Capnographie

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Centre Hospitalier Universitaire de Montréal

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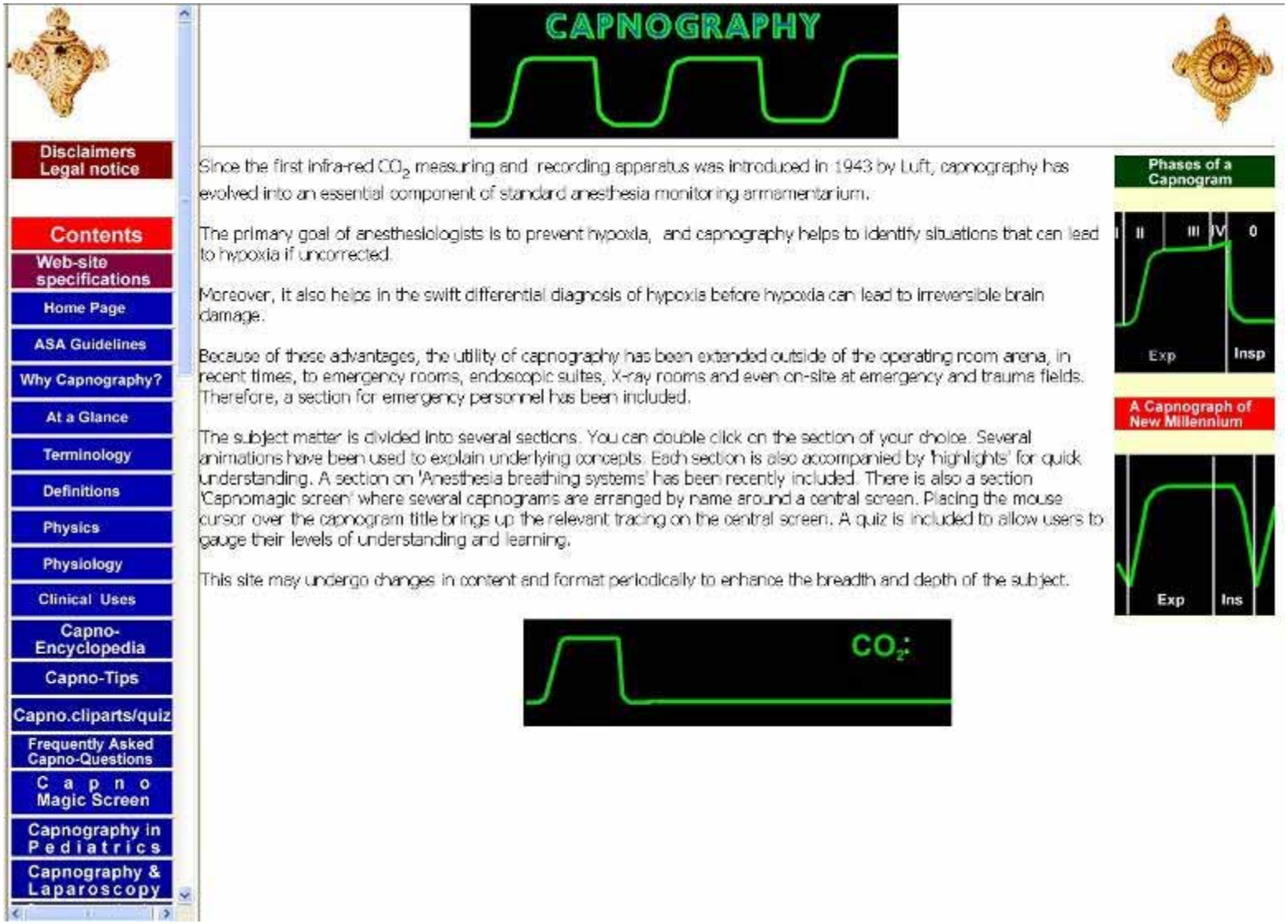
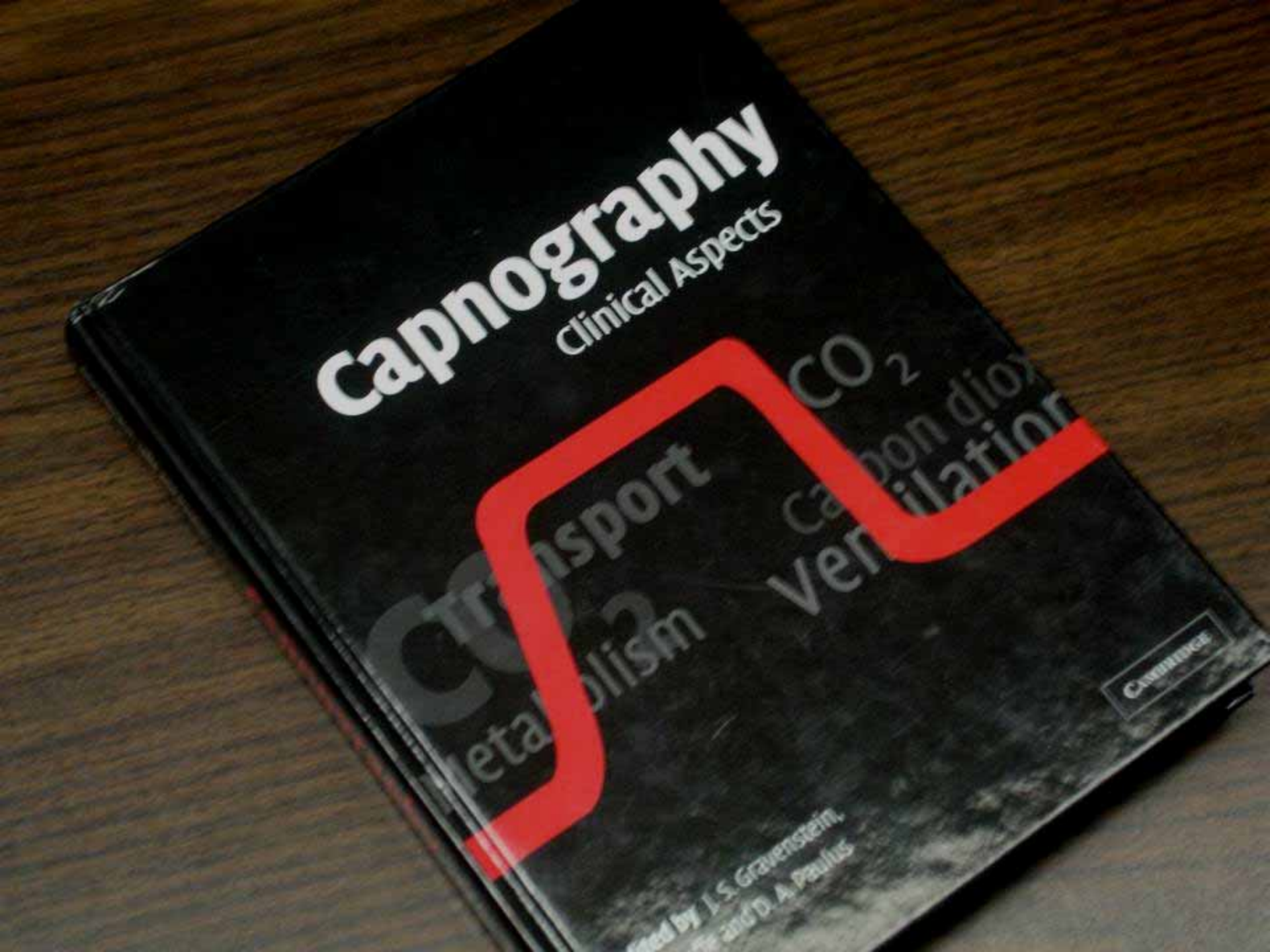
http://www.capnography.com/




Capnography
Clinical Aspects
CO 2
Transport
Ventilation
CAMBRIDGE

Capnographie: standards nord-américain

ASA: “ To ensure adequate ventilation of the patient during all anesthetics … every patients shall have the adequacy of ventilation continually evaluated“

AHA, Am Coll Emer Phys, ACLS: Capnography: "standard of care to determine endotracheal tube position in cardiopulmonary resuscitation“

Guide de l’exercice de l’anesthésie (JCA Novembre 2005): Monitorage requis (utilisés sans interruption) “un capnographe lorsqu’un tube endotrachéal ou un capnographe est inséré’

Review Article

Capnometry and anaesthesia

K. Bhavani-Shankar MD, H. Moseley FFARCS,
A.Y. Kumar MD, Y. Delph DA

”It has been concluded from a closed claims study that application of capnography and pulse oximetry together could have helped the anaesthetist prevent 93% of avoidable anaesthetic mishaps.[7] “

CAN J ANAESTH 1992 / 39: 6 / pp 617–32

Aspect médicolégal

- “..from a legal point of view, a physician, EMT, or paramedic who do not use a disposable $ETCO_2$ detector in the process of intubation, in the absence of electronic capnography, is not acting as the average reasonable reputable physician….."

Ginsburg (avocat) 1993 Ann Emerg Med (Los Angeles)

Rôle de la capnographie

A: « Airway » ou détecteur du le positionnement du TET

B: « Breathing » ou détecte la présence d'une ventilation, sa fréquence, le type de ventilation, les anomalies V/Q, estime la $PaCO_2$ et la profondeur de l'anesthésie

C: Circulation sanguine pulmonaire et systémique

D: Diagnostique

E: Espérance de survie

Plan

1-Méthodes et système de mesure

2-Physiologie du CO_2

3-Courbes de CO_2

4-CO_2 volumétrique

5-Autres applications

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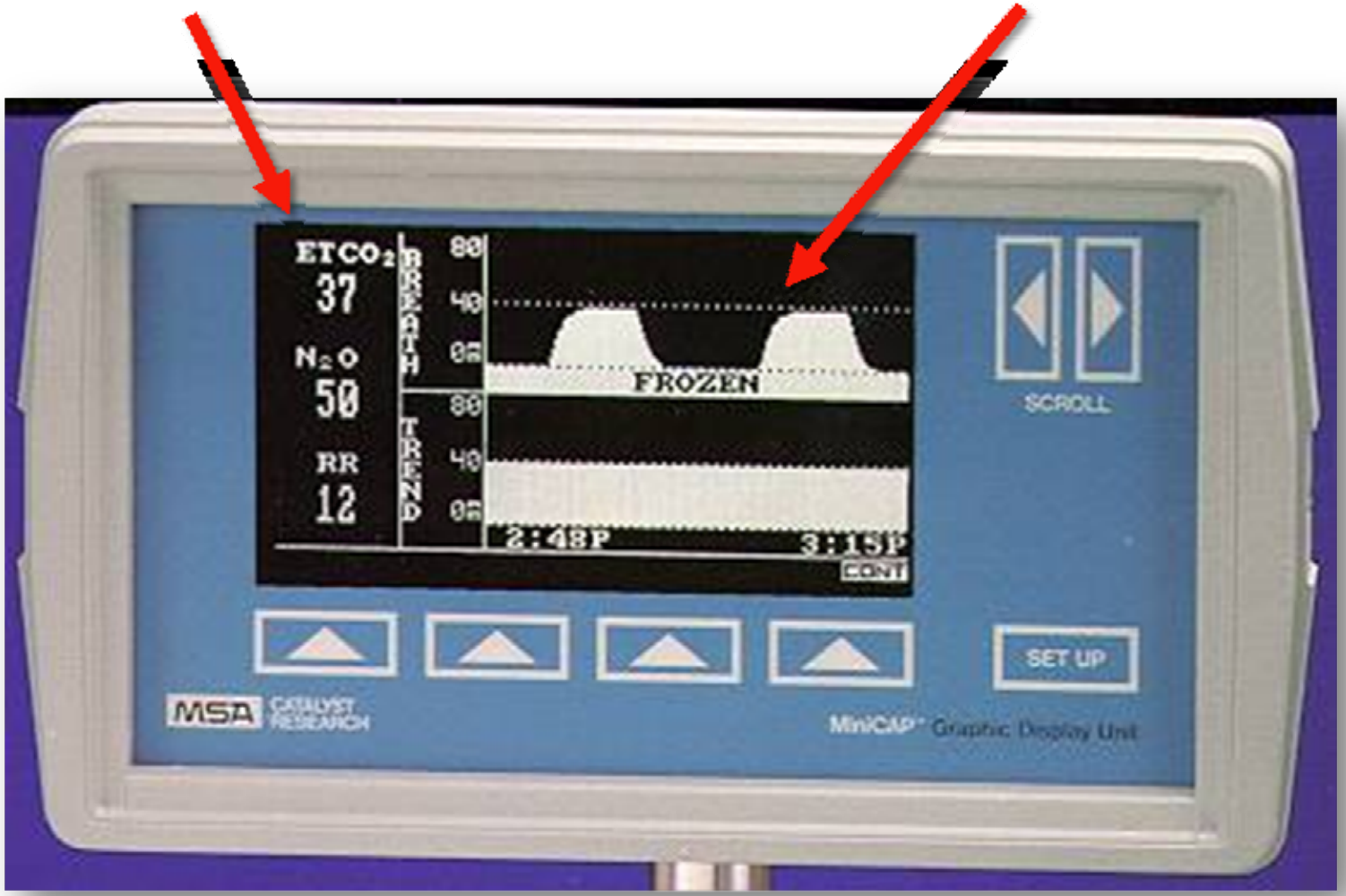
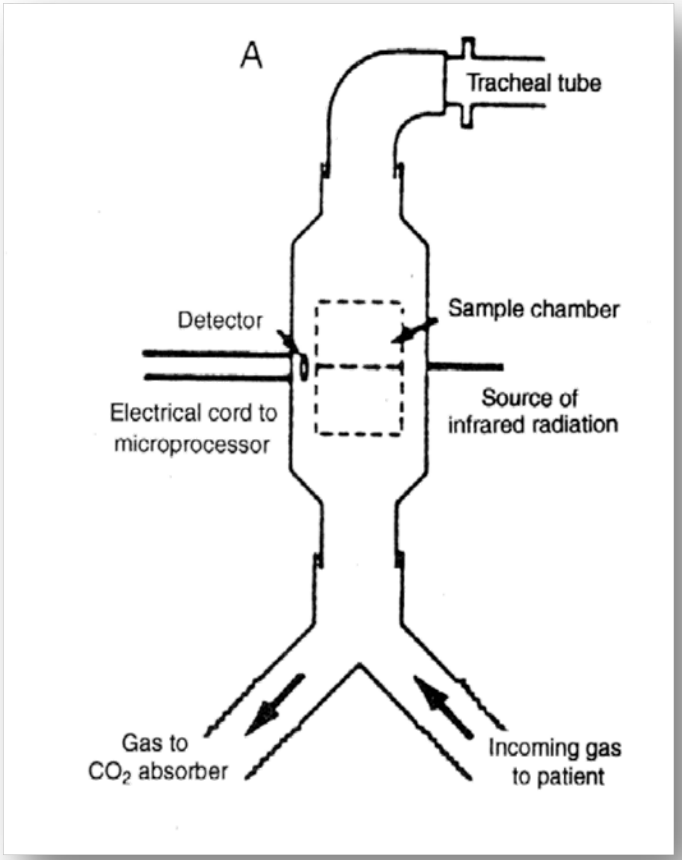
Capnométrie

