

SEVRAGE RESPIRATOIRE DIFFICILE: ORIGINE CARDIAQUE?

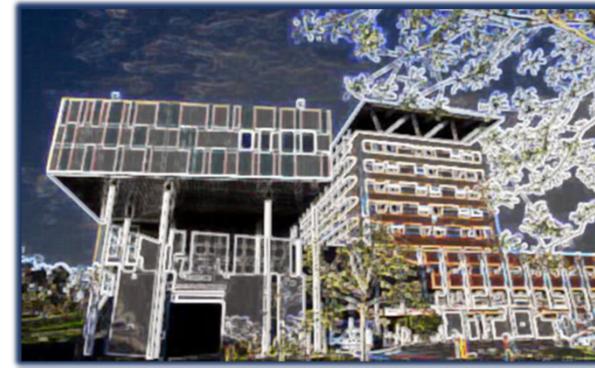
Pr Alexandre OUATTARA

Servcie d'Anesthésie-Réanimation cardiovasculaire

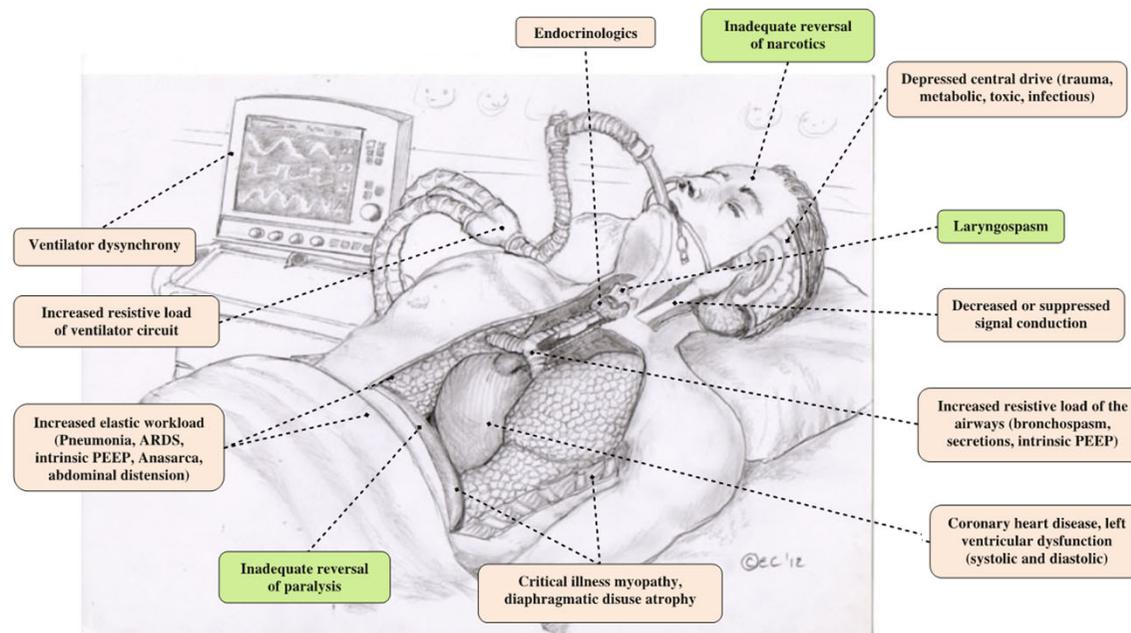
Biologie des maladies cardiovasculaires, INSERM UMR 1034

Hôpital Haut-Lévêque, Université de Bordeaux, France

Email: alexandre.ouattara@chu-bordeaux.fr



ECHEC DU SEVRAGE RESPIRATOIRE: DES ORIGINES DIVERSES...



Perren A et al. *Intensive Care Med* 2013; 39:1885-95

Teboul *et al. Critical Care* 2010, **14**:211
<http://ccforum.com/14/2/211>



REVIEW

Weaning failure of cardiac origin: recent advances

Jean-Louis Teboul*, Xavier Monnet, and Christian Richard

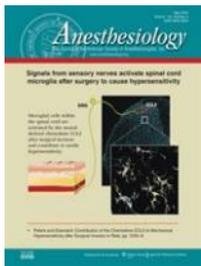
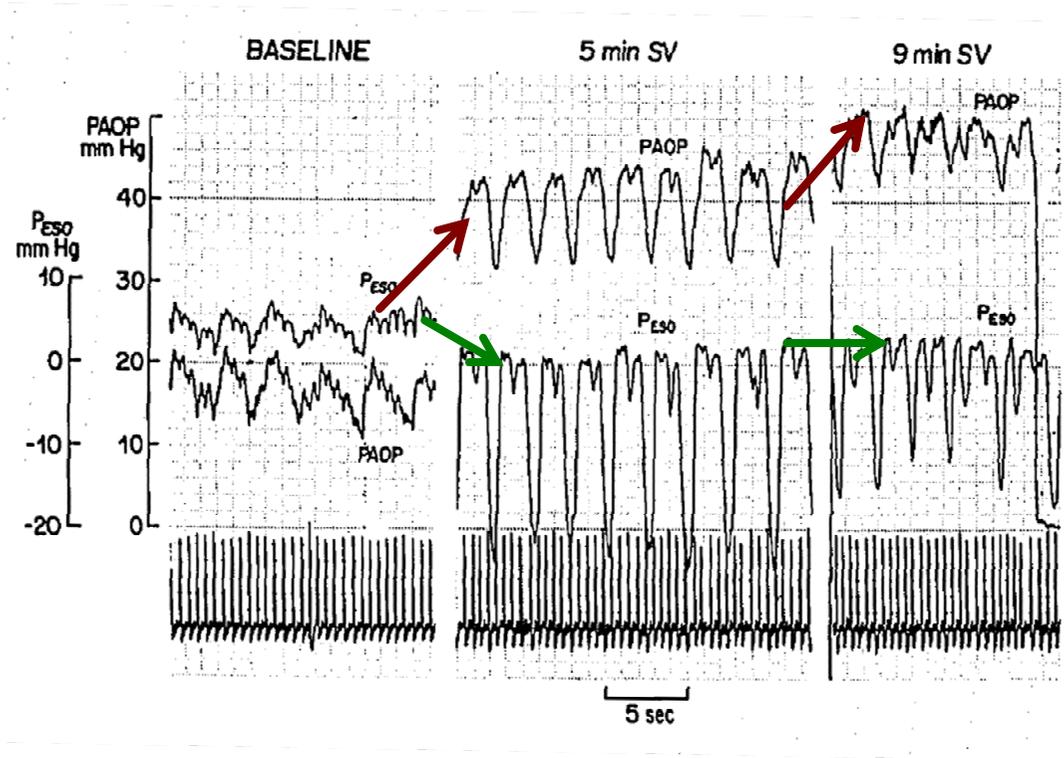
Acute Left Ventricular Dysfunction during Unsuccessful Weaning from Mechanical Ventilation

15 pts BPCO porteurs pathologie cardiaque

- Passage en ventilation spontanée (10 min)
- Pression oesophagienne ↘ de +5 à -2 mmHg
- DC ↗ de 3,2 à 4,3 L.min⁻¹
- FC ↗ de 77 à 90 bpm
- PAPO ↗ 8 à 20 mmHg

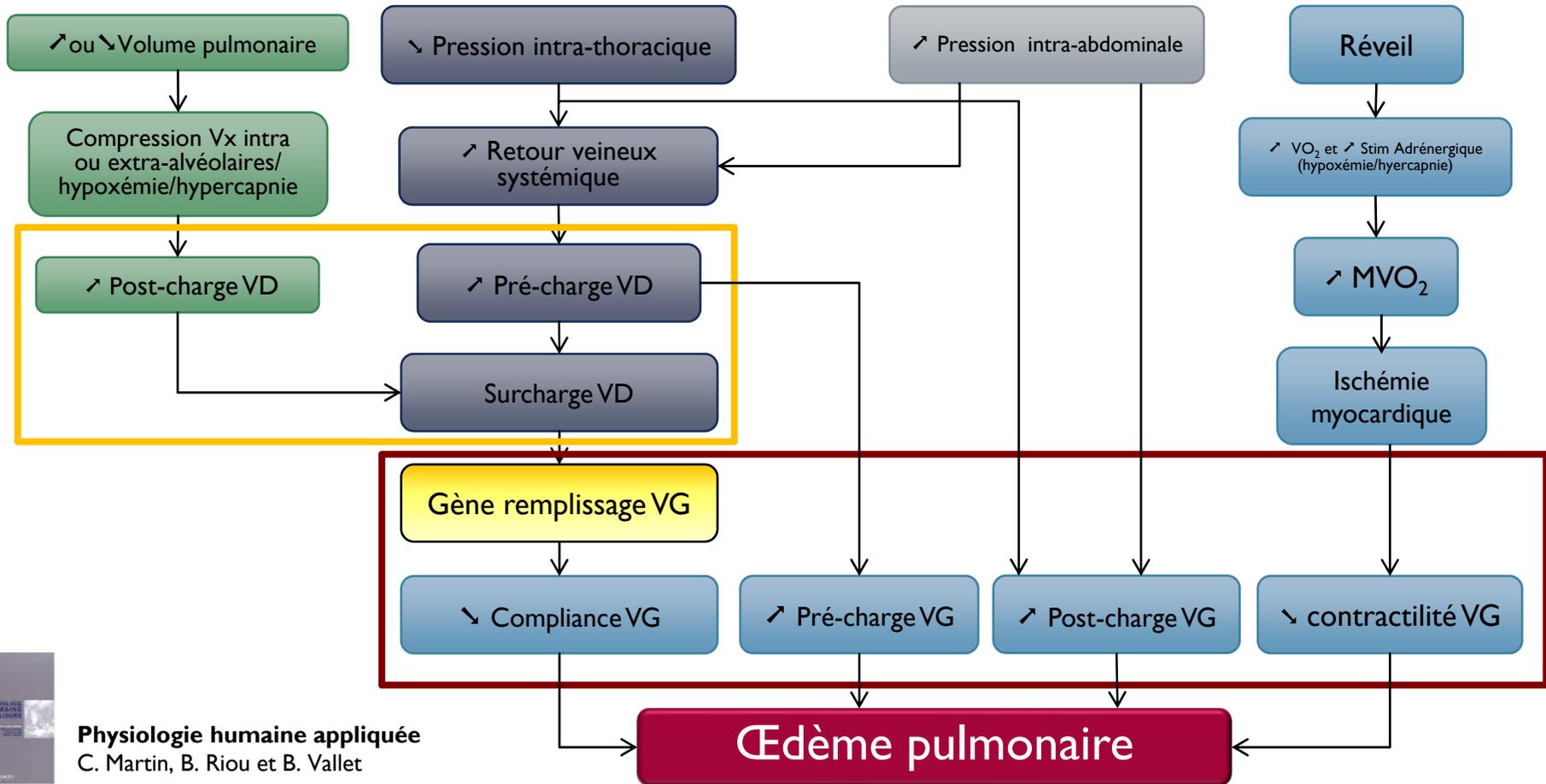


Lemaire F. et al. Anesthesiology 1988; 69:171-9

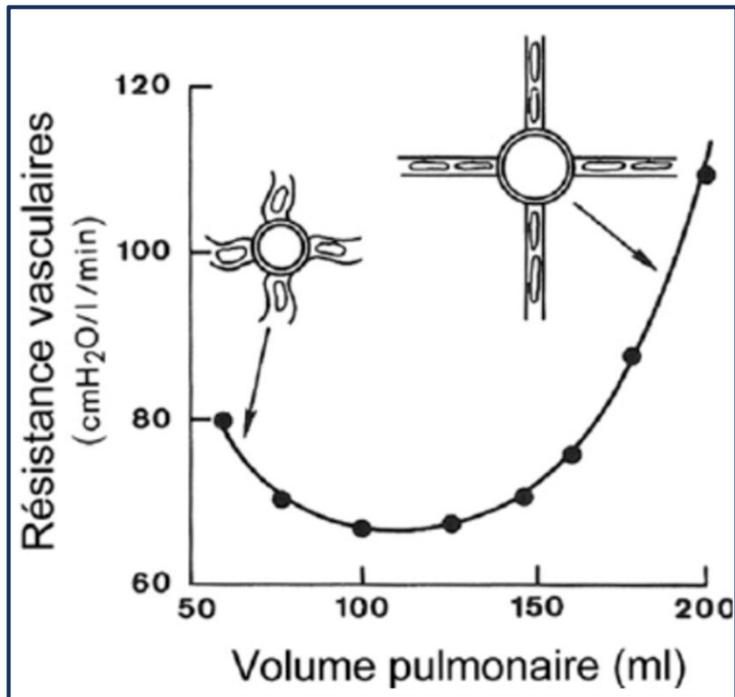


Lemaire F et al. *Anesthesiology* 1988; 69:171-9

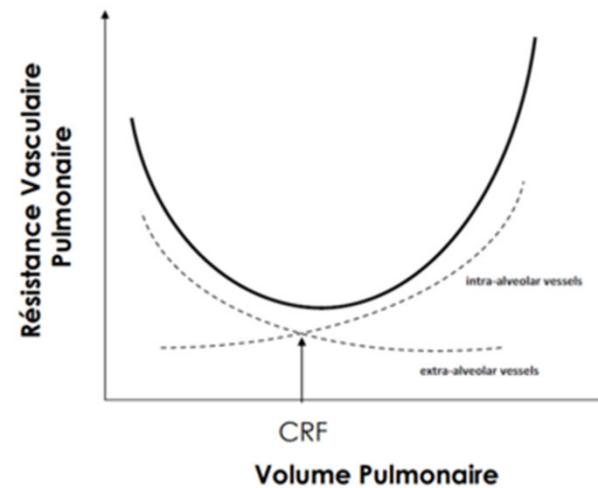
Sevrage de la ventilation mécanique (VS+++)



