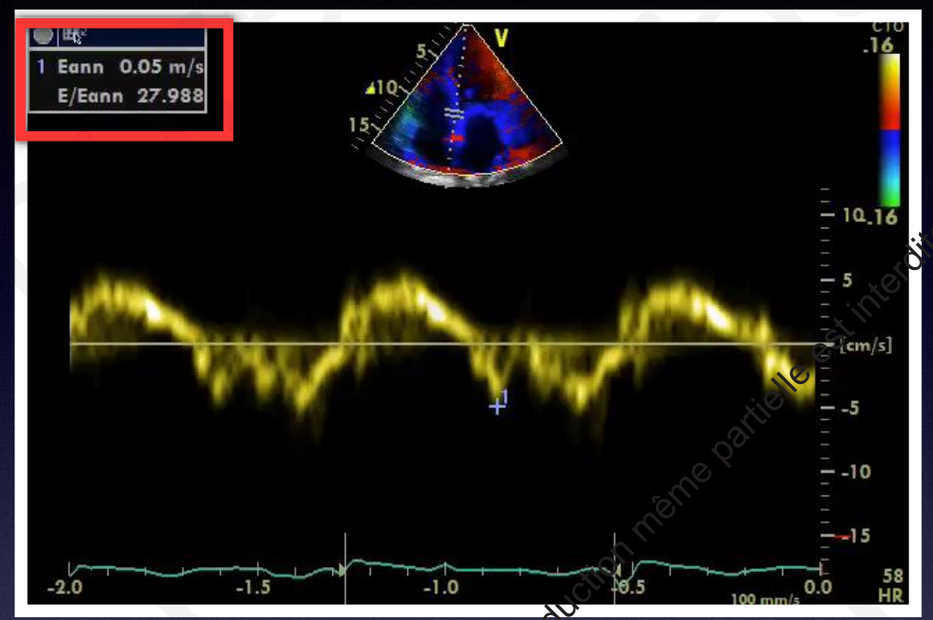


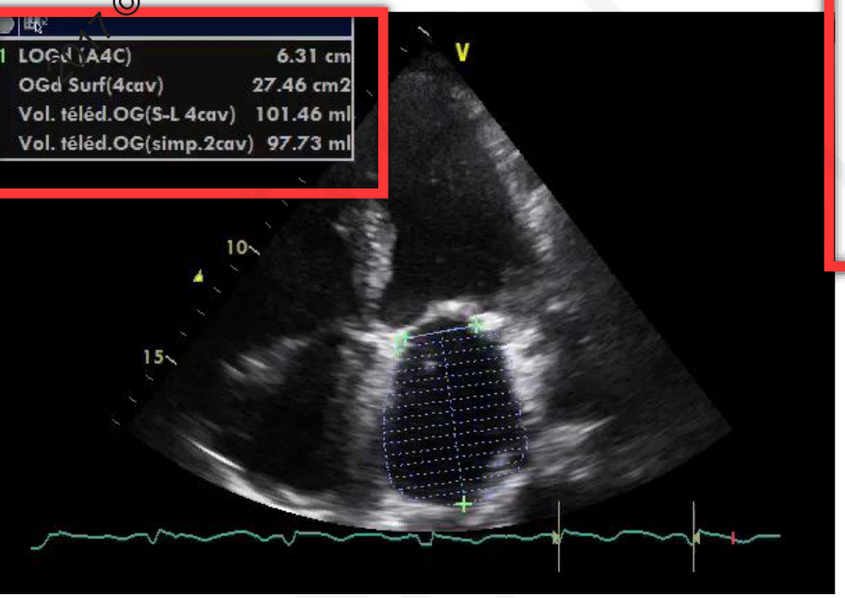
LEQUEL DE CES PATIENTS EST ADMIS EN USIC et MALHEUREUSEMENT N'EN SORTIRA PAS,
PENDANT QUE L'AUTRE GAMBADE DANS LA NATURE ?

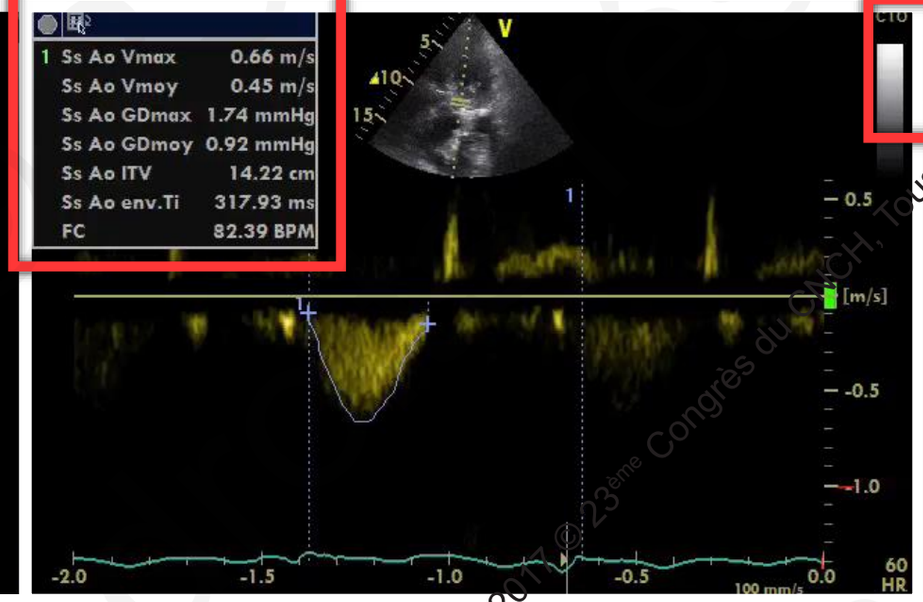
Patiente n°1

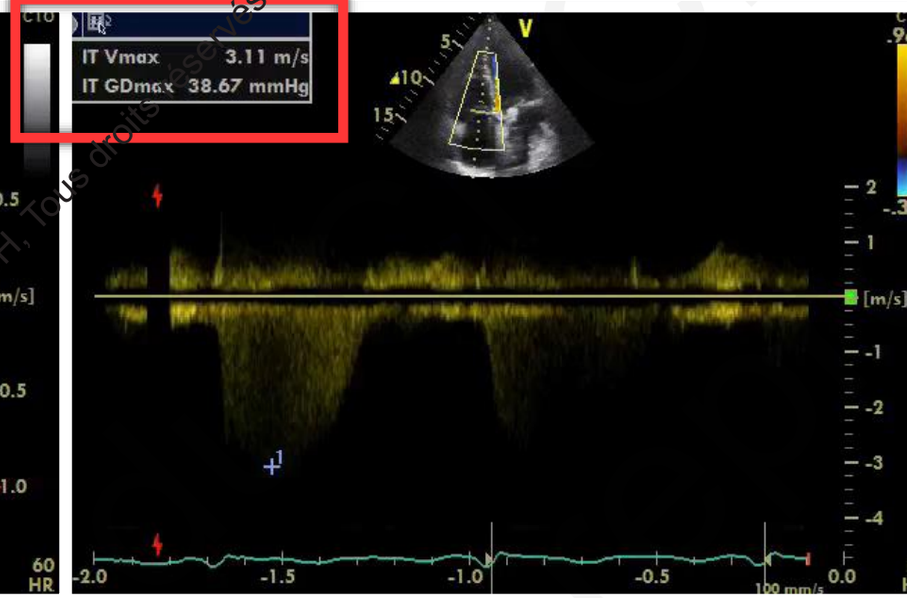
Patiente n°1



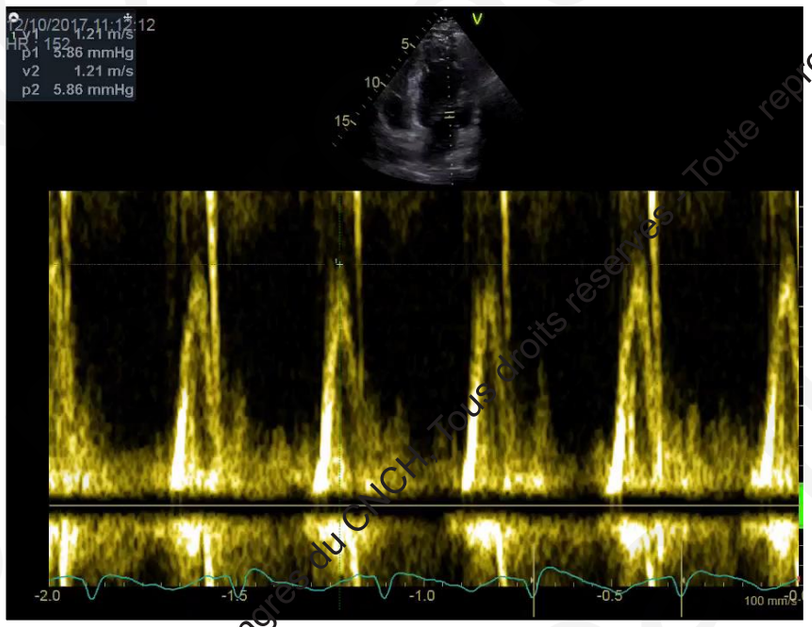


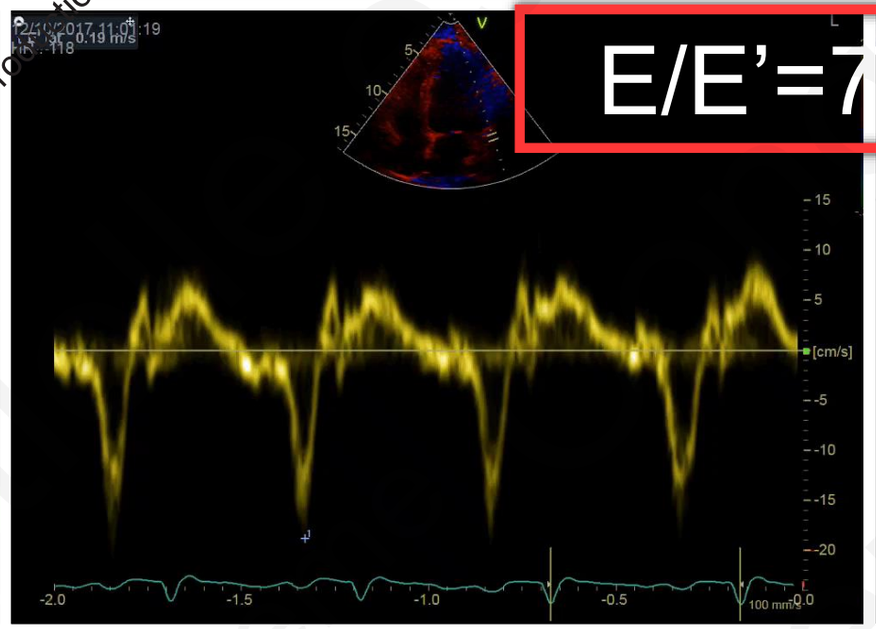


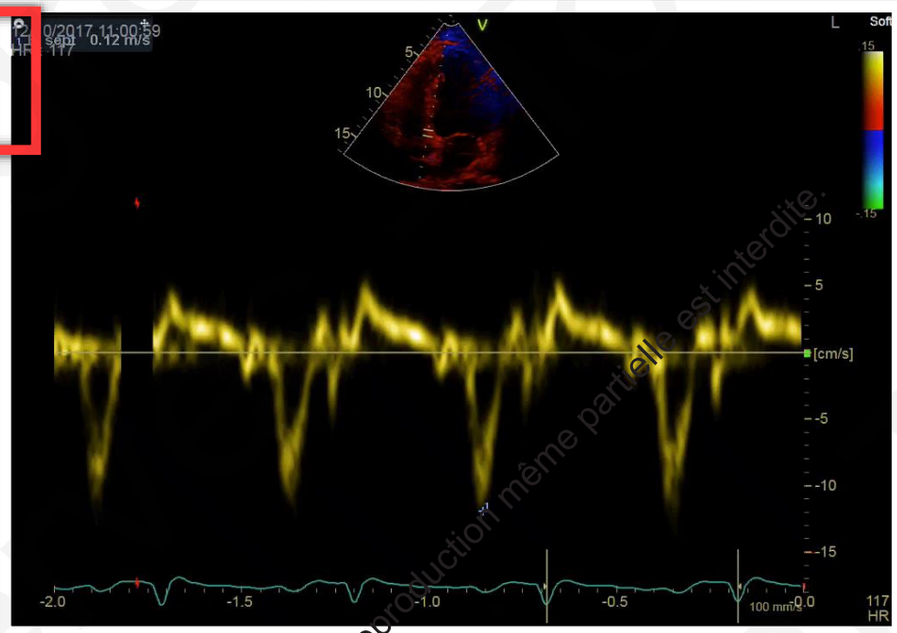


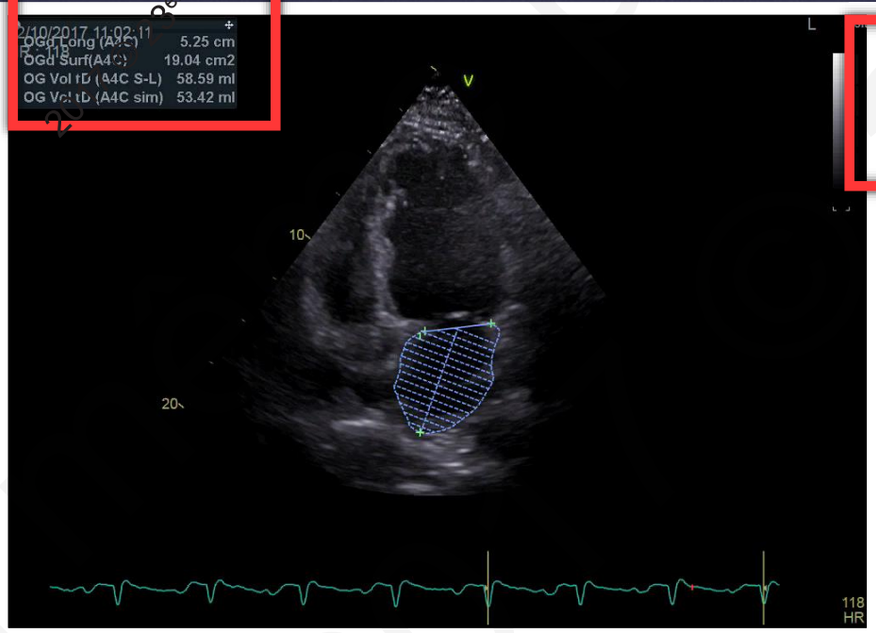


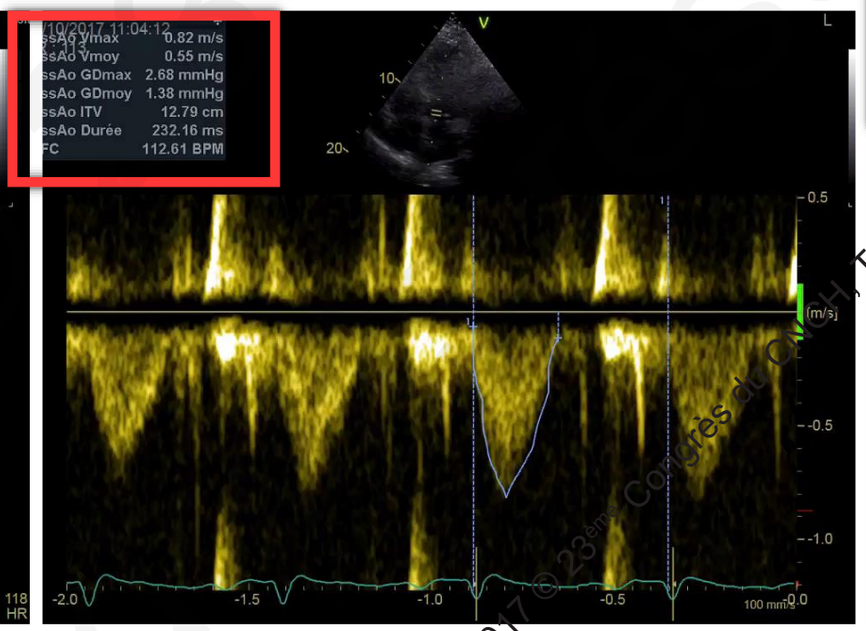
Patient n°2

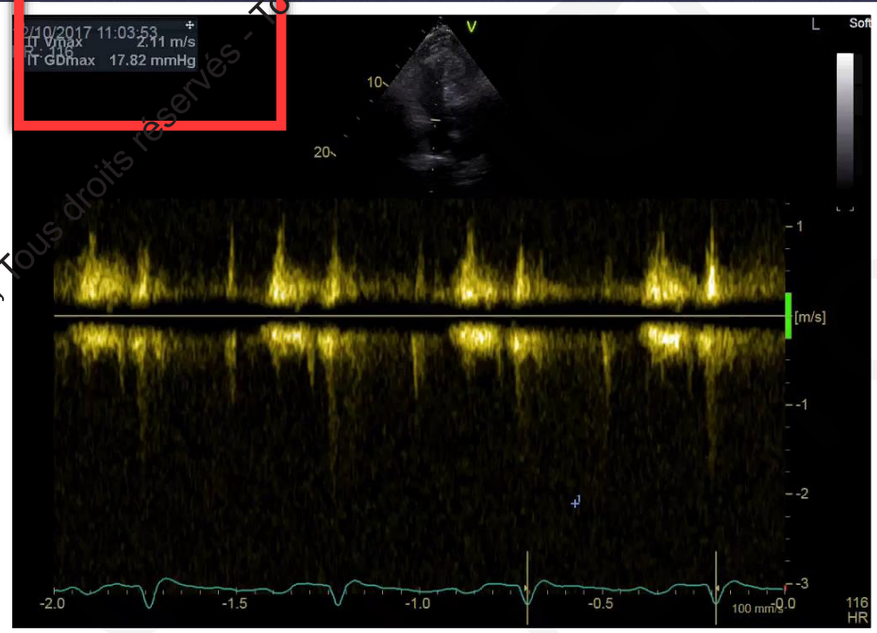












ICA à FE préservée

- Def: Tableau d'ICA avec une FE > 40-50%
- Au moins 45% des ICA
- Ratio femme/homme 3/2
- HTA ou Card. Isch ou Diabete > 90%
- Histoire d'ICA : > 60%
- Pronostic (presque) aussi mauvais que FE altérée

Clinical Presentation, Management,and In-Hospital Outcomes of Patients Admitted With Acute Decompensated Heart Failure With Preserved Systolic Function
A Report From the Acute DecompensatedHeart Failure National Registry (ADHERE) Database
Clyde W. Yancy, MD, FACC et al. 2006

ICA à FE préservée
Prévalence

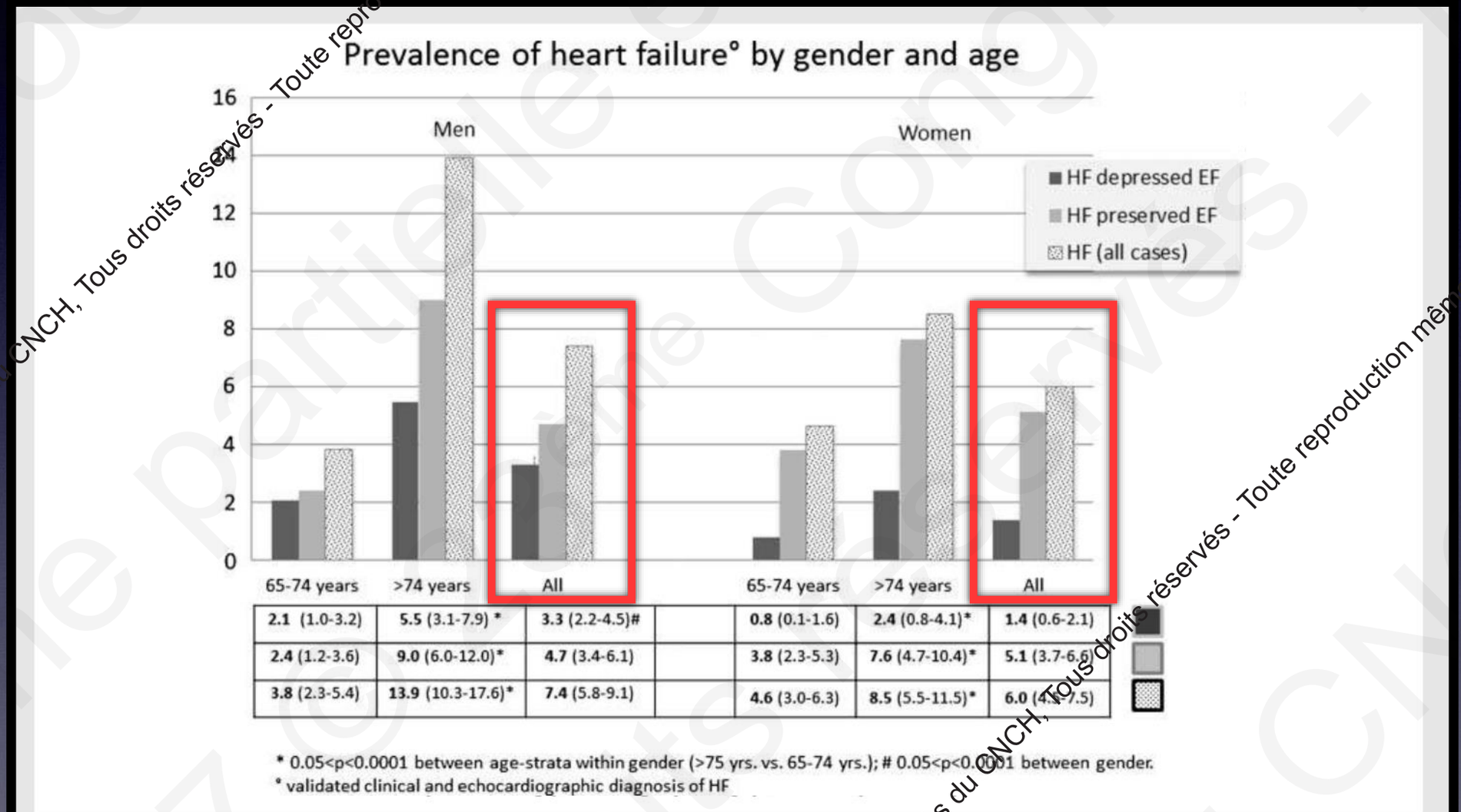


Figure 2 Prevalence of heart failure (HF) by gender and age. Prevalence of HF as a percentage (ordinate, %) is shown for age (65–74 years, >75 years, and all) and gender groups (abscissa). Dark grey bars, HF with depressed ejection fraction (EF); light grey bars, HF with preserved EF; dotted bars, all cases of HF. Mean percentage (in bold) and the 95% confidence interval (in parentheses) are shown for each condition (HF depressed EF, HF preserved EF, and all cases) at the bottom of the figure.

Mureddu Eur J Heart Fail 2012

IC à FE préservée
Sous diagnostiquée

Table 2 Prevalence of previously unknown heart failure with reduced ejection fraction (HF-REF) and heart failure with preserved ejection fraction (HF-PEF) stratified by age and sex

Age (years)	Male			Female			Total			
	n	HF-REF	HF-PEF	*n*	HF-REF	HF-PEF	*n*	HF-REF	HF-PEF	All HF*
64–74	155	5 (3.2)	9 (5.8)	179	2 (1.1)	10 (5.6)	334	7 (2.1)	19 (5.7)	28 (8.4)
≥75	111	6 (5.4)	21 (18.9)	140	4 (2.9)	30 (21.4)	251	10 (4.0)	51 (20.3)	64 (25.5)
All ages	266	11 (4.1)	30 (11.3)	319	6 (1.9)	40 (12.5)	585	17 (2.9)	70 (12.0)	92 (15.7)
95% CI		2.2–7.5	7.9–15.9		0.8–4.3	9.2–16.8		1.8–4.7	9.5–14.9	12.9–19.0

*In all heart failures; the five cases of isolated right-sided heart failure were also included.
Values are numbers (percentage); 95% CI, 95% confidence interval.