Capnographie



1-Moniteurs de la mesure du CO_2

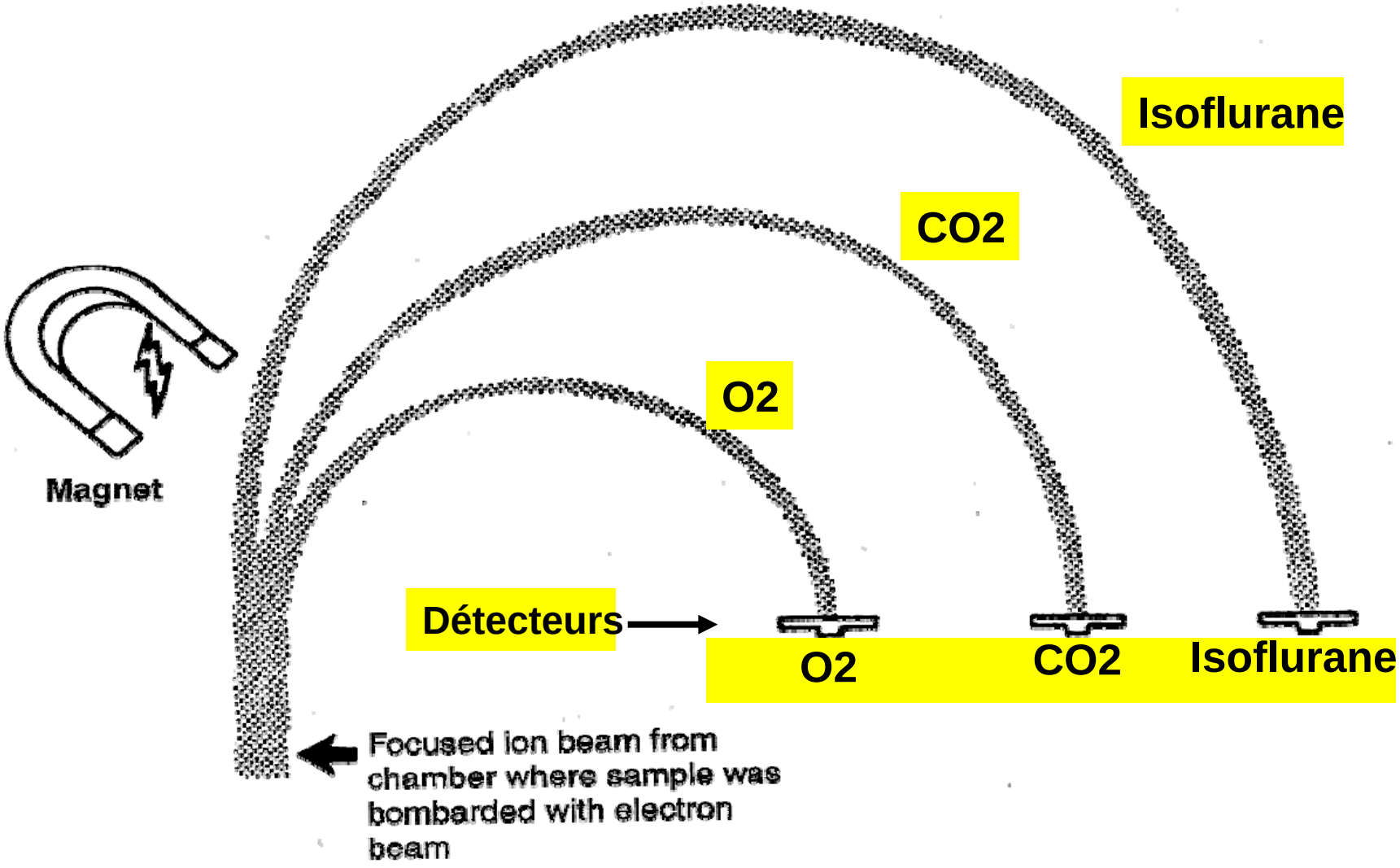
Échantillonage central



Méthodes de mesure du CO2

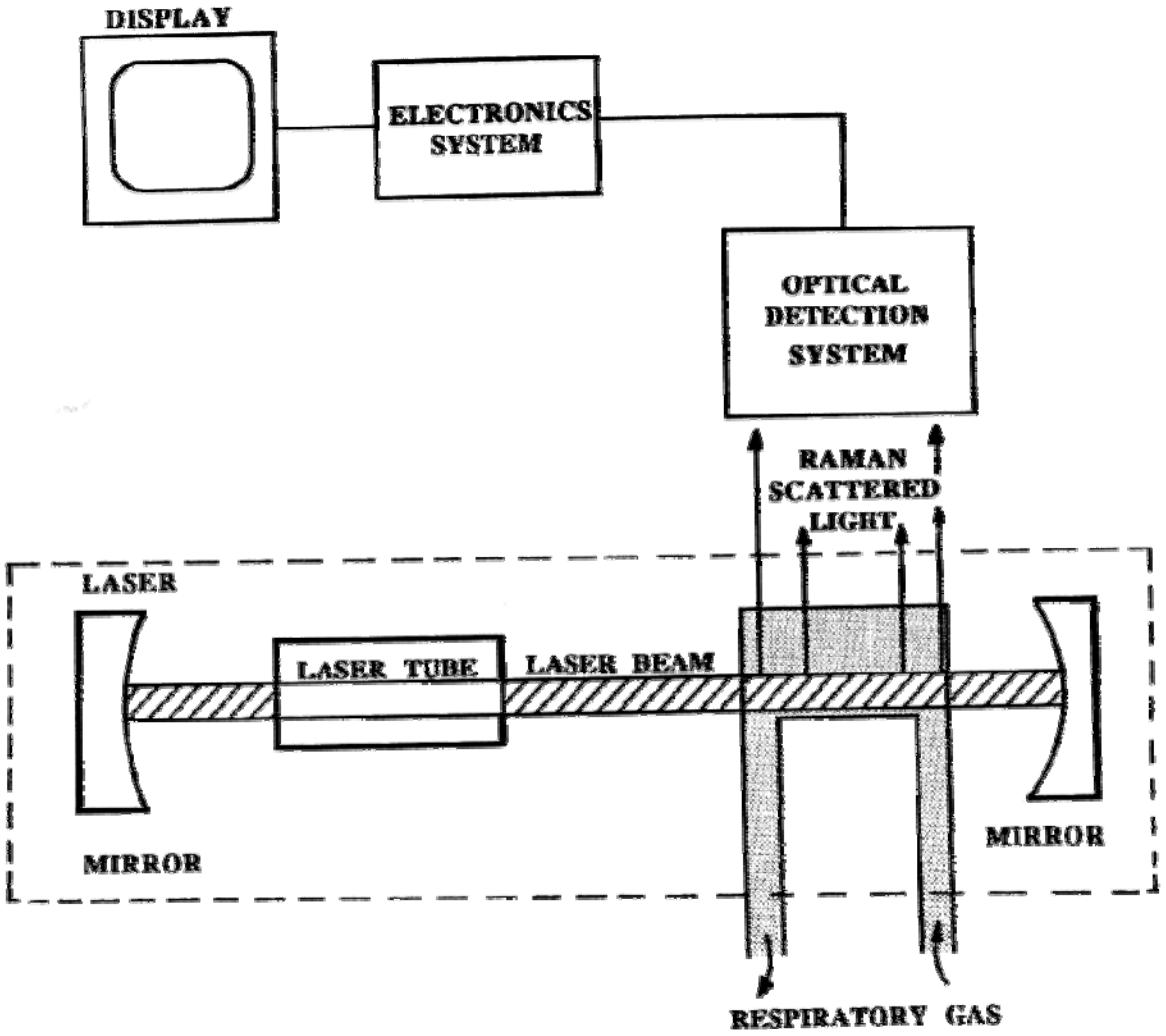
- De masse
- Raman
- Infra-rouge
- Photoacoustique