Volume pulmonaire et Résistances Vasculaires Pulmonaires

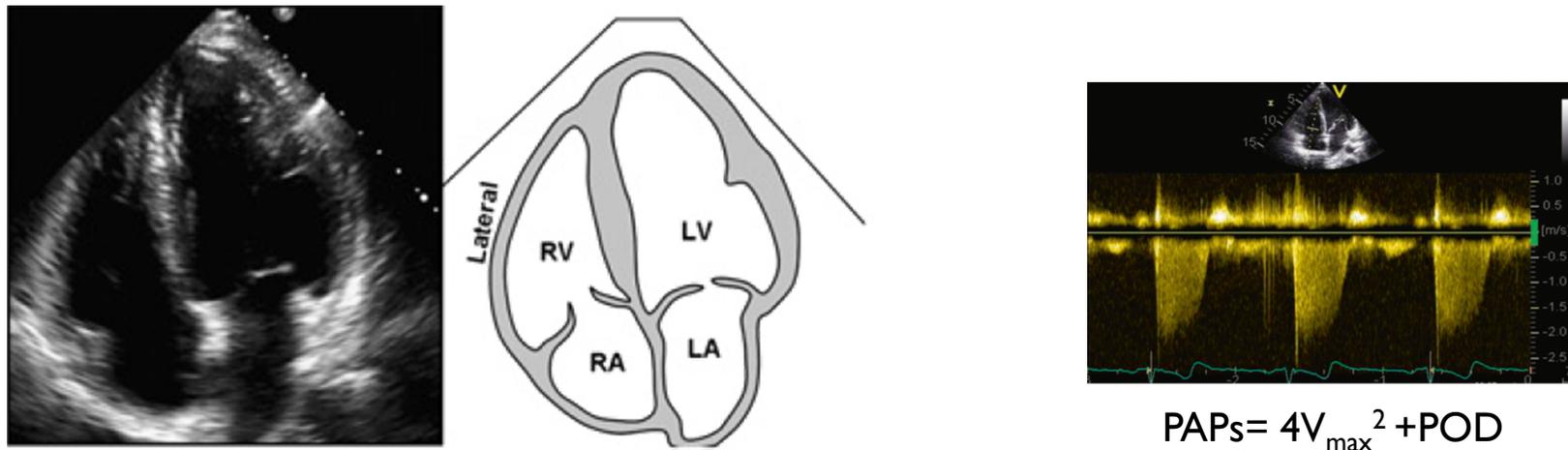


Effet du volume pulmonaire sur la RVP



CRF = capacité résiduelle fonctionnelle

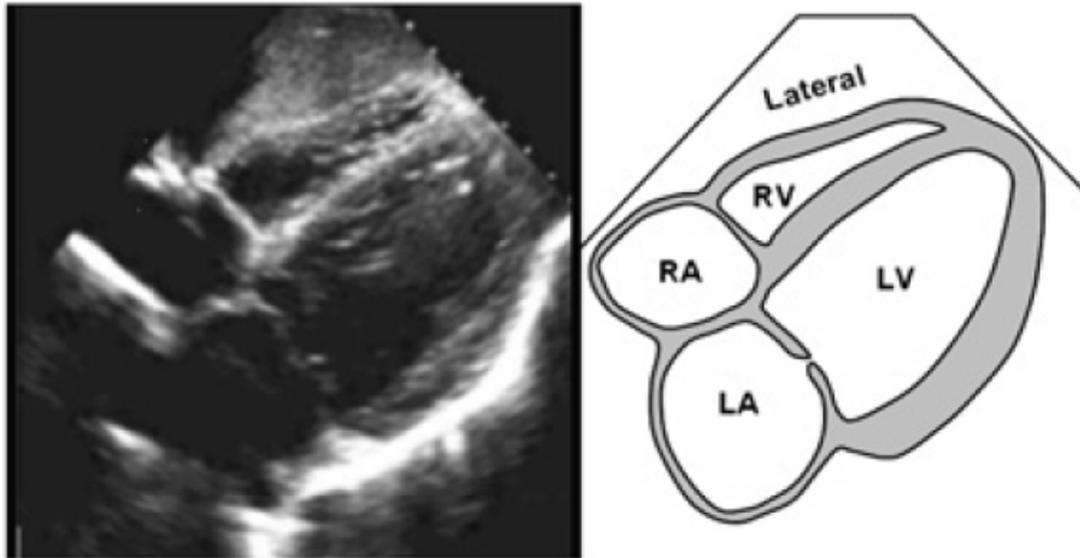
ANALYSE ECHO VD: INCIDENCE APICALE 4 CAVITES



- Paroi libre (distension des cavités)
- Mesure FR VD (Fractional area change), TAPSE (mode TM), Tissue doppler (Pic S')
- Estimation pression artérielle pulmonaire (systolique)

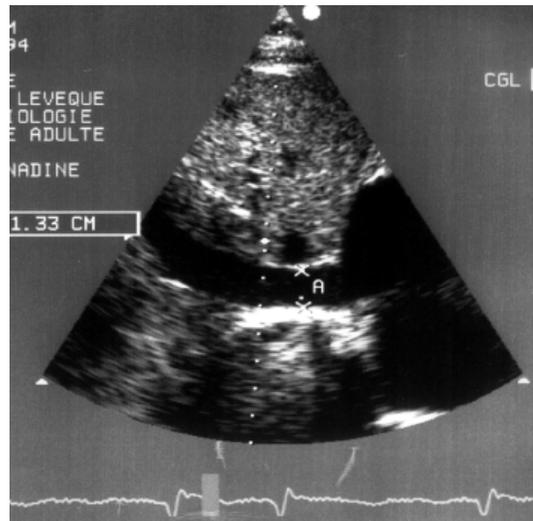
ANALYSE ECHO VD: INCIDENCE SOUS-COSTALE 4 CAVITES

- Dilatation des cavités droites
- Epaissement paroi libre VD

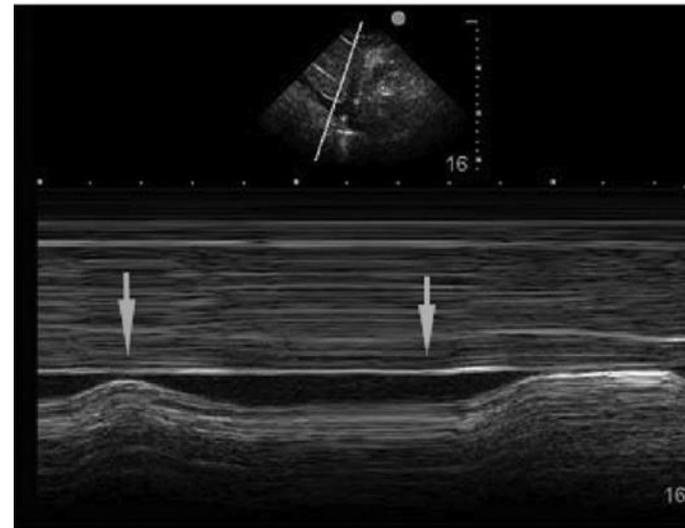


ANALYSE ECHO VD: INCIDENCE SOUS-COSTALE 4 CAVITES

- Analyse VCI (distension, variabilité)

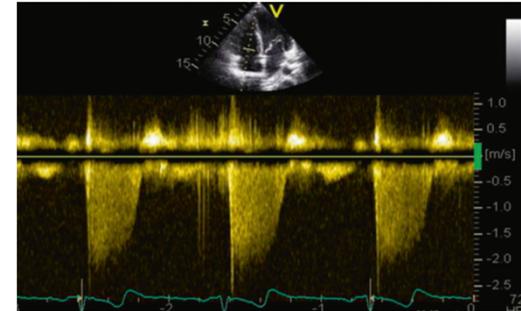


Mesure à 1-2 cm de l'abouchement OD
(N= 14-17 mm)

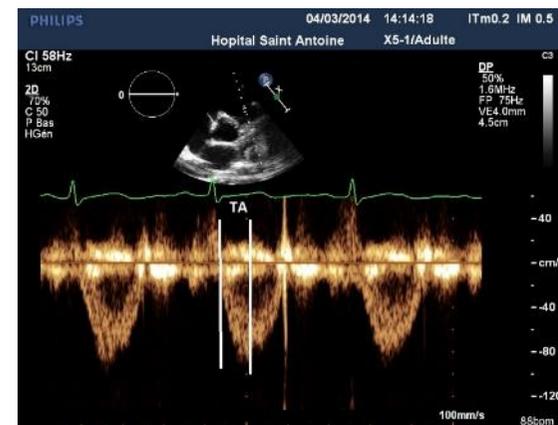
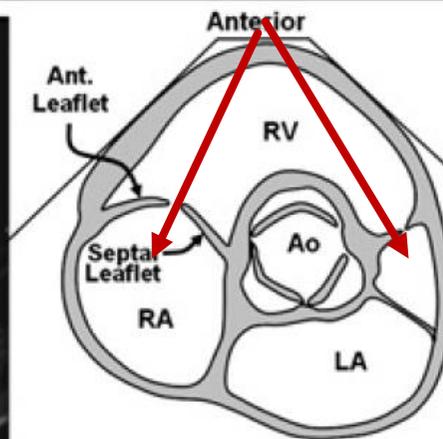
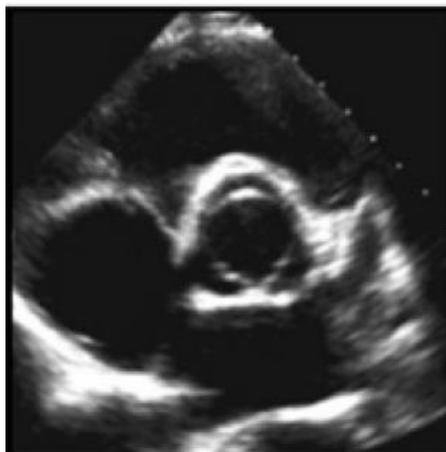


ANALYSE ECHO VD: INCIDENCE PSG PETIT AXE-BASALE

- Tricuspide (feuillet antérieur et septal)
- Flux régurgitation tricuspide (PAP systolique)
- Flux d'éjection pulmonaire (Doppler pulsé)



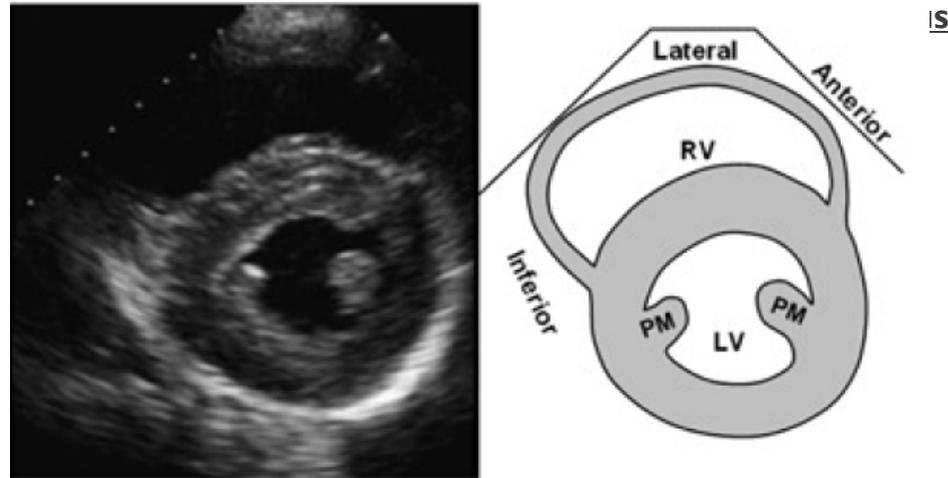
$$PAP_s = 4V_{\max}^2 + POD$$



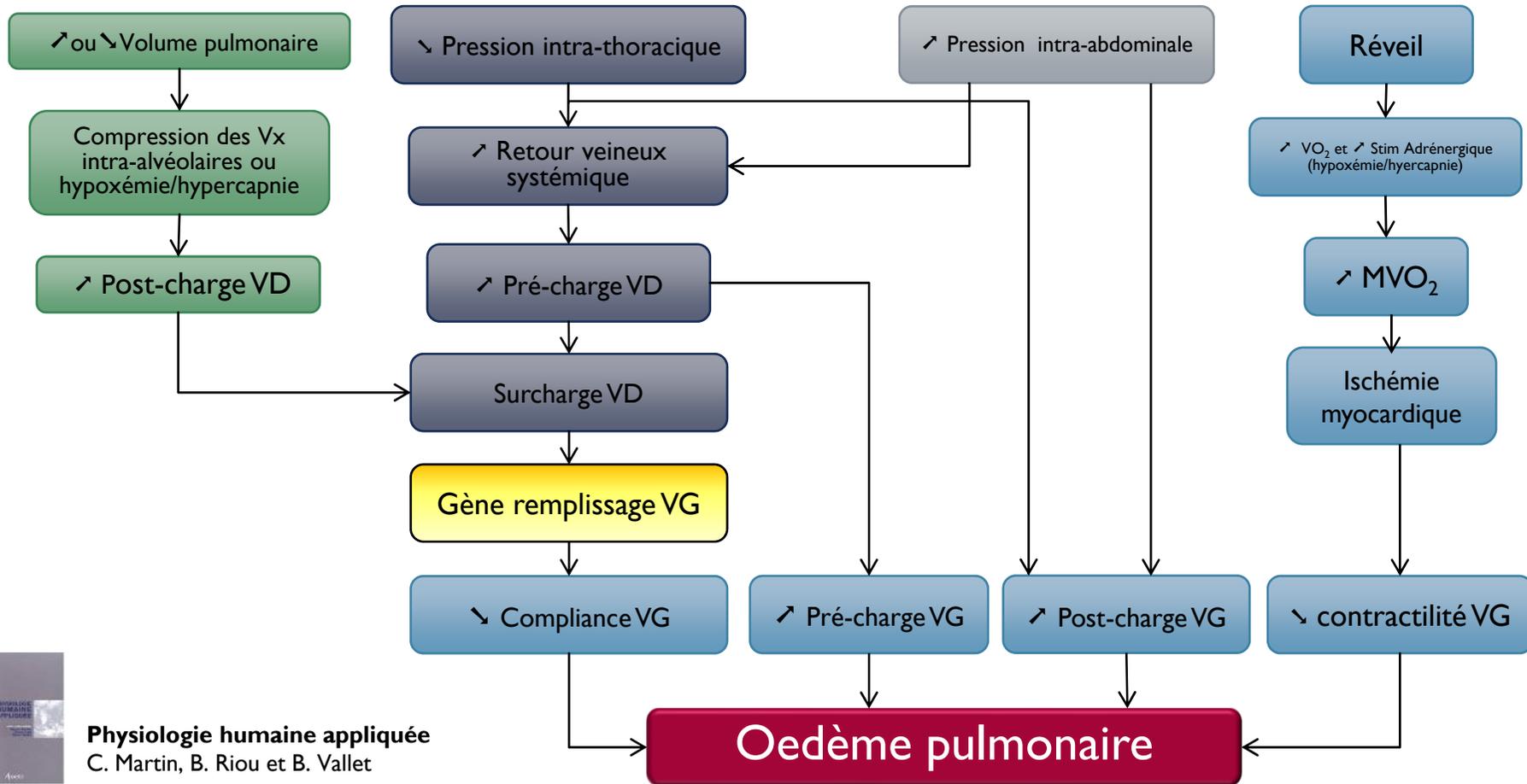
Temps d'accélération flux pulmonaire > 130 ms