Van Riet Eur J Heart Fail 2014

ICA à FE préservée
Prévalence

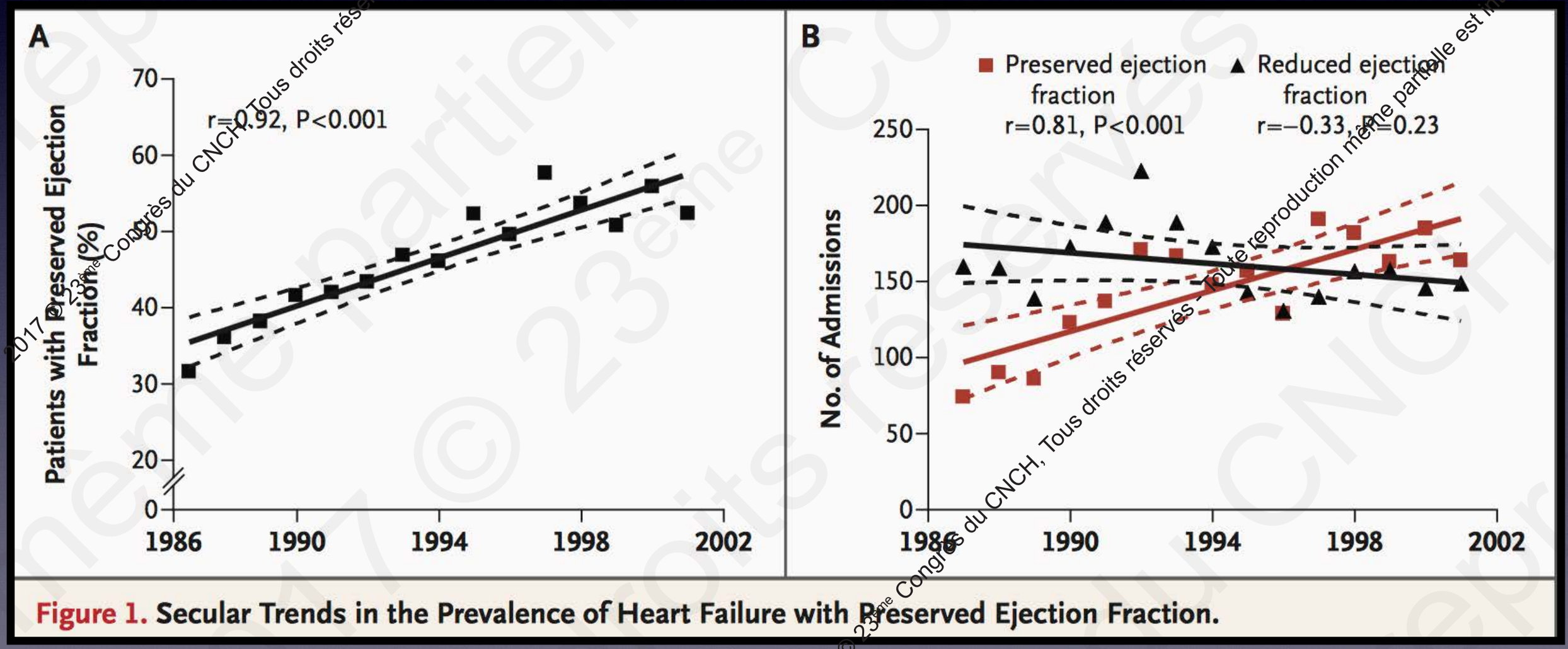
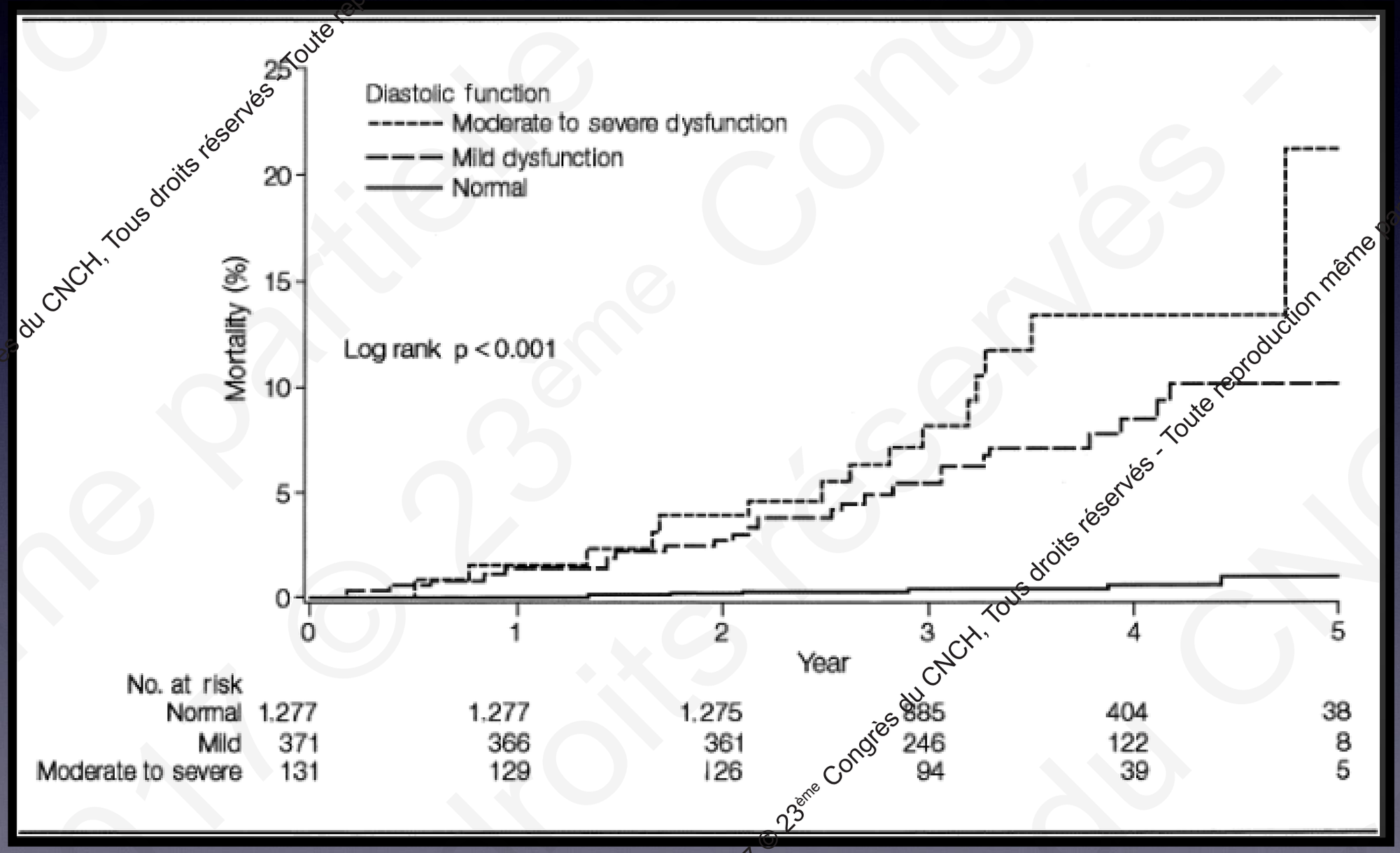


Figure 1. Secular Trends in the Prevalence of Heart Failure with Preserved Ejection Fraction.

Owan NEJM 2006

IC à FE préservée
Pronostic



Am J Cardiol 2005

IC à FE préservée
Pronostic

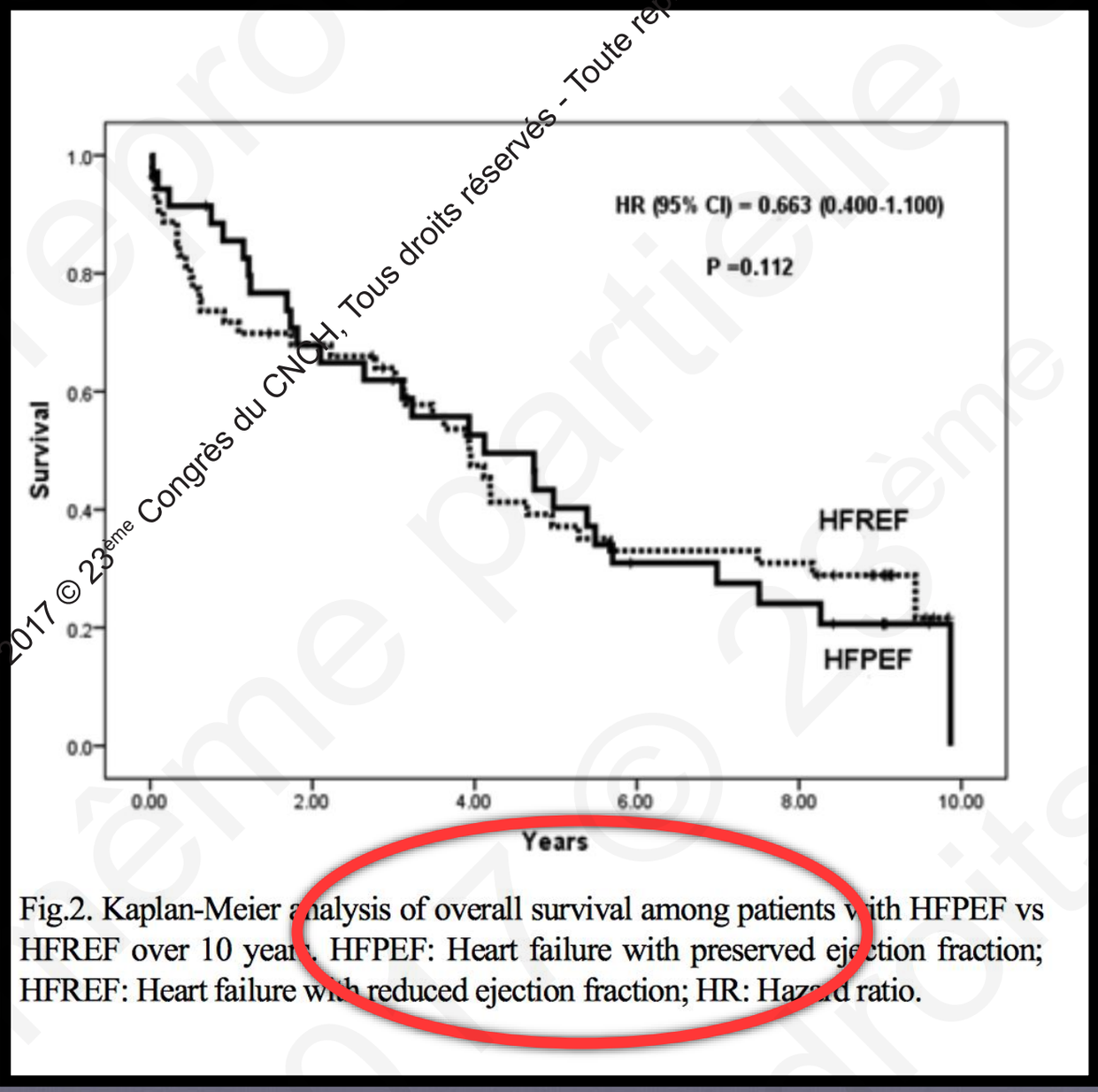


Fig.2. Kaplan-Meier analysis of overall survival among patients with HFPEF vs HFREF over 10 years. HFPEF: Heart failure with preserved ejection fraction; HFREF: Heart failure with reduced ejection fraction; HR: Hazard ratio.

Ruan Ann Acad Med Singapore 2016

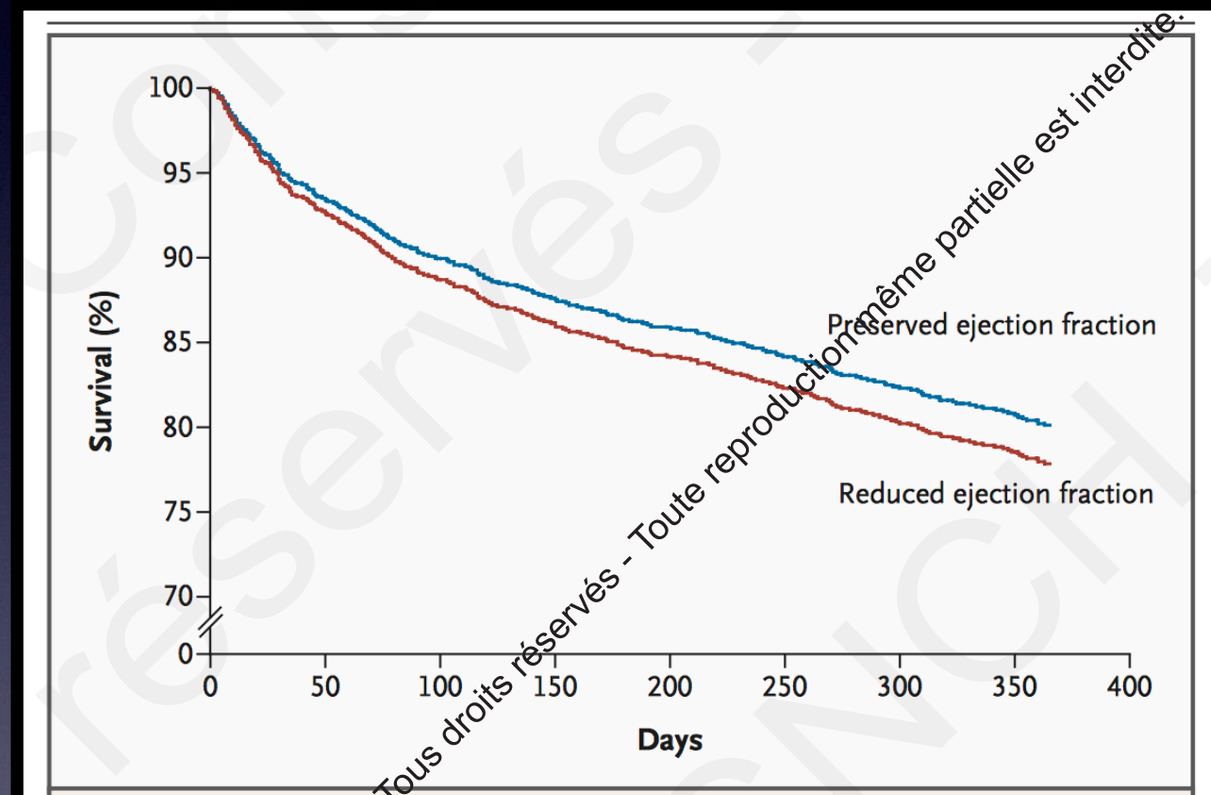
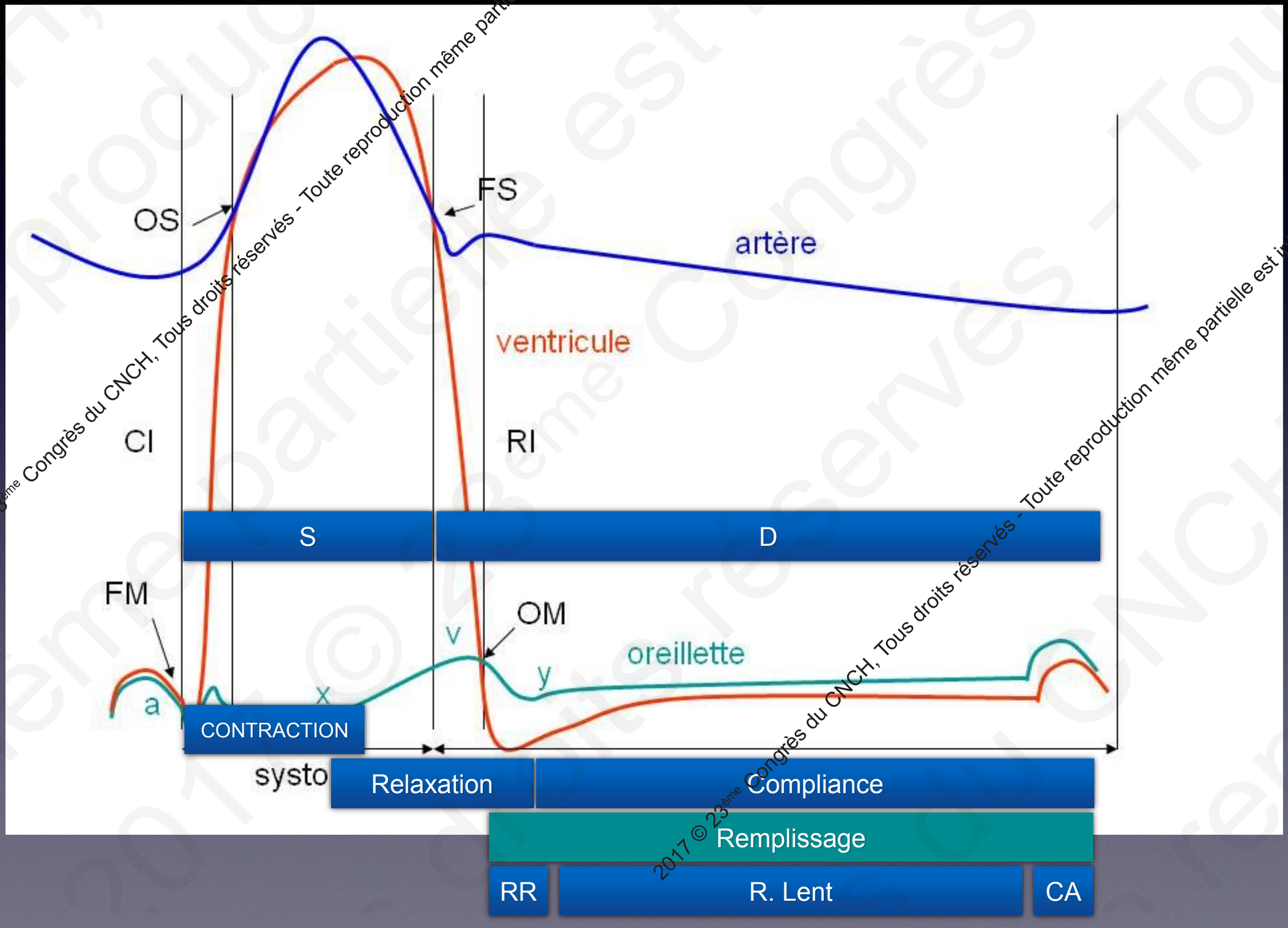


Figure 1. Adjusted Survival Curves for Patients with Heart Failure with Reduced or Preserved Ejection Fraction over the Year after the First Hospital Admission.

Bhatia NEJM 2006

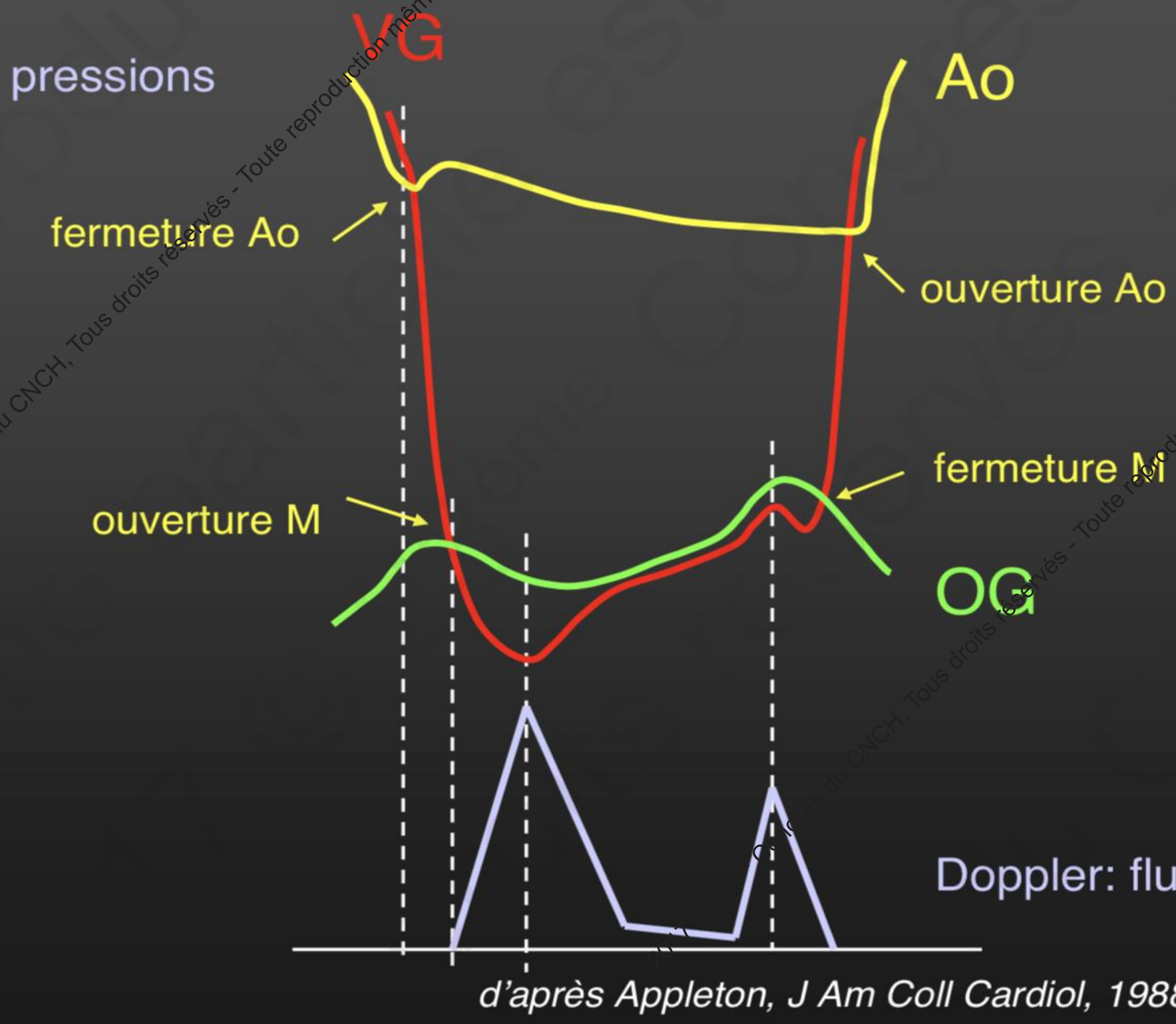
COMMENT (BIEN) EVALUER CES PATIENTS ?