Spectrographie de masse



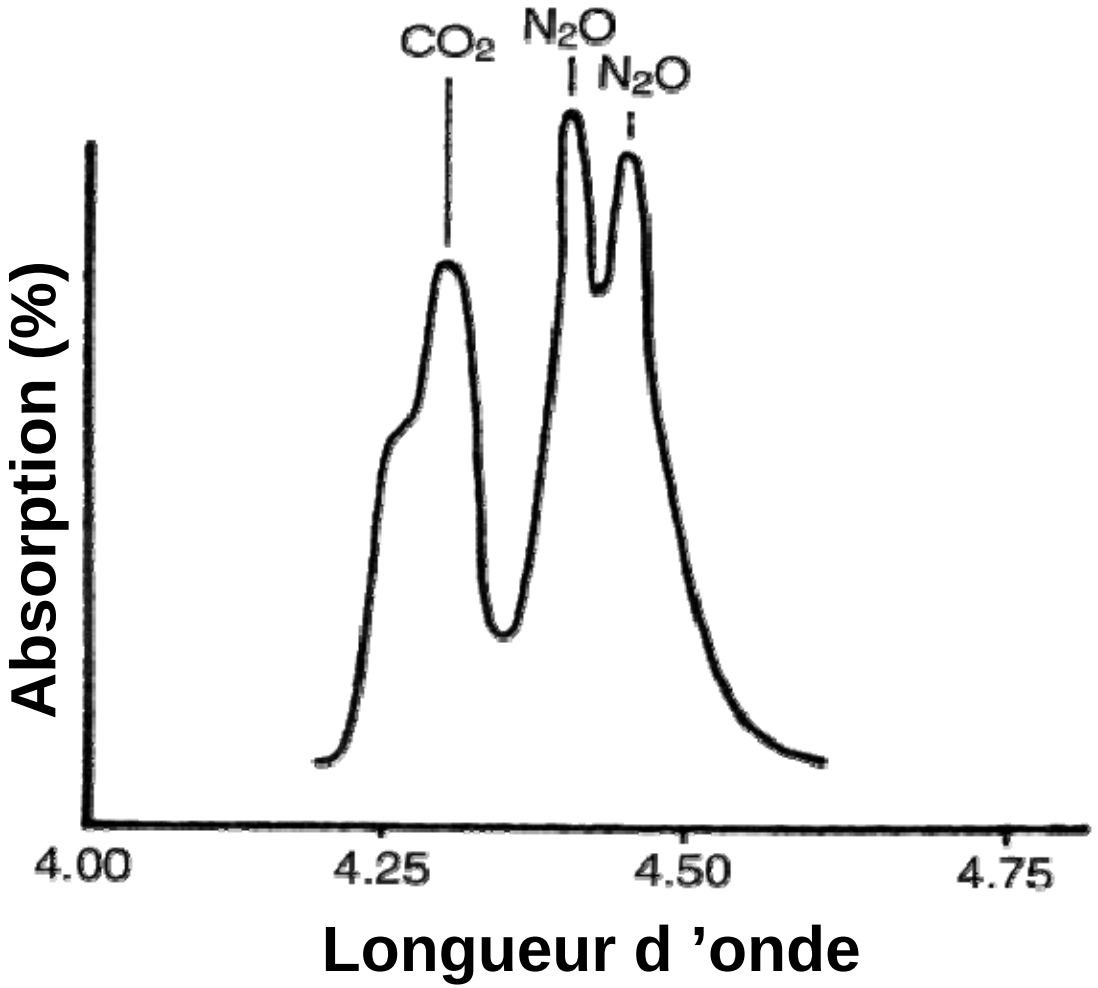
Adapté de Stock Crit Care Clinic 1995

Spectrographie de Raman



Adapté de Jacobson E. et al Int Anes Clinics 1996

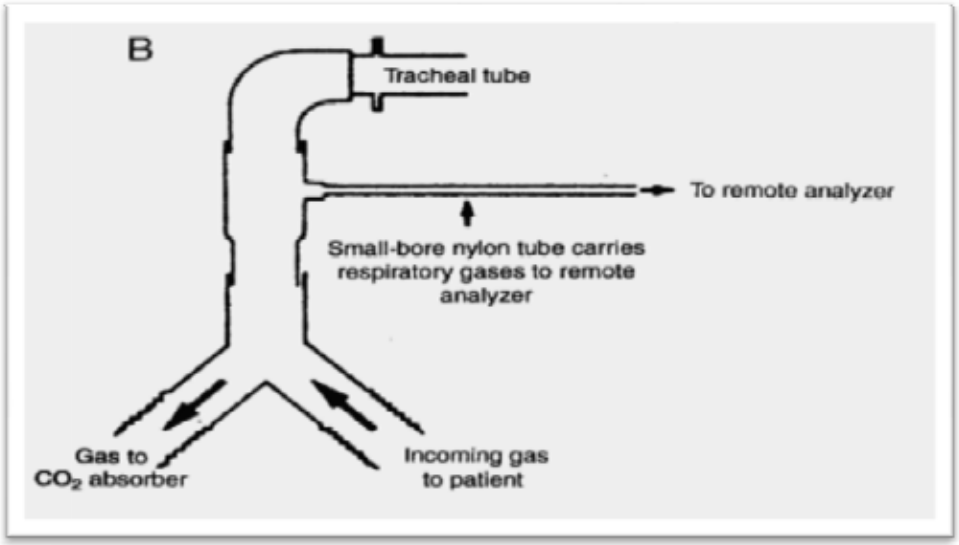
Spectrographie à infra-rouge



Adapté de Stock Crit Care Clinic 1995


CO2
ISO
O2
SPO2
PLS
NIBP
1.1
0.8
46
96
86
38
134
82
vitalert 2000

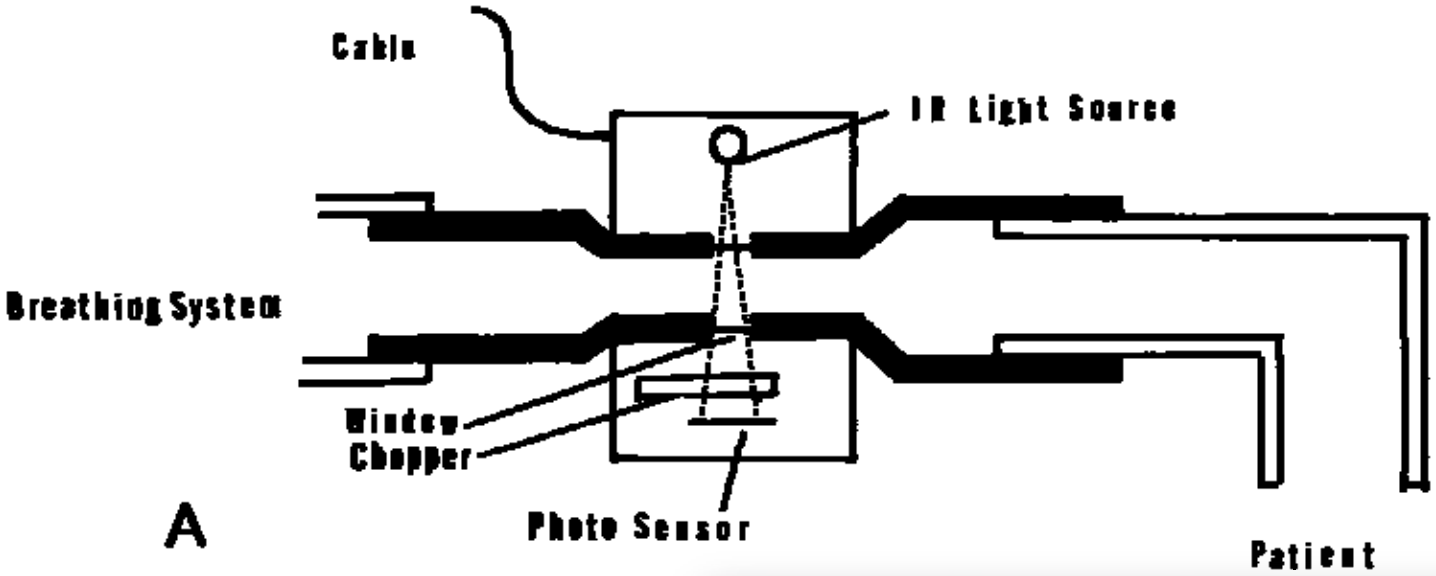
Moniteurs de la mesure du CO_2



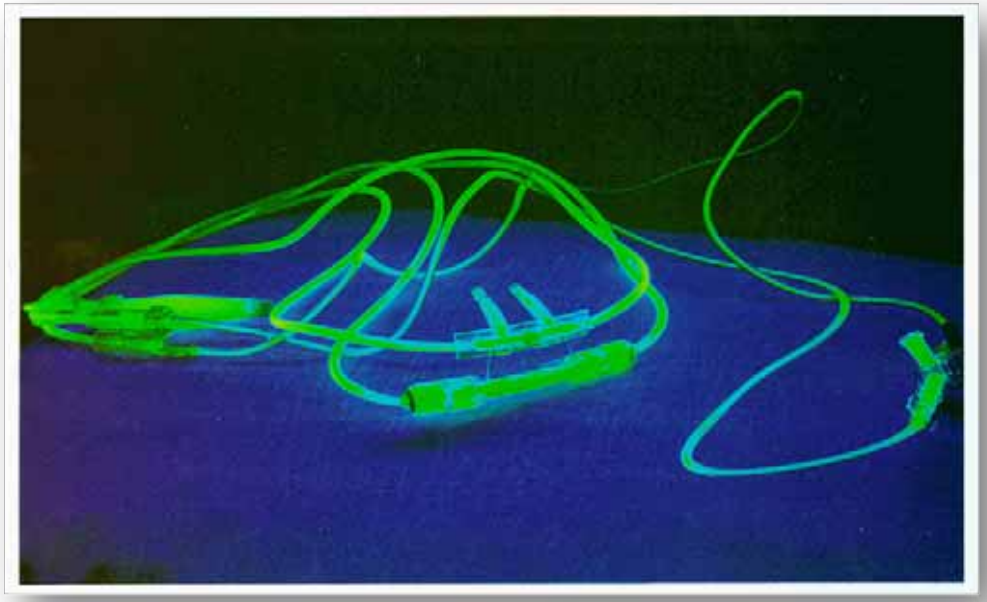
Échantillonage latéral

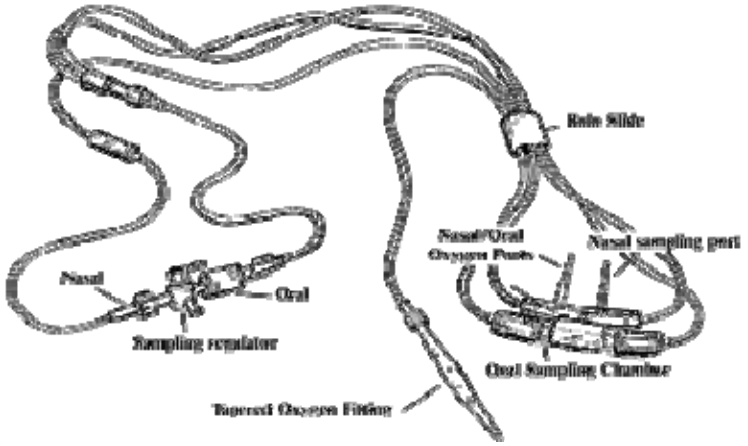
Cuvette

Échantilonage central

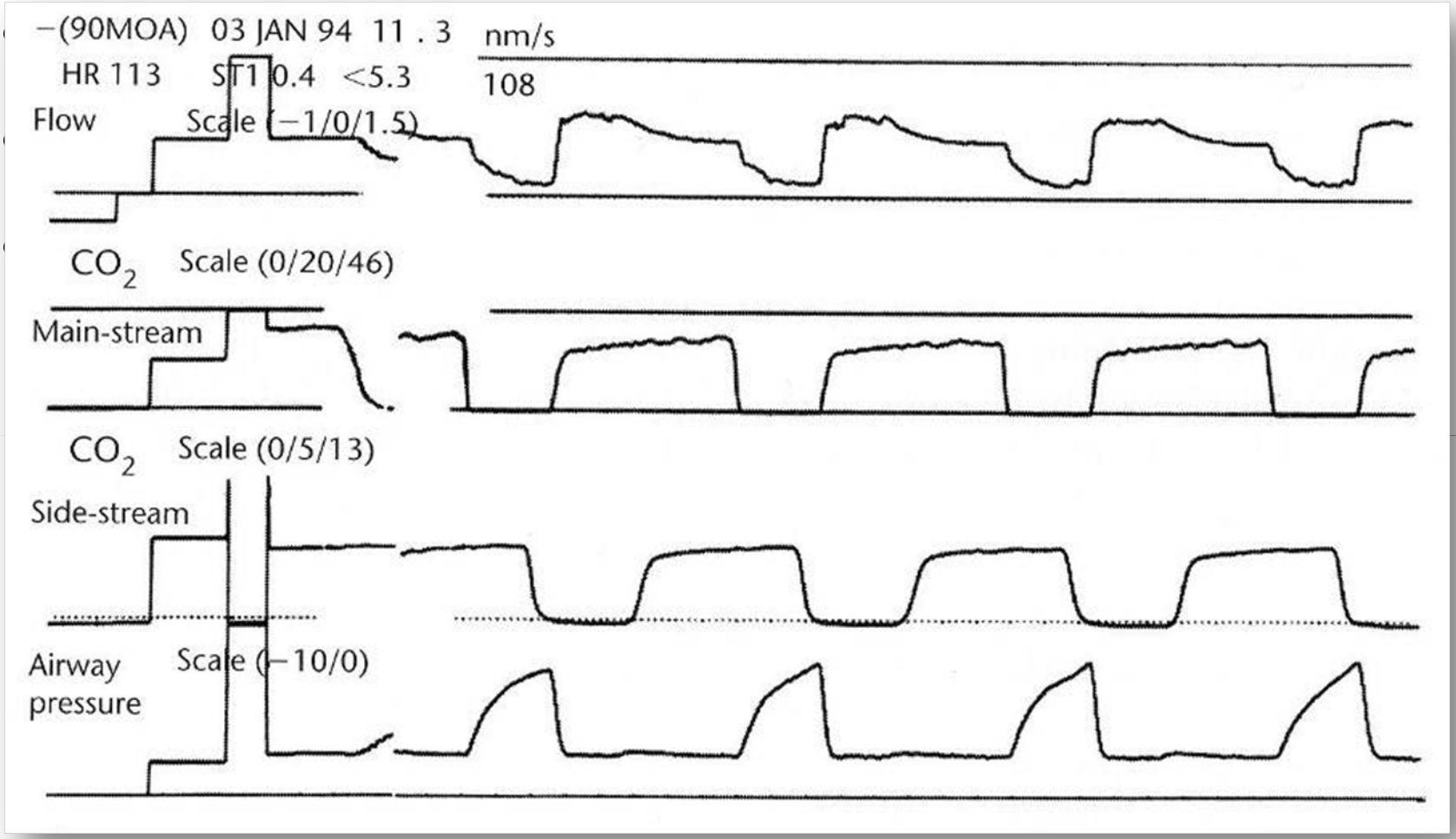


Moniteurs de la mesure du CO_2





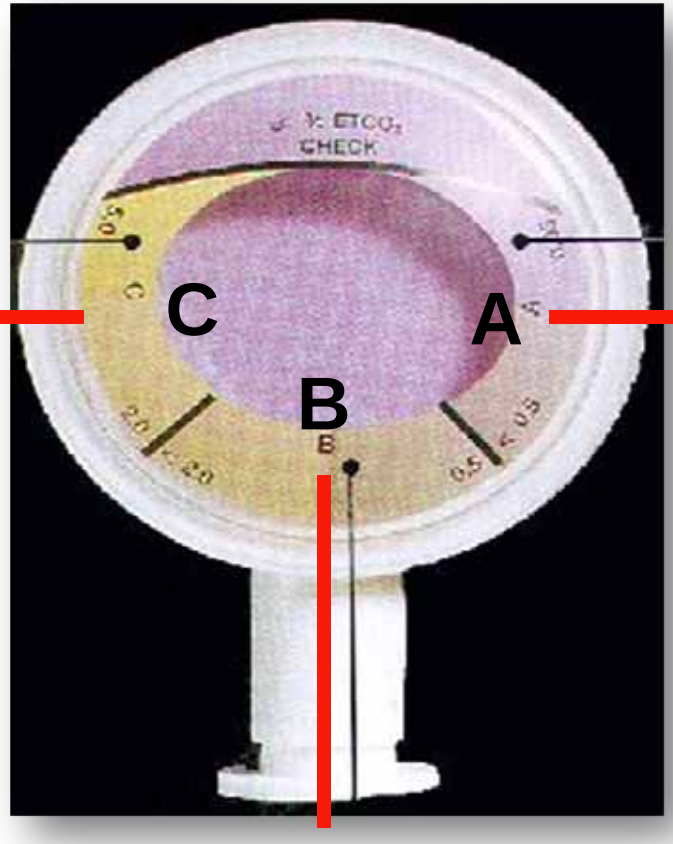
Différence échantillonnage central (main-stream) vs latéral (side-stream)



Moniteurs de la mesure du CO_2

	Type d'échantillonage	
	Latéral (« sidestream »)	Central (« mainstream »)
Délai	+	-
Fuites	+	-
Déconnection	++	+
Circuit fermé	-	+
Obstruction	+	-
Analyse multiple gaz	+	-
Bris du capteur	rare	+
Non-intubé	+	difficile

Détecteur chimique de CO_2

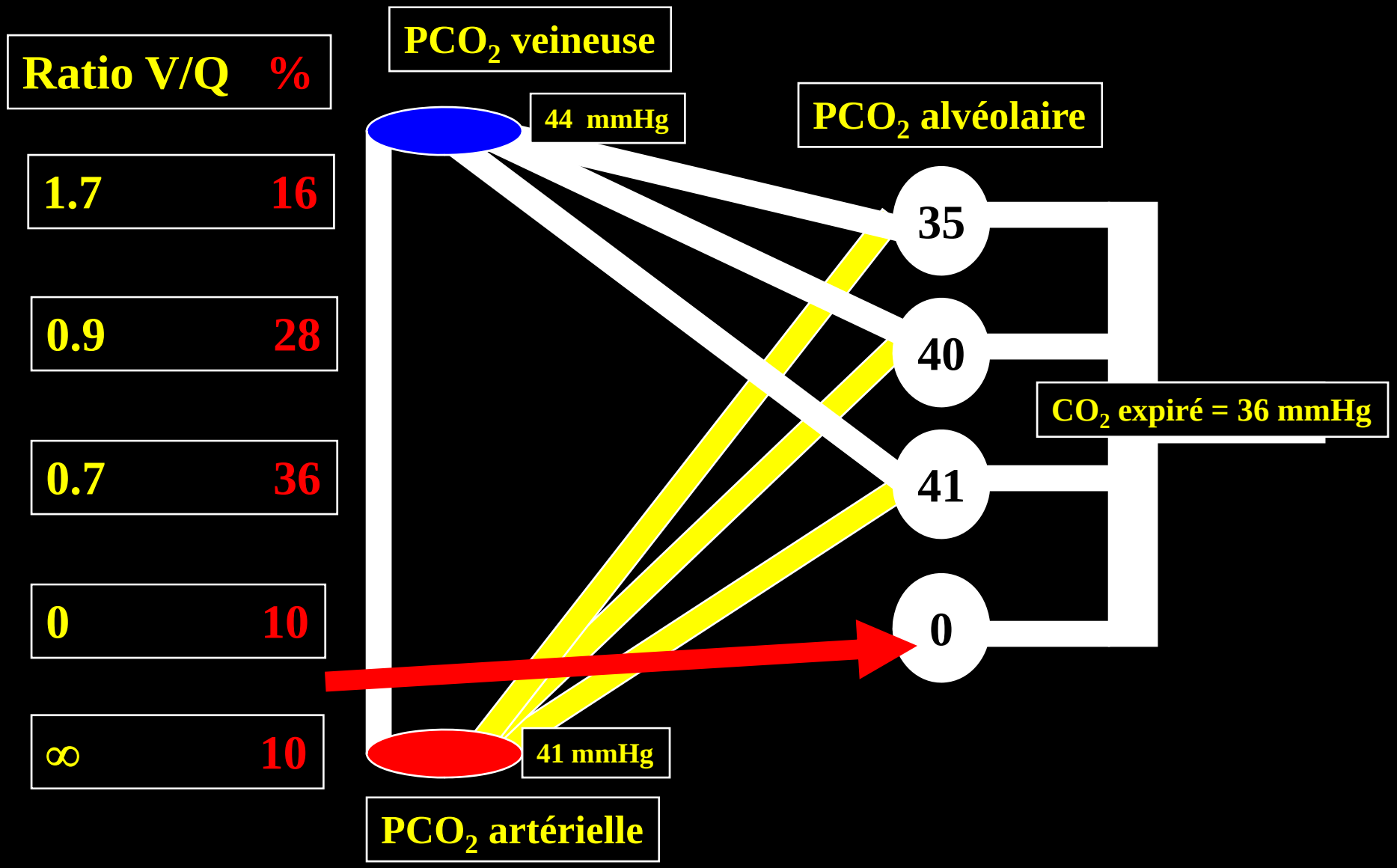


2-5%
> 15 mmHg

< 0.5%
(2.2 mmHg)