ANALYSE ECHO DU VD: INCIDENCE PSG PETIT AXE-TRANSPIILIER

- Cinétique VD/VG
- Surcharge systolique VD
- Analyse septum interventriculaire



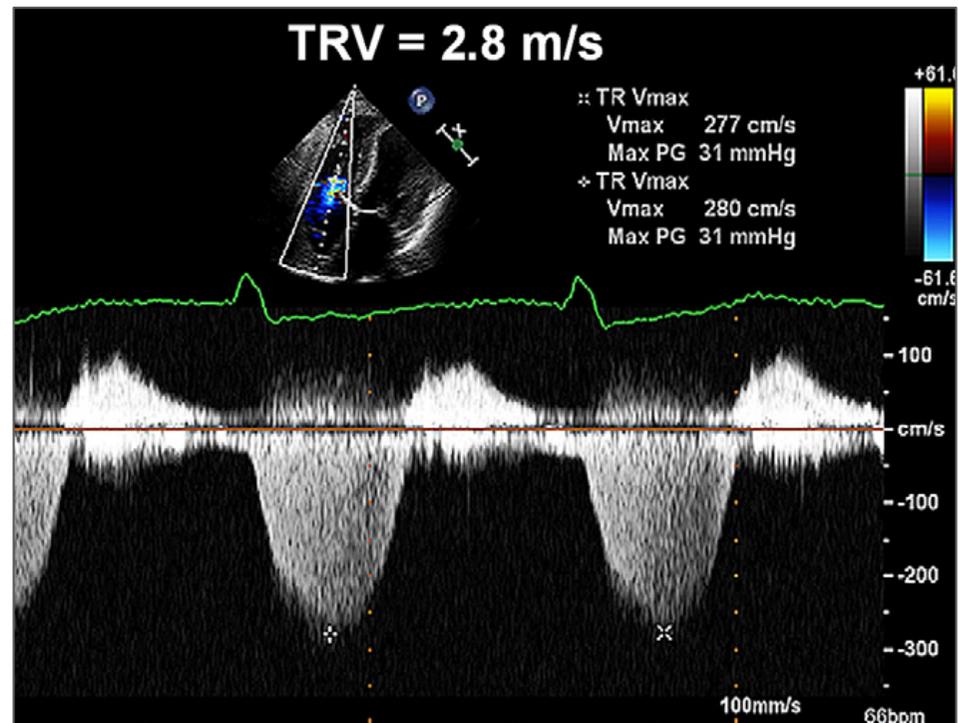
Sevrage de la ventilation mécanique (VS +++)



Analyse régurgitation tricuspide

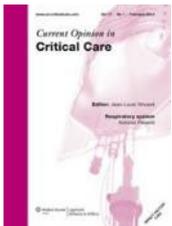
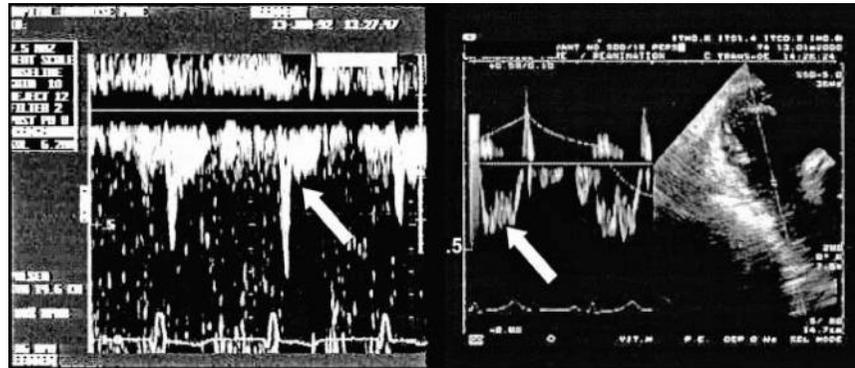
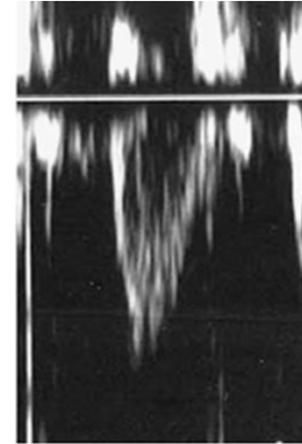
Vitesse maximale (HTAP si $> 3 \text{ m}\cdot\text{s}^{-1}$)

Mesure PAPs ($\text{PAPs} = 4V_{\text{max}}^2 + \text{POD}$)



Analyse flux d'éjection pulmonaire

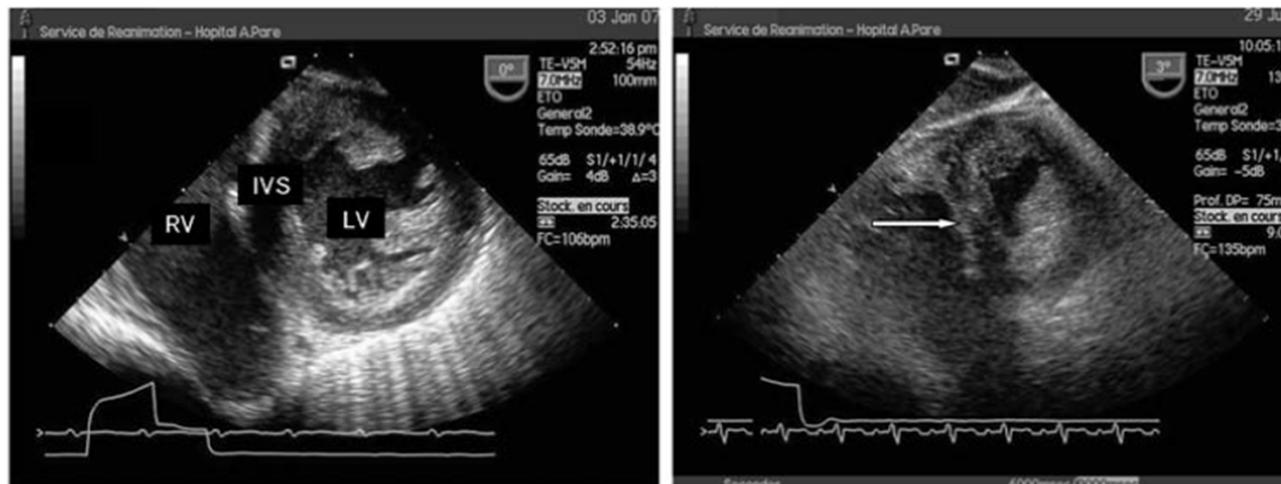
- Raccourcissement du temps d'accélération < 90-100 ms
- Aspect flux biphasique du flux d'éjection pulmonaire
- Signe d'augmentation post-charge VD



Veillard Baron A. *Current Opinion in Critical Care* 2009, 15:254–260

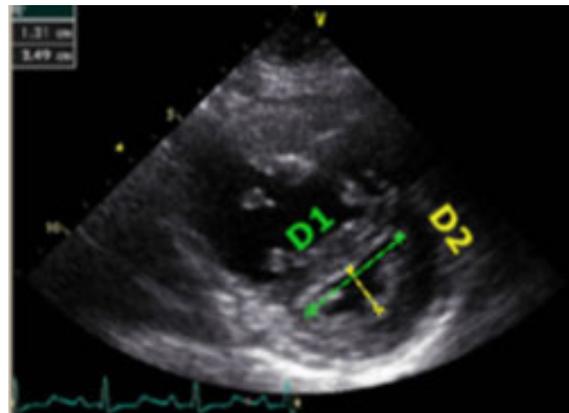
ANALYSE MORPHOLOGIQUE (SURCHARGE SYSTOLIQUE DU VD)

- Septum plat ou paradoxal



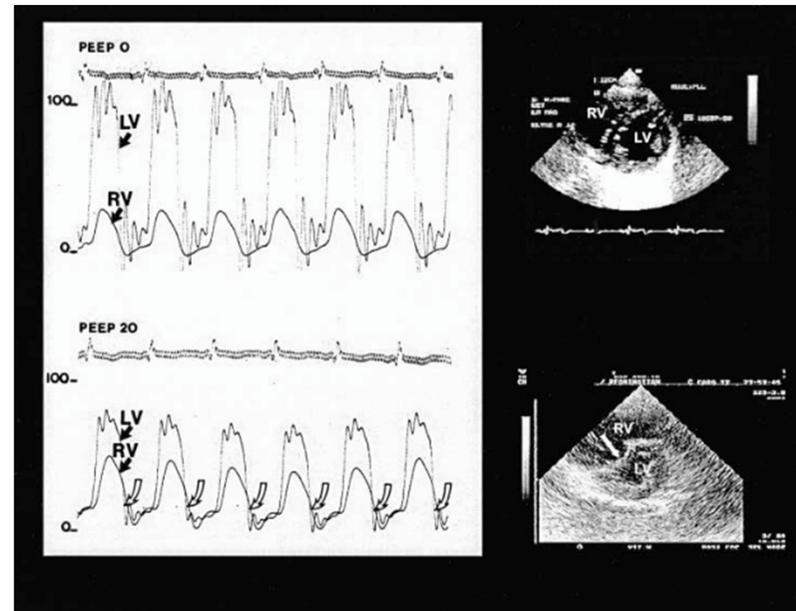
Veillard Baron A. *Current Opinion in Critical Care* 2009, 15:254–260





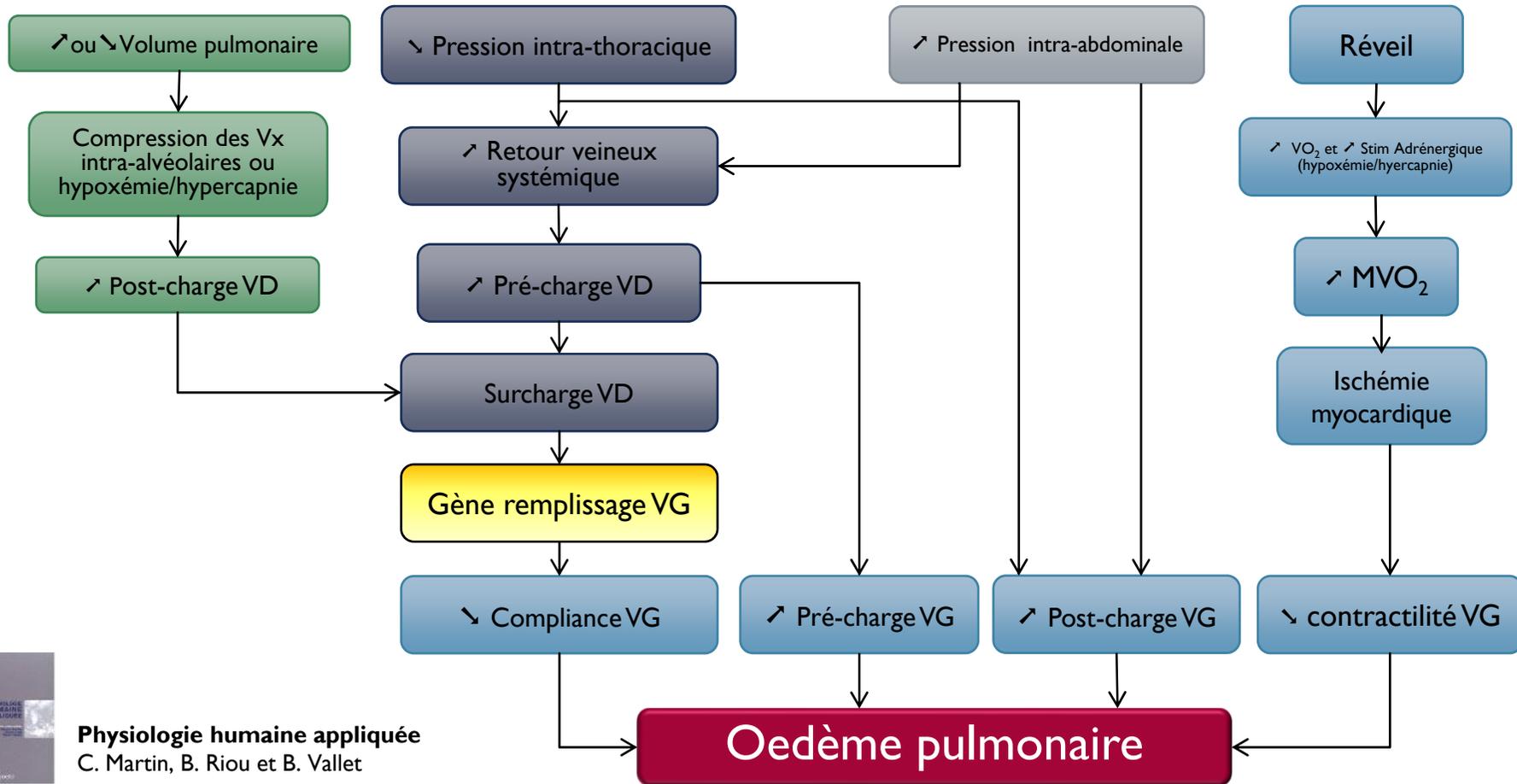
Index d'excentricité

- Valeur normale $D2/D1 = 1$ (Pathologique > 1)