Diastologie en bref



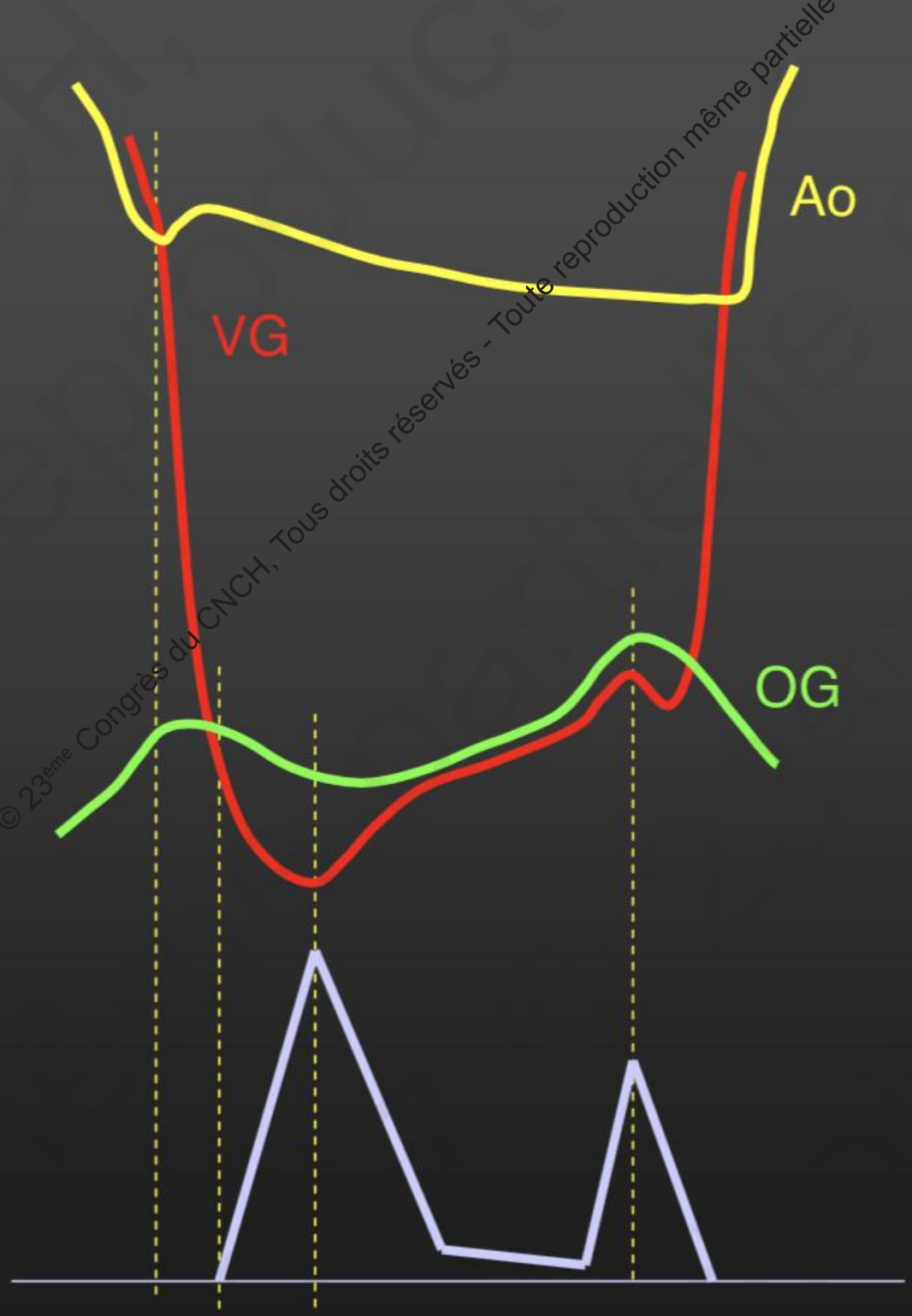
Paramètres à recueillir

Flux transmitral normal

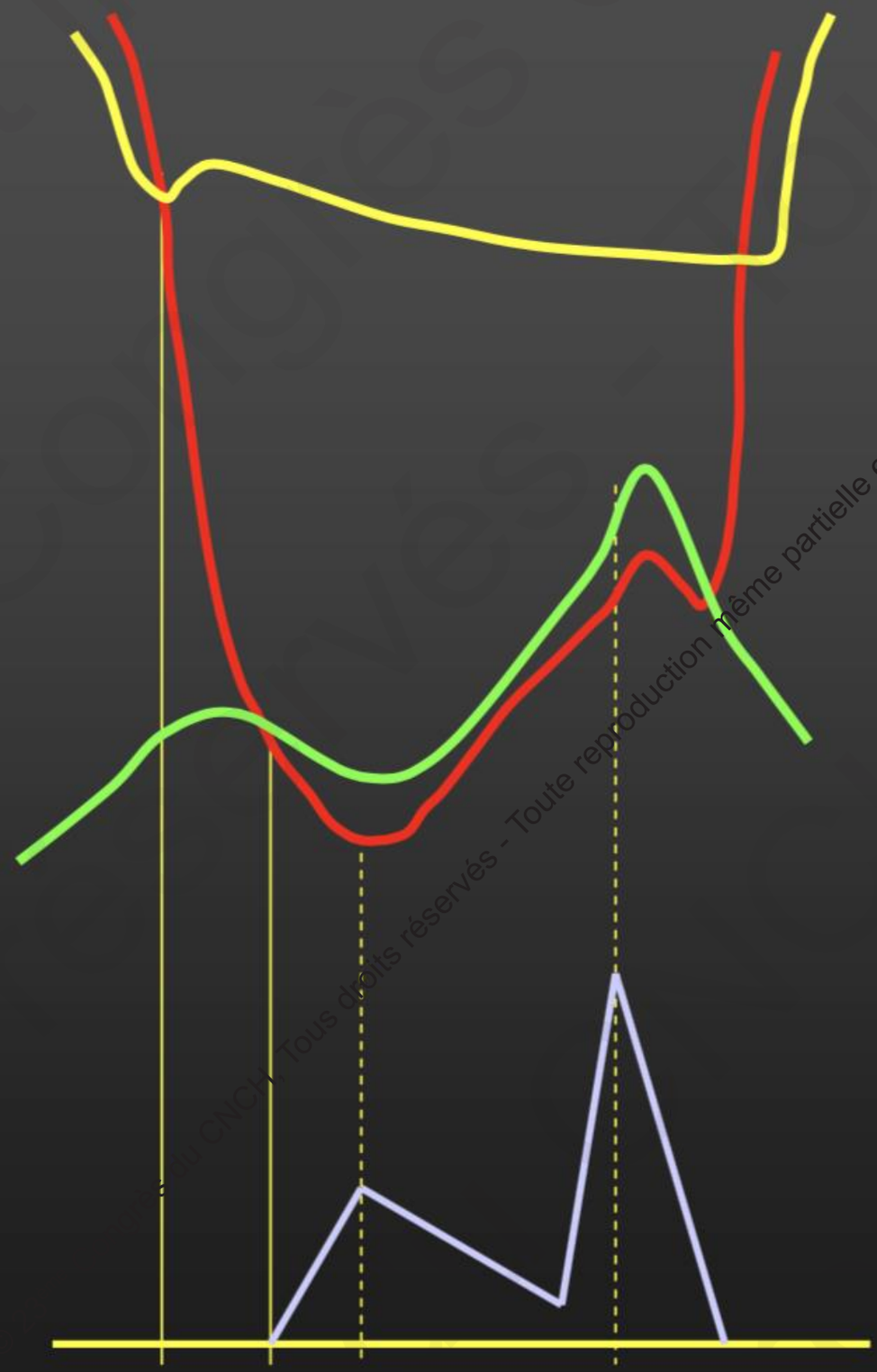


d'après Appleton, J Am Coll Cardiol, 1988; 12: 426 - 40

Anomalie de relaxation

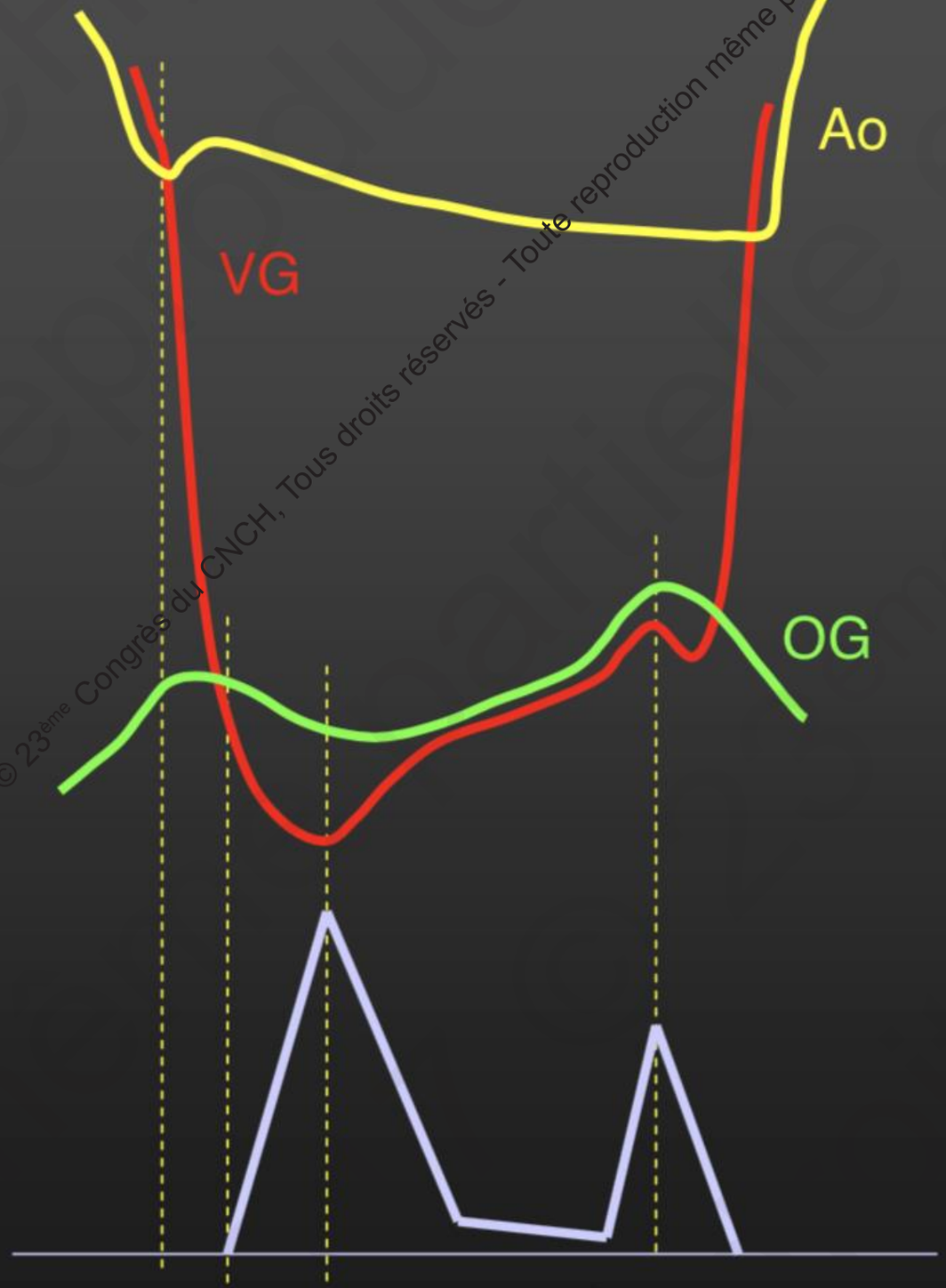


normal

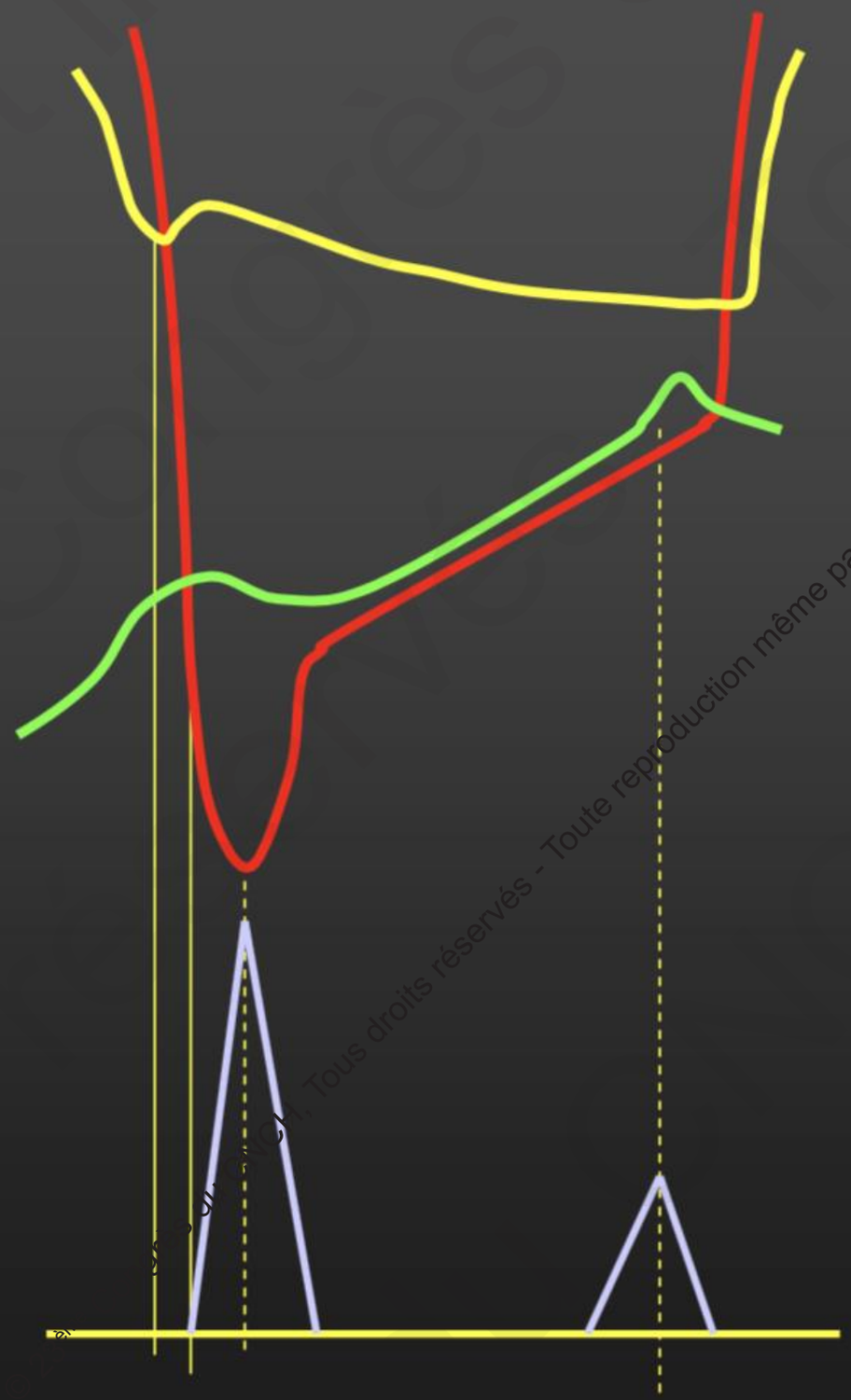


anomalie relaxation

Anomalie de type restrictif

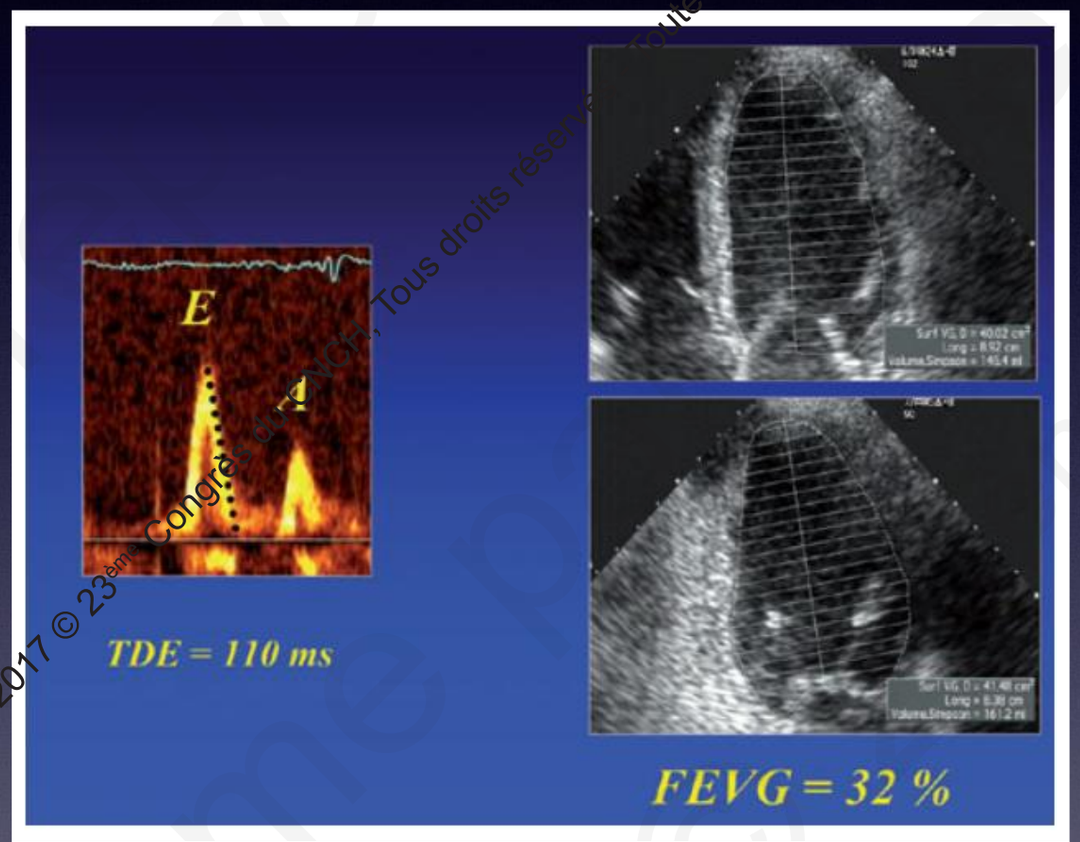


normal

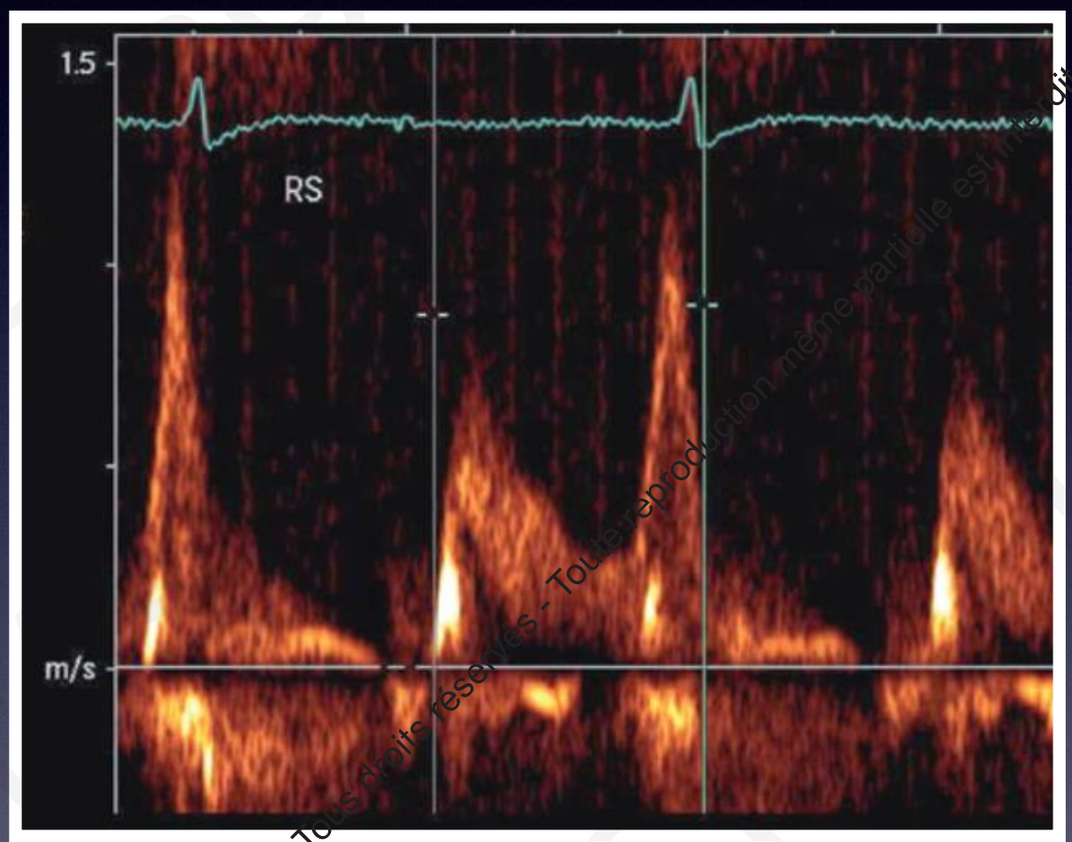


restrictif

Peut on se contenter du flux mitral ?

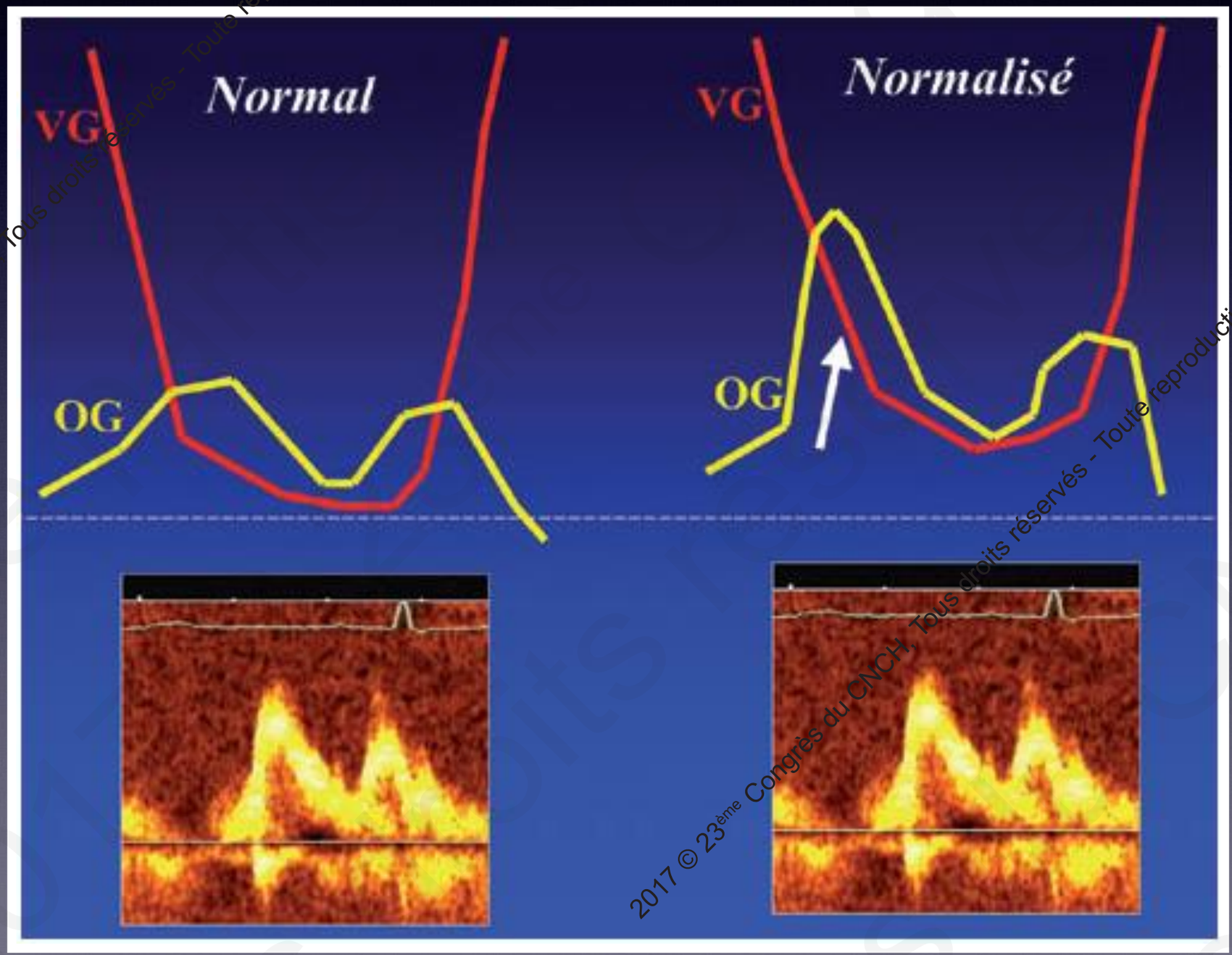


PRVG toujours élevées
(sauf grand sportif)

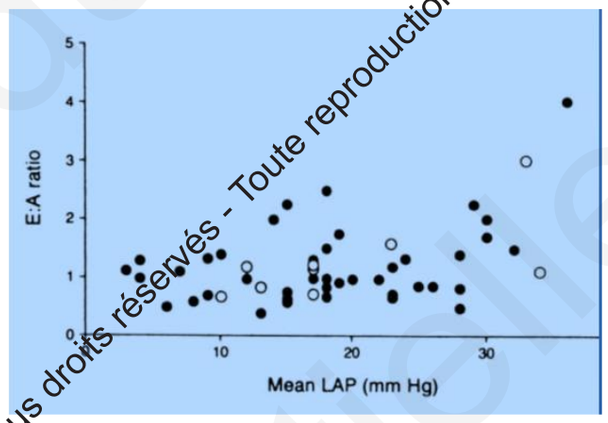


PRVG presque tjs basses
(sauf si CMH)

Le plus souvent

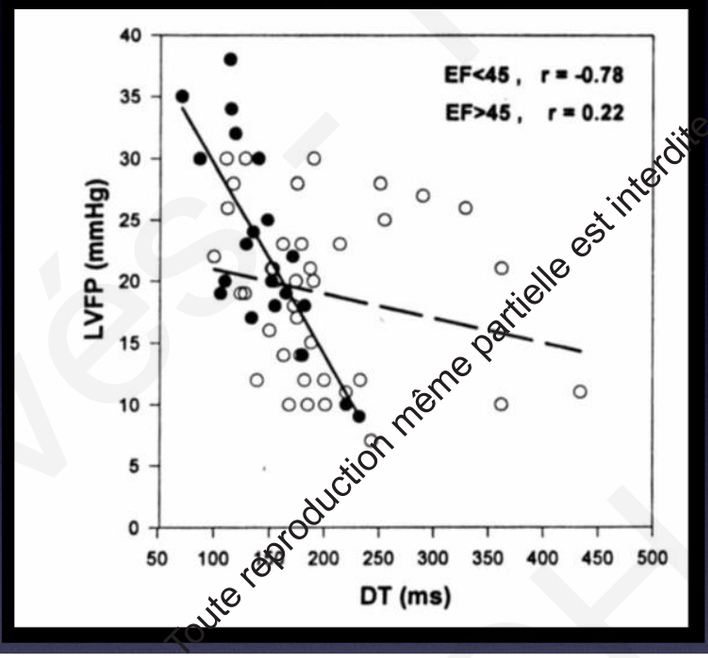


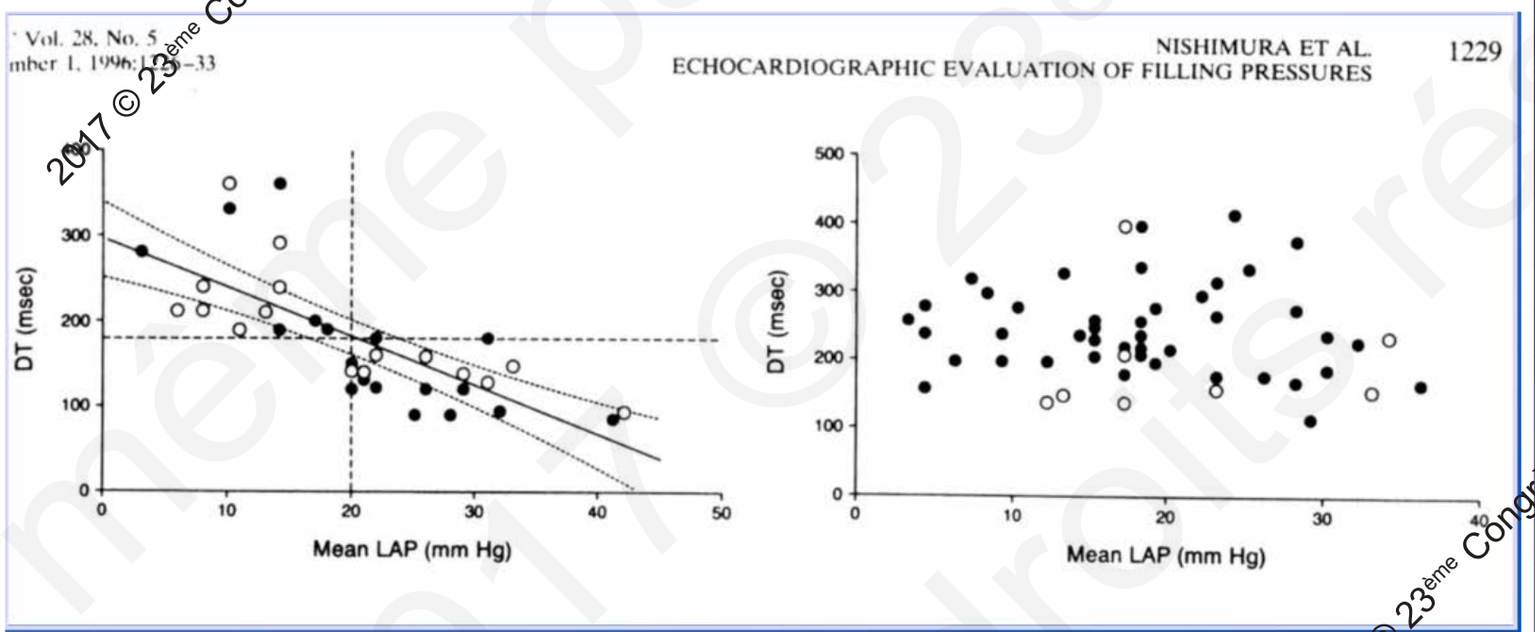
Peut on se contenter du flux mitral ?