0.5-2%
(3.8-7.6 mmHg)

2-Physiologie CO_2: Anomalies ventilation/perfusion



Déterminants de la $PaCO_2$

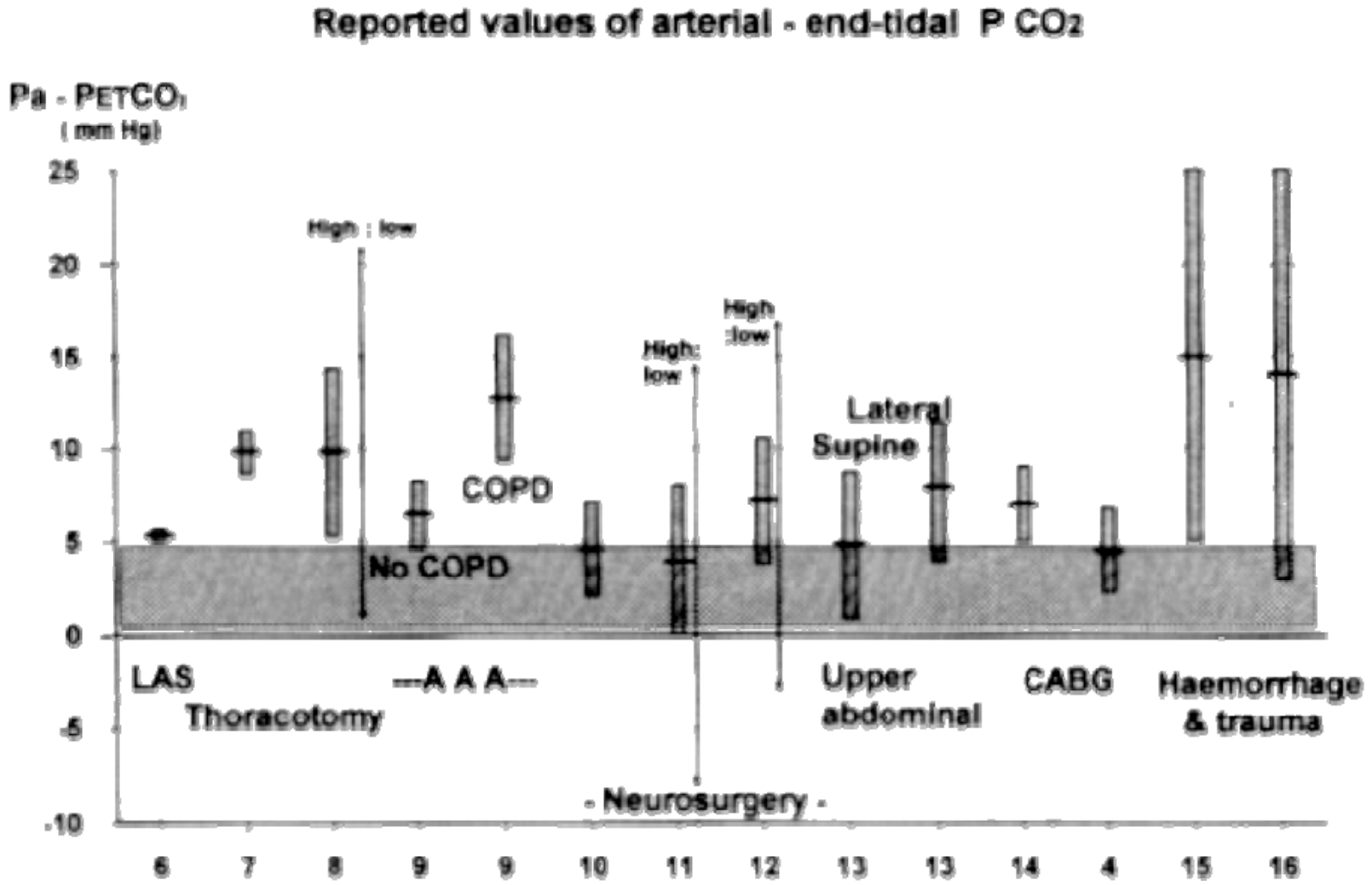
$$PaCO_2 = Pb \times \left(\frac{\text{Production en } CO_2}{\text{Élimination de } CO_2} + FiCO_2 \right)$$

$$PaCO_2 = \frac{\text{Production en } CO_2}{\text{Élimination de } CO_2}$$

$$PaCO_2 = \frac{VCO_2}{\text{Ventilation (totale - espace mort)}}$$

$$PaCO_2 = \frac{VCO_2}{Vt \times FR \, (1 - Vd/Vt)}$$

Différence $PaCO_2$ et CO_2 expiré



Wahba RWM. Can J Anesth 1996 :862-6

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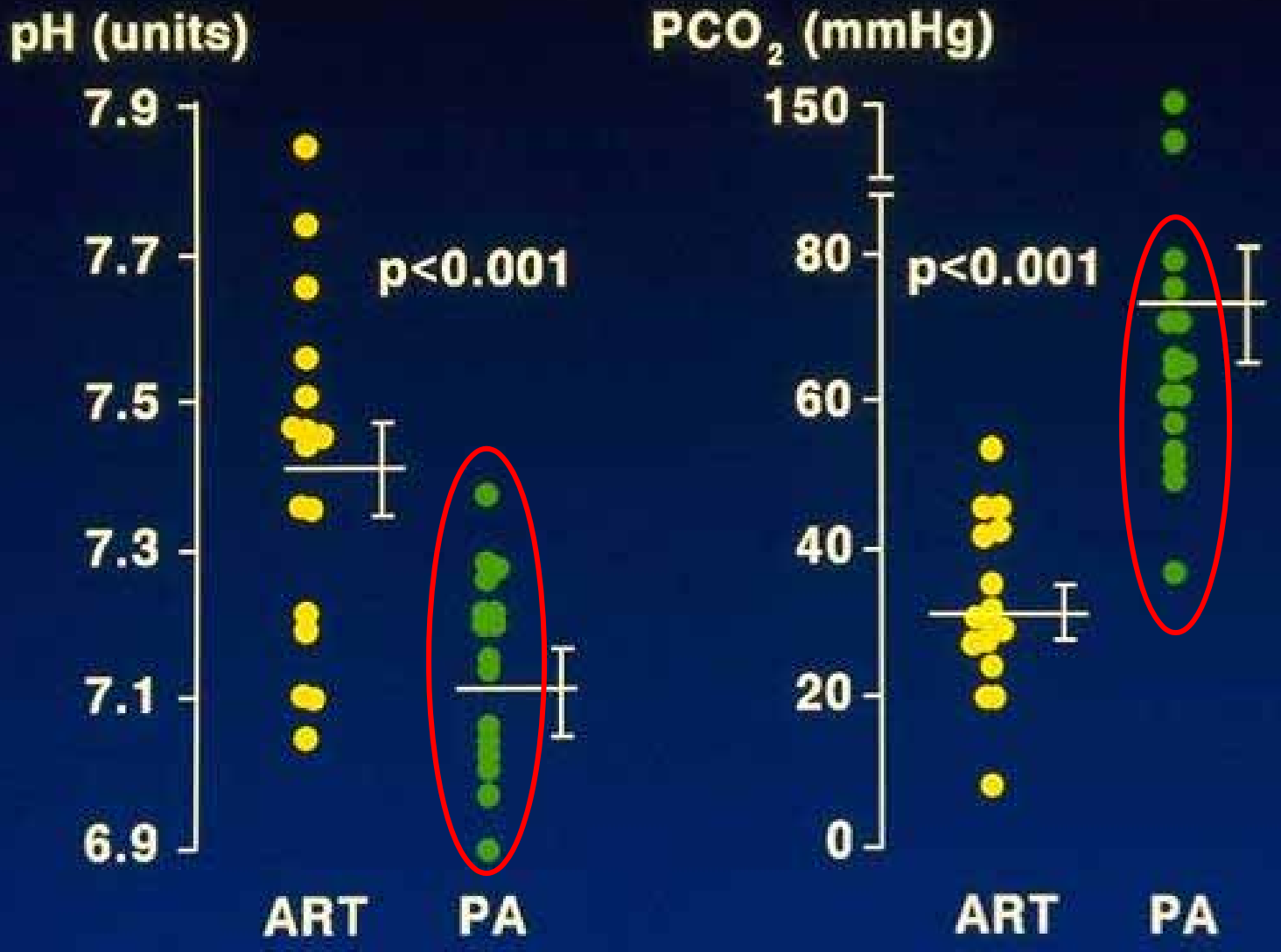
Gaz artériel et veineux

«(peripheral) venous pH, PCO2, bicarbonate and saturation is of little value in predicting the precise level in arterial blood »

R.N. Sutton et al

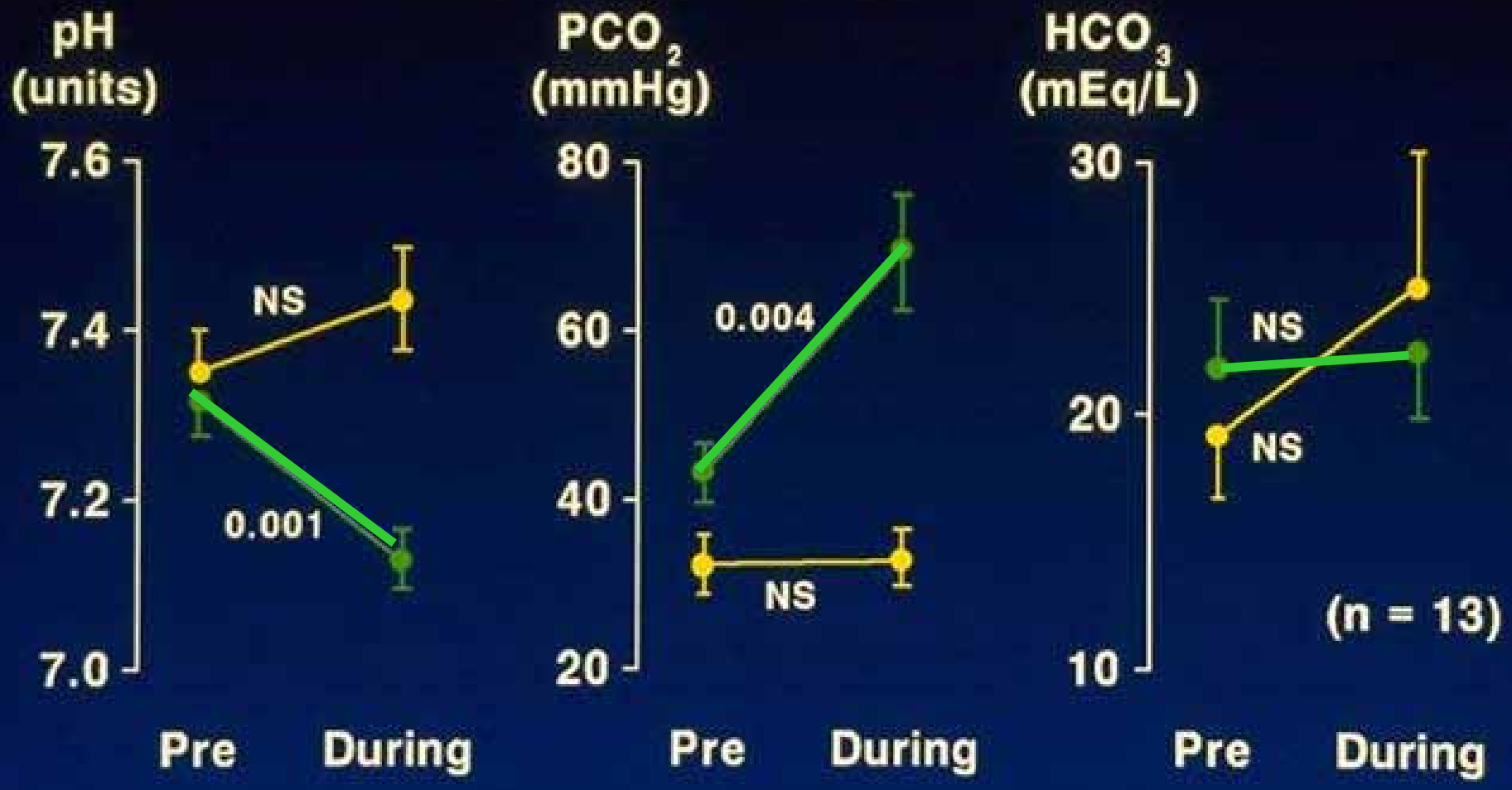
Lancet 1967;2:748-51

Difference in acid-base state between venous and arterial blood during cardiopulmonary resuscitation.