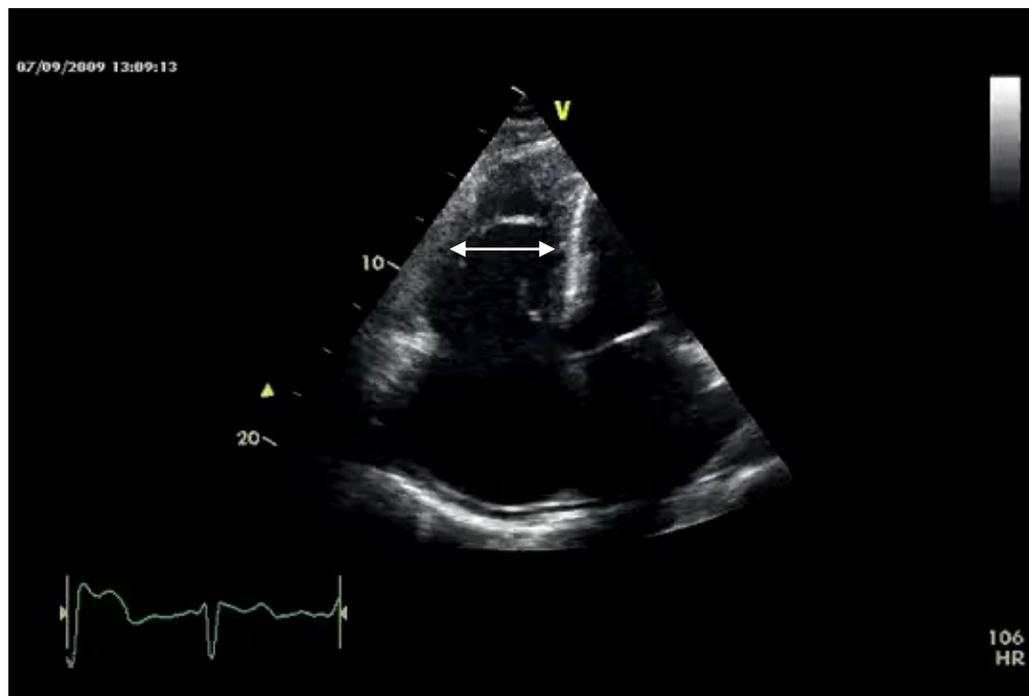


Veillard-Baron A et al. Am J Resp Crit Care Med 2002; 166:1310-9

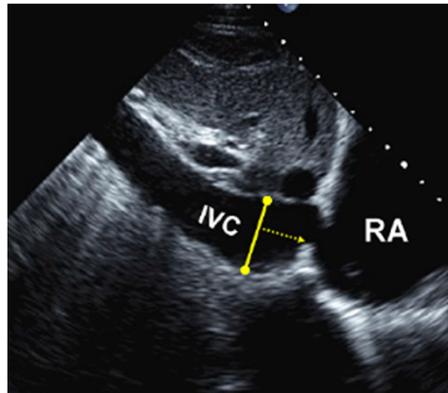
Sevrage de la ventilation mécanique



-
- 7 patients BPCO
 - Sans dysfonction cardiaque gauche préalable
 - Cathéter de Swan-Ganz
 - Augmentation PAP 25 à 28 mmHg au sevrage
 - Pas de modification significative FEVD 0,36 à 0,35
 - **Volume télé-diastolique VD 117 à 126 ml**



Incidence apicale 4 cavités

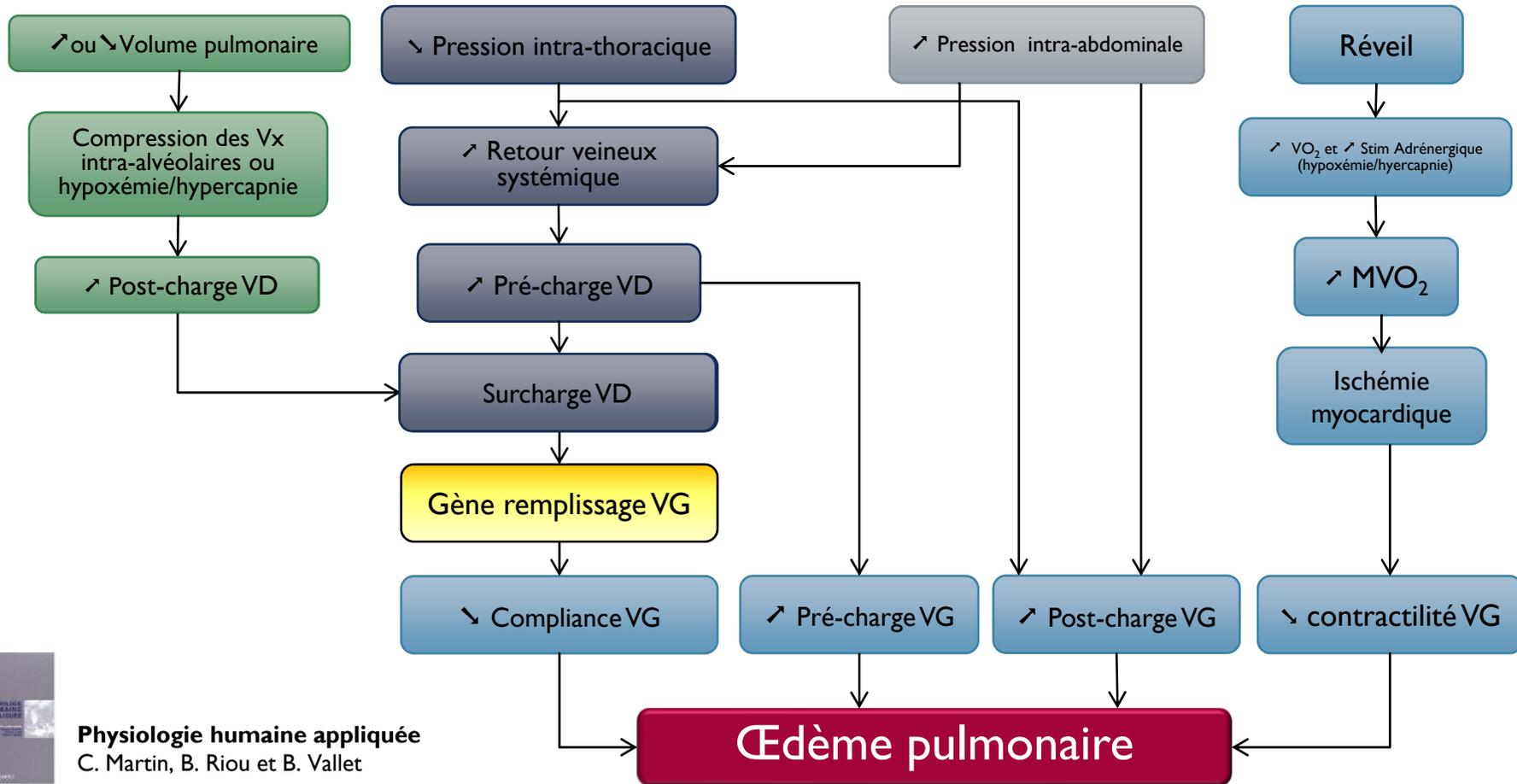


Incidence sous-costale 4 cavités (centrée sur VCI)

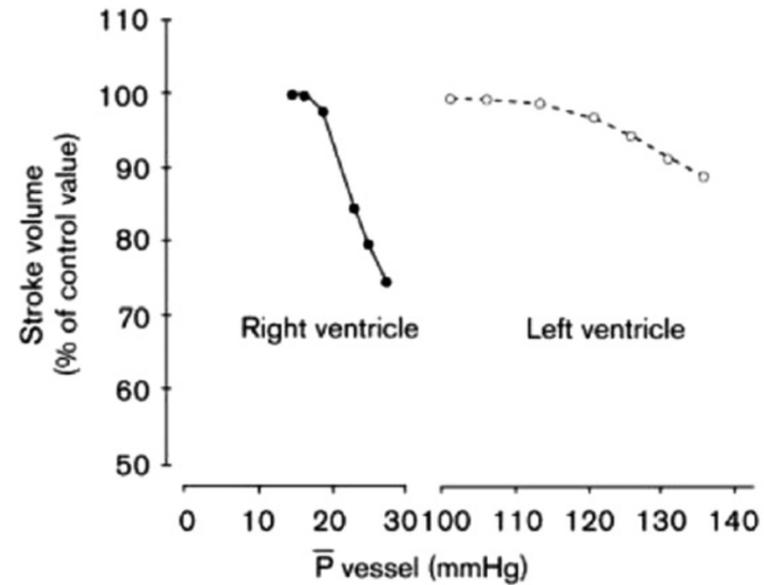
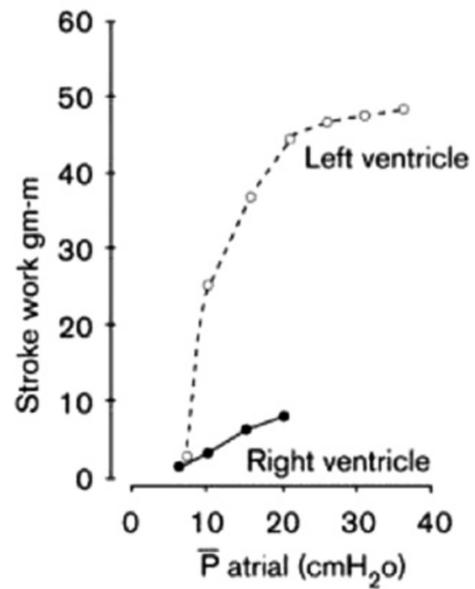
Table 3 Estimation of RA pressure on the basis of IVC diameter and collapse

Variable	Normal (0-5 [3] mm Hg)	Intermediate (5-10 [8] mm Hg)	High (15 mm Hg)
IVC diameter	≤2.1 cm	≤2.1 cm	>2.1 cm
Collapse with sniff	>50%	<50%	>50%
Secondary indices of elevated RA pressure			<ul style="list-style-type: none"> • Restrictive filling • Tricuspid E/E' > 6 • Diastolic flow predominance in hepatic veins (systolic filling fraction < 55%)

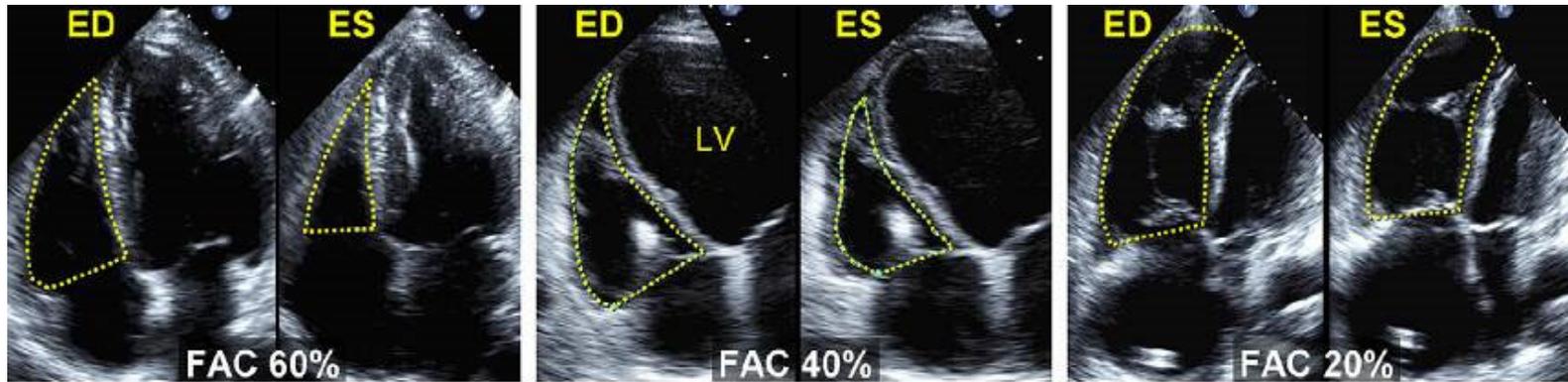
Sevrage de la ventilation mécanique



Réponse adaptive différente aux conditions de charge.....