Mauvaise correlation entre POG et ratio E/A

(Nishimura et al JACC 1996; 5: 1226-33)





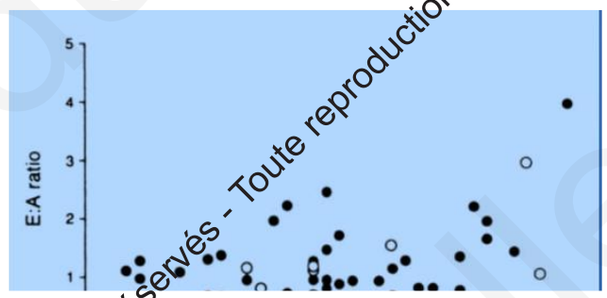
Mauvaise correlation entre POG et TDE

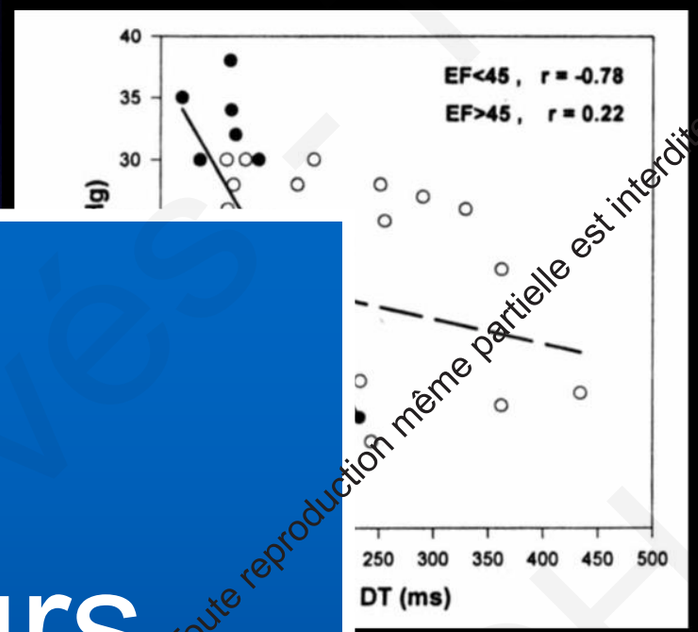
(Nishimura et al JACC 1996; 5: 1226-33)

Mauvaise correlation entre TDE PTDVG si FE> 45 %

(Nagueh et al Circulation 1996; 94: 2138-45)

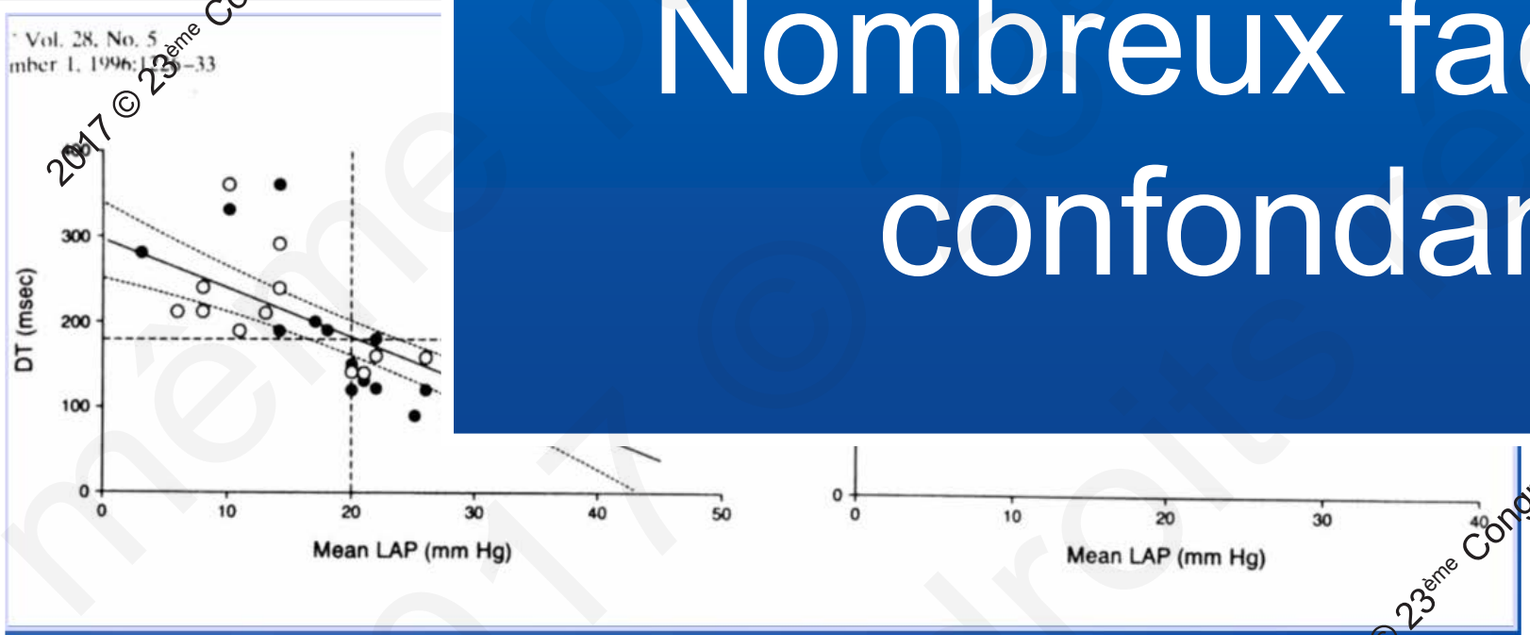
Peut on se contenter du flux mitral ?





Mauvaise co

Nombreux facteurs confondants



rrelation

tion

1996; 94: 2138-45)

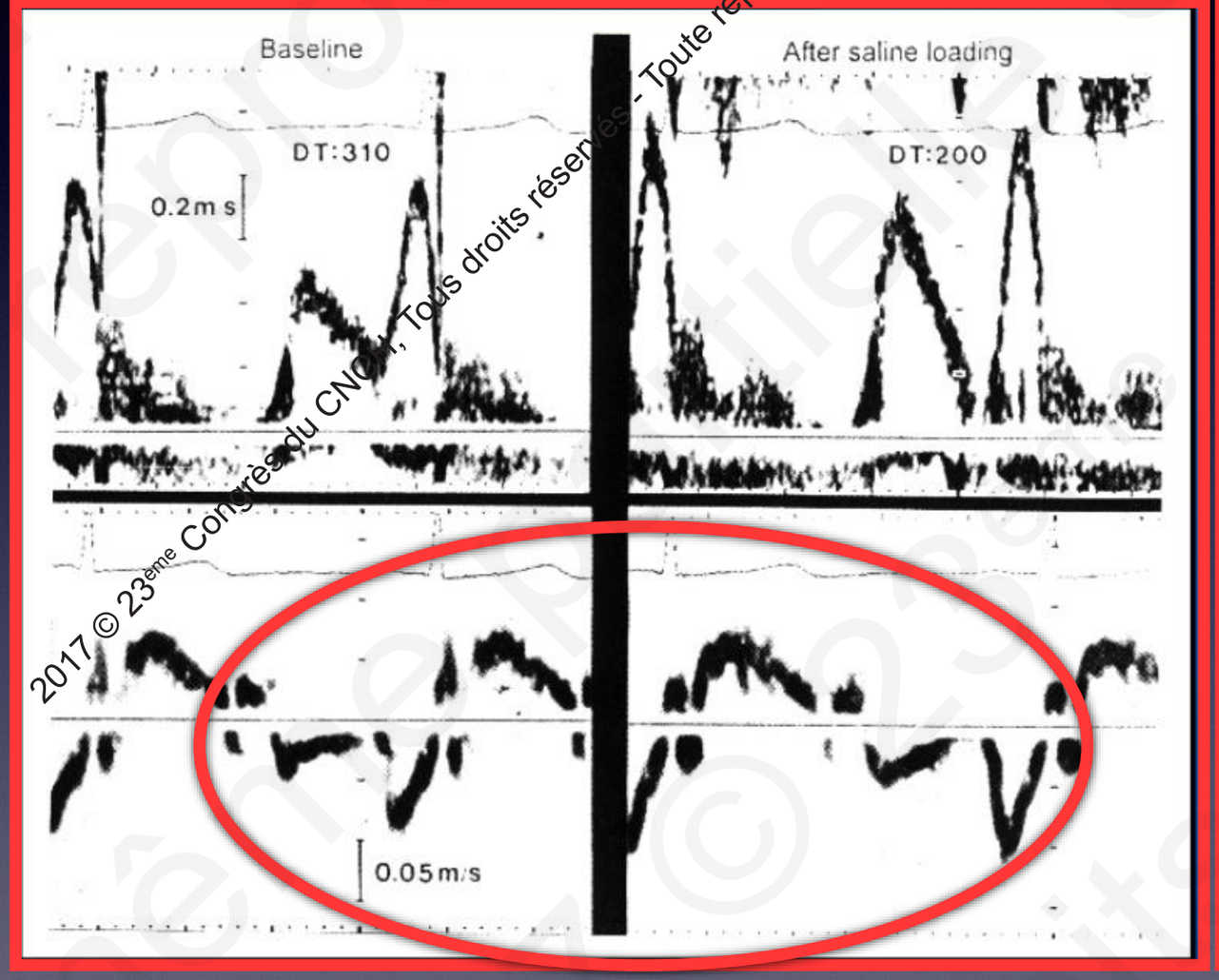
Mauvaise correlation entre POG et TDE

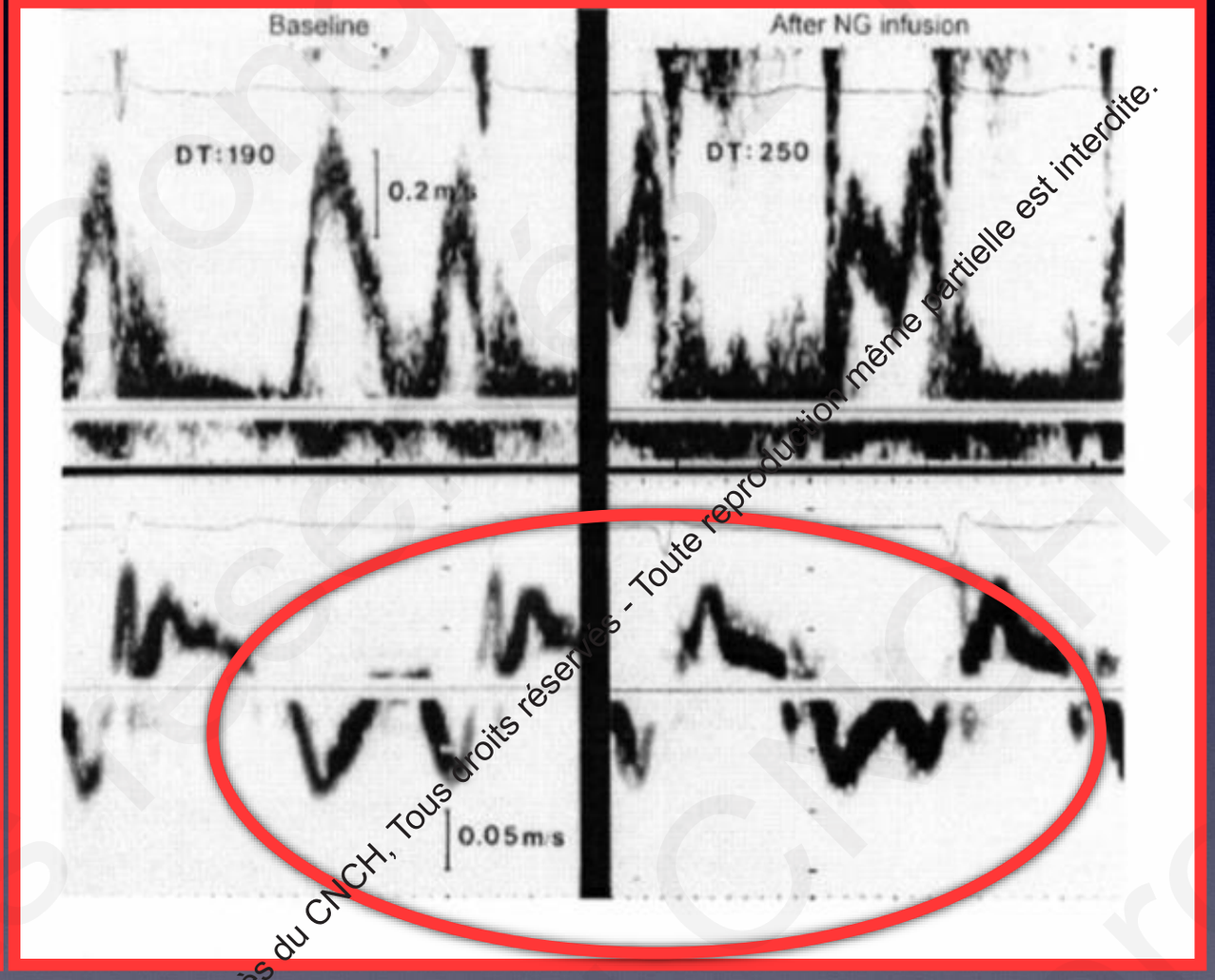
(Nishimura et al JACC 1996; 5: 1226-33)

Facteurs de variations du flux mitral

- Age
- Fréquence cardiaque
- Conduction AV et InterV
- Pré/post charge
- Fonction contractile OG
- Volémie
- Valvulopathies

DTI anneau mitral



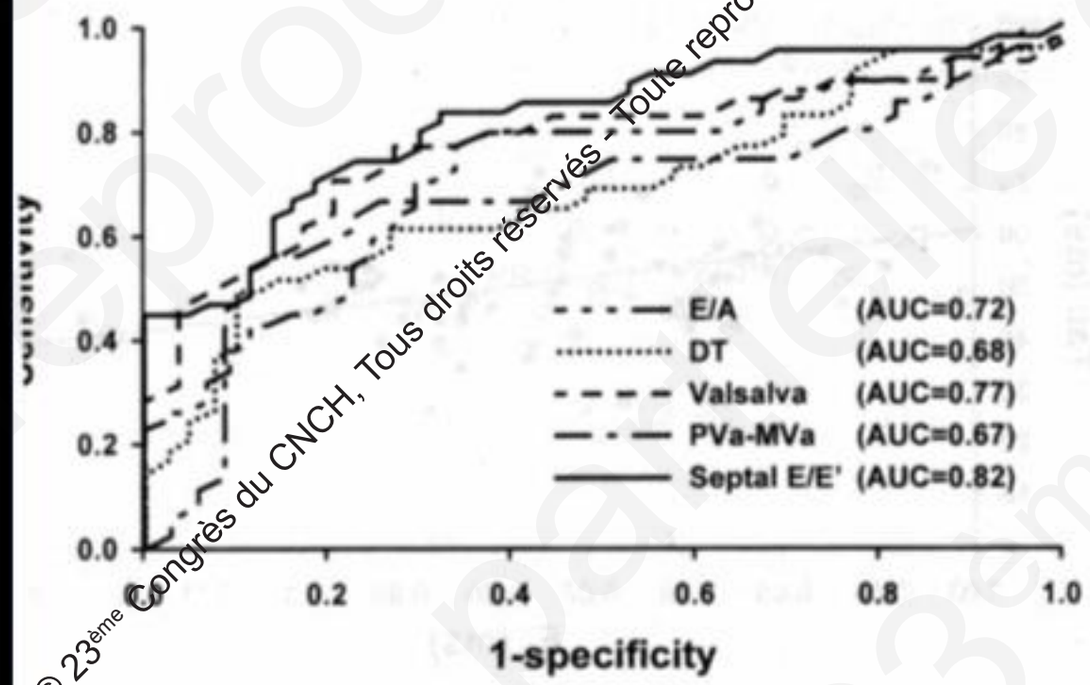


Après sérum PHY

Après TNT

Pas de modification significative de E’ ni de E/E’

Relation ratio E/E’ et PTDVG



ure 5. ROC curves for prediction of M-LVDP >12 mm Hg for Doppler parameters. AUC indicates area under curve.

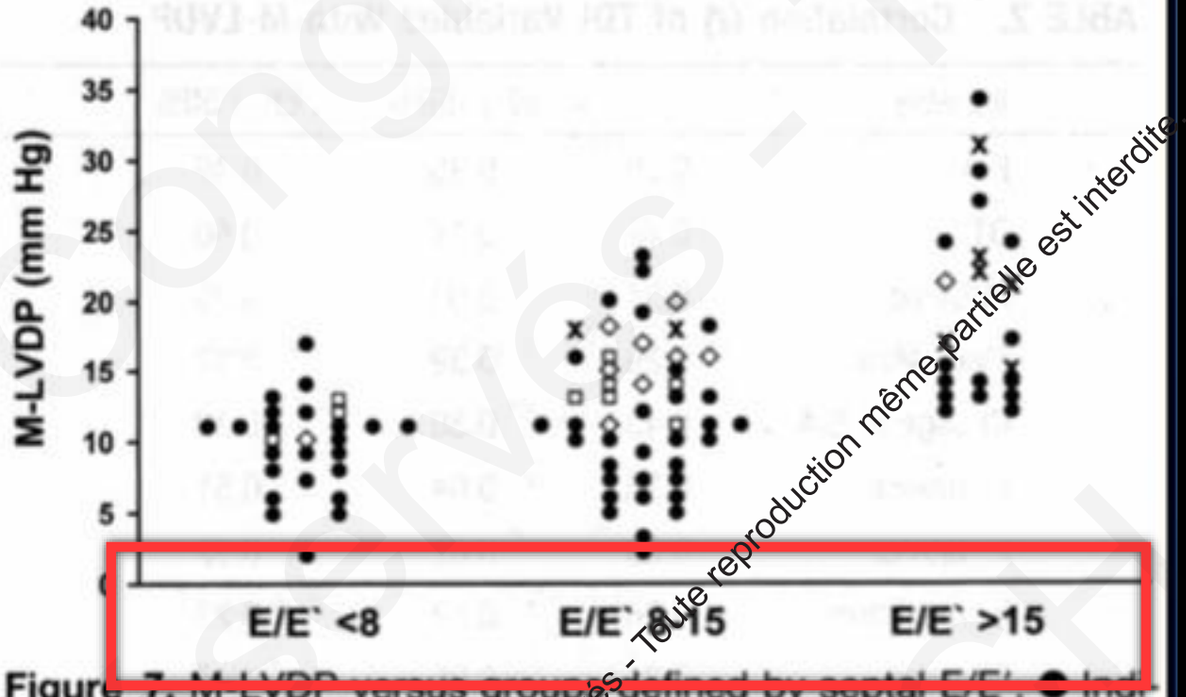


Figure 7. M-LVDP versus groups defined by septal E/E'. ● Indicates patients without conventional Doppler variables suggesting increased filling pressure; □, patients with PVa 30 ms > MVa; ◇, patients with positive Valsalva maneuver; and X, >1

85% de pts avec E/E’ < 8 ont des PRVG basses et
100% des pts avec E/E’ > 15 ont des PRVG hautes

Ommen et al. Circulation 2000

Table 4 e′ wave, *E*/e′ ratio, left atrial volume (LA), and systolic pulmonary artery pressure (sPAP) according to age and gender

Parameters	20–40 years			40–60 years			≥60 years			Global cohort		
	Total (*N* = 172) *n*/*N* (%)	Male (*N* = 79) *n*/*N* (%)	Female (*N* = 93) *n*/*N* (%)	Total (*N* = 194) *n*/*N* (%)	Male (*N* = 80) *n*/*N* (%)	Female (*N* = 114)*n*/*N*(%)	Total (*N* = 83) *n*/*N* (%)	Male (*N* = 39) *n*/*N* (%)	Female (*N* = 44) *n*/*N* (%)	Total (*N* = 449) *n*/*N* (%)	Male (*N* = 198) *n*/*N* (%)	Female (*N* = 251) *n*/*N* (%)
Septal e′ <8 cm/s	2/170 (1.2)	2/79 (2.5)	0/91 (0)	38/193 (19.7)	13/80 (16.3)	25/113 (22.1)	46/83 (55.4)	22/39 (56.4)	24/44 (54.5)	86/446 (19.3)	37/198 (18.7)	49/248 (19.8)
Lateral e′ <8 cm/s	2/167 (1.2)	1/76 (1.3)	1/91 (1.1)	11/192 (5.7)	4/80 (5.0)	7/112 (6.3)	15/79 (19.0)	5/36 (13.9)	10/43 (23.3)	28/438 (6.4)	10/192 (5.2)	18/246 (7.3)
Average sept-lat. *E*/e′ >15	0/158 (0)	0/75 (0)	0/83 (0)	2/184 (1.1)	1/76 (1.3)	1/108 (0.9)	0/78 (0)	0/36 (0)	0/42 (0)	2/420 (0.5)	1/187 (0.5)	1/233 (0.4)
Lateral *E*/e′ >13	0/159 (0)	0/75 (0)	0/84 (0)	3/184 (1.6)	1/76 (1.3)	2/108 (1.9)	0/78 (0)	0/36 (0)	0/42 (0)	3/421 (0.7)	1/187 (0.5)	2/234 (0.9)
LA volume >34 mL/m^{2a}	18/149 (12.1)	9/68 (13.2)	9/81 (11.1)	30/169 (17.8)	15/68 (22.1)	15/101 (14.9)	10/66 (15.2)	5/33 (15.2)	5/33 (15.2)	58/384 (15.1)	29/169 (17.2)	29/215 (13.5)
LA volume >37 mL/m^{2b}	10/149 (6.7)	6/68 (8.8)	4/81 (4.9)	18/169 (10.7)	8/68 (11.8)	10/101 (9.9)	6/66 (9.1)	3/33 (9.1)	3/33 (9.1)	34/384 (8.9)	17/169 (10.1)	17/215 (7.9)
LA volume >34 mL/m^{2c}	4/124 (3.2)	2/58 (3.4)	2/66 (3.0)	19/131 (14.5)	7/54 (13.0)	12/77 (15.6)	5/53 (9.4)	4/26 (15.4)	1/27 (3.7)	28/308 (9.1)	13/138 (9.4)	15/170 (8.8)
LA volume >34 mL/m^{2d}	10/117 (8.5)	4/53 (7.5)	6/64 (9.4)	18/127 (14.2)	7/51 (13.7)	11/76 (14.5)	3/50 (6.0)	2/24 (8.3)	1/26 (3.8)	31/294 (10.5)	13/128 (10.2)	18/166 (10.8)
LA volume >37 mL/m^{2e}	5/117 (4.3)	2/53 (3.8)	3/64 (4.7)	10/127 (7.9)	5/51 (9.8)	5/76 (6.6)	1/50 (2.0)	0/24 (0.0)	1/26 (3.8)	16/294 (5.4)	7/128 (5.5)	9/166 (5.4)
LA volume >34 mL/m^{2f}	20/117 (17.1)	8/53 (15.1)	12/64 (18.8)	33/127 (26.0)	16/51 (31.4)	17/76 (22.4)	8/50 (16.0)	6/24 (25.0)	2/26 (7.7)	61/294 (20.7)	30/128 (23.4)	31/166 (18.7)
LA volume >37 mL/m^{2g}	12/117 (10.3)	6/53 (11.3)	6/64 (9.4)	21/127 (16.5)	11/51 (21.6)	10/76 (13.2)	4/50 (8.0)	3/24 (12.5)	1/26 (3.8)	37/294 (12.6)	20/128 (15.6)	17/166 (10.2)
sPAP >36 mmHg	1/106 (0.9)	1/48 (2.1)	0/58 (0.0)	0/131 (0.0)	0/57 (0.0)	0/74 (0.0)	0/57 (0.0)	0/24 (0.0)	0/33 (0.0)	1/294 (0.3)	1/129 (0.8)	0/165 (0.0)
sPAP >45 mmHg	0/106 (0.0)	0/48 (0.0)	0/58 (0.0)	0/131 (0.0)	0/57 (0.0)	0/74 (0.0)	0/57 (0.0)	0/24 (0.0)	0/33 (0.0)	0/294 (0.0)	0/129 (0.0)	0/165 (0.0)

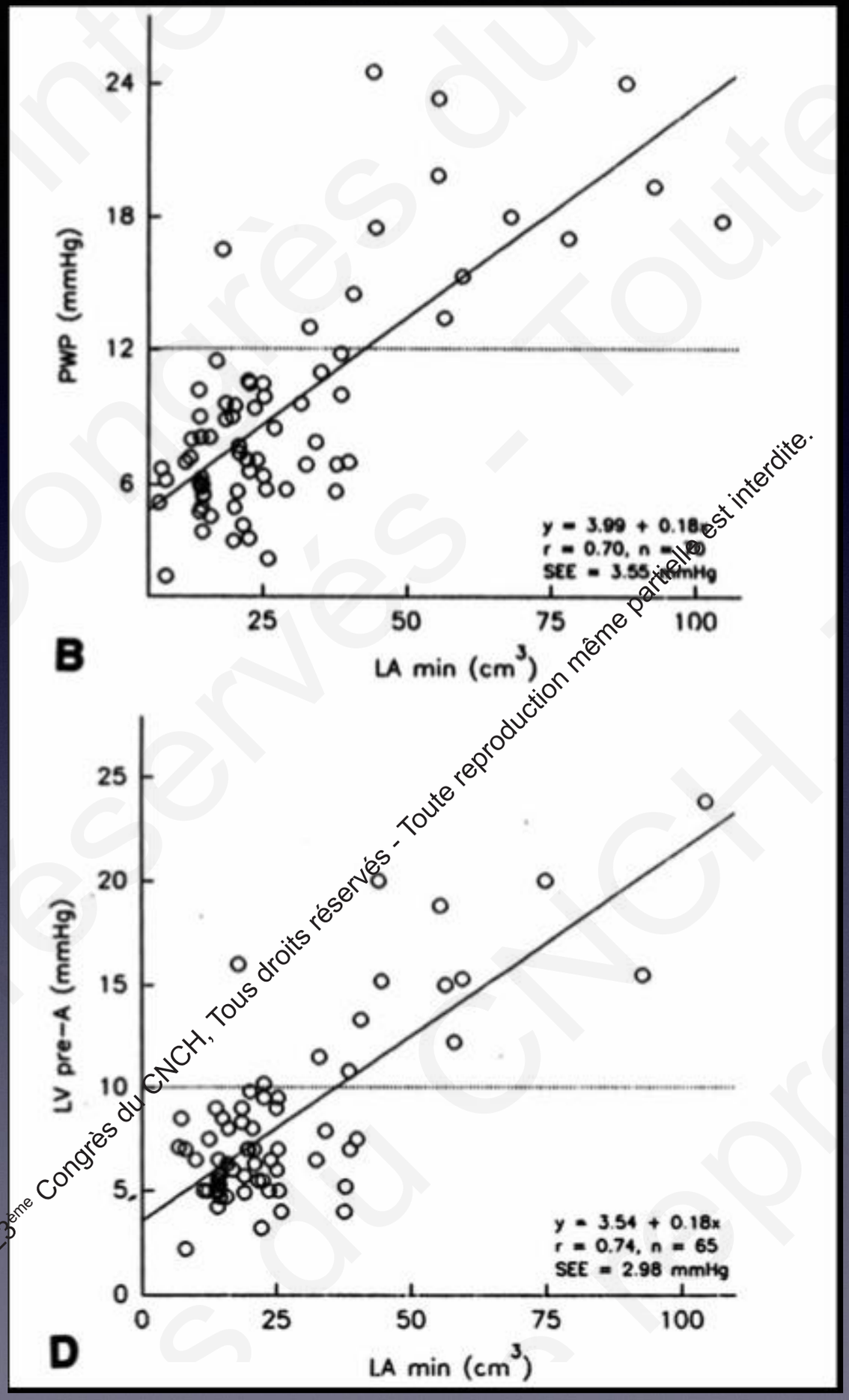
[a]LA volume >34 mL/m^2 by single plane area-length method (four-chamber view).
[b]LA volume >37 mL/m^2 by single plane area-length method (four-chamber view).
[c]LA volume >34 mL/m^2 by single plane Simpson method (four-chamber view).
[d]LA volume >34 mL/m^2 by biplane Simpson method.
[e]LA volume >37 mL/m^2 by biplane Simpson method.
[f]LA volume >34 mL/m^2 by biplane area-length method.
[g]LA volume >34 mL/m^2 by biplane area-length method.