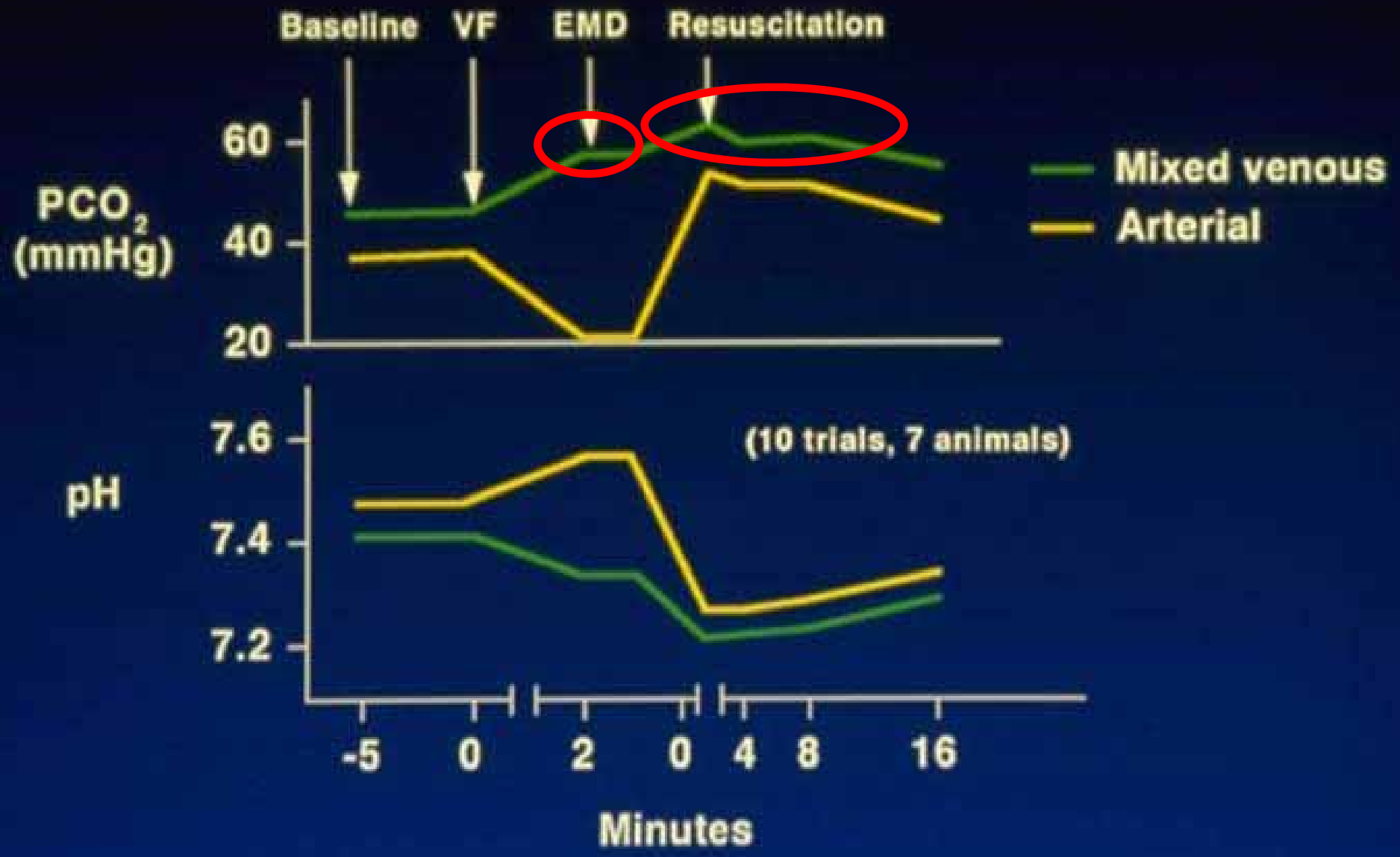
Weil MH et al. NEJM 1986; 315(3): 153-157

Difference in acid-base state between venous and arterial blood during cardiopulmonary resuscitation.



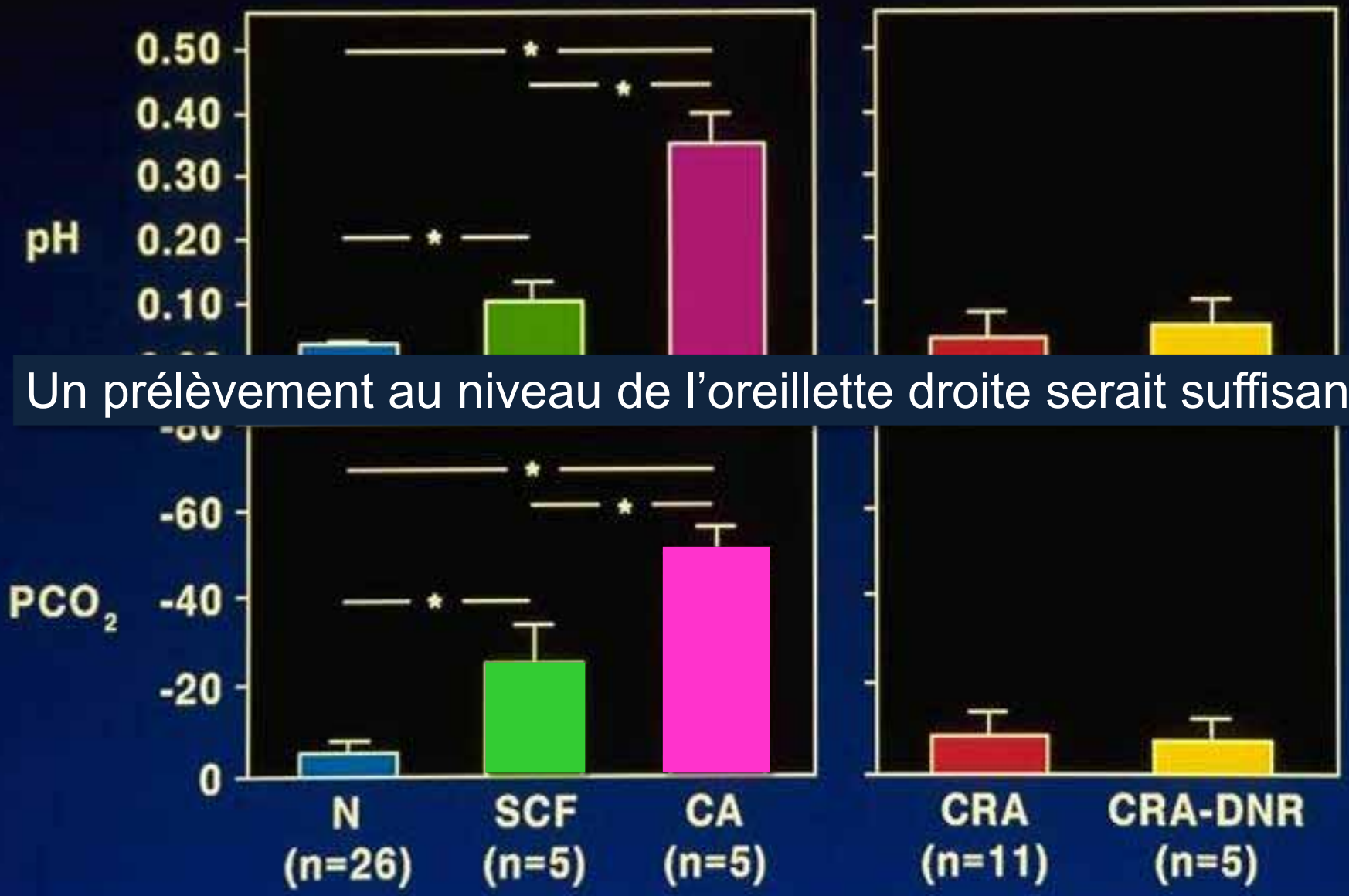
Weil MH et al. NEJM 1986; 315(3): 153-157

Arteriovenous carbon dioxide and pH gradients during cardiac arrest.



Grundler W et al. Circulation 1986; 74(5):1071-107

Assessing acid-base status in circulatory failure: differences between arterial and central venous blood.



Un prélèvement au niveau de l'oreillette droite serait suffisant

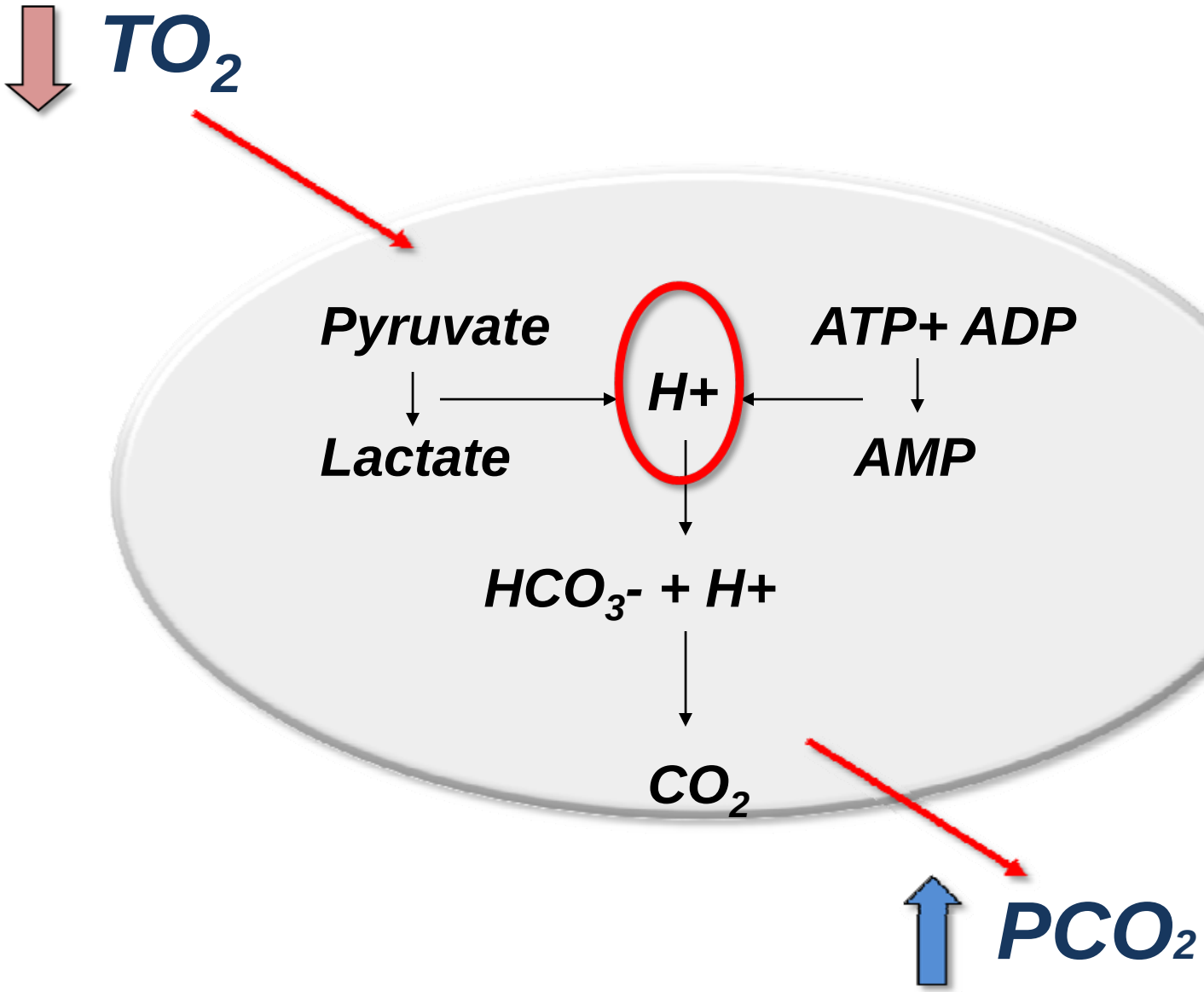
Adrogue HL et al. NEJM 1989; 320(20): 1312-1316

Pourquoi une différence AV en PCO_2?

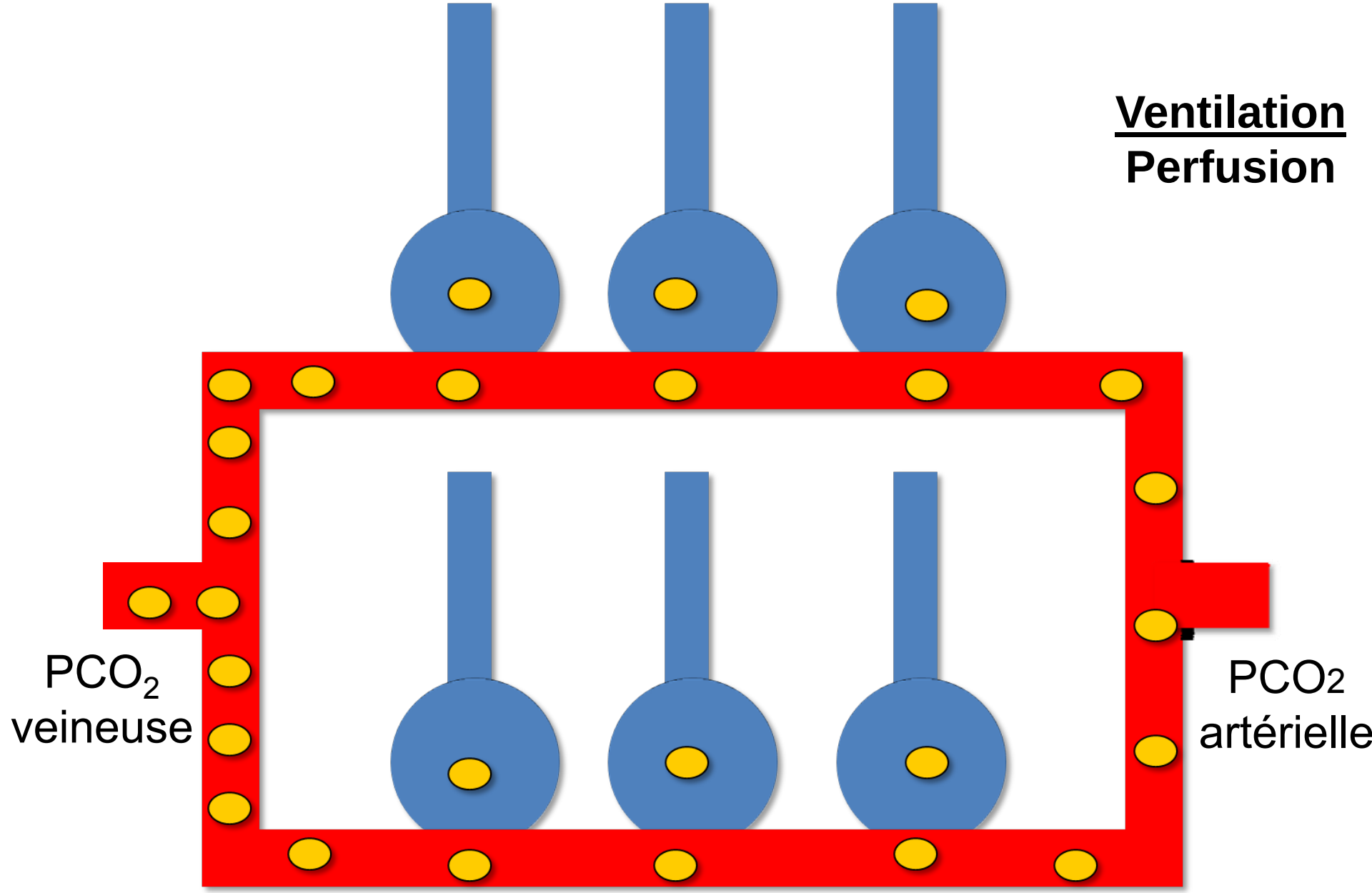
Hypothèses:

1. Mécanisme circulatoire
2. Production en CO_2 et diffusion par voie anaérobique

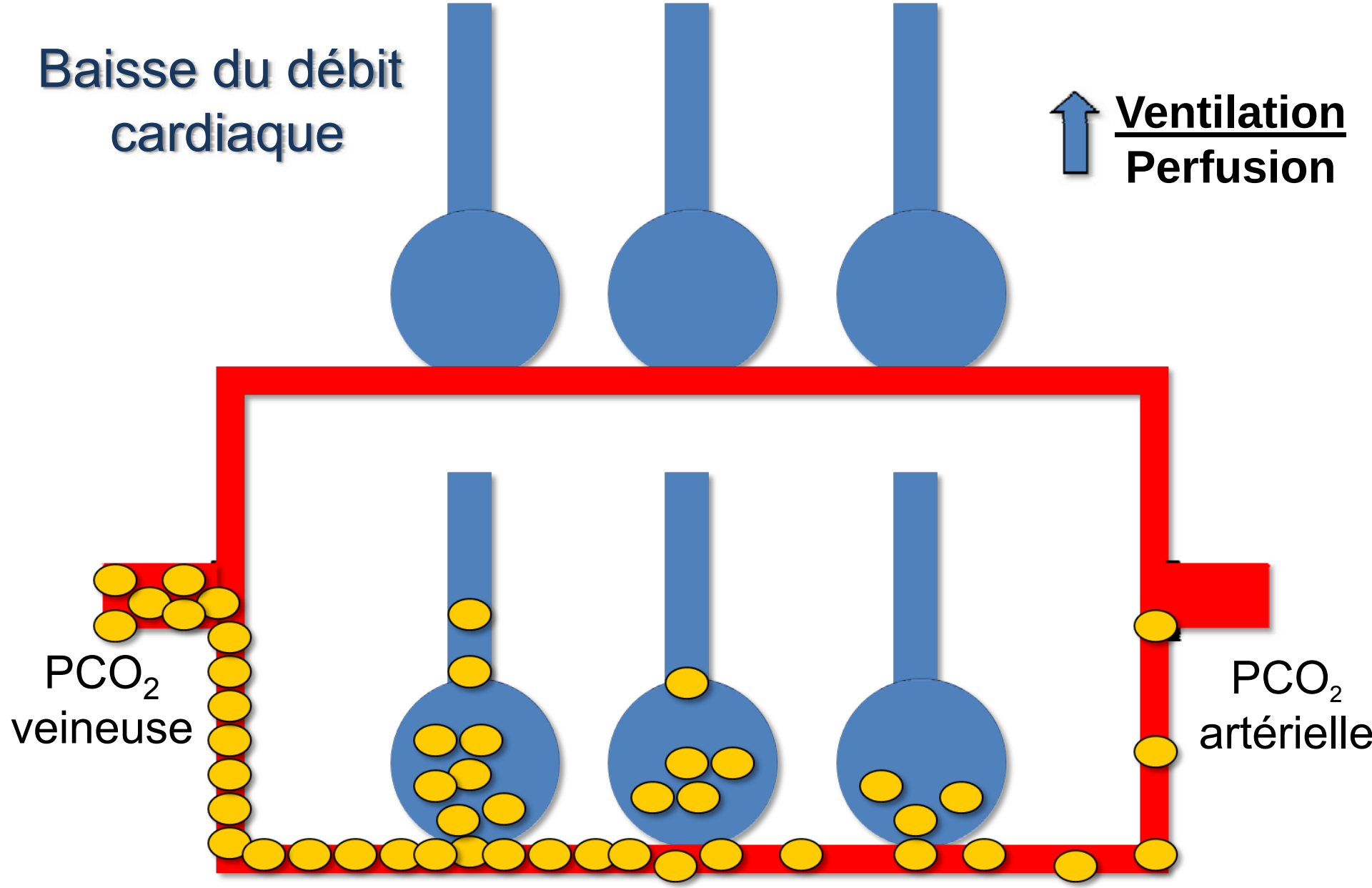
Métabolisme anaérobique



Hypothèse circulatoire


Ventilation
Perfusion
PCO2 veineuse
PCO2 artérielle

Baisse du débit cardiaque

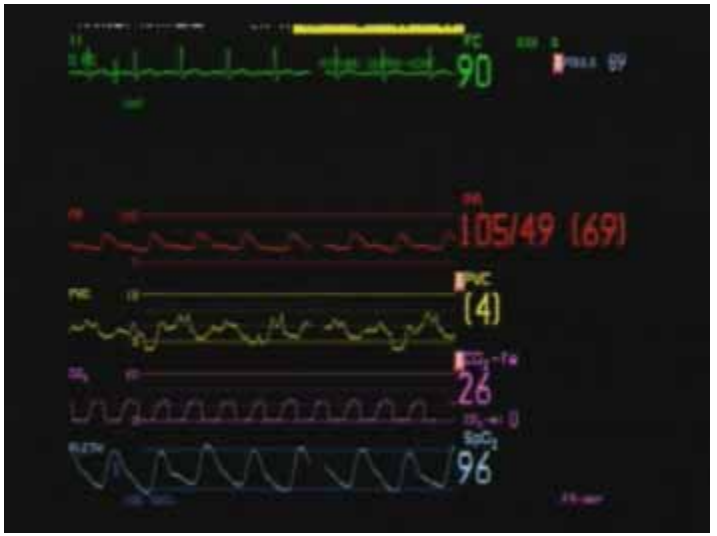


Wolfgang Peterson 2004

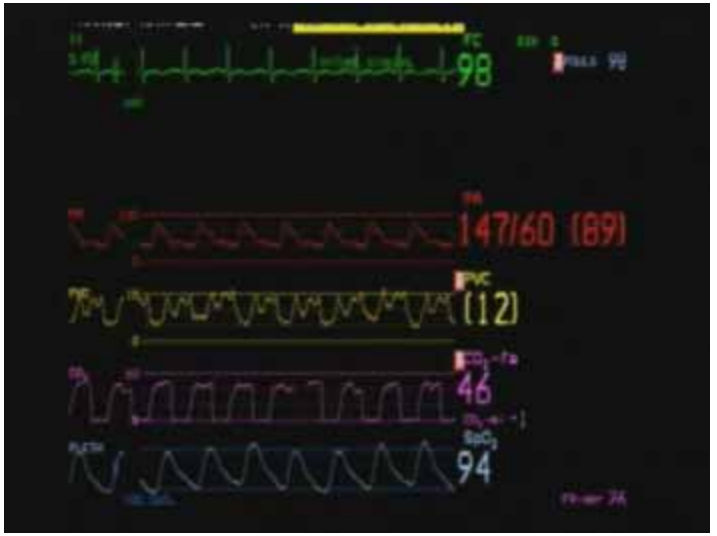
Effets de l’hypercapnie

- Cardiovasculaire
- Neurologique

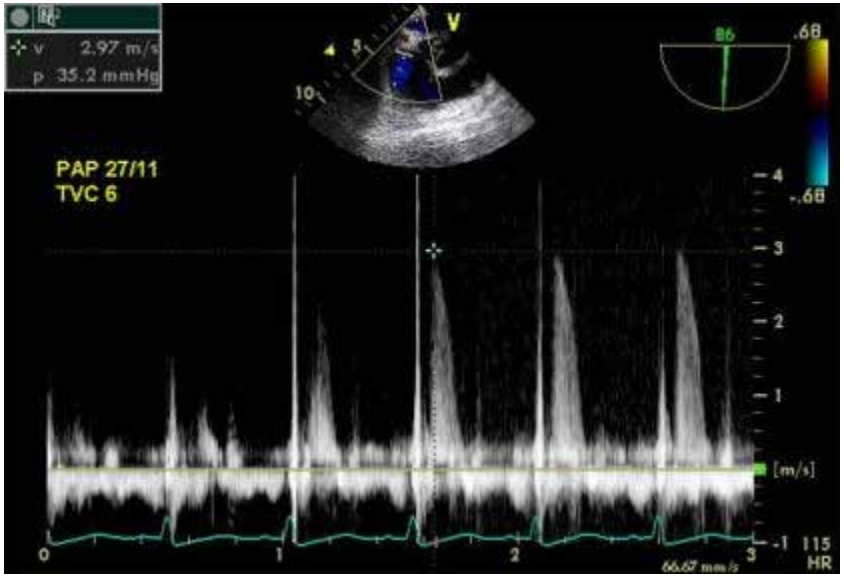
Homme de 68 ans ARDS
Effet hémodynamique de l'hypercapnie