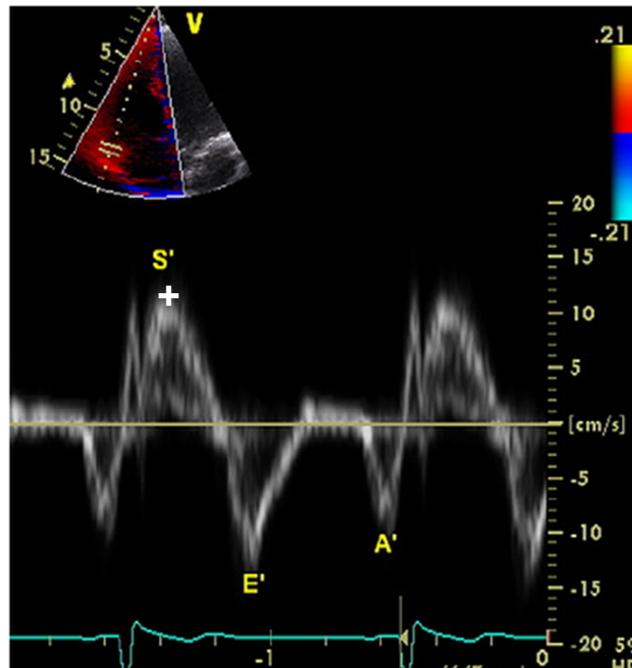
FRACTION DE RACCOURCISSEMENT DE SURFACE (FRS OU FAC)



$$\text{FAC} = \left[\frac{(\text{STDVD} - \text{STSVD})}{\text{STDVD}} \right] \times 100$$

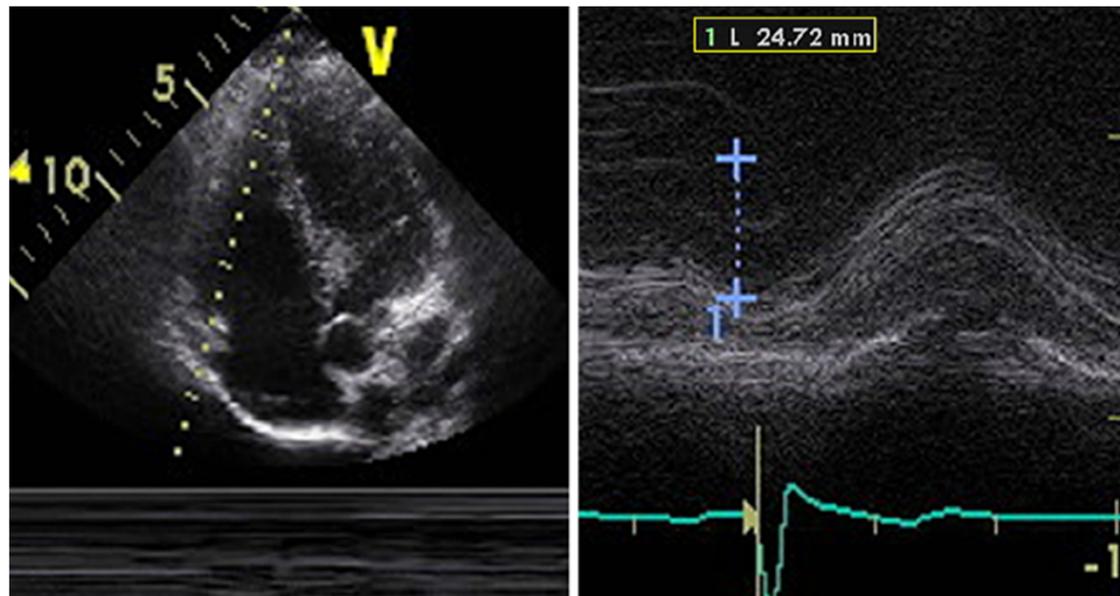
(valeur normale = 50%)

PIC VÉLOCITÉ SYSTOLIQUE À L'ANNEAU TRICUSPIDIEN EN DOPPLER TISSULAIRE (ONDE S')



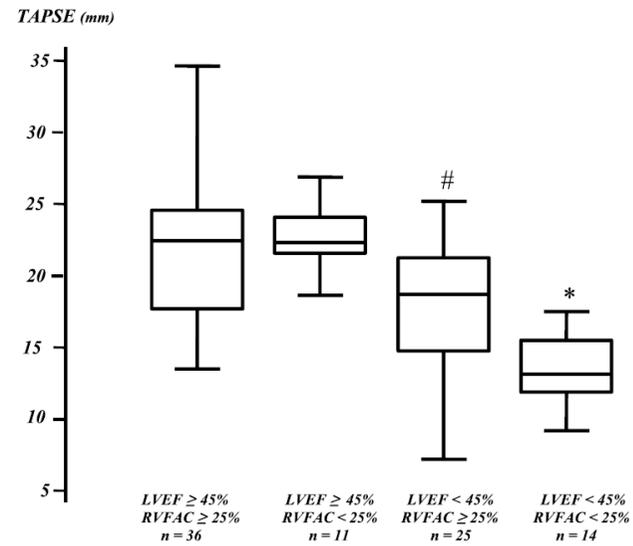
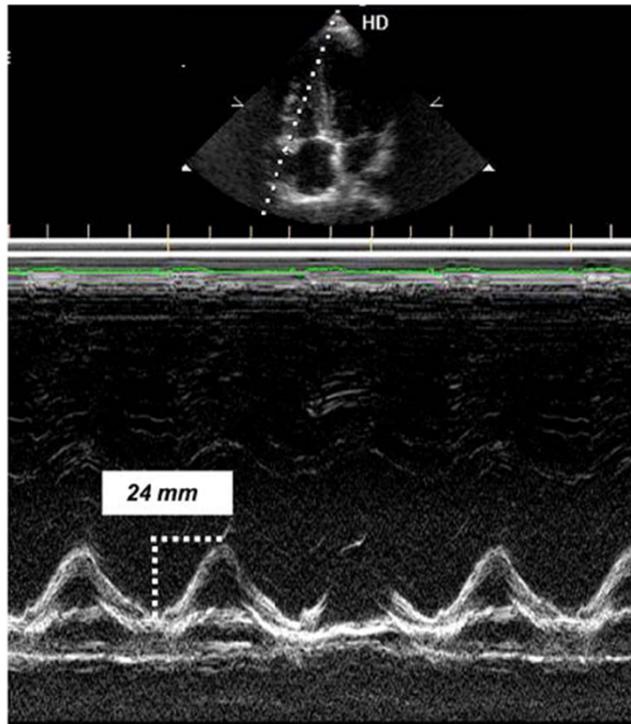
- Angle entre bord libre VD et curseur $< 30^\circ$
- Dysfonction VD si < 10 cm/s

TRISCUPID ANNULAR PLANE SYSTOLIC EXCURSION (TAPSE)



- Angle entre bord libre VD et curseur $< 30^\circ$ (dysfonction VD si < 15 mm)

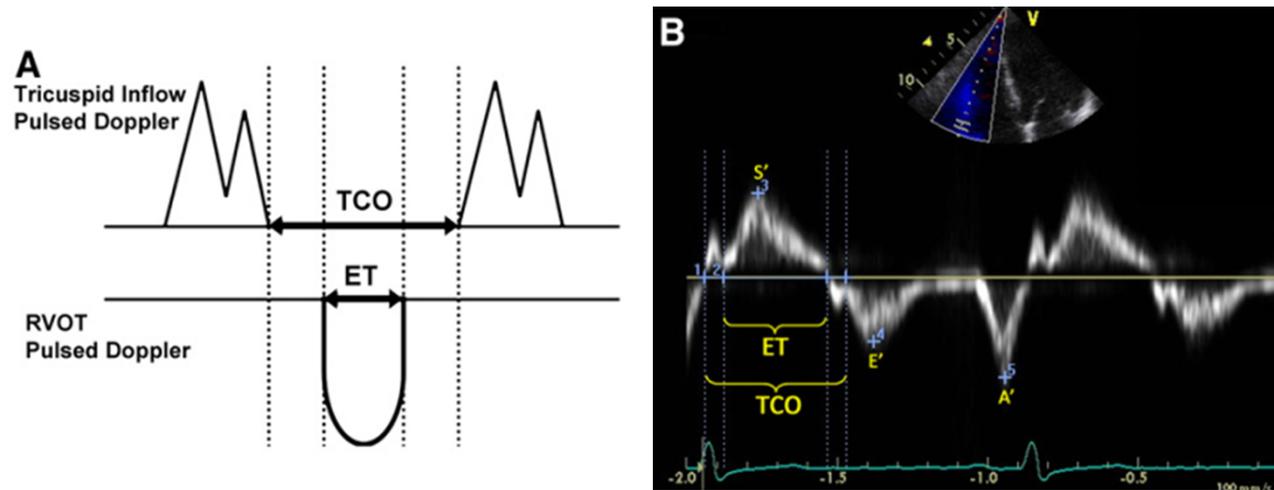
ANALYSE DU TAPSE POUR LA FONCTION VG AUX VARIATIONS DE CHARGE



Lamia B. Intensive Care Med. 2007 Dec;33(12):2143-9



INDEX TEI VD



$$\text{Tei index} = (\text{TCO} - \text{TE}) / \text{TE}$$

CALCUL TEI VD (MYOCARDIAL PERFORMANCE INDEX)

TEI Cœur Droit			
	Summary of Doppler intervals		
	Normal subjects	PPH	p Value
PEP (msec)	101 ± 13	109 ± 19	<0,05
ICT (msec)	38 ± 7	80 ± 35	<0,001
IRT (msec)	49 ± 9	131 ± 35	<0,001
ICT + IRT (msec)	90 ± 14	214 ± 50	<0,001
ET (msec)	322 ± 21	242 ± 40	<0,001
PEP/ET	0,32 ± 0,04	0,46 ± 0,10	<0,001
ICT/ET	0,12 ± 0,02	0,33 ± 0,16	<0,001
Index	0,28 ± 0,04	0,89 ± 0,25	<0,001

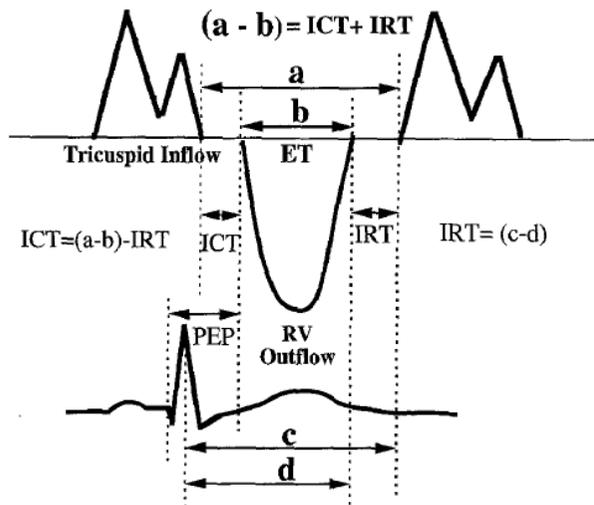
PPH, Primary pulmonary hypertension ICT, isovolumetric contraction time
IRT, isovolumetric relaxation time ET, ejection time.



Tei C. J Am Soc Echocardiogr 1996;9:838-47

CALCULATION OF RIGHT VENTRICULAR PERFORMANCE

$$\text{Index} = \frac{(a - b)}{b} = \frac{(\text{ICT} + \text{IRT})}{\text{ET}}$$



TEI Cœur Gauche		
	Control	CHF
E/A	0.86 +/- 0.27	0.90 +/- 0.44
DT (ms)	203 +/- 42	206 +/- 36
ICT (ms)	43 +/- 17	66 +/- 27
ET (ms)	349 +/- 38	283 +/- 33**
IRT (ms)	93 +/- 16	104 +/- 28
(ICT+IRT)/ET	0.39 +/- 0.1	0.60 +/- 0.18**

CHF=congestive heart failure E=peak velocity of the early diastolic transmitral flow A=peak velocity of the late diastolic transmitral flow E/A=ratio of peak early vs late transmitral flow velocity DT=deceleration time ICT=isovolumic contraction time ET=ejection time IRT=isovolumic relaxation time.

TEI Cœur Droit			
	Summary of Doppler intervals		
	Normal subjects	PPH	p Value
PEP (msec)	101 +/- 13	109 +/- 19	<0,05
ICT (msec)	38 +/- 7	80 +/- 35	<0,001
IRT (msec)	49 +/- 9	131 +/- 35	<0,001
ICT + IRT (msec)	90 +/- 14	214 +/- 50	<0,001
ET (msec)	322 +/- 21	242 +/- 40	<0,001
PEP/ET	0,32 +/- 0,04	0,46 +/- 0,10	<0,001
ICT/ET	0,12 +/- 0,02	0,33 +/- 0,16	<0,001
Index	0,28 +/- 0,04	0,89 +/- 0,25	<0,001

PPH, Primary pulmonary hypertension ICT, isovolumetric contraction time IRT, isovolumetric relaxation time ET, ejection time.

