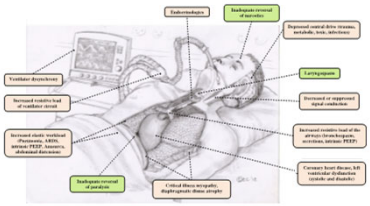
SEVRAGE RESPIRATOIRE DIFFICILE: ORIGINE CARDIAQUE?

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

CHU Bordeaux — université BORDEAUX — Inserm

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

CRITICAL CARE

REVIEW

Weaning failure of cardiac origin: recent advances

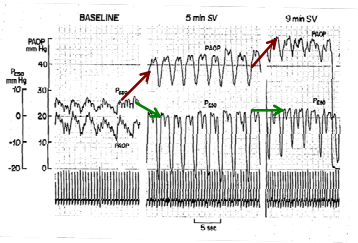
Jean-Louis Teboul*, Xavier Monnet, and Christian Richard

Acute Left Ventricular Dysfunction during Unsuccessful Weaning from Mechanical Ventilation

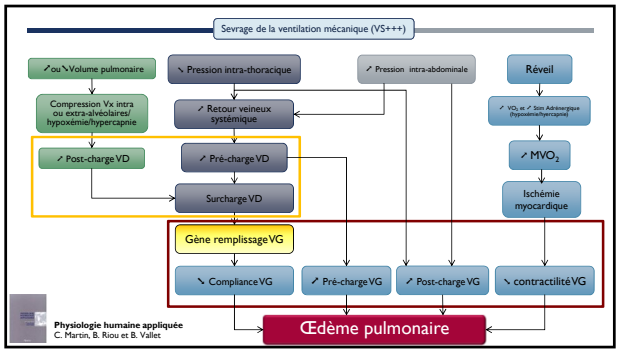
15 pts BPCO porteurs pathologie cardiaque

- 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

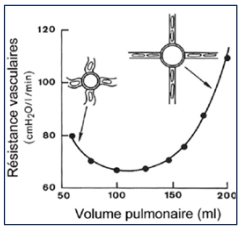


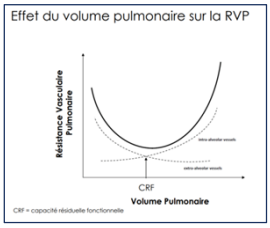
Lemaire F et al Anesthesiology 1988; 69:171-9



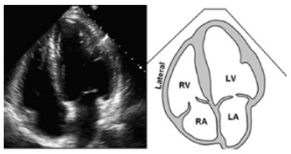
Physiologie humaine appliquée
C. Martin, B. Riou et B. Vallet

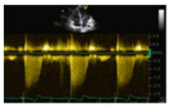
Volume pulmonaire et Résistances Vasculaires Pulmonaires





ANALYSE ECHO VD: INCIDENCE APICALE 4 CAVITES



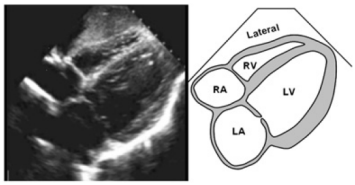


PAPs= $4V_{max}^2$ +POD

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

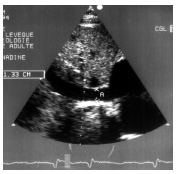
ANALYSE ECHO VD: INCIDENCE SOUS-COSTALE 4 CAVITES

- Dilatation des cavités droites
- Epaississement paroi libre VD

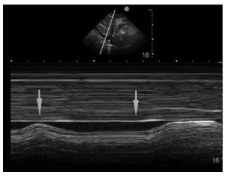


ANALYSE ECHO VD: INCIDENCE SOUS-COSTALE 4 CAVITES

- Analyse VCI (distension, variabilité)

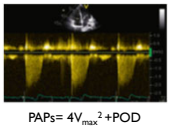


Mesure à 1-2 cm de l'abouchement OD
(N= 14-17 mm)