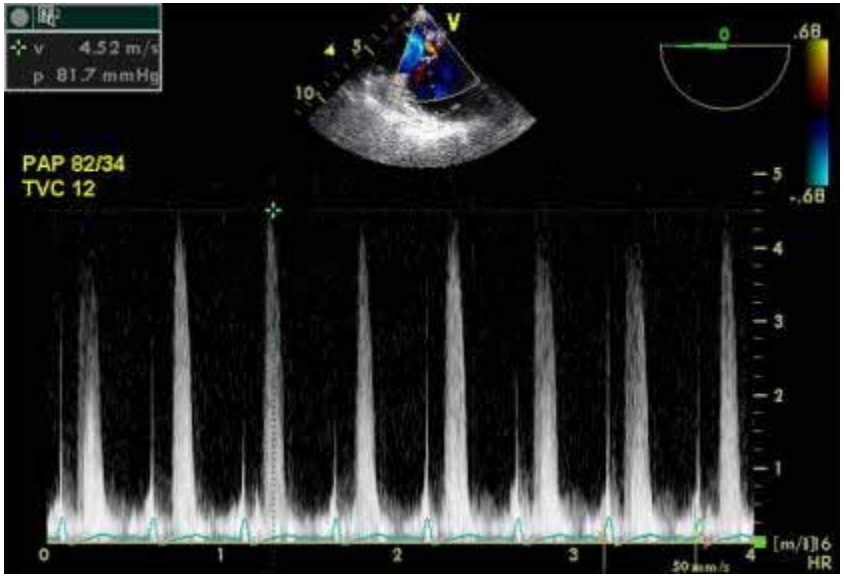


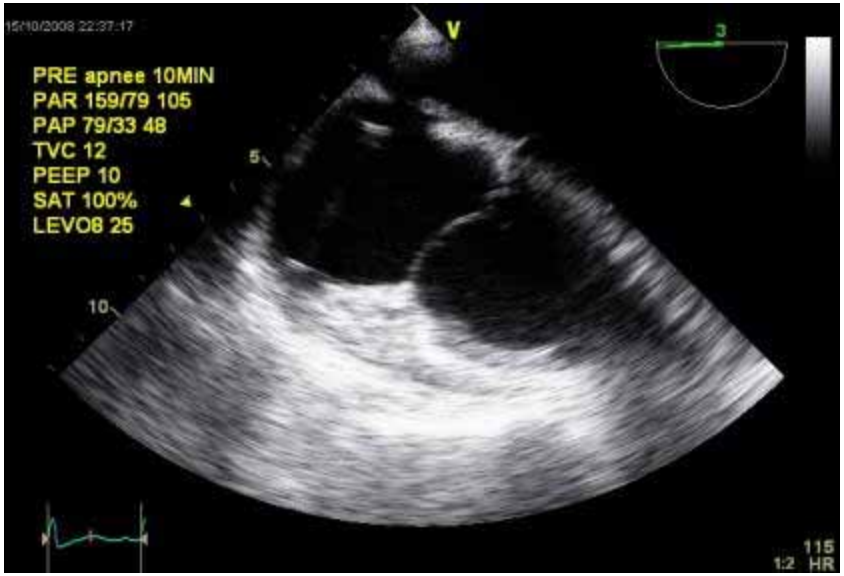
Avant le retrait de ventilation 2re

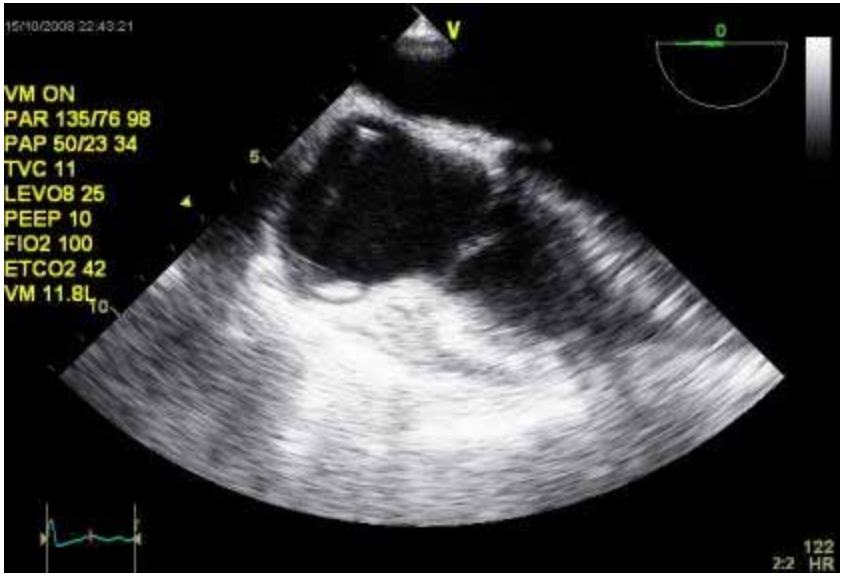


Après le retrait de ventilation 2re

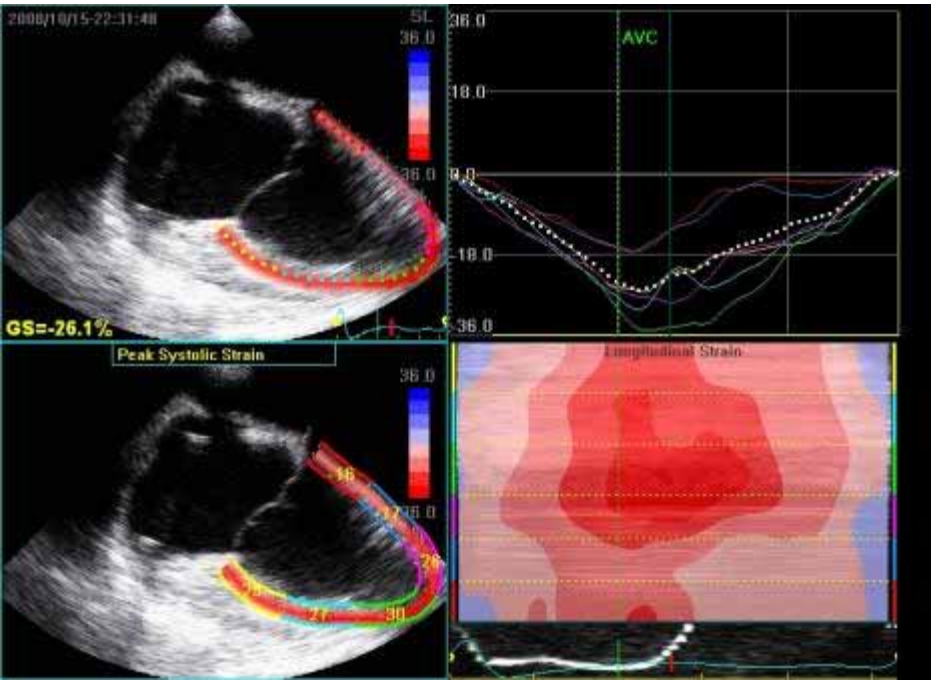

v 2.97 m/s
p 35.2 mmHg
PAP 27/11
TVC 6
[m/s]
115
HR


v 4.52 m/s
p 81.7 mmHg
PAP 82/34
TVC 12
[m/s]
HR


PRE apnee 10MIN
PAR 159/79 105
PAP 79/33 48
TVC 12
PEEP 10
SAT 100%
LEVO8 25
115
1:2 HR

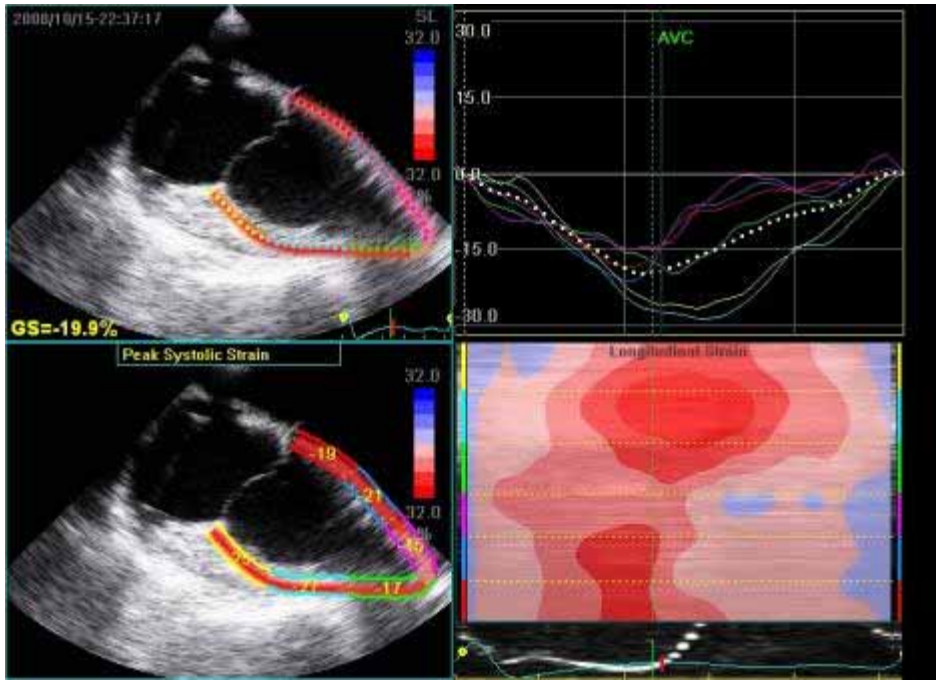

VM ON
PAR 135/76 98
PAP 50/23 34
TVC 11
LEVO8 25
PEEP 10
FIO2 100
ETCO2 42
VM 11.8L
122
2:2 HR

(A) 5 minutes

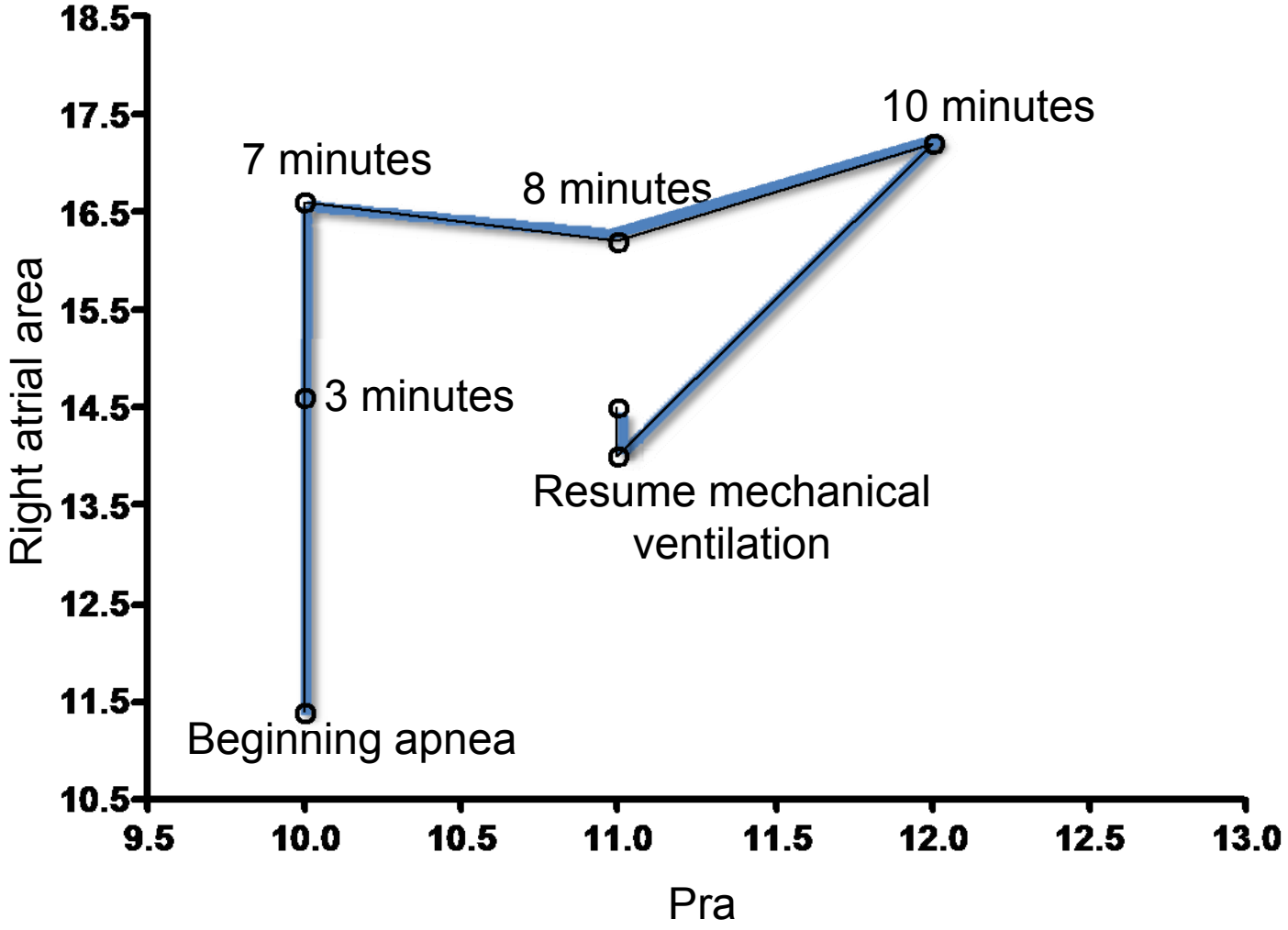


HR = 113 beats/min
Pa = 175/95 (122) mmHg
Pap = 64/27 (40) mmHg
Pod = 10 mmHg
RAA = 14.6 cm²

(B) 10 minutes



HR = 115 beats/min
Pa = 159/79 (105) mmHg
Pap = 79/33 (48) mmHg
Pod = 12 mmHg
RAA = 17.2 cm²


18.5
17.5
16.5
15.5
14.5
13.5
12.5
11.5
10.5
Right atrial area
9.5
10.0
10.5
11.0
11.5
12.0
12.5
13.0
Pra
7 minutes
8 minutes
10 minutes
3 minutes
Resume mechanical ventilation
Beginning apnea

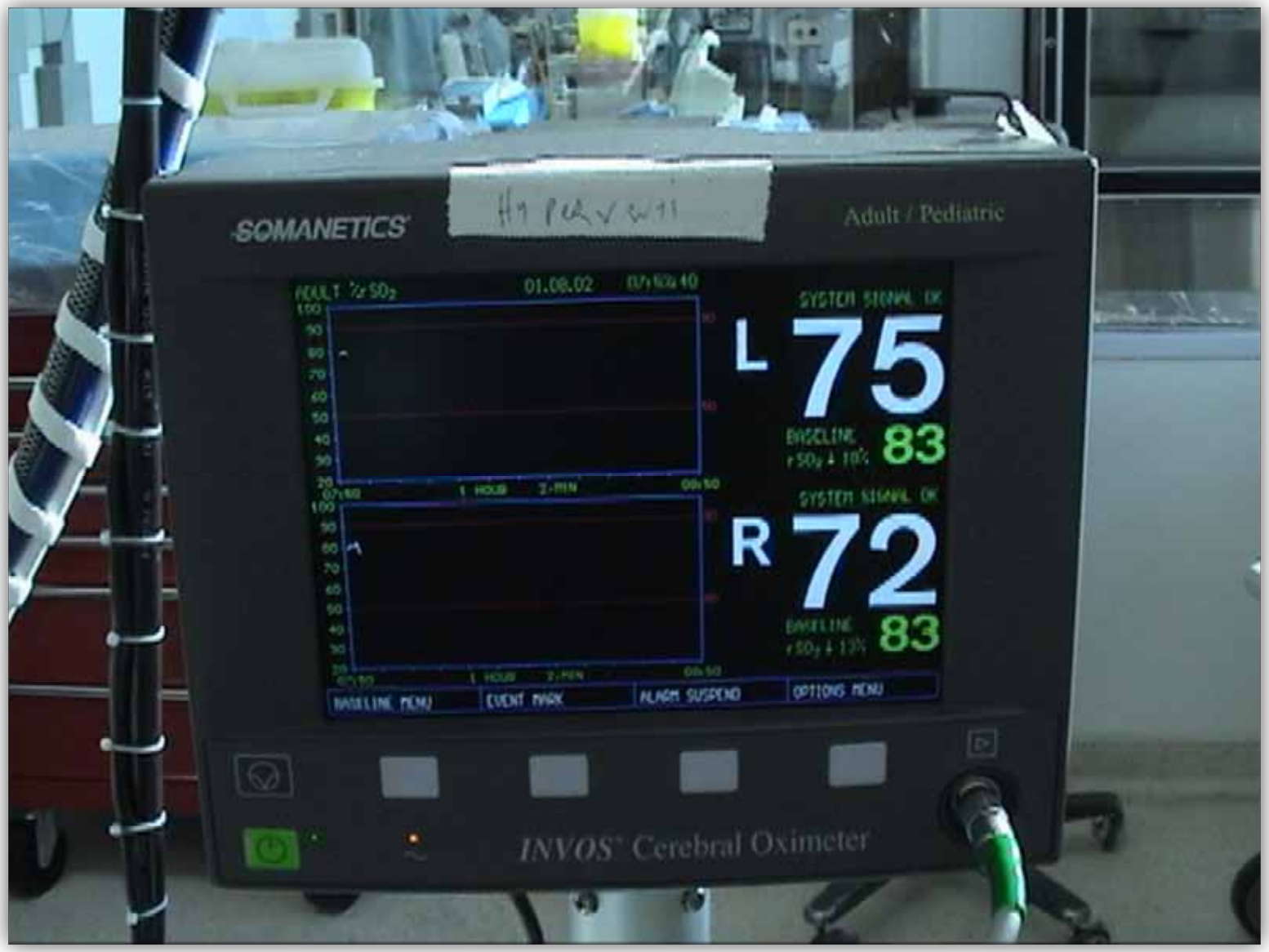
Effet neurologique de CO_2

55:55:35 - Lovell: « Houston, we've had a problem. We've had a main B bus undervolt. …a warning light showed that the carbon dioxide had built up to a dangerous level. »

Apollo XIII Ron Howard 1995

Homme de 24 ans: fermeture CIA

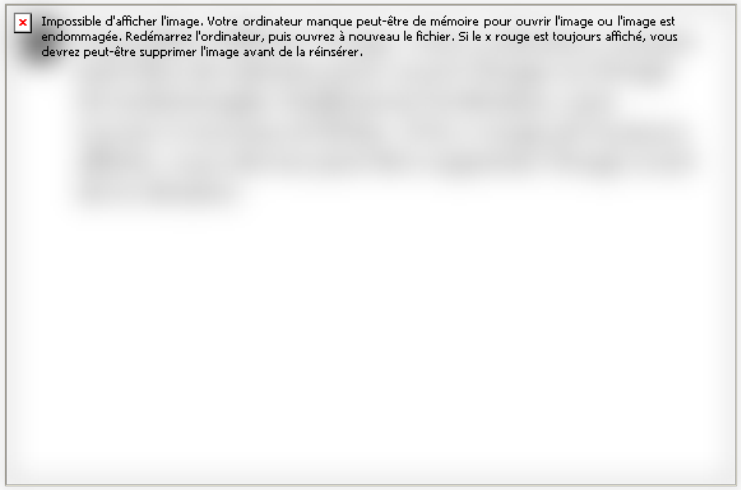
Hyperventilation éveillée



Intubation difficile

Mortalité et hyperventilation

- Aucune indication d'hyperventilation sauf hernie intra-cérébrale imminente ($PaCO_2$ 40-45 mmHg)
- 50% des intubation avec $ETCO_2$ < 25 mmHg (Davies et al 2004 Neu. Crit Care)