Tei C. J Am Soc Echocardiogr 1996;9:838-47



FACTEURS PRÉDICTIFS DYSFONCTION VD

	Sensitivity (%)	Specificity (%)	ROC AUC (95% CI)
TAPSE <1.5 cm	59	94	0.82 (.68-.95)
DTI peak systolic velocity <10 cm/s	59	92	0.83 (.72-.85)
MPI > 0.40	100	35	0.8 (.69-.91)

➤ MPI= myocardial performance index

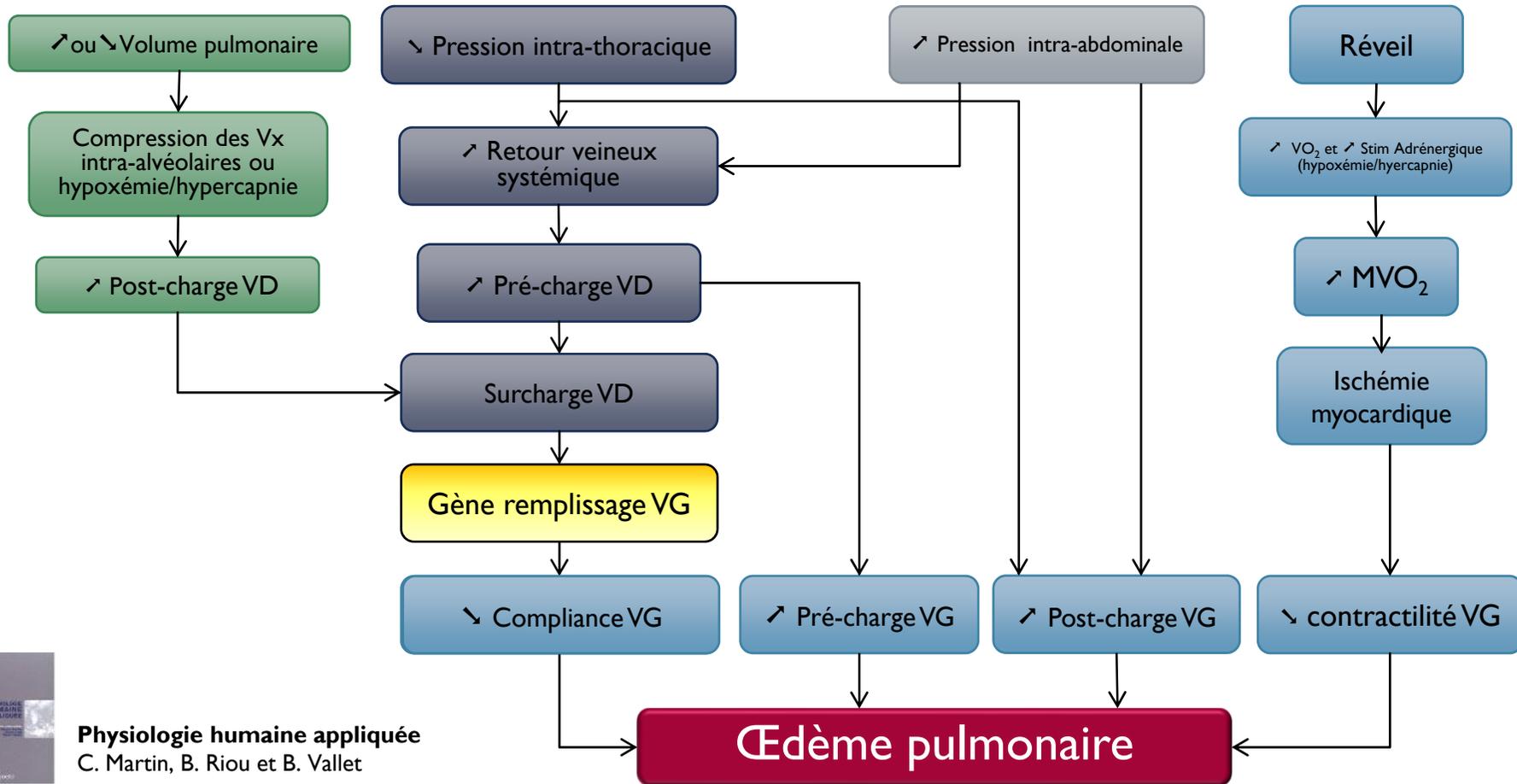
Variable	Unit	Abnormal	Illustration
Chamber dimensions			
RV basal diameter	cm	>4.2	Figure 7
RV subcostal wall thickness	cm	>0.5	Figure 5
RVOT PSAX distal diameter	cm	>2.7	Figure 8
RVOT PLAX proximal diameter	cm	>3.3	Figure 8
RA major dimension	cm	>5.3	Figure 3
RA minor dimension	cm	>4.4	Figure 3
RA end-systolic area	cm ²	>18	Figure 3
Systolic function			
TAPSE	cm	<1.6	Figure 17
Pulsed Doppler peak velocity at the annulus	cm/s	<10	Figure 16
Pulsed Doppler MPI	—	>0.40	Figure 16
Tissue Doppler MPI	—	>0.55	Figures 16 and 18
FAC (%)	%	<35	Figure 9
Diastolic function			
E/A ratio	—	<0.8 or >2.1	
E/E' ratio	—	>6	
Deceleration time (ms)	ms	<120	

FAC, Fractional area change; MPI, myocardial performance index; PLAX, parasternal long-axis; PSAX, parasternal short-axis; RA, right atrium; RV, right ventricle; RVD, right ventricular diameter; RVOT, right ventricular outflow tract; TAPSE, tricuspid annular plane systolic excursion.

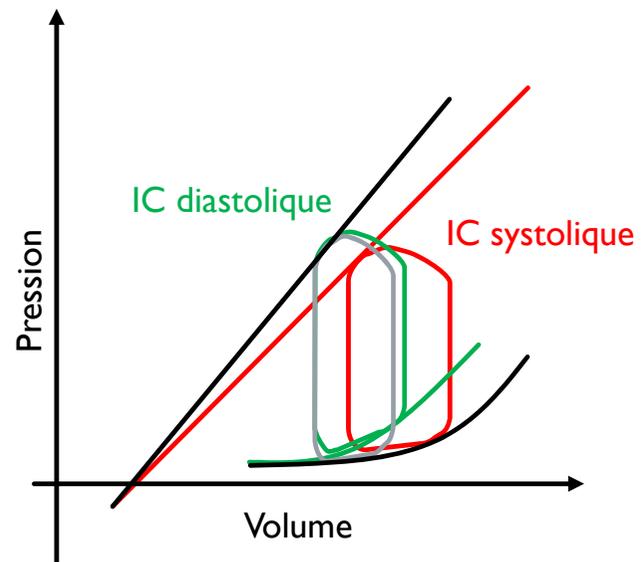
J Am Soc Echocardiogr 2010;23:685-713



Sevrage de la ventilation mécanique



LA BOUCLE PRESSION / VOLUME



Echocardiographic diagnosis of pulmonary artery occlusion pressure elevation during weaning from mechanical ventilation*

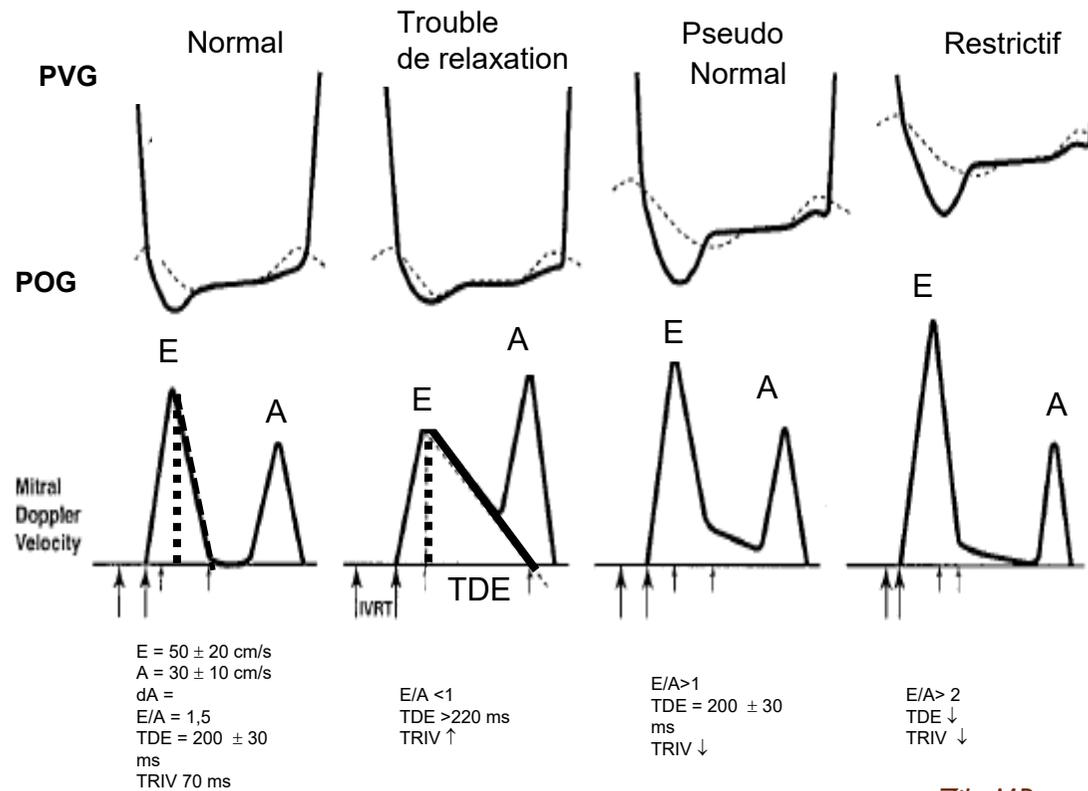
Bouchra Lamia, MD, MPH, PhD; Julien Maizel, MD; Ana Ochagavia, MD; Denis Chemla, MD, PhD; David Osman, MD; Christian Richard, MD; Jean-Louis Teboul, MD, PhD

- 39 patients en echec de mise en RS
- Augmentation PAPO chez 17 patients
- Analyse echographique

Bouchra L. Crit Care Med 2009; 37:1696–1701



ANALYSE DU PROFIL TRANSMITRAL



Zile MR et al. Circulation 2002; 105:1387-1393

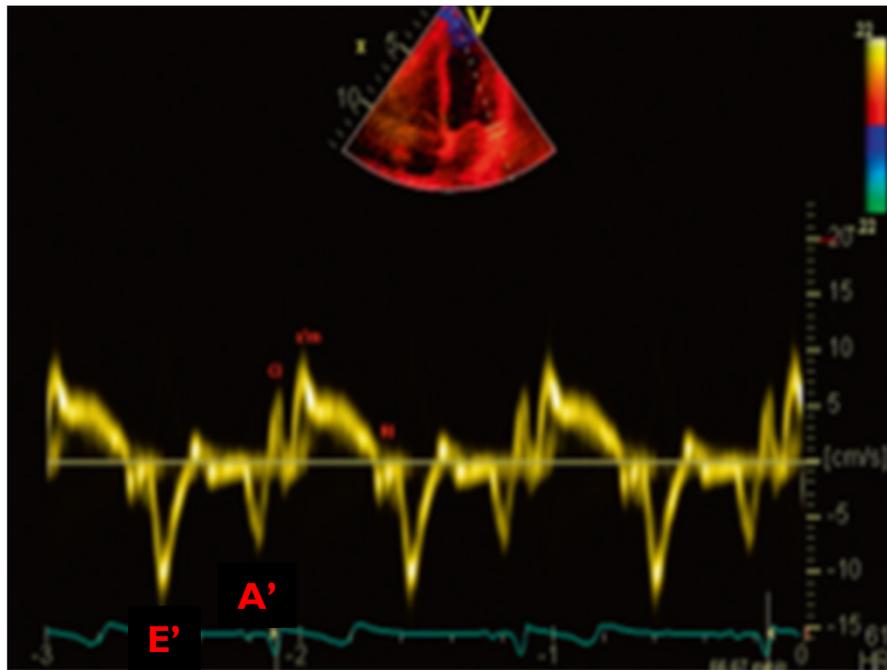
Flux transmitral et evaluation des pression de remplissage

Ajuster flux transmitral à un paramètre spécifique de relaxation

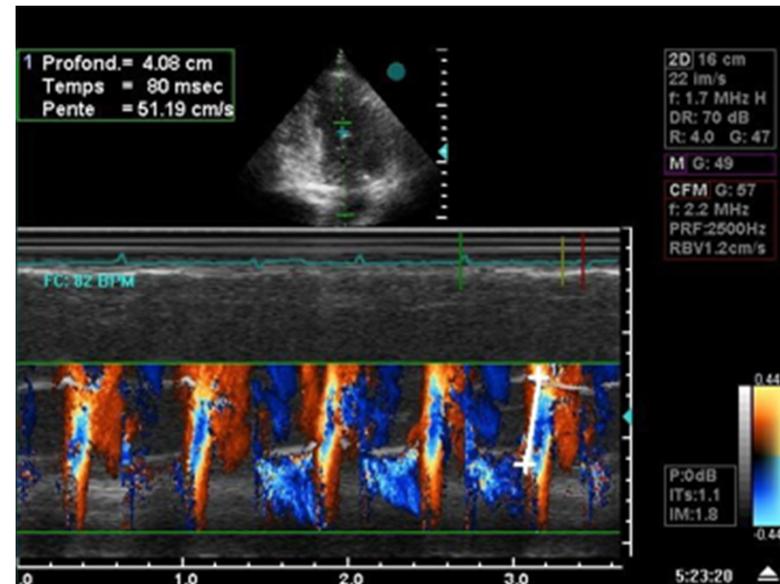
$$\frac{\text{Flux TM (E)}}{\text{???}} \approx \frac{\text{Relaxation} \cdot \text{Pression de remplissage}}{\text{Relaxation}}$$

- Doppler pulsé tissulaire à l'anneau mitral (dT_i)
- TM couleur de remplissage proto-diastolique du VG (V_p)