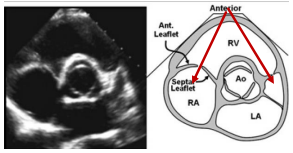


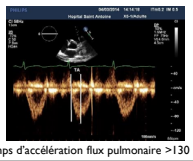
ANALYSE ECHO VD: INCIDENCE PSG PETIT AXE-BASALE

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



PAPs= $4V_{max}^2$ +POD

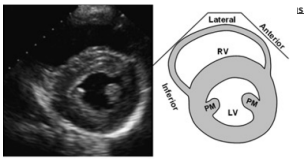


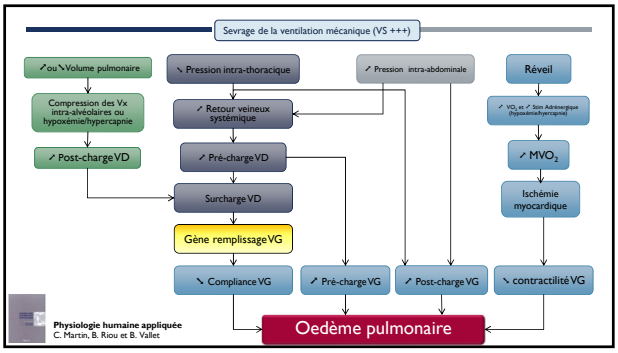


Temps d'accélération flux pulmonaire >130 ms

ANALYSE ECHO DU VD: INCIDENCE PSG PETIT AXE-TRANSPILIER

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

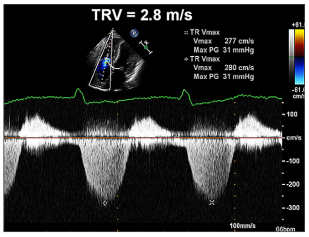




Analyse régurgitation tricuspide

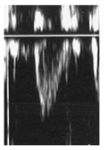
Vitesse maximale (HTAP si > 3 m.s^{-1})

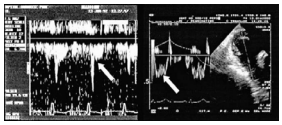
Mesure PAPs (PAPs = 4V$_{max}^{2}$+POD)



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

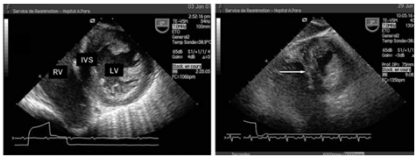




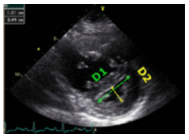
Veillard Baron A. Current Opinion in Critical Care 2009, 15:254–260

ANALYSE MORPHOLOGIQUE (SURCHARGE SYSTOLIQUE DU VD)