Autres paramètres

TAILLE ET CONTRACTION DE L'OG

Un volume d'OG au delà de 34 ml/m2 est un indicateur indépendant de décès et d'insuffisance. Cardiaque

Abhayaratna et al JACC 2006



PAPs et dysfonction diastolique

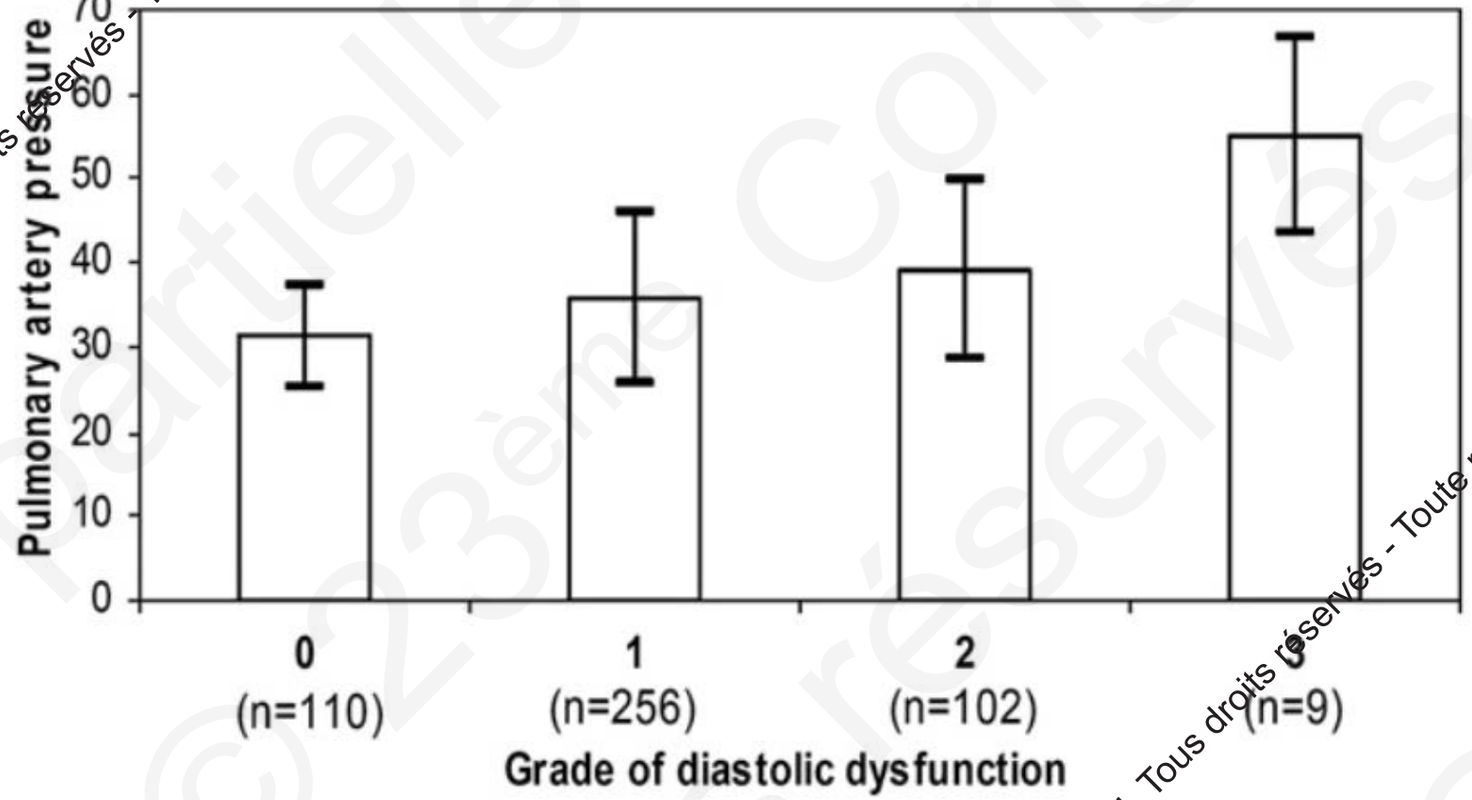


Fig. 1. Mean pulmonary artery pressure (mm Hg) by grade of diastolic dysfunction. $P<0.001$ by one-way ANOVA for the differences was between each 2 groups of diastolic dysfunction.

Neuman Intern J Cardiol 2008

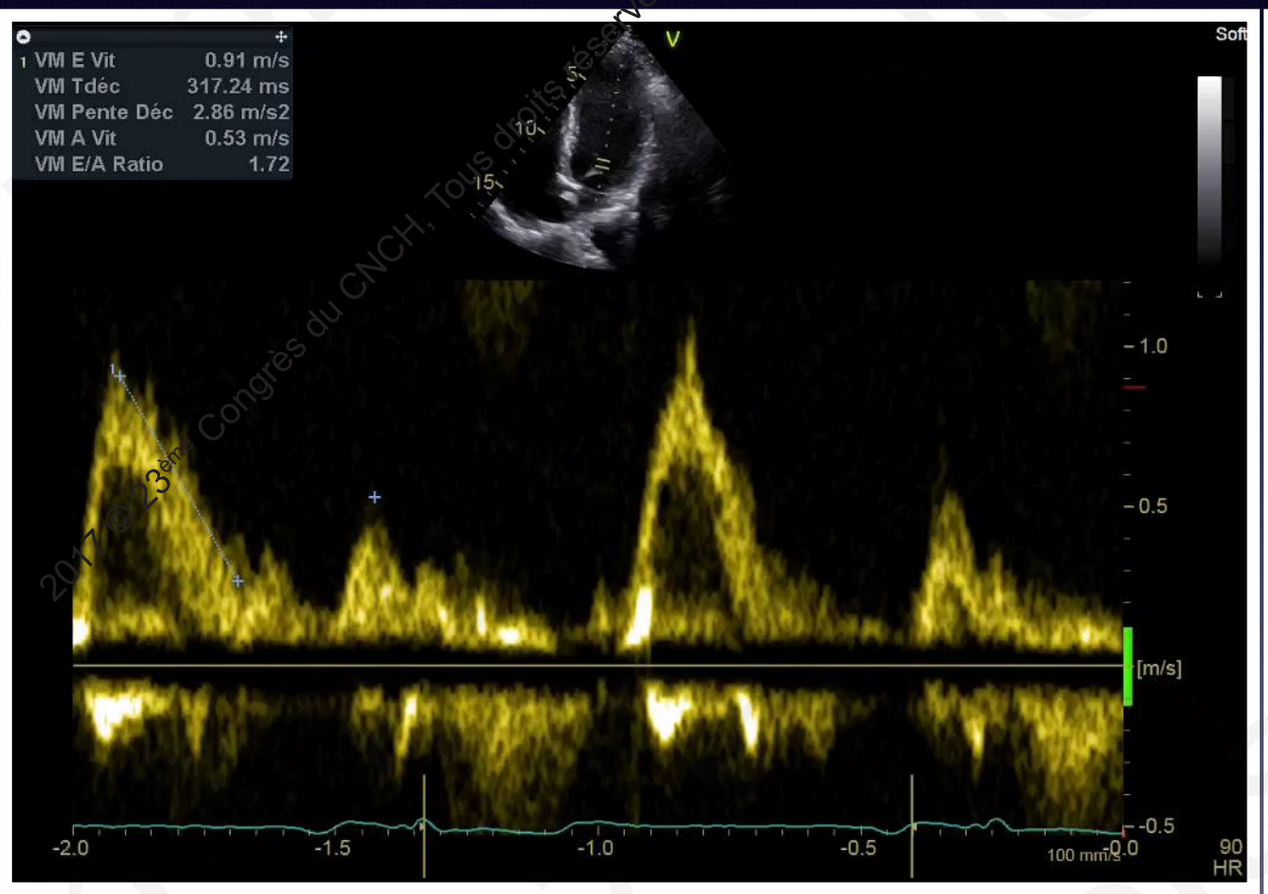
PAPs et dysfonction diastolique

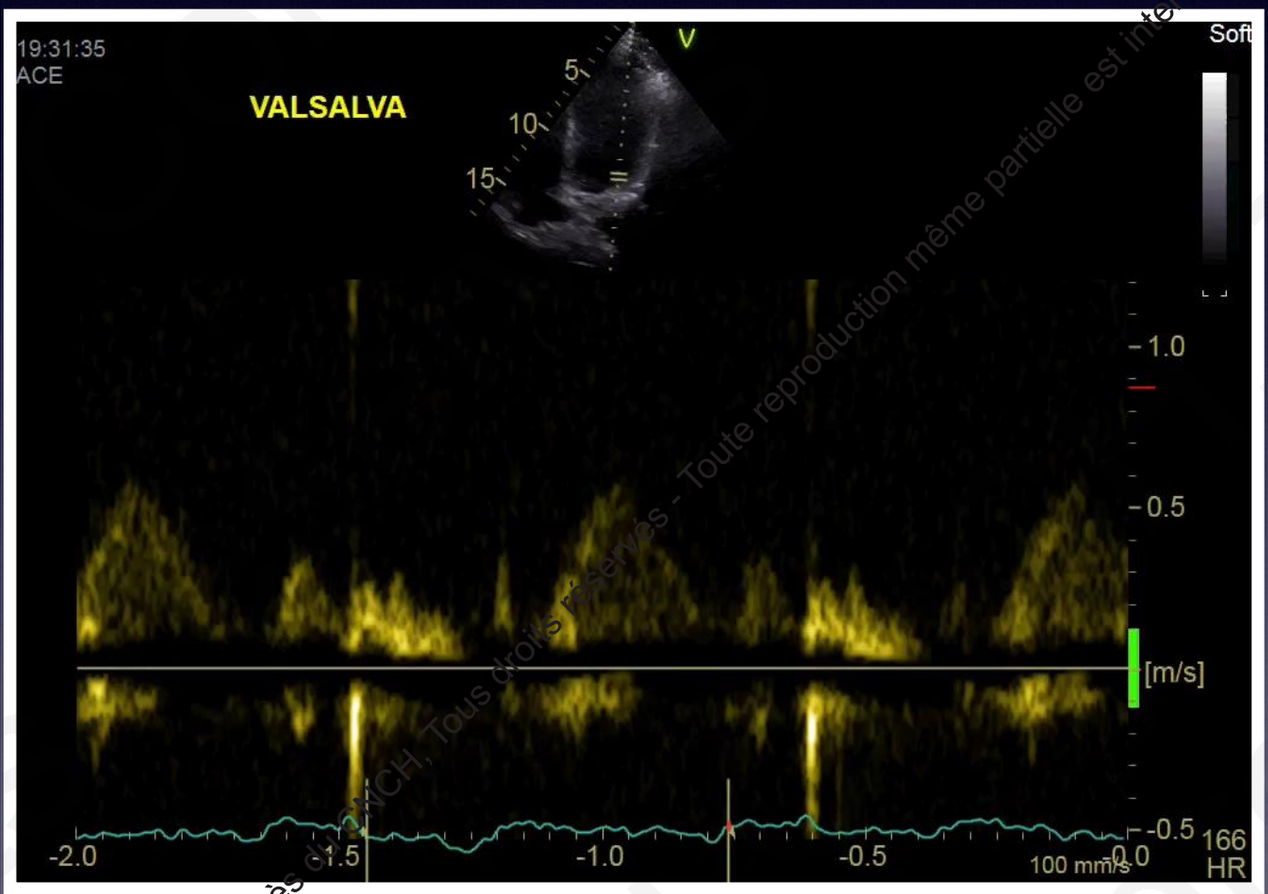
Table 3 Proportion of normal subjects with abnormal LA volume index and Doppler velocities

Parameter	20–40 y			40–60 y			≥60 y			Global cohort		
	Total (*N* = 172) *n/N* (%)	Male (*N* = 79) *n/N* (%)	Female (*N* = 93) *n/N* (%)	Total (*N* = 194) *n/N* (%)	Male (*N* = 80) *n/N* (%)	Female (*N* = 114) *n/N* (%)	Total (*N* = 83) *n/N* (%)	Male (*N* = 39) *n/N* (%)	Female (*N* = 44) *n/N* (%)	Total (*N* = 449) *n/N* (%)	Male (*N* = 198) *n/N* (%)	Female (*N* = 251) *n/N* (%)
Septal e' < 8 cm/sec	2/170 (1.2)	2/79 (2.5)	0/91 (0)	38/193 (19.7)	13/80 (16.3)	25/113 (22.1)	46/83 (55.4)	22/39 (56.4)	24/44 (54.5)	86/446 (19.3)	37/198 (18.7)	49/248 (19.8)
Lateral e' < 8 cm/sec	2/167 (1.2)	1/76 (1.3)	1/91 (1.1)	11/192 (5.7)	4/80 (5.0)	7/112 (6.3)	15/79 (19.0)	5/36 (13.9)	10/43 (23.3)	28/438 (6.4)	10/192 (5.2)	18/246 (7.3)
Lateral e' < 10 cm/sec	3/167 (1.8)	2/76 (2.6)	1/91 (1.1)	30/192 (15.6)	9/80 (11.3)	21/112 (18.8)	41/79 (51.9)	17/36 (47.2)	24/43 (55.8)	74/438 (16.9)	28/192 (14.6)	46/246 (18.7)
Average (septal-lateral) E/e' > 14	0/158 (0)	0/75 (0)	0/83 (0)	3/184 (1.6)	1/76 (1.3)	2/108 (1.9)	1/78 (1.3)	1/36 (2.8)	0/42 (0)	4/420 (1.0)	2/187 (1.1)	2/233 (0.9)
Septal E/e' > 15	0/162 (0)	0/78 (0)	0/84 (0)	2/185 (1.1)	1/76 (1.3)	1/109 (0.9)	3/81 (3.7)	2/38 (5.3)	1/43 (2.3)	5/428 (1.2)	3/192 (1.6)	2/236 (0.8)
Lateral E/e' > 13	0/159 (0)	0/75 (0)	0/84 (0)	3/184 (1.6)	1/76 (1.3)	2/108 (1.9)	0/78 (0)	0/36 (0)	0/42 (0)	3/421 (0.7)	1/187 (0.5)	2/234 (0.9)
LA volume index > 34 mL/m^2 (*)	10/117 (8.5)	4/53 (7.5)	6/64 (9.4)	18/127 (14.2)	7/51 (13.7)	11/76 (14.5)	3/50 (6.0)	2/24 (8.3)	1/26 (3.8)	31/294 (10.5)	13/128 (10.2)	18/166 (10.8)
SPAP > 36 mm Hg	1/106 (0.9)	1/48 (2.1)	0/58 (0.0)	0/131 (0.0)	0/57 (0.0)	0/74 (0.0)	0/57 (0.0)	0/24 (0.0)	0/33 (0.0)	1/294 (0.3)	1/129 (0.8)	0/165 (0.0)
SPAP > 45 mm Hg	0/106 (0.0)	0/48 (0.0)	0/58 (0.0)	0/131 (0.0)	0/57 (0.0)	0/74 (0.0)	0/57 (0.0)	0/24 (0.0)	0/33 (0.0)	0/294 (0.0)	0/129 (0.0)	0/165 (0.0)

SPAP, Systolic pulmonary artery pressure.
*LA volume index > 34 mL/m^2 by biplane Simpson method (adapted from Caballero *et al.*[52]).