DOPPLER TISSULAIRE À L'ANNEAU
MITRAL (DTI)
APICALE 4 CAVITÉS



TM COULEUR DE REMPLISSAGE PROTO-DIASTOLIQUE DU VG (VP)
APICALE 4 CAVITÉS

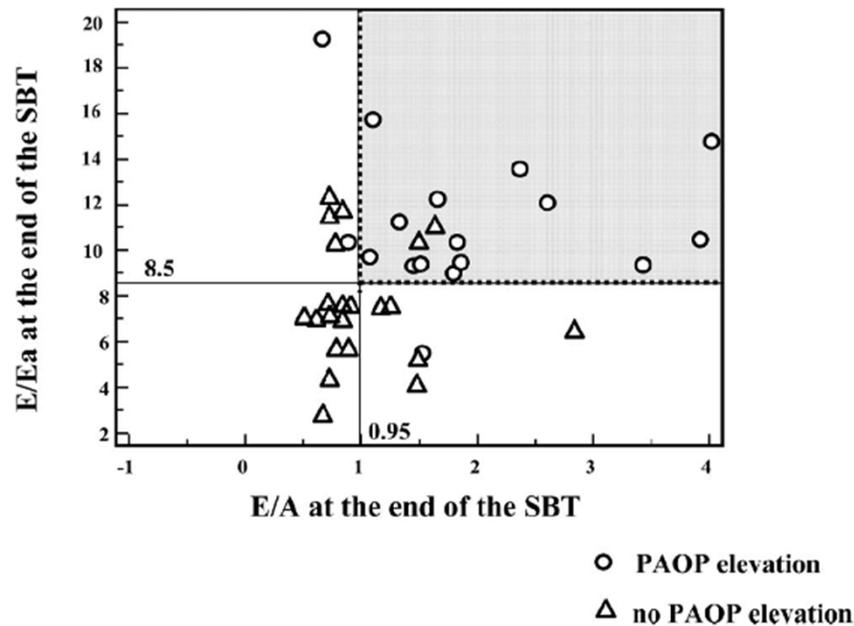


Trouble de relaxation si $V_p < 45$ cm/s

Peu utilisé

FONCTION DIAST	Normal	Pseudo- normal (type 2)	Anomalie relaxation (type 1)	Anomalie compliance (type 3)
Rapport E/A	> 1	> 1	< 1	> 2
Tps décélérat° onde E	160-240	160-240	> 240	< 160
TRIV ms)	70-120	70-120	> 120	< 70
E/Ea	<8	>15	>15	>15
E/Vp	<1.5	>2.5	>2.5	>2.5
Rapport S/D	>1	<1	>1	<1
Durée Ap/Amit	$A_{mit} > A_p$	$A_{mit} < A_p$	$A_{mit} > A_p$	$A_{mit} < A_p$

PRÉDICTION DE L'AUGMENTATION DE PAPO AU SEVRAGE

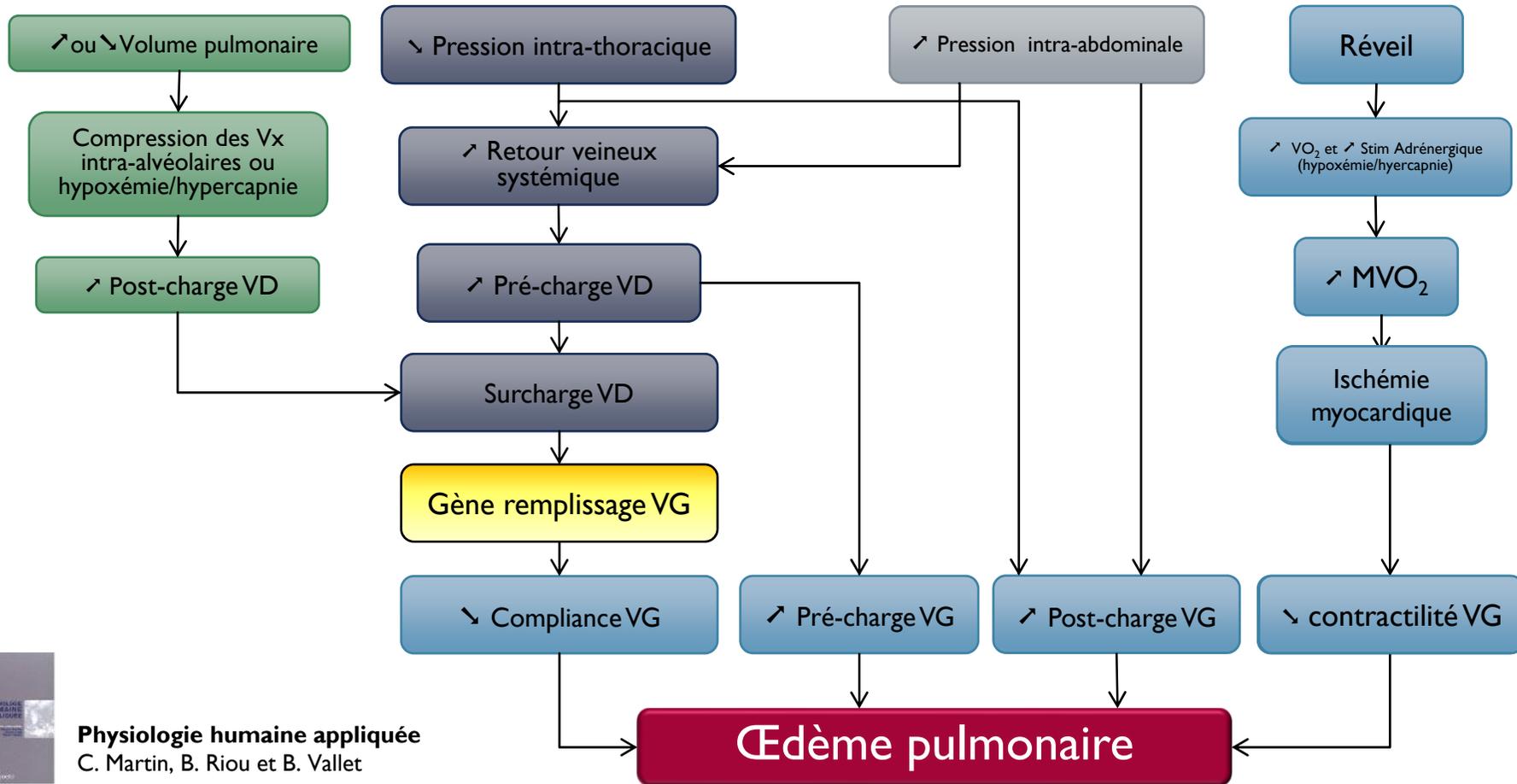


- E/A >0.95 fin épreuve de RS de 1h
 - Élévation PAPO
 - Se 88%; Sp 68%
- E/Ea >8.5 à la fin de l'épreuve de RS de 1h
 - Elévation PAPO
 - Se 94% Sp 73%
- La combinaison des 2 indices prédit l'augmentation de PAPO
 - Se 82%; Sp 91%.

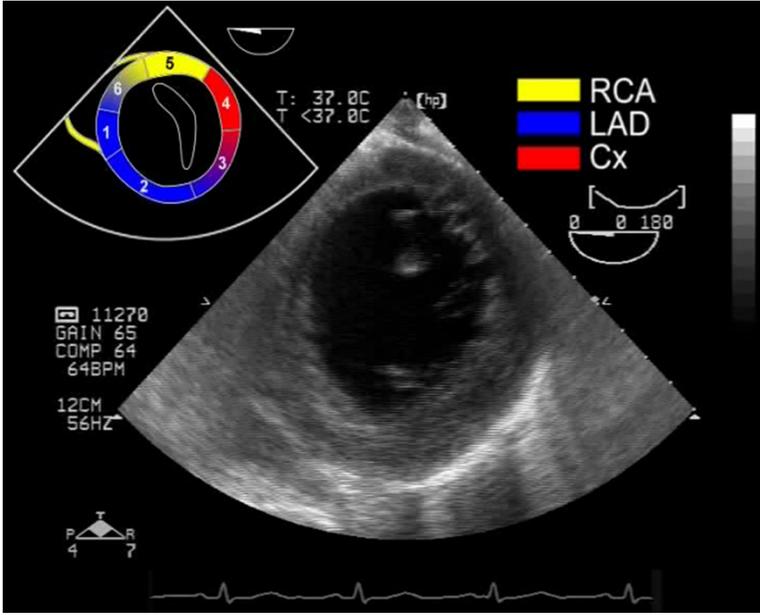
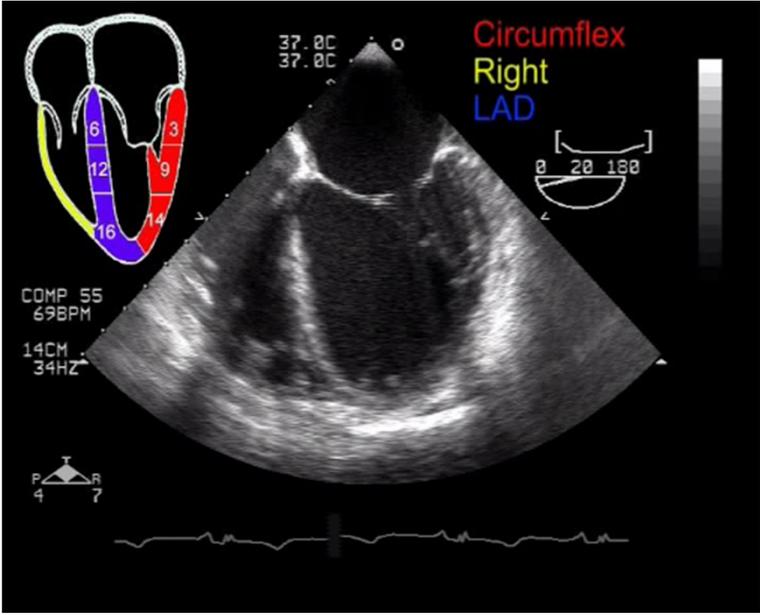


Bouchra L. Crit Care Med 2009;37:1696–1701

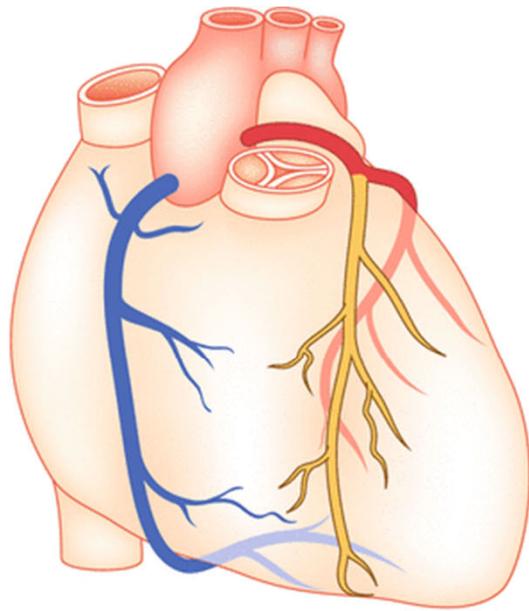
Sevrage de la ventilation mécanique



ANALYSE SEGMENTAIRE ETO

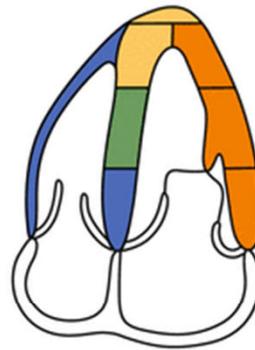


ANALYSE SEGMENTAIRE ETT

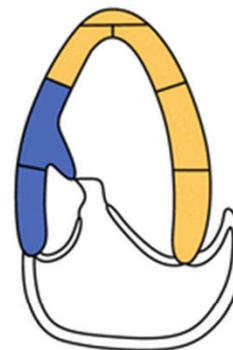


- RCA
- LAD
- Cx
- RCA or Cx
- LAD or Cx
- RCA or LAD

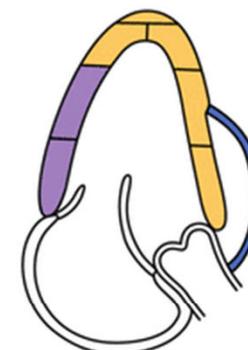
① Four chamber



② Two chamber



③ Long axis



④ Base



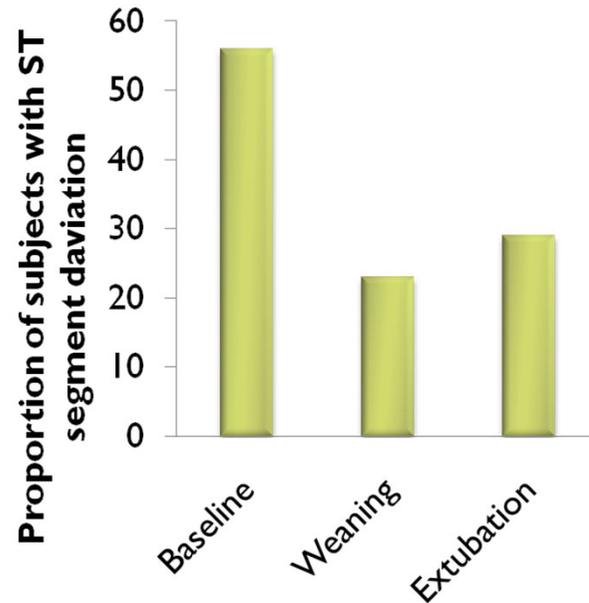
⑤ Mid



⑥ Apex



Prevalence of ST segment deviation



- 43 patient, 21% maladie coronaire connue
- Ischémie souvent silencieuse
- Modifications du ST à l'intubation pronostique du sevrage



Frazier SK Heart Lung. 2006 Nov-Dec;35(6):363-73.