- Septum plat ou paradoxal

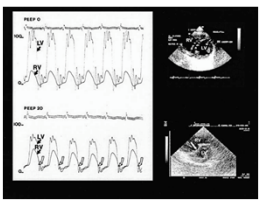


Veillard Baron A. Current Opinion in Critical Care 2009, 15:254–260

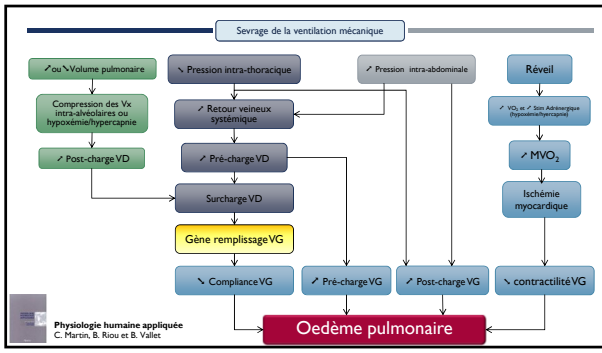


Index d'excentricité

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

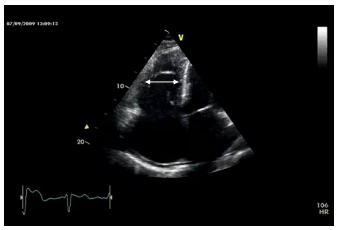


Veillard-Baron A et al. Am J Resp Crit Care Med 2002; 166:1310-9



- 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**

Teboul JL, Intensive Care Med. 1988;14 Suppl 2:483-5

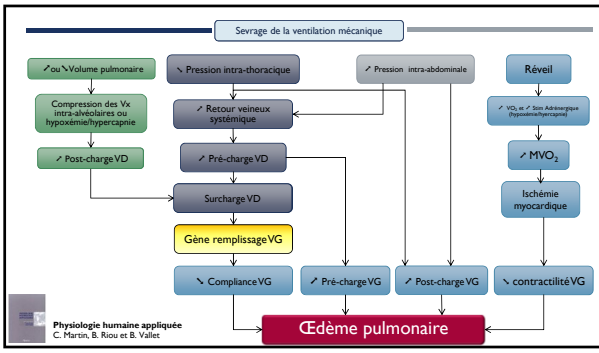


Incidence apicale 4 cavités

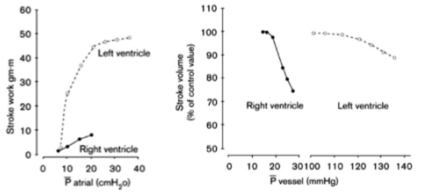
Incidence sous-costale 4 cavités (centrée sur VCI)

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	>2.1 cm
Collapse with sniff	>50%	<50%	>50%	<50%
Secondary indices of elevated RA pressure				• Restrictive filling • Tricuspid E/E' > 6 • Diastolic flow predominance in hepatic veins (systolic filling fraction < 55%)

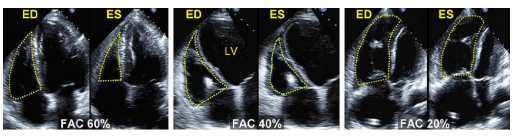


Réponse adaptive différente aux conditions de charge…..



Ventetuolo CE et al. Ann Am Thorac Soc 2014; 11:811-22

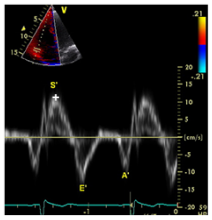
FRACTION DE RACCOURCISSEMENT DE SURFACE (FRS OU FAC)



FAC = [(STDVD – STSVD)/ STDVD]X100

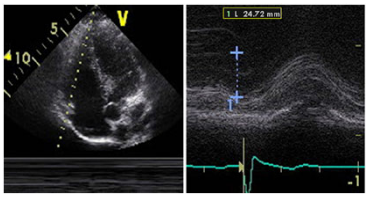
(valeur normale = 50%)

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



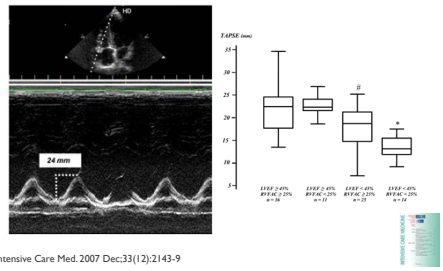
- Angle entre bord libre VD et curseur <30°
- Dysfonction VD si <10 cm/s

TRISCUPID ANNULAR PLANE SYSTOLIC EXCURSION (TAPSE)



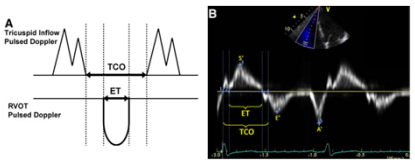
- Angle entre bord libre VD et curseur <30° (dysfonction VD si < 15 mm)

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



Tei index = (TCO-TE)/TE

CALCUL TEI VD (MYOCARDIAL PERFORMANCE INDEX)

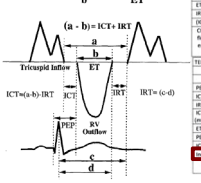
TEI Cœur Droit			
	Summary of Doppler intervals		
	Normal subjects	PPH	p Value
PEP (msec)	101 _+ 13	109 + 19	<0,05
ICT (msec)	38 _+ 7	80 _+ 35	<0,001
IRT (msec)	49 _+ 9	131 + 35	<0,001
ICT + IRT (msec)	90 + 14	214 + 50	<0,001
ET (msec)	322 + 21	242 _+ 40	<0,001
PEP/ET	0,32 _+ 0,04	0,46 + 0,10	<0,001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

CALCUL TEI VD (MYOCARDIAL PERFORMANCE INDEX)

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



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 +/-22
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
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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