- Hyperventilation préviens réanimation dans les arrêt cardiaque. (Aufderheide et al. Circulation 2004;1960) « Unrecognized and inadvertent hyperventilation may be contributing to the currently dismal survival rates from cardiac arrest »

Homme de 47 ans obèse morbide

pH = 7.37

PCO_2 = 98 mmHg

Jour 2

pH = 7.34

PCO_2 = 83 mmHg

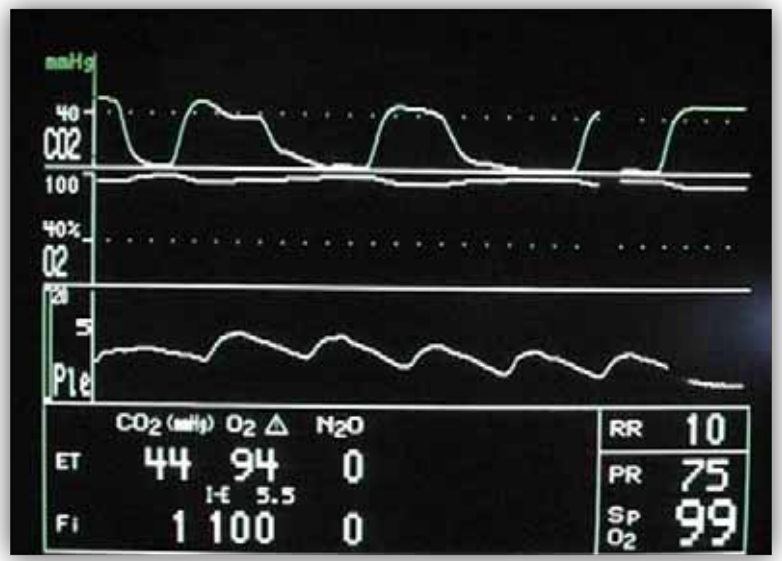
Jour 3

Pression / Ratio	PH	PCO_2	PO_2	HCO_3	CO_2	SAO_2
	7,37 – 7,43	35/45 m/Hg	80/110 mm/L	21/28 mm/L	22/29 m/Hg	92/98 %
Jour 1	7.29	98	78	45	48	.91
Jour 2	7.34	83	55	45	44	0.94
	7.32	84	64	43	46	0.90
	7.27	96	64	45	45	0.90
	7.32	89	71	46	49	.91
Jour 3	7.40	75	58	46	48	.90
	7.36	80	75	45	47	0,94
	7.35	76	60	42	44	.90

Homme de 59 ans MPOC décompensé

Homme de 49 ans: EPS flutter

Agitation en fin de procédure



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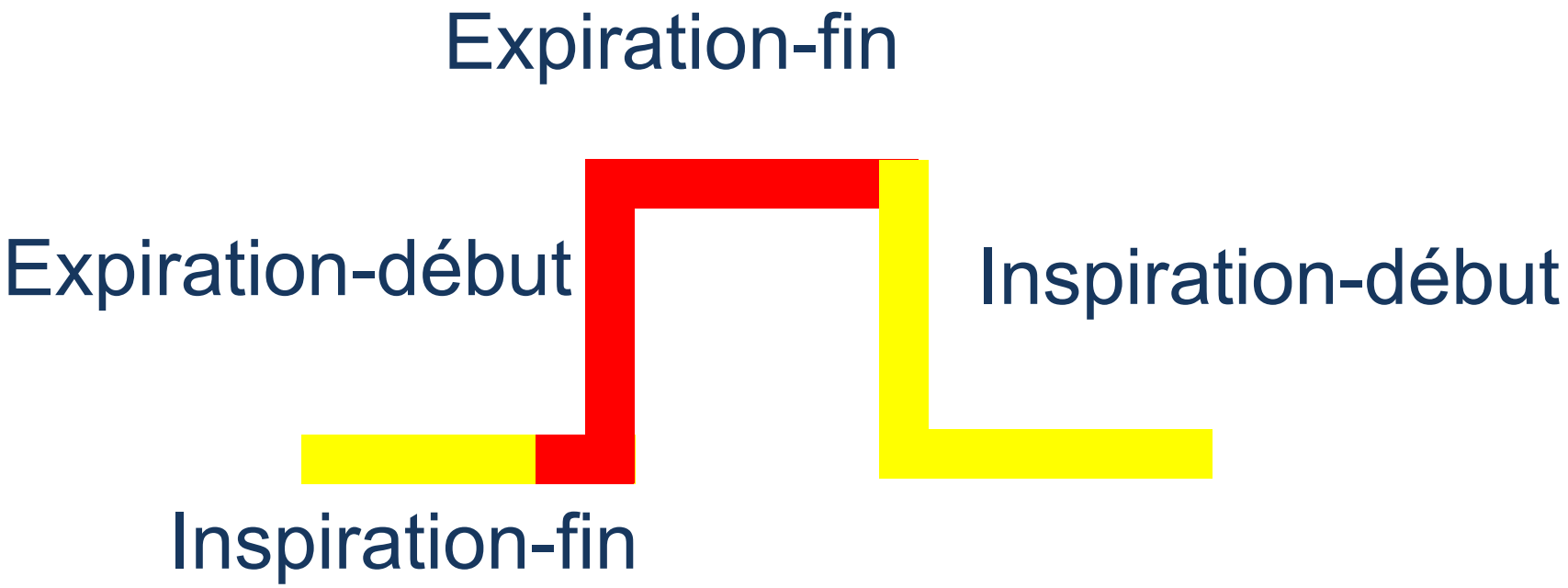
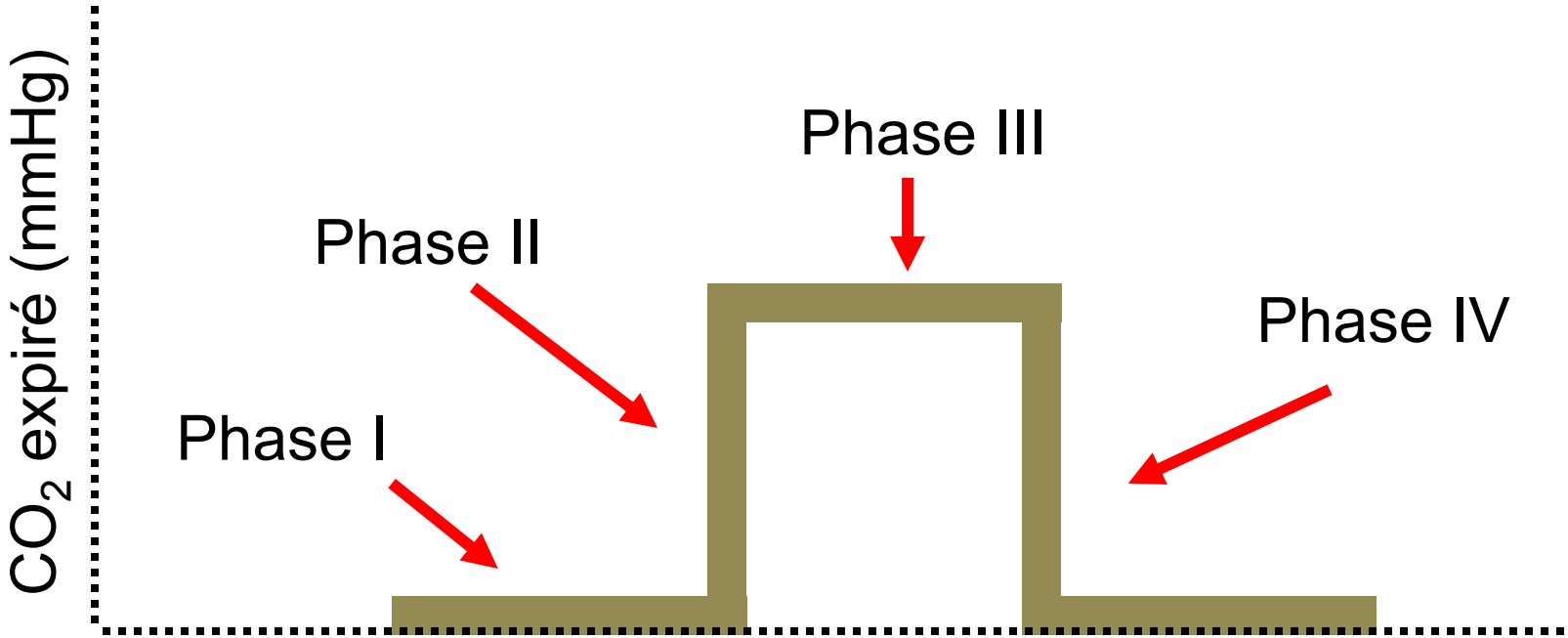
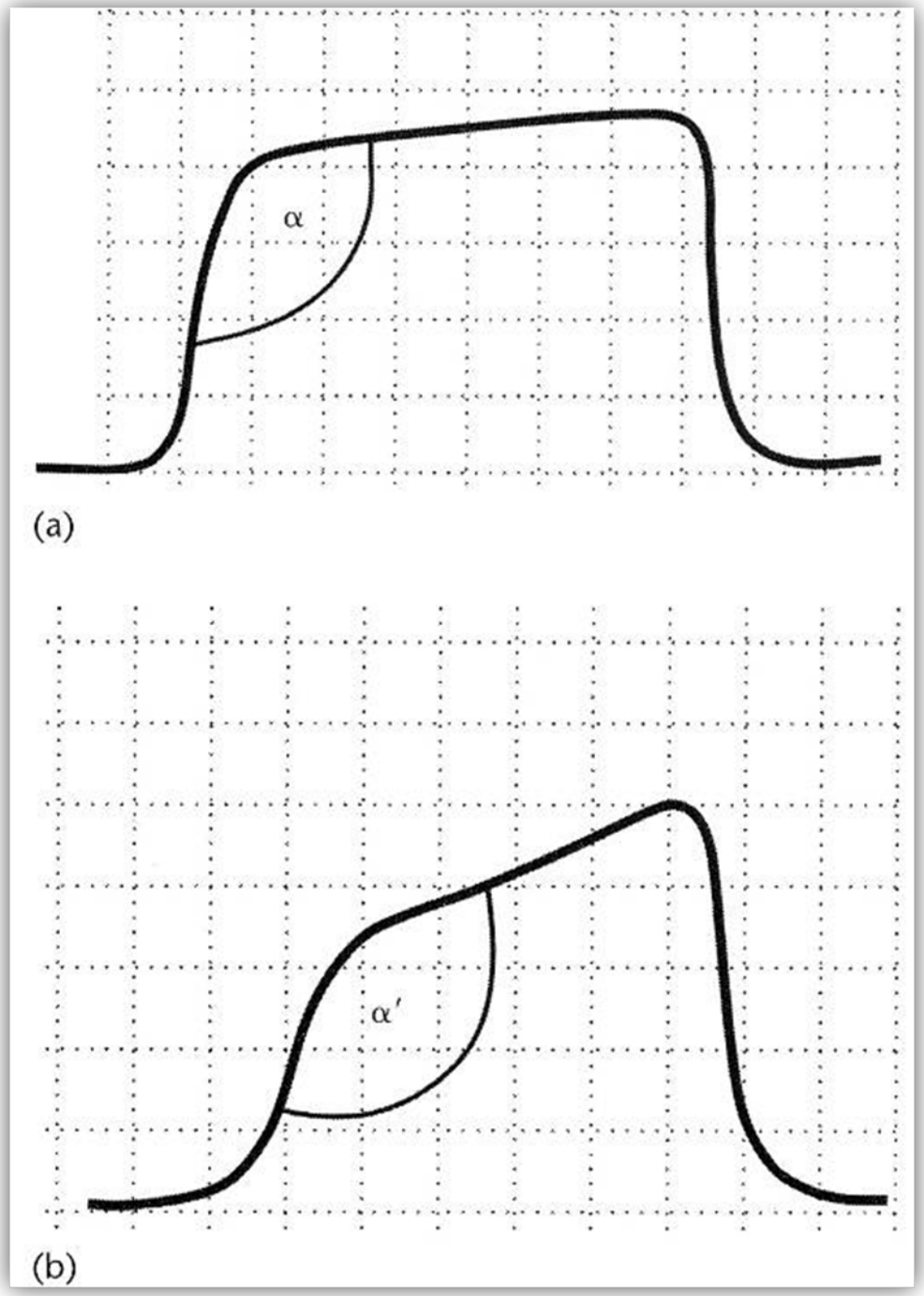
Tracé capnographique



Tracé capnographique





Angle α

Normale 105º

Phase III: selon anomalies V/Q et la constante de temps

Analyse des courbes de capnographie

1-CO_2 présent?

2-Forme de la phase I, II, III et IV

3-Valeur à la fin de l'expiration

4-Différence entre la $PaCO_2$ et CO_2 expiré

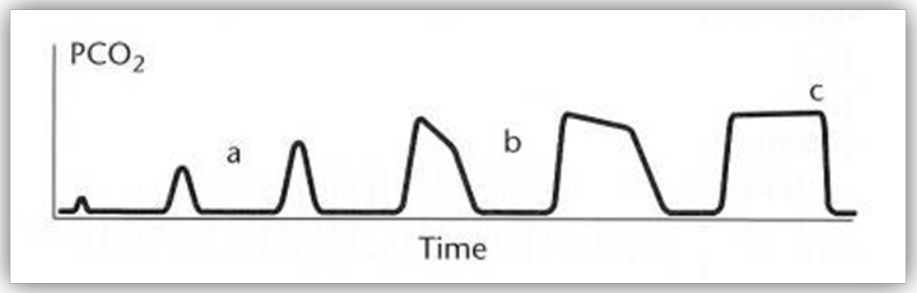
5-Différence entre la $PvCO_2$ et le CO_2 expiré

Intubation et capnographie

Time is brain!