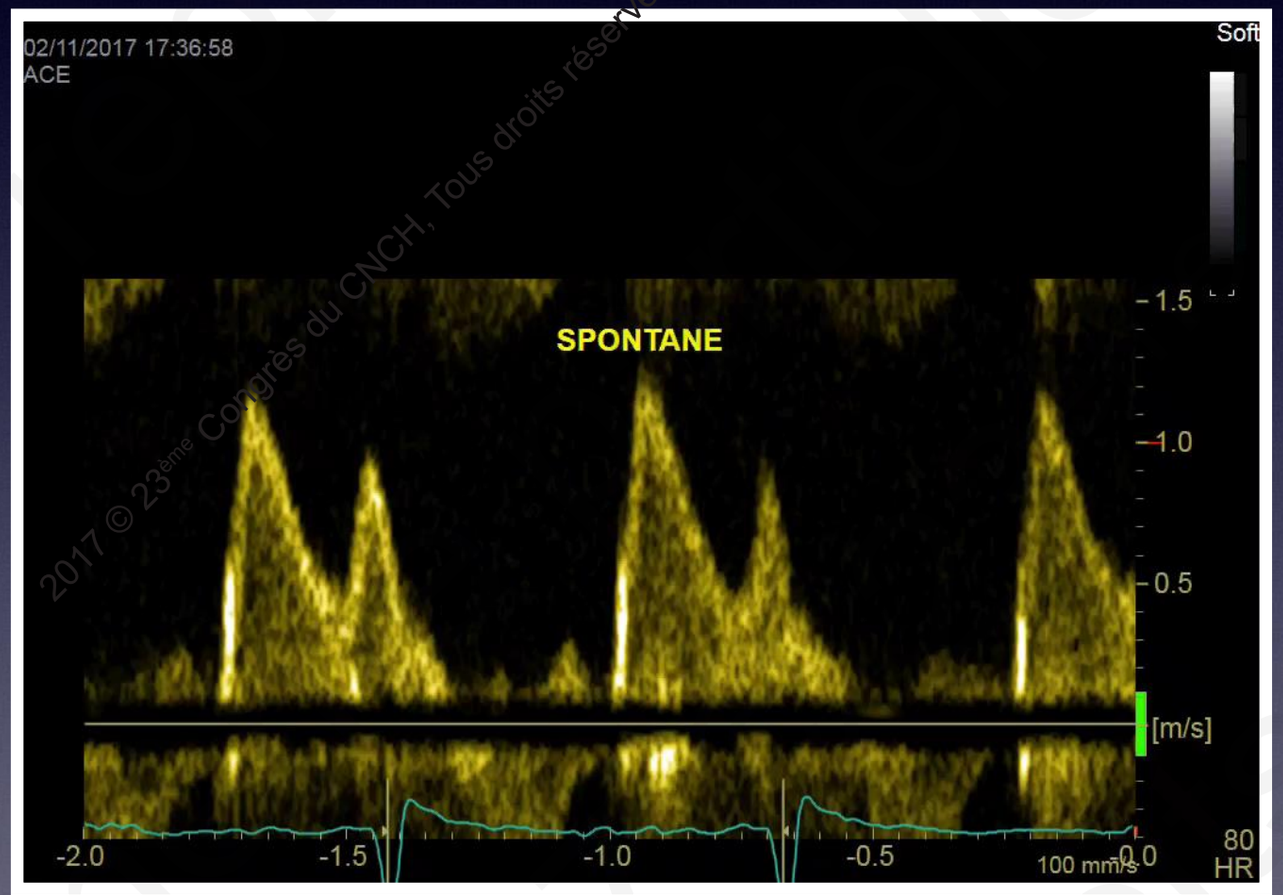
Valsalva

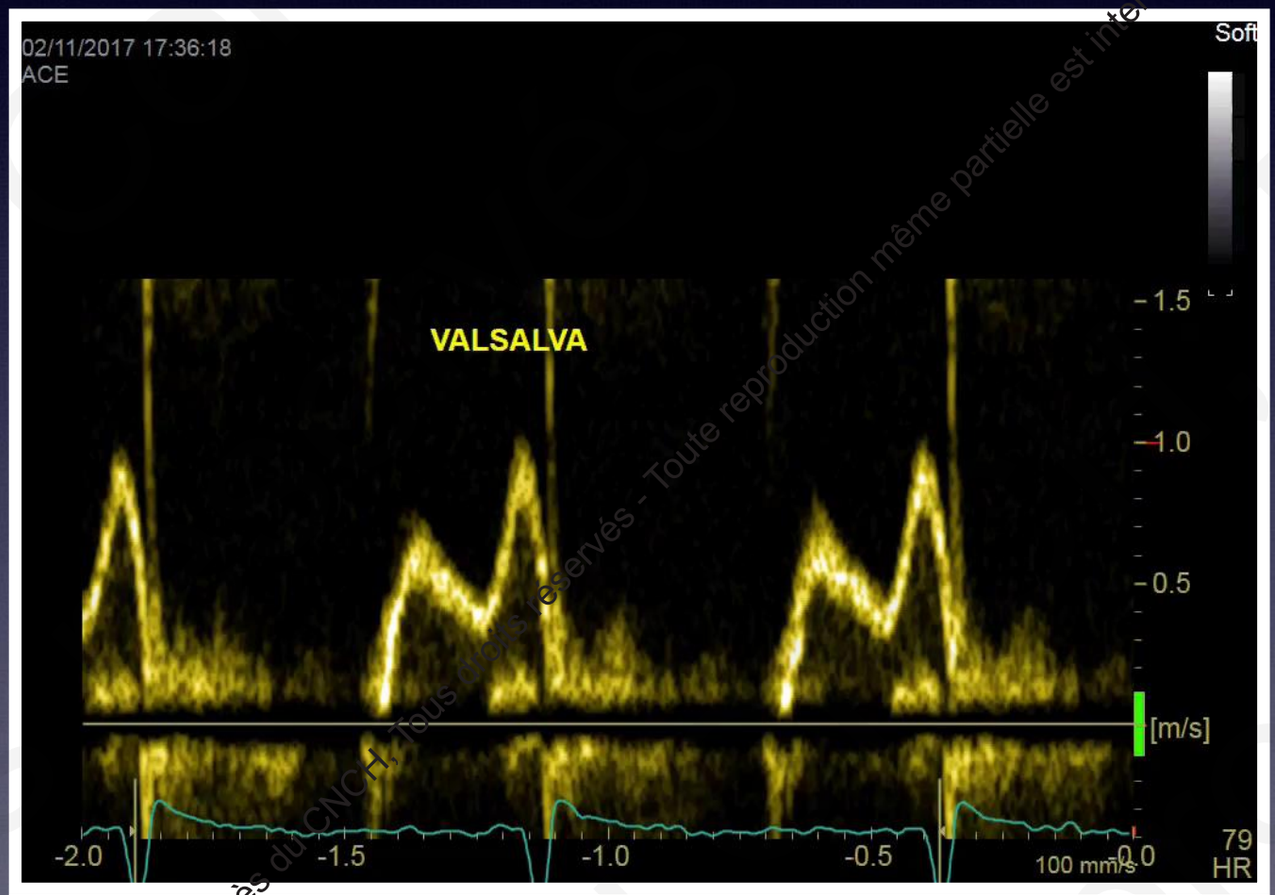




Sujet normal

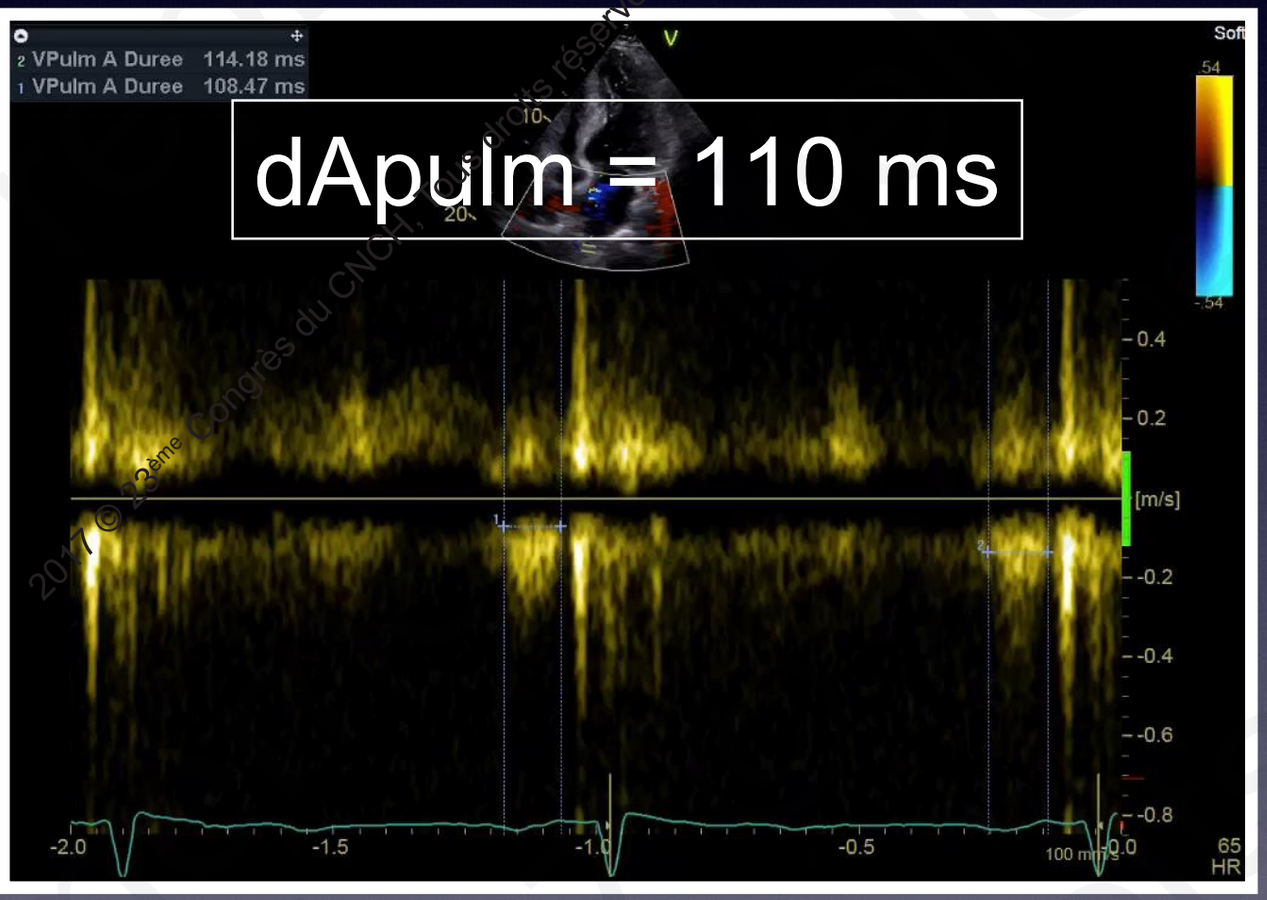
Valsalva

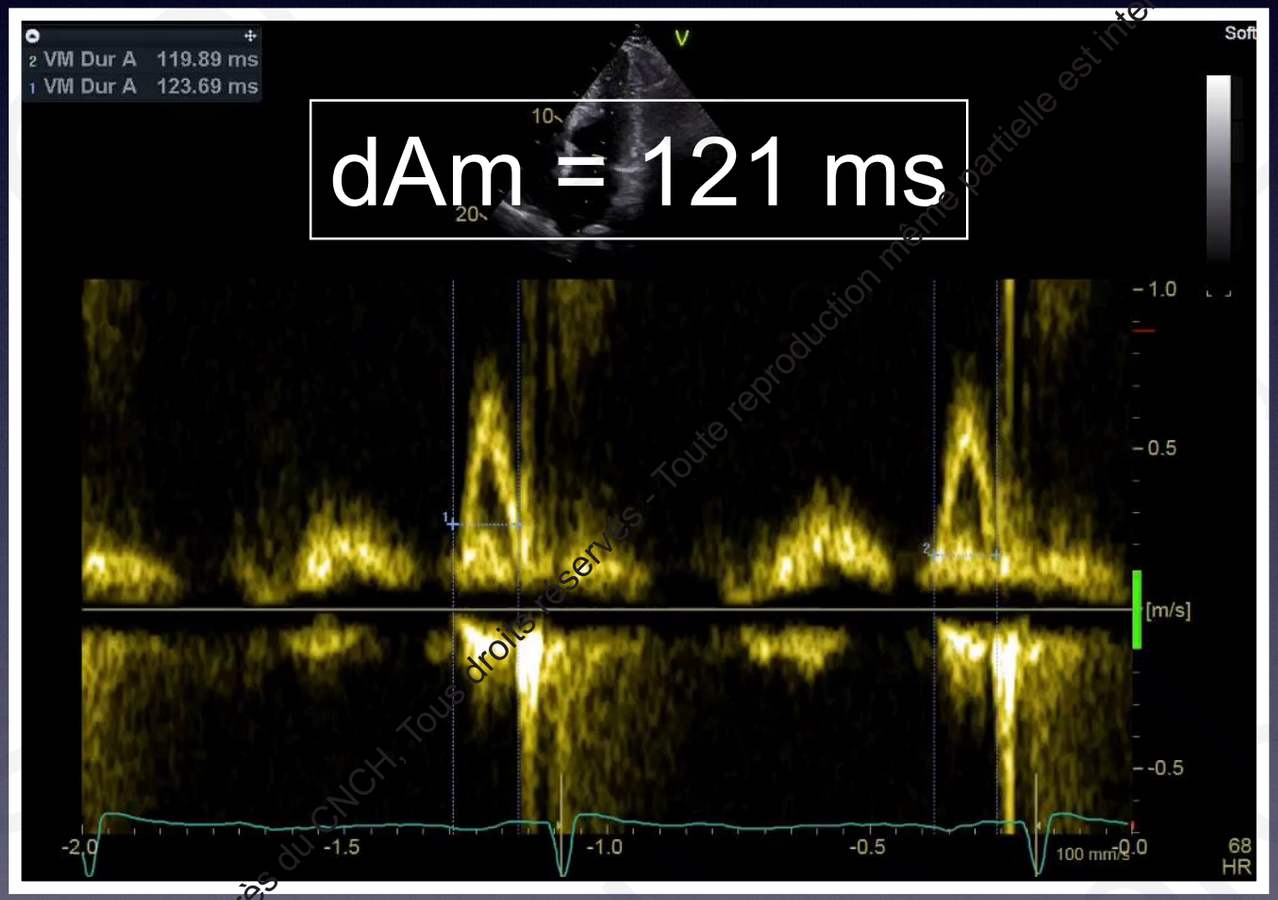




PRVG augmentées

dAp-dAm





PRVG normales

Méthodes échographiques d'évaluation de la fonction diastolique

Table 1 Two-dimensional and Doppler methods for assessment of LV diastolic function

Variable	Acquisition	Analysis
Peak E-wave velocity (cm/sec)	1. Apical four-chamber with color flow imaging for optimal alignment of PW Doppler with blood flow. 2. PW Doppler sample volume (1–3 mm axial size) between mitral leaflet tips. 3. Use low wall filter setting (100–200 MHz) and low signal gain. 4. Optimal spectral waveforms should not display spikes or feathering.	Peak modal velocity in early diastole (after ECG T wave) at the leading edge of spectral waveform
Peak A-wave velocity (cm/sec)	1. Apical four-chamber with color flow imaging for optimal alignment of PW Doppler with blood flow 2. PW Doppler sample volume (1–3 mm axial size) between mitral leaflet tips. 3. Use low wall filter setting (100–200 MHz) and low signal gain. 4. Optimal spectral waveforms should not display spikes or feathering.	Peak modal velocity in late diastole (after ECG P wave) at the leading edge of spectral waveform
MV A duration (msec)	1. Apical four-chamber with color flow imaging for optimal alignment of PW Doppler with blood flow. 2. PW Doppler sample volume (1–3 mm axial size) at level of mitral annulus (limited data on how duration compares between annulus and leaflet tips) 3. Use low wall filter setting (100–200 MHz) and low signal gain. 4. Optimal spectral waveforms should not display spikes or feathering.	Time interval from A-wave onset to end of A wave at zero baseline. If E and A are fused (E velocity > 20 cm/sec when A velocity starts), A-wave duration will often be longer because of increased atrial filling stroke volume.
MV E/A ratio	See above for proper technique of acquisition of E and A velocities.	MV E velocity divided by A-wave velocity
MV DT (msec)	Apical four-chamber: pulsed Doppler sample volume between mitral leaflet tips	Time interval from peak E-wave along the slope of LV filling extrapolated to the zero-velocity baseline.
Pulsed-wave TDI e′ velocity (cm/sec)	1. Apical four-chamber view: PW Doppler sample volume (usually 5–10 mm axial size) at lateral and septal basal regions so average e′ velocity can be computed. 2. Use ultrasound system presets for wall filter and lowest signal gain. 3. Optimal spectral waveforms should be sharp and not	Peak modal velocity in early diastole at the leading edge of spectral waveform

PV S/D ratio	See above for acquisition of pulmonary vein S and D velocities.	PV S wave divided by D-wave velocity or PV S wave time-velocity integral/PV D wave time-velocity integral.
CW Doppler: TR systolic jet velocity (m/sec)	1. Parasternal and apical four-chamber view with color flow imaging to obtain highest Doppler velocity aligned with CW. 2. Adjust gain and contrast to display complete spectral envelope without signal spikes or feathering	Peak modal velocity during systole at leading edge of spectral waveform

(Continued)

Table 1 (*Continued*)

Variable	Acquisition	Analysis
Valsalva maneuver	Recording obtained continuously through peak inspiration and as patient performs forced expiration for 10 sec with mouth and nose closed.	Change in MV E velocity and E/A ratio during peak strain and following release
Secondary measures		
Color M-mode Vp (cm/sec)	Apical four-chamber with color flow imaging for M-mode cursor position, shift color baseline in direction of mitral valve inflow to lower velocity scale for red/yellow inflow velocity profile	Slope of inflow from MV plane into LV chamber during early diastole at 4 cm distance
IVRT	Apical long-axis or five-chamber view, using CW Doppler and placing sample volume in LV outflow tract to simultaneously display end of aortic ejection and onset of mitral inflow.	Time between aortic valve closure and MV opening. For IVRT, sweep speed should be 100 mm/sec.
TE-e′	Apical four-chamber view with proper alignment to acquire mitral inflow at mitral valve tips and using tissue Doppler to acquire septal and lateral mitral annular velocities.	Time interval between peak of R wave in QRS complex and onset of mitral E velocity is subtracted from time interval between QRS complex and onset of e′ velocity. RR intervals should be matched and gain and filter settings should be optimized to avoid high gain and filter settings. For time intervals, sweep speed should be 100 mm/sec.

ASE/EACVI GUIDELINES AND STANDARDS

Recommendations for the Evaluation of Left Ventricular Diastolic Function by Echocardiography: An Update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging

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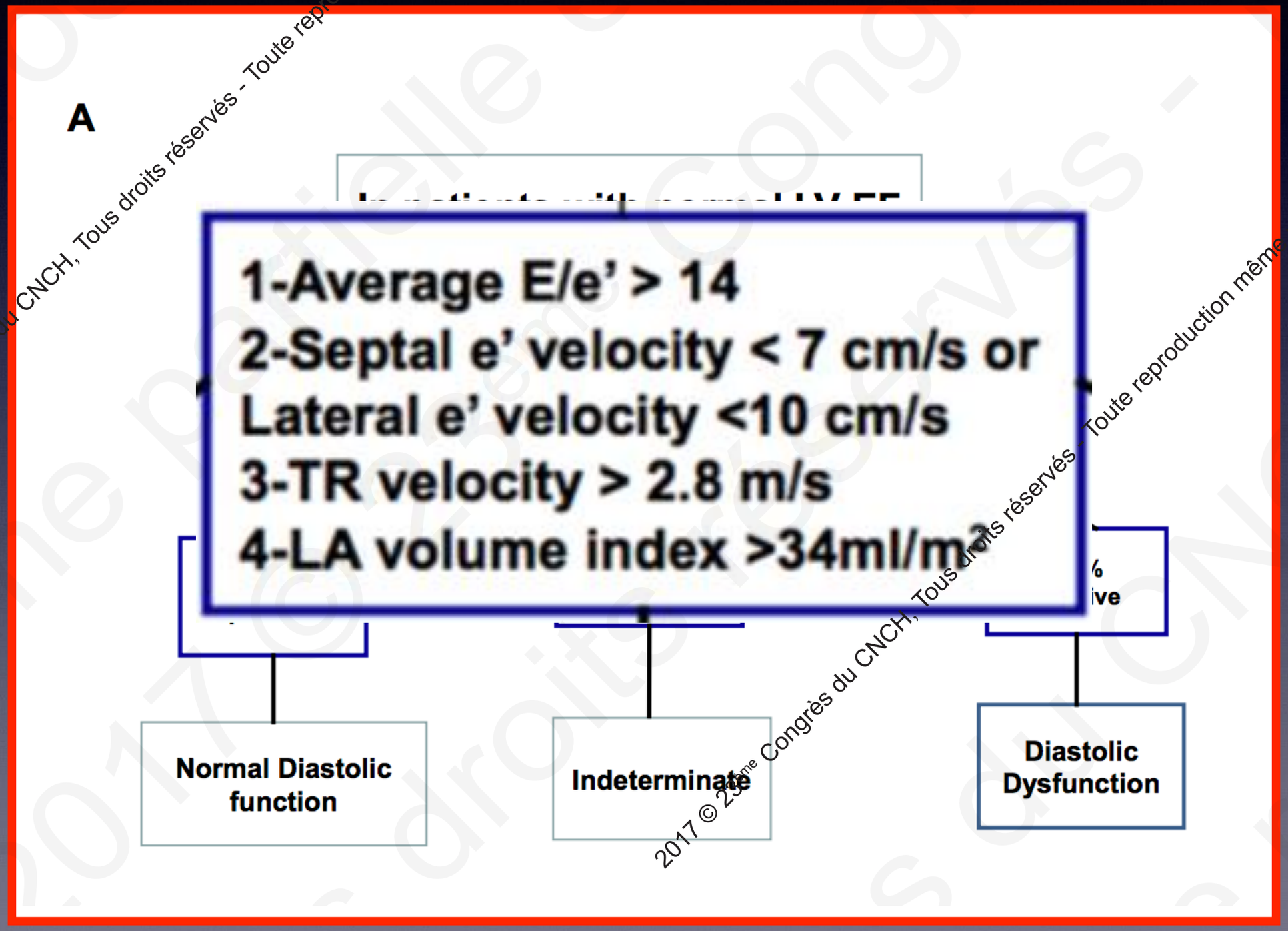
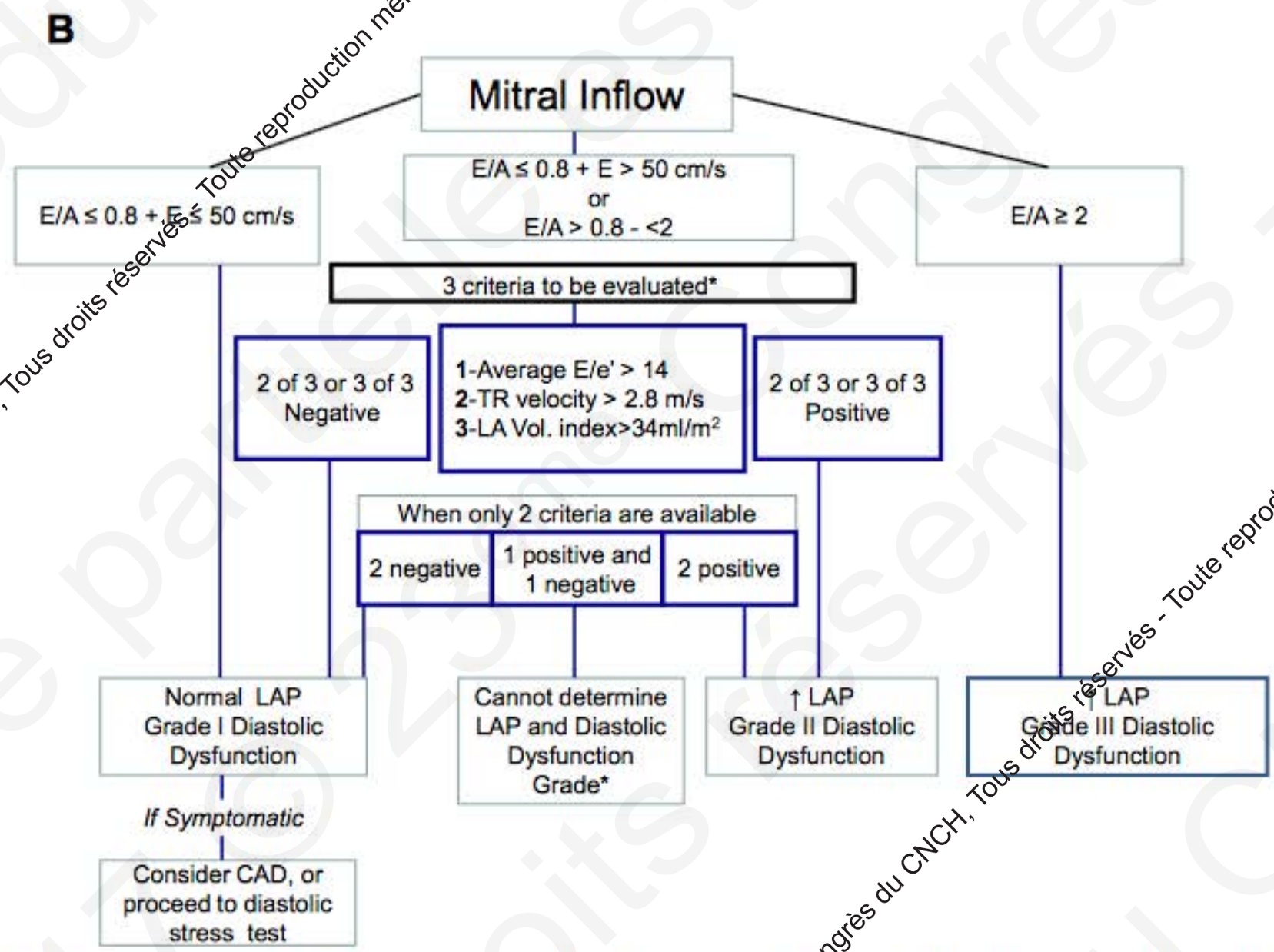
(J Am Soc Echocardiogr 2016;29:277-314.)