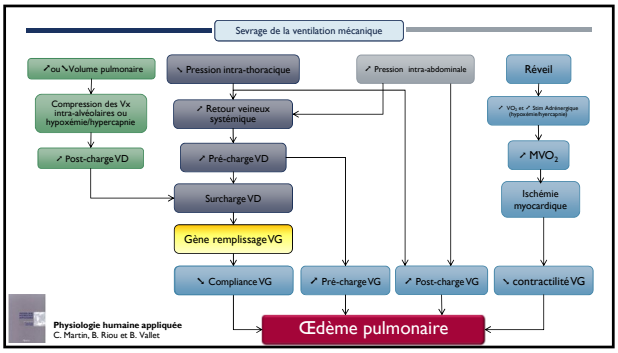
	Sensitivity (%)	Specificity (%)	ROC AUC (95% CI)
TAPSE <1.5 cm	59	94	0.82 (.68–.95)
DTI peak systolic velocity <10 cm/s	59	92	0.83 (.72–.85)
MPI > 0.40	100	35	0.8 (.69–.91)

- *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	

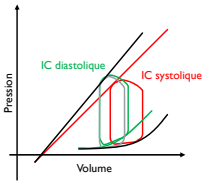
FAC, Fractional area change; *MPI*, myocardial performance index; *PLAX*, parasternal long-axis; *PSAX*, parasternal short-axis; *RA*, right atrium; *RV*, right ventricle; *RVD*, right ventricular diameter; *RVOT*, right ventricular outflow tract; *TAPSE*, tricuspid annular plane systolic excursion.

J Am Soc Echocardiogr 2010;23:685-713



Physiologie humaine appliquée
C. Martin, B. Riou et B. Vallet

LA BOUCLE PRESSION / VOLUME



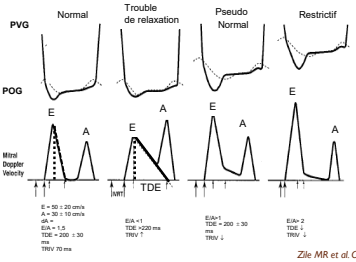
Echocardiographic diagnosis of pulmonary artery occlusion pressure elevation during weaning from mechanical ventilation*

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

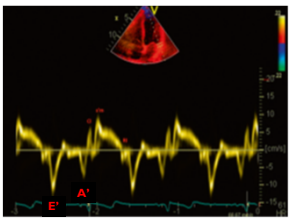
Flux transmitral et evaluation des pression de remplissage

Ajuster flux transmitral à un paramètre spécifique de relaxation

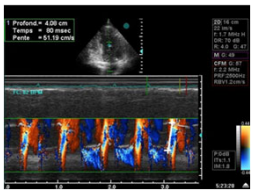
$$\frac{\text{Flux TM (E)}}{???} \approx \frac{\text{Relaxation / Pression de remplissage}}{\text{Relaxation}}$$

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

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



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

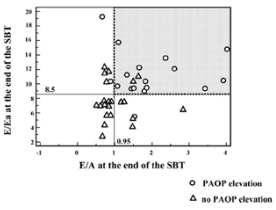


Trouble de relaxation si Vp< 45 cm/s

Peu utilisé

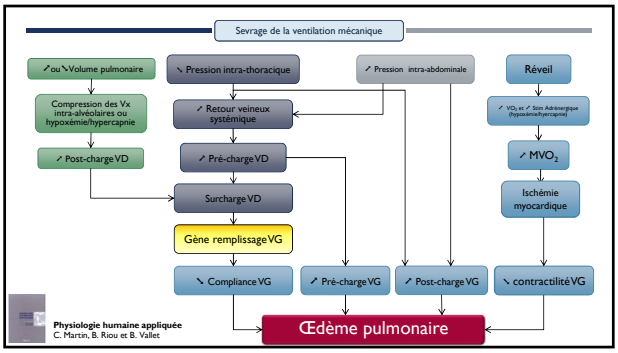
FONCTION DIAST	Normal	Pseudo-normal (type 2)	Anomalie relaxation (type 1)	Anomalie compliance (type 3)
Rapport E/A	> 1	> 1	< 1	> 2
Tps décélérat° onde E	160-240	160-240	> 240	< 160
TRIV ms)	70-120	70-120	> 120	< 70
E/Ea	<8	>15	>15	>15
E/Vp	<1.5	>2.5	>2.5	>2.5
Rapport S/D	>1	<1	>1	<1
Durée Ap/Amit	$A_{mit}>A_p$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