AUTRES ÉTIOLOGIES D'HYPOXÉMIE AU SEVRAGE DE LA VENTILATION

Intensive Care Med (2005) 31:734–737
DOI 10.1007/s00134-005-2616-2

BRIEF REPORT

Chris Adamopoulos
Matthew Tsagourias
Kostoula Arvaniti
Fotini Veroniki
Dimitrios Matamis

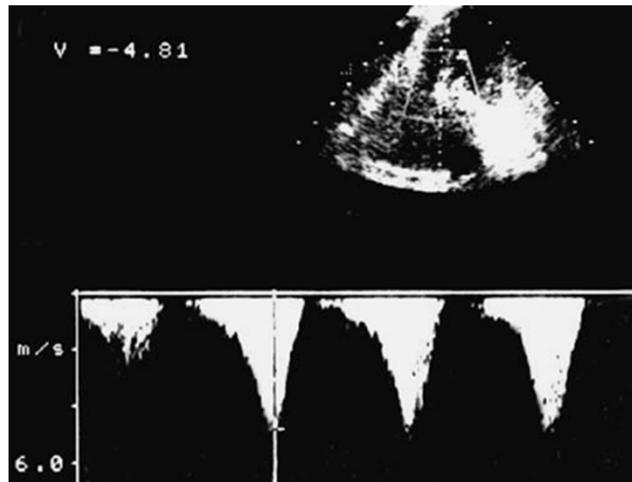
Weaning failure from mechanical ventilation due to hypertrophic obstructive cardiomyopathy

- Case report
- Modifications cardiaques liées aux conditions de charge et aux vitesses des flux

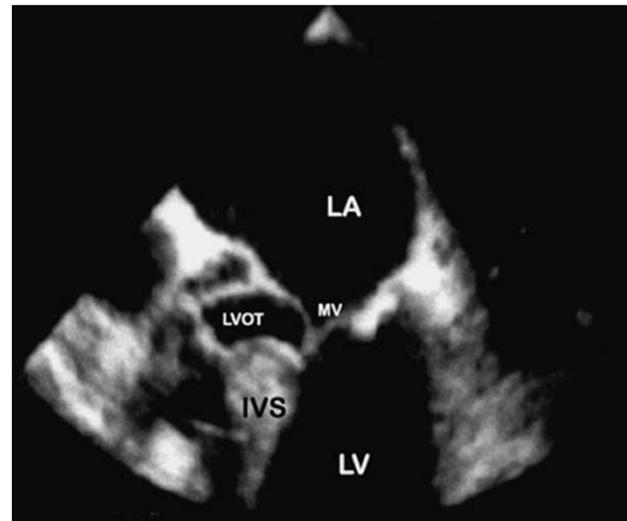
Adamopoulos C. Intensive Care Med (2005) 31:734–737

HYPOXÉMIE BRUTALE AU SEVRAGE DE LA VENTILATION

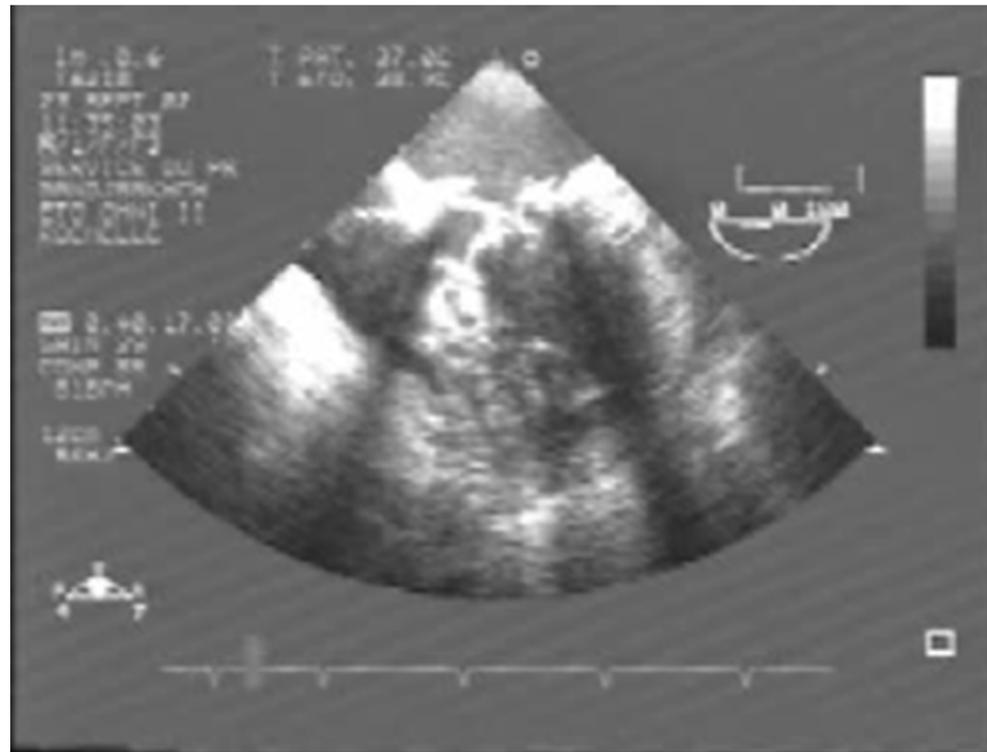
Obstacle dans la chambre de chasse:
Accélération du flux transaortique
($V_{max}=4.81$ m/s) . $GRAD_{max}=92$ mmHg

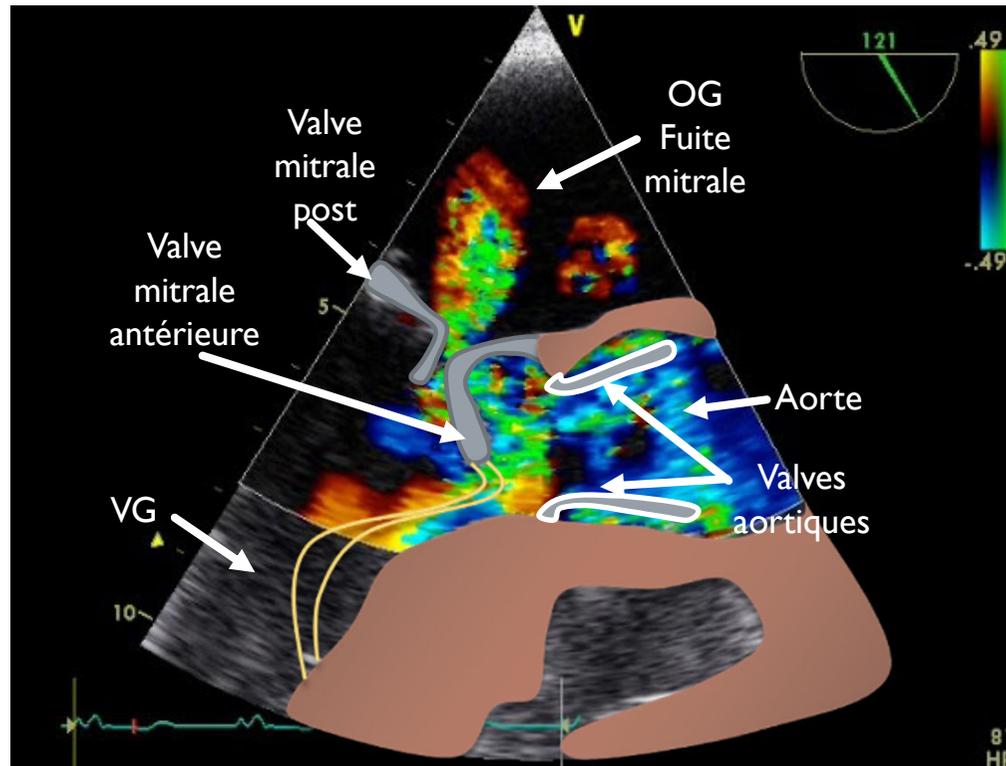


Mouvement systolique antérieur de
la grande valve mitrale

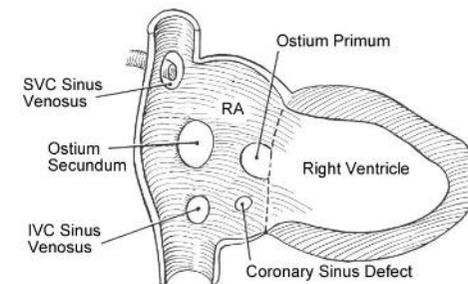
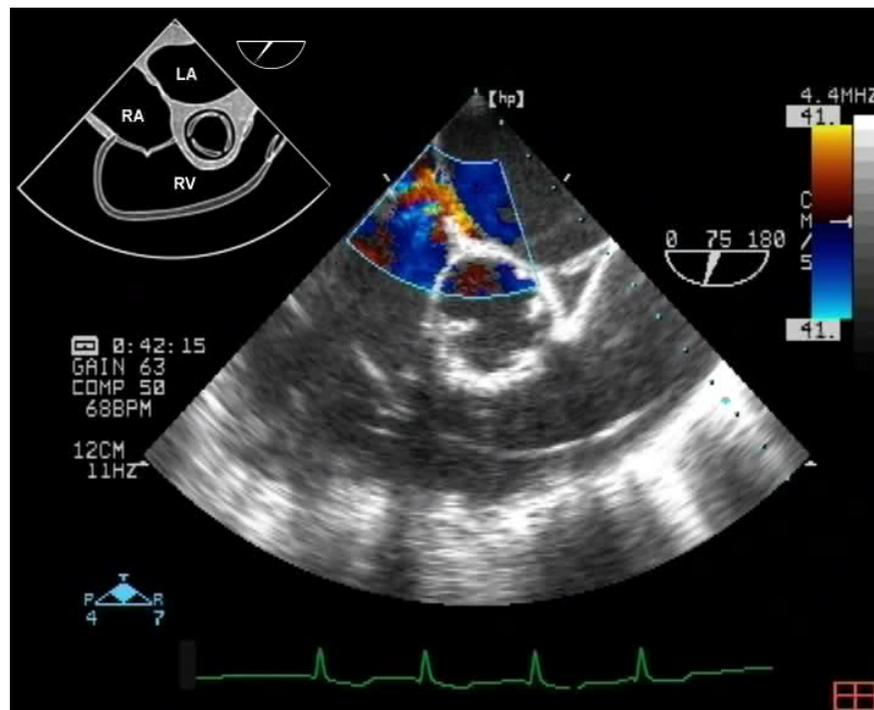


HYPOXÉMIE BRUTALE AU SEVRAGE DE LA VENTILATION

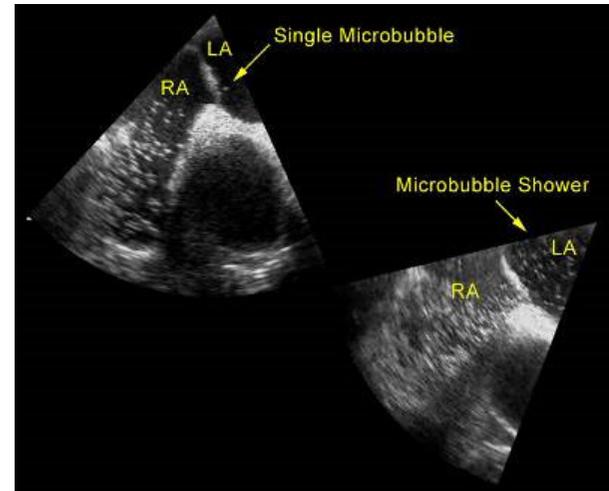
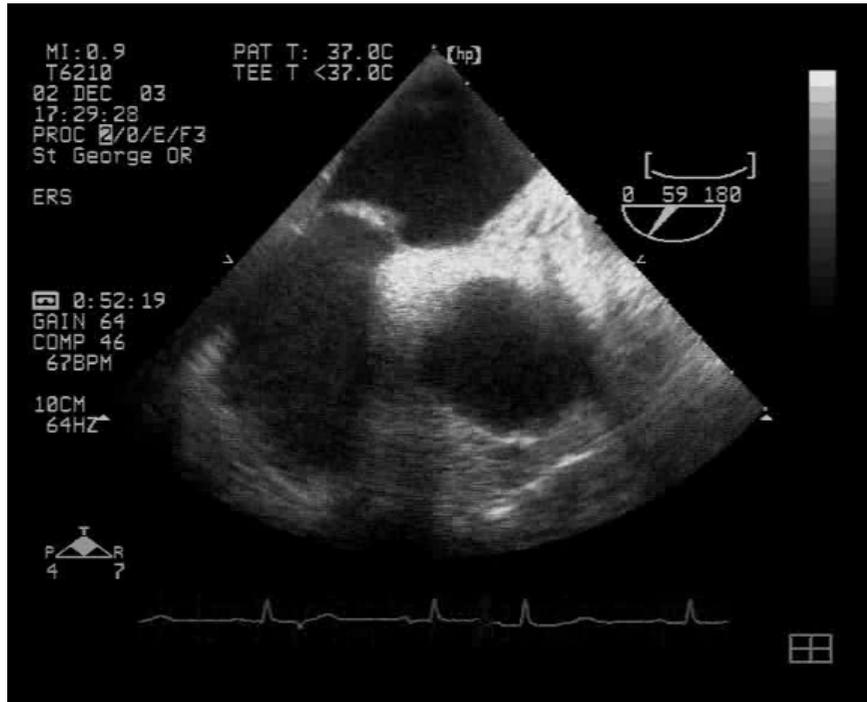




FORAMEN OVALE PERMÉABLE (FOP)



MANŒUVRE DE VALSALVA ET TEST DE CONTRASTE



EPREUVE DE CONTRASTE

- Distinction Foramen Ovale Perméable (FOP) et Shunt Intra Pulmonaire (SIP)
 - FOP : passage immédiat (moins de 3 battements cardiaques) des microbulles dans les cavités gauches dès leur apparition dans les cavités droites
 - SIP : passage retardé (plus de 3 battements cardiaques)

- Mais...
 - FOP > 3 battements si dépendant de la ventilation
 - SIP < 3 battements si proximal

CONCLUSION

- Le sevrage respiratoire peut être en échec dès les premières heures
 - Étiologie respiratoire
 - Modification des conditions de charge VG/VD +++
- ETT , ETO permettent d'évoquer le diagnostic
 - Rôle des indices combinés reste à valider dans cette indication
 - Limites classiques liées à une pathologie préexistante ou à des anomalies rythmiques
 - Cathétérisme de Swan-Ganz peut se révéler intéressant mais reste invasif
- Traitement vise à améliorer les conditions de charge
 - Déplétion hydrique, dérivés nitrés, inhibiteurs calciques, milrinone...