Algorithme FE préservée



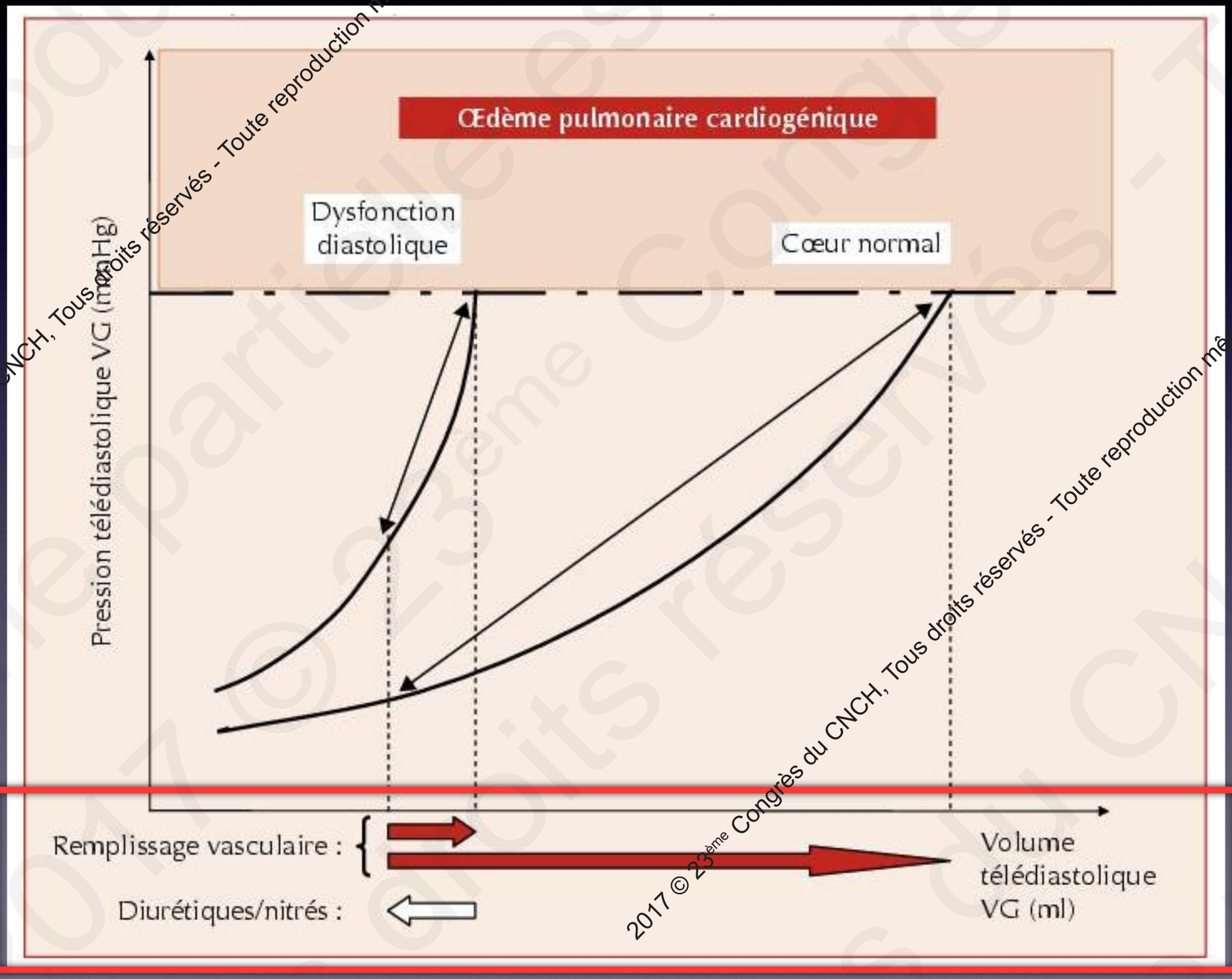
Algorithme FE altérée et indéterminé

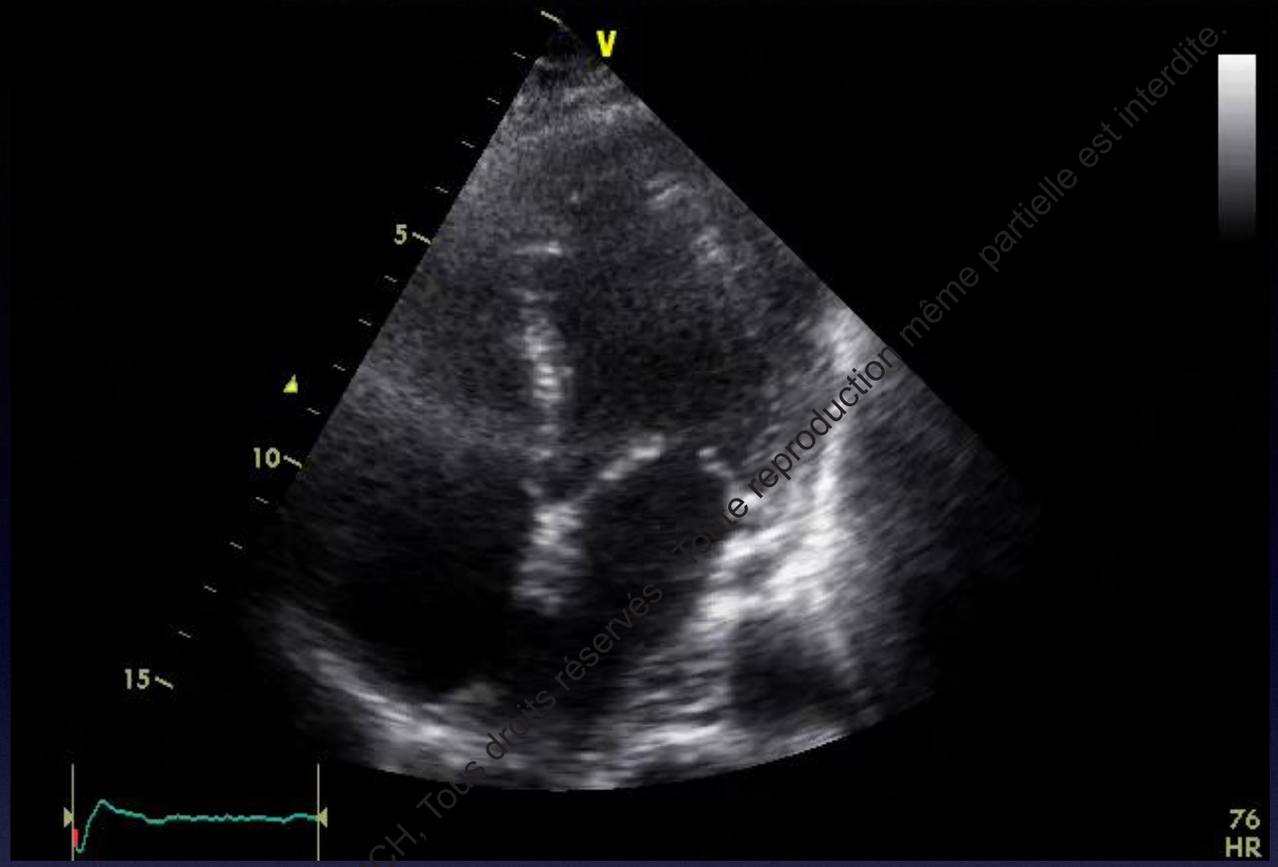


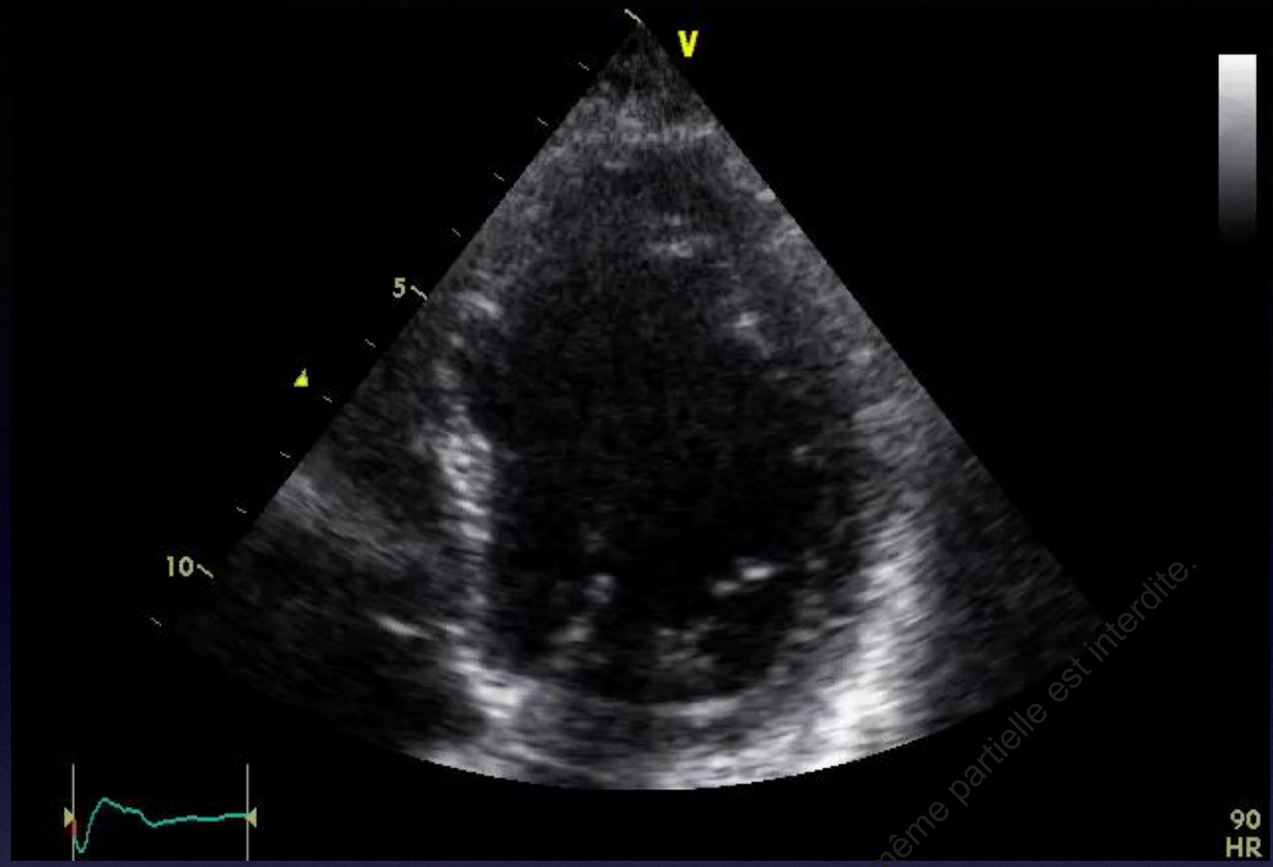
(* : LAP indeterminate if only 1 of 3 parameters available. Pulmonary vein S/D ratio <1 applicable to conclude elevated LAP in patients with depressed LV EF)

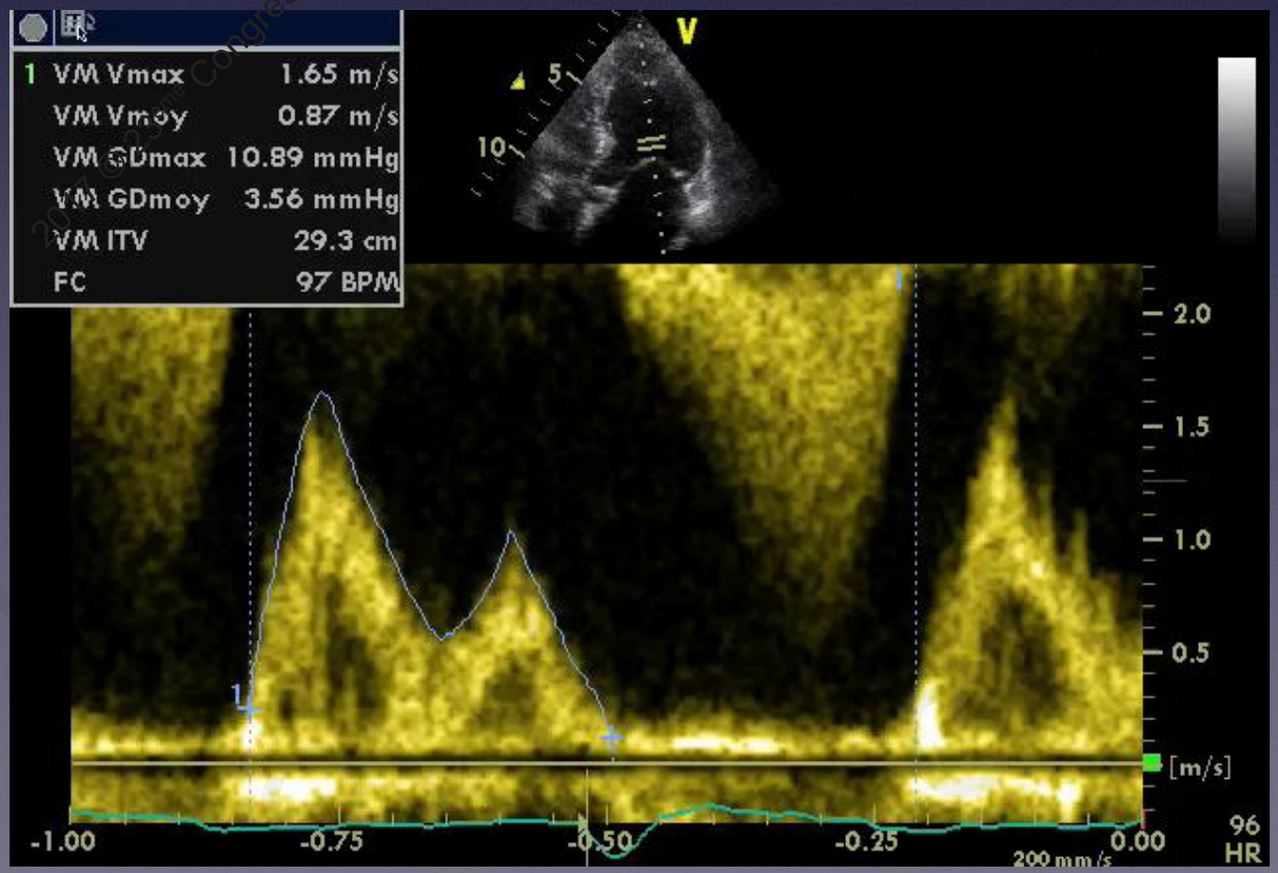
Figure 8 **(A)** Algorithm for diagnosis of LV diastolic dysfunction in subjects with normal LVEF. **(B)** Algorithm for estimation of LV filling pressures and grading LV diastolic function in patients with depressed LVEFs and patients with myocardial disease and normal LVEF after consideration of clinical and other 2D data.

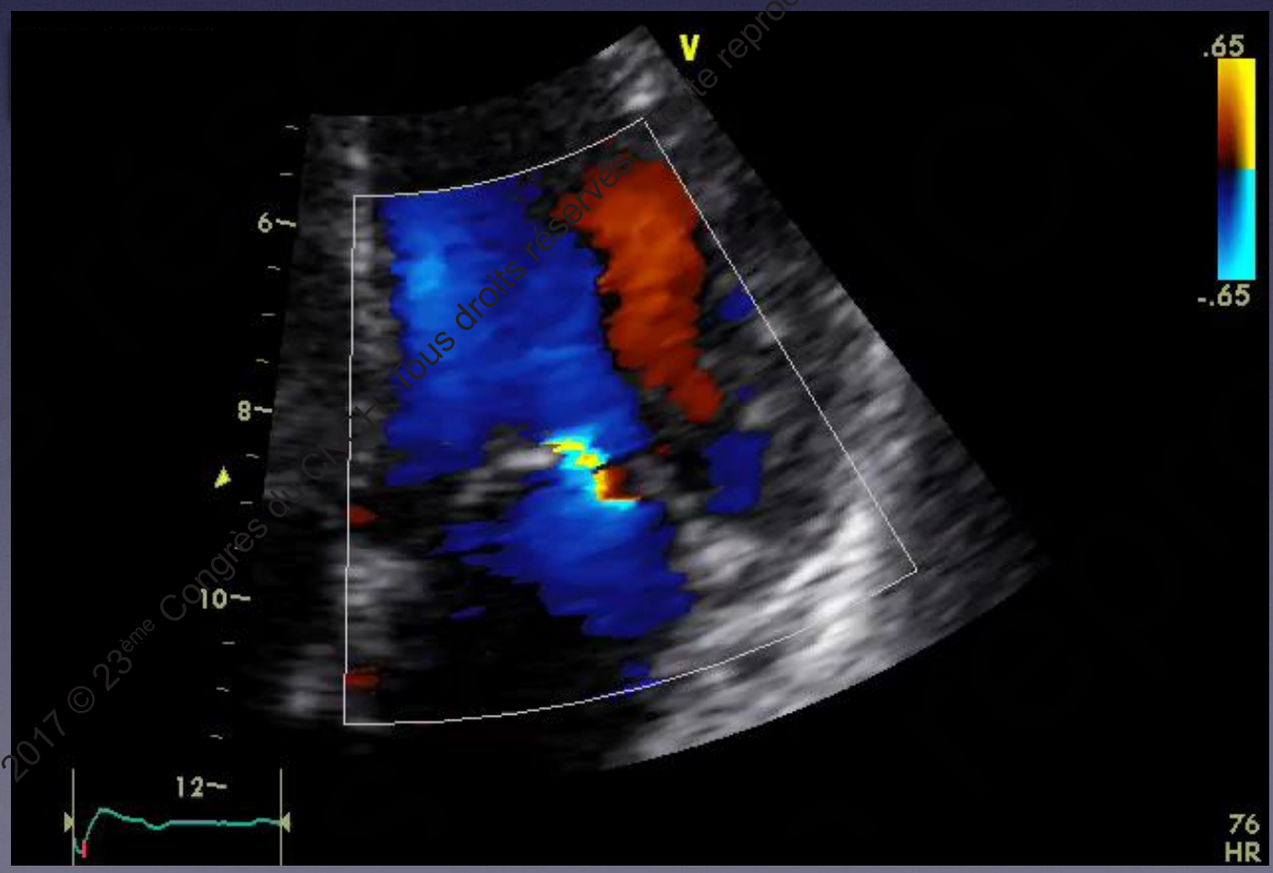
Ne pas attendre l'arrivée des troupes fraiches

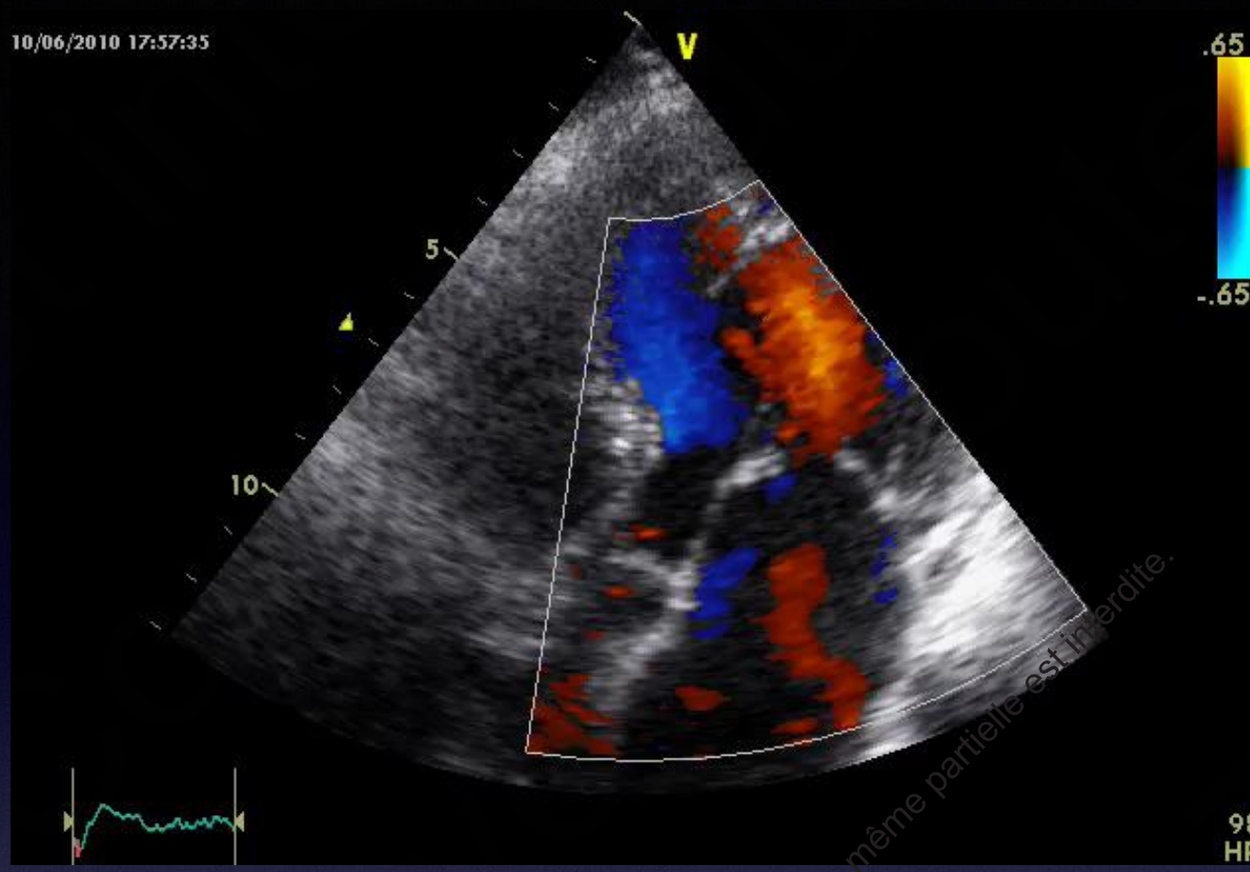


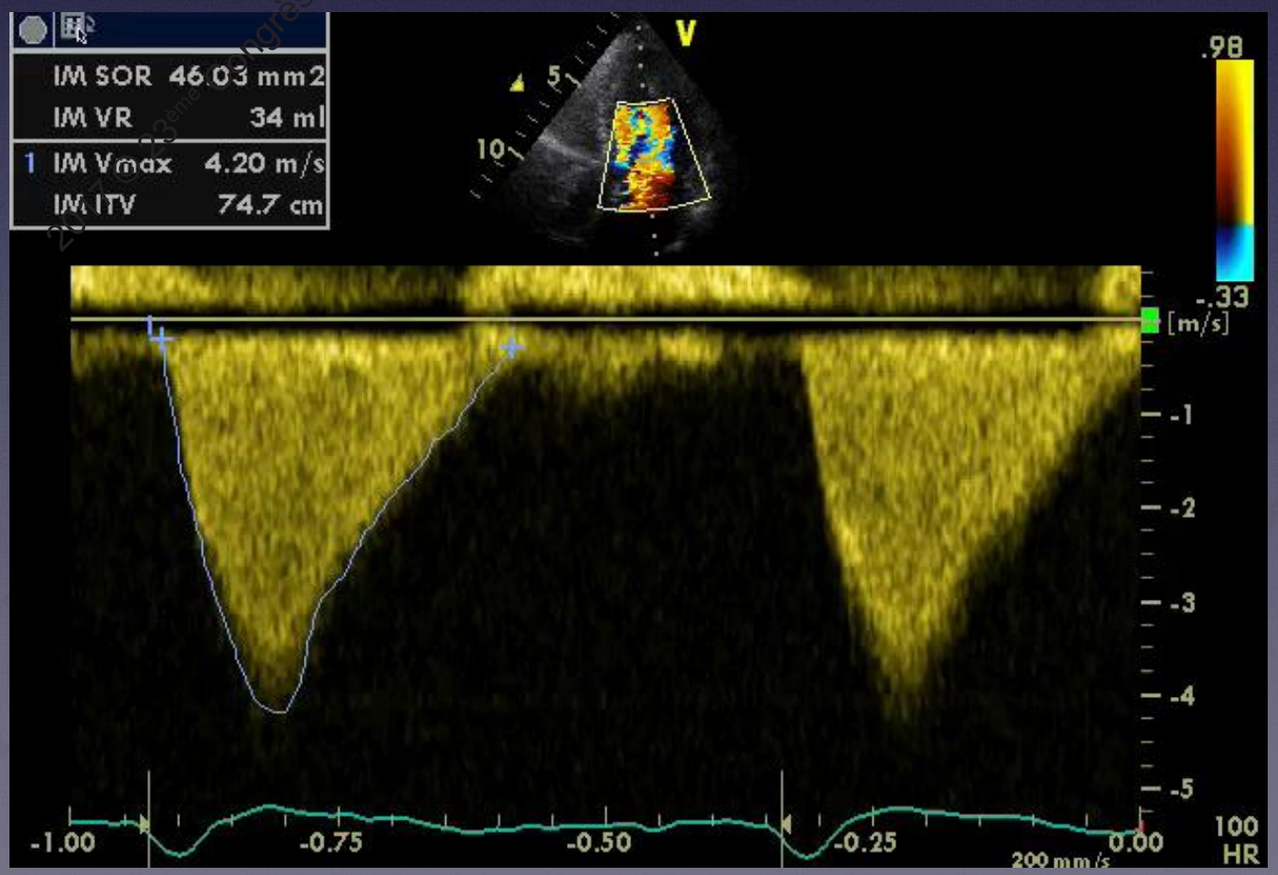


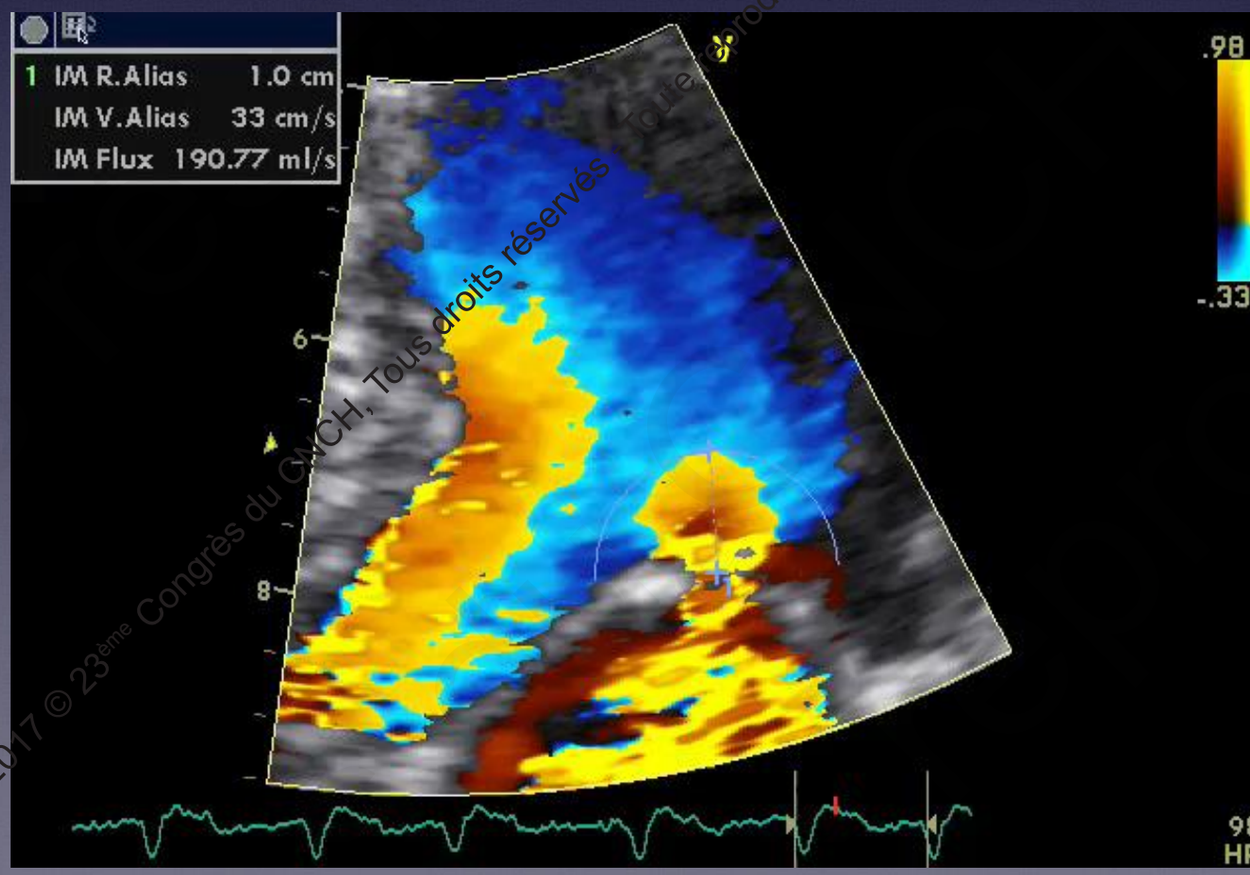












The use of echocardiography in acute cardiovascular care: Recommendations of the European Association of Cardiovascular Imaging and the Acute Cardiovascular Care Association

Patrizio Lancellotti[1]*, Susanna Price[2]*, Thor Edvardsen[3], Bernard Cosyns[4], Aleksandar N. Neskovic[5], Raluca Dulgheru[1], Frank A. Flachskampf[6], Christian Hassager[7], Agnes Pasquet[8], Luna Gargani[9], Maurizio Galderisi[10], Nuno Cardim[11], Kristina H. Haugaa[3], Arnaud Ancion[1], Jose-Luis Zamorano[12], Erwan Donal[13], Héctor Bueno[14], and Gilbert Habib[15]

Table 2 Echocardiographic signs indicative or suggestive of the cause of clinical admission in acute cardiovascular conditions

Systolic heart failure	Heart failure with preserved left ventricular ejection	Pulmonary embolism	Tamponade[e]
(1) LVEF<45–50%[a]	(1) LVEF ≥ 50%[a]	(1) Thrombus into right chambers	(1) Usually large pericardial effusion
(2) LVEDD >55 mm and/or >32 mm/m^2	(2) LVEDV<97 mL/m^2	(2) Abnormal septal motion	(2) Swinging heart
(3) LVESD >45 mm[a] and/or 25 mm/m^2	(3) LVESV<43 mL/m^{2a}	(3) Dilatation RA, RV (end-diastolic RV/LV diameter>0.6 or area>1.0)	(3) RA collapse (rarely LA)
(4) LVEDV>97 mL/m^2	(4) E–e′ ≥13[b]	(4) Global RV hypokinesia	(4) Diastolic collapse of the anterior RV-free wall (rarely LV)
(5) LVESV>43 mL/m^2	(5) Ar – A ≥ 30 ms	(5) McConnell sign hyperkinesia[d]	(5) IVC dilatation (no collapse with inspiration)
(6) Abnormal wall motion	(6) LA volume ≥ 34 mL/m^2	(6) Mild to severe TR	(6) TV flow increases and MV flow decreases during inspiration (reverse in expiration)
(7) Functional MR and/or TR	(7) Peak tricuspid velocity>3 m/s	(7) Pulmonary hypertension around 40–50 mmHg (>60 mmHg in the case of pre-existing pulmonary hypertension)	(7) Systolic and diastolic flows are reduced in systemic veins in expiration and reverse flow with atrial contraction is increased
(8) Peak tricuspid velocity >3 m/s	(8) Ultrasound lung comets[c] + signs and symptoms of heart failure		
(9) Aortic time velocity integral <15 cm[a]			
(10) Diastolic dysfunction (E/A ≥ 2 + DT<150 ms indicates increased LV filling pressures)[b]			
(11) Ultrasound lung comets[c]			

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EN CONCLUSION

- ETT indispensable à chaque étape du séjour d'un patient en USIC pour ICA
- Échographe dédié
- Le plus tôt possible et le plus souvent possible
- Mesure des pressions de remplissage VG: Algorithmes +++

MERCI

parametres a retenir

- onde E dépende de la relaxation et de la POG
- TD depend de Pog, Pvg, relaxation VG
- onde A depend contractilité A, PVG, charge OG
- durée onde Apulm-Amitrale (indépendant de FEvg et de l'age) :

6. Rossvoll O et al. J Am Coll Cardiol 1993 ; 21 : 1687-96.

- mais aussi, TRIV, Flux veineux pulmonaire, Vp, manoeuvres due Valsalva, TD Amitrale, TD onde D pulmonaire, morphologie de la fuite mitrale ou aortique

EVALUATION DES PRESSIONS DE REMPLISSAGE VG

TACHYCARDIE SINUSALE = FUSION E et A

E/Ea > 10

TD onde A < 60 ms

Evaluation des PRVG CMH

- E/Ea > 14
- Vol OG indexé > 34ml/m2
- Durée Apulm - Amitrale > 30 sec
- Pic IT > 2,8 m/s
  - Si > 2 valeurs + = PPRVG augmentées

+/- durée Ap-Am

EVALUATION DES PRESSIONS DE REMPLISSAGE VG

AC/FA Onde E exclusive

TDE < 150 ms
si fonction systolique altérée

E/Ea > 11
E/ Vp> 2.5
Indépendamment de la fonction systolique

pourquoi mesurer les prvg ?