PRÉDICTION DE L'AUGMENTATION DE PAPO AU SEVRAGE



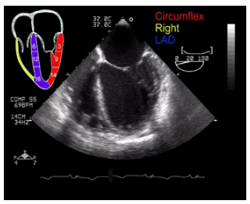
- E/A >0.95 fin épreuve de RS de 1h
  - Élévation PAPO
  - Se 88%; Sp 68%
- E/Ea >8.5 à la fin de l'épreuve de RS de 1h
  - Elévation PAPO
  - Se 94% Sp 73%
- La combinaison des 2 indices prédit l'augmentation de PAPO
  - Se 82%; Sp 91%.

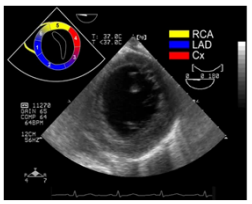
Bouchra L . Crit Care Med 2009; 37:1696–1701



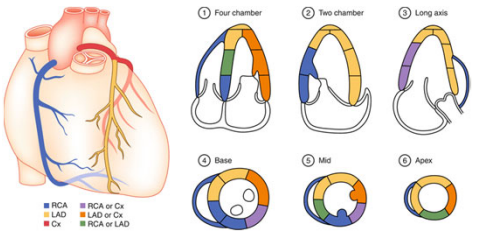
Physiologie humaine appliquée
C. Martin, B. Riou et B. Vallet

ANALYSE SEGMENTAIRE ETO

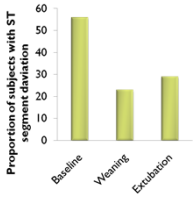




ANALYSE SEGMENTAIRE ETT



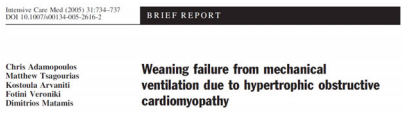
Prevalenceof ST segment deviation



- 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

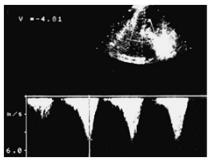
Weaning failure from mechanical ventilation due to hypertrophic obstructive cardiomyopathy

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

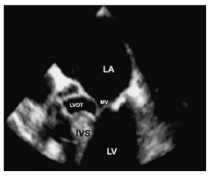
Adamopoulos C. Intensive Care Med (2005) 31:734–737

HYPOXÉMIE BRUTALE AU SEVRAGE DE LA VENTILATION

Obstacle dans la chambre de chasse: Accélération du flux transaortique (Vmax=4.81 m/s) . GRADmax =92 mmHg

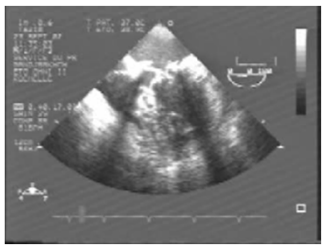


Mouvement systolique antérieur de la grande valve mitrale

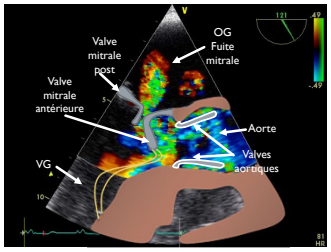


Adamopoulos C. Intensive Care Med (2005) 31:734–737

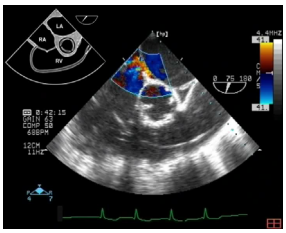
HYPOXÉMIE BRUTALE AU SEVRAGE DE LA VENTILATION

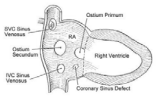


HYPOXÉMIE BRUTALE AU SEVRAGE DE LA VENTILATION

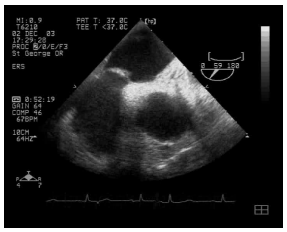


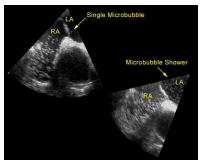
FORAMEN OVALE PERMÉABLE (FOP)





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 dés 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
  - Cathéterisme 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…