- en rea d'abord pour évaluer les besoins en remplissage vasculaire chez les pats en défaillance circulatoire

- c'est ce qui conditionne la prise en charge d'un patient dyspnéique voire intubé différenciant l'insuf cardiaque d'une autre cause de dyspnee (ep, pneumopathie, sdra, …) et donc conditionnant la prise en charge thérapeutique que la fonction systolique soit altérée ou non (oap avec fe conservée ça existe mais sera chez un insu cardiaque équilibré ça existe aussi)

- l'echo/doppler permet d'approcher de manière non invasive des mesures hémodynamique difficile à obtenir de façon invasive

- définition: méthodes invasive déterminer la P diastolique minimale, P moyenne, la PTDVG pré A et PTDVG, toutes ces valeurs n'évoluent pas forcément parallèles; le plus souvent les corrélations sont faites avec Pog moyenne

- pronostic: FEvg basse CMD ou post IDM)et profil restrictif ; bad

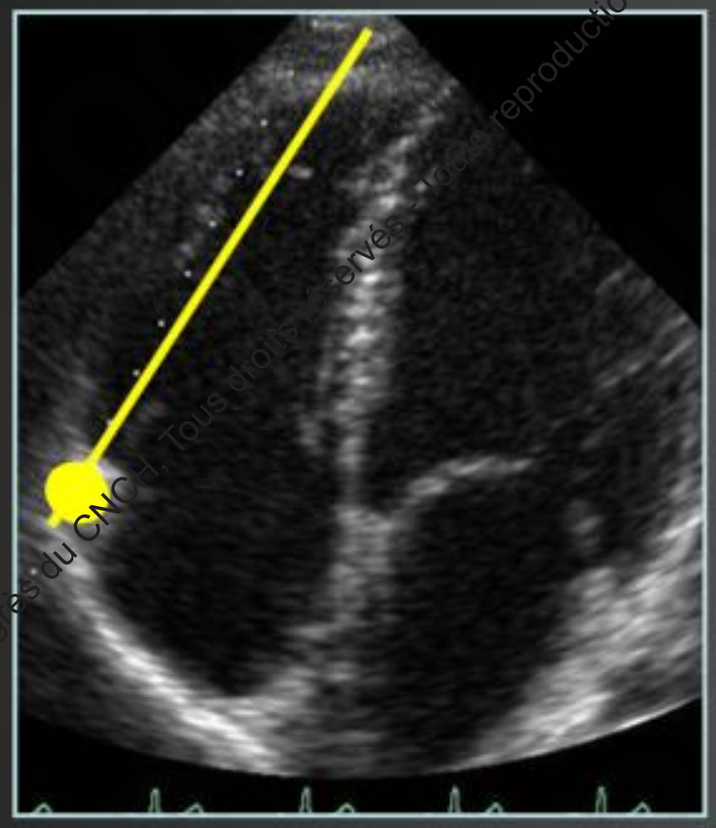
9. Rihal CS et al. Circulation 1994 ; 90 : 2772-9. Rechercher l'
10. Nijland F et al. J Am Coll Cardiol 1997 ; 30 : 1618-24.

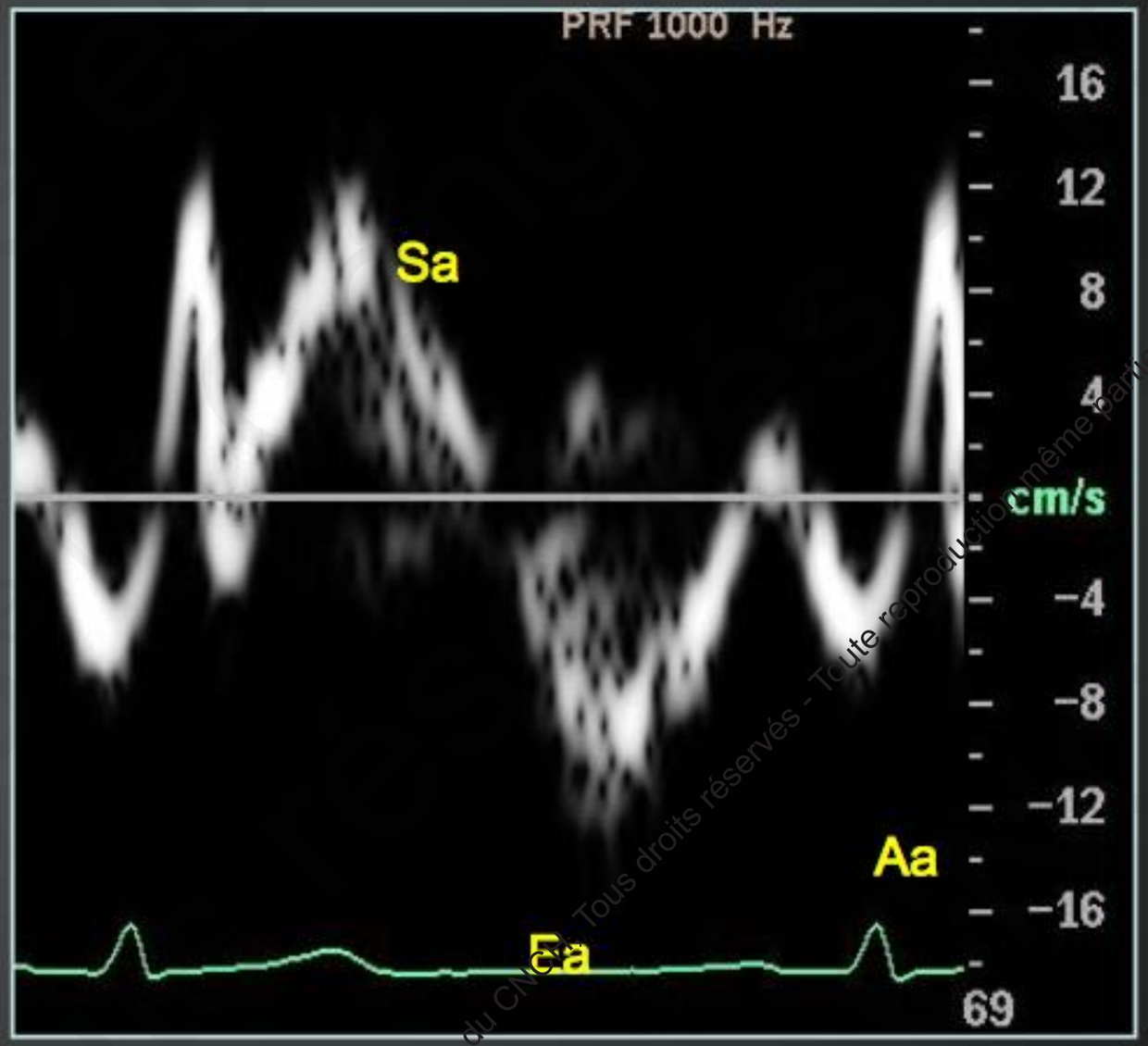
INsuf cardiaque droite aigue role de l'echo

Fonction ventriculaire droite

- morphologie
- cinétique pariétale
- fonction systolique
- diastole
- conditions de charge

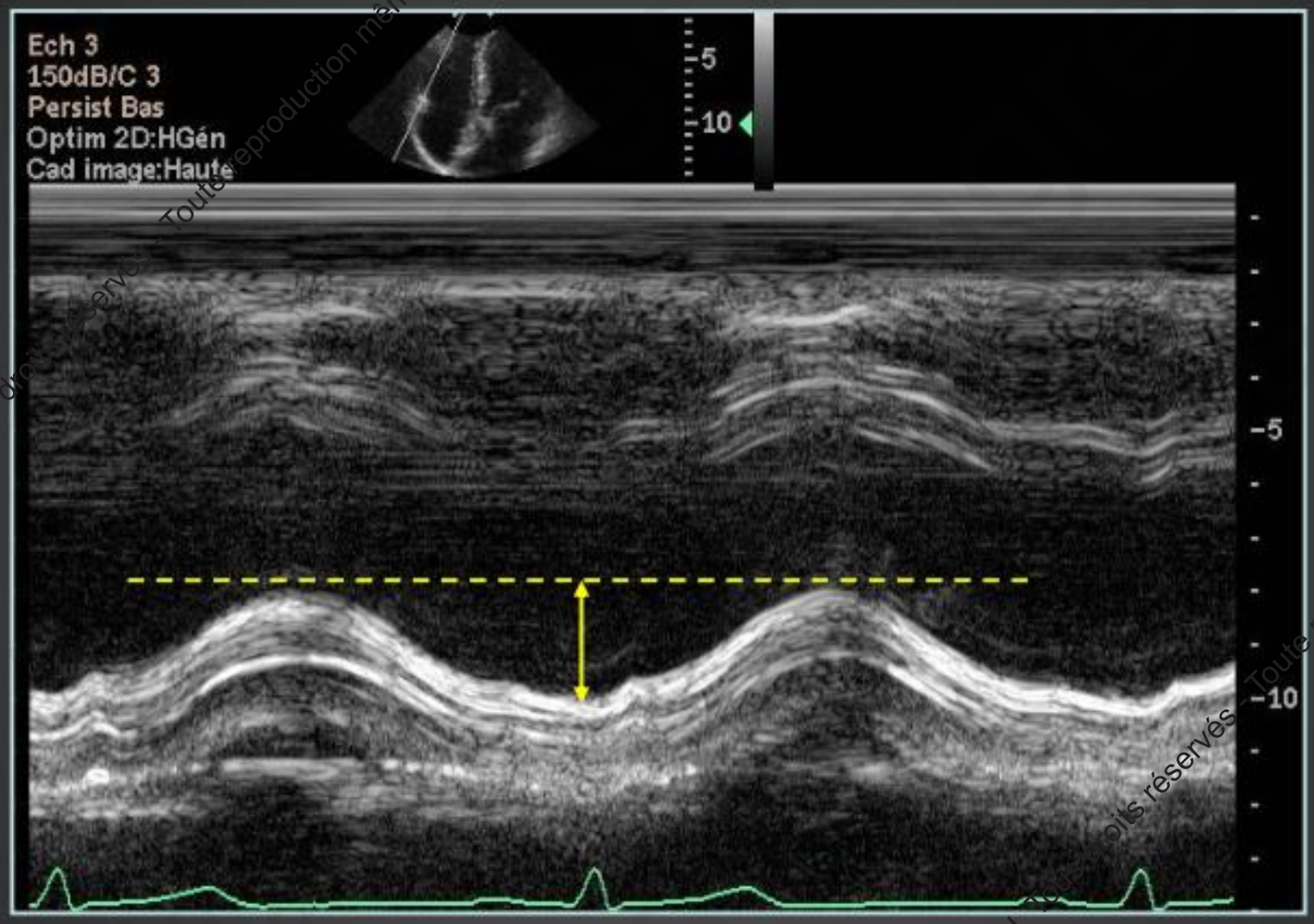
Fonction VD: *DTI anneau tricuspidien*





Sa > 15 cm/s

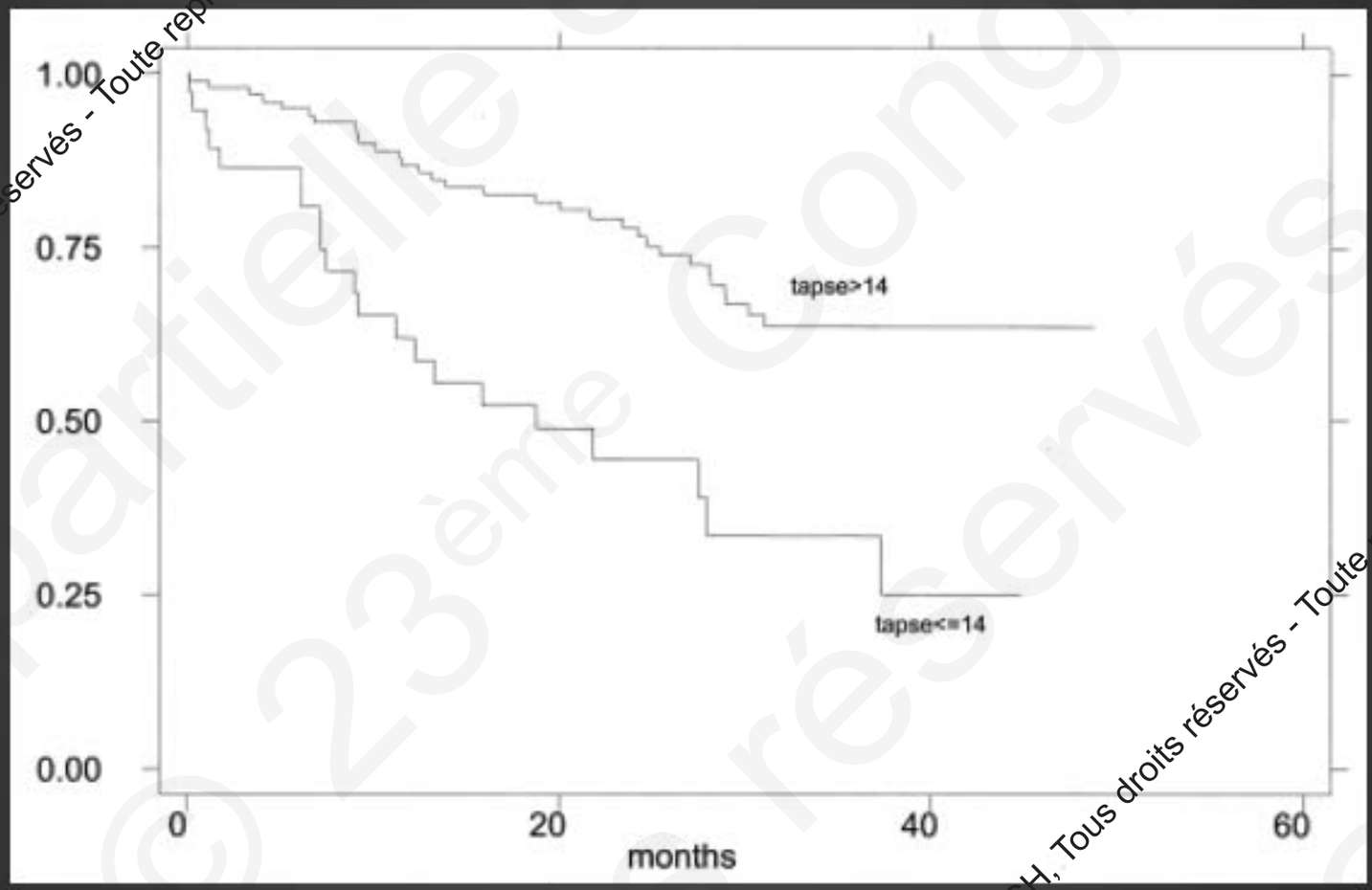
Fonction VD: *TM anneau tricuspidien*



normale ≥ 16mm

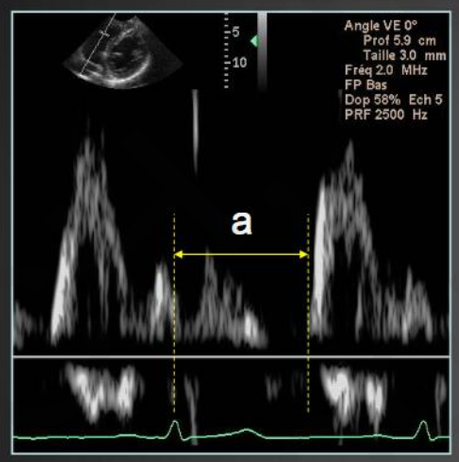
dysfonction VD: < 12mm (r = 0,92 FE isotopique)

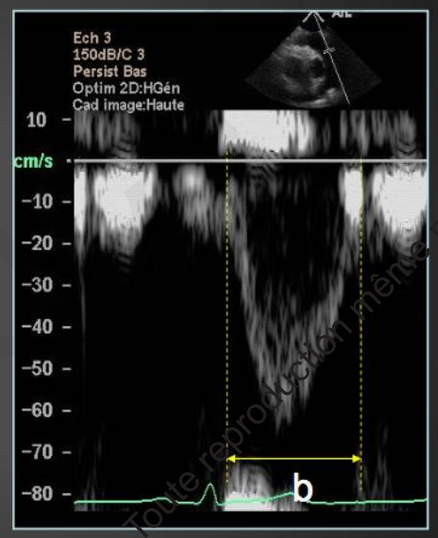
Ventricule droit – TAPSE: pronostic



Ghio AJC 2000

Ventricule droit: index de Tei

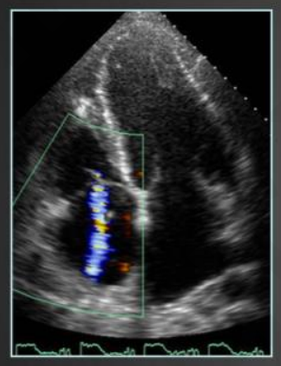


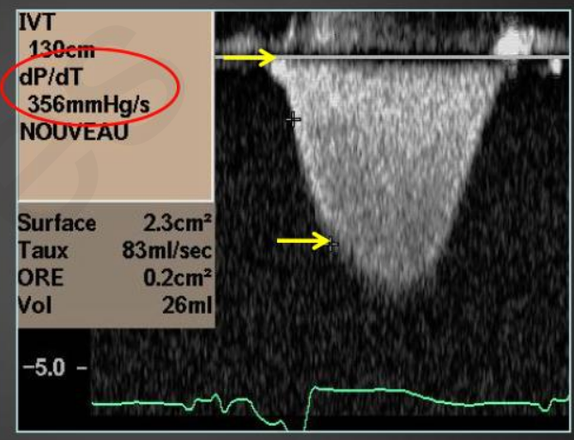


index Tei VD = a – b / b

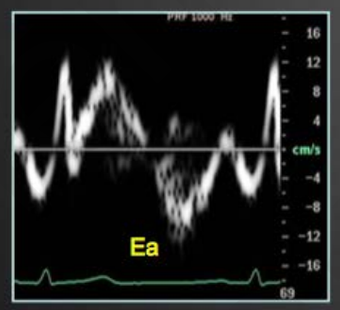
normal: 0.28 ± 0.04

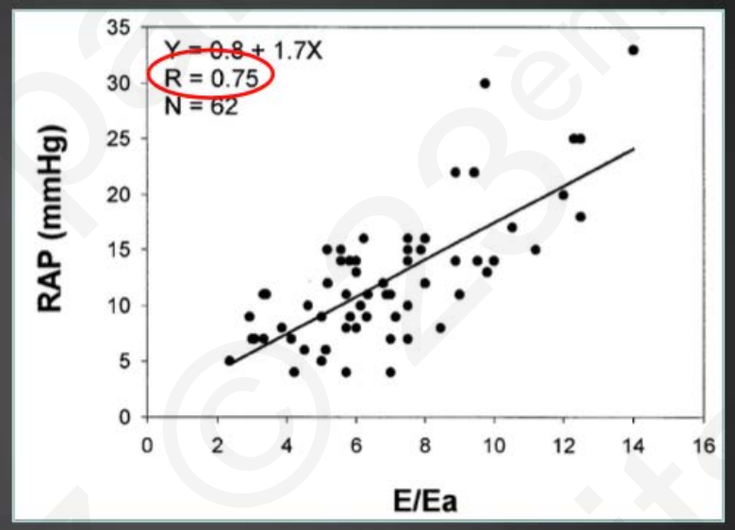
Fonction VD: *IT - dP /dt*





Pression OD: *doppler tricuspidien / doppler tissulaire anneau*

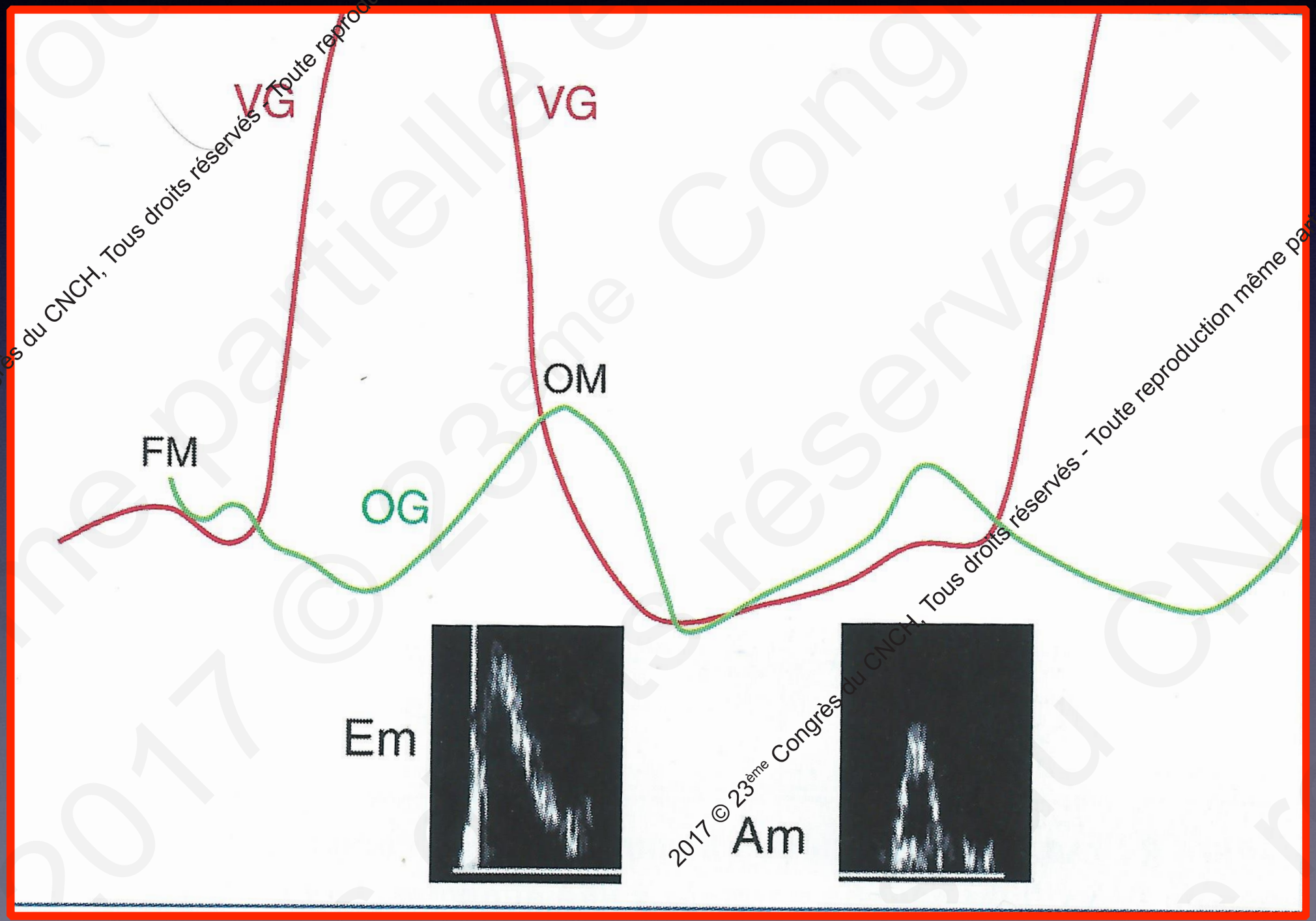




E/Ea > 6 → P OD ≥ 10 mm Hg (Se= 79% - Sp = 73%)

Nagueh Am J Cardiol 1999

Flux transmitral normal



Onde E et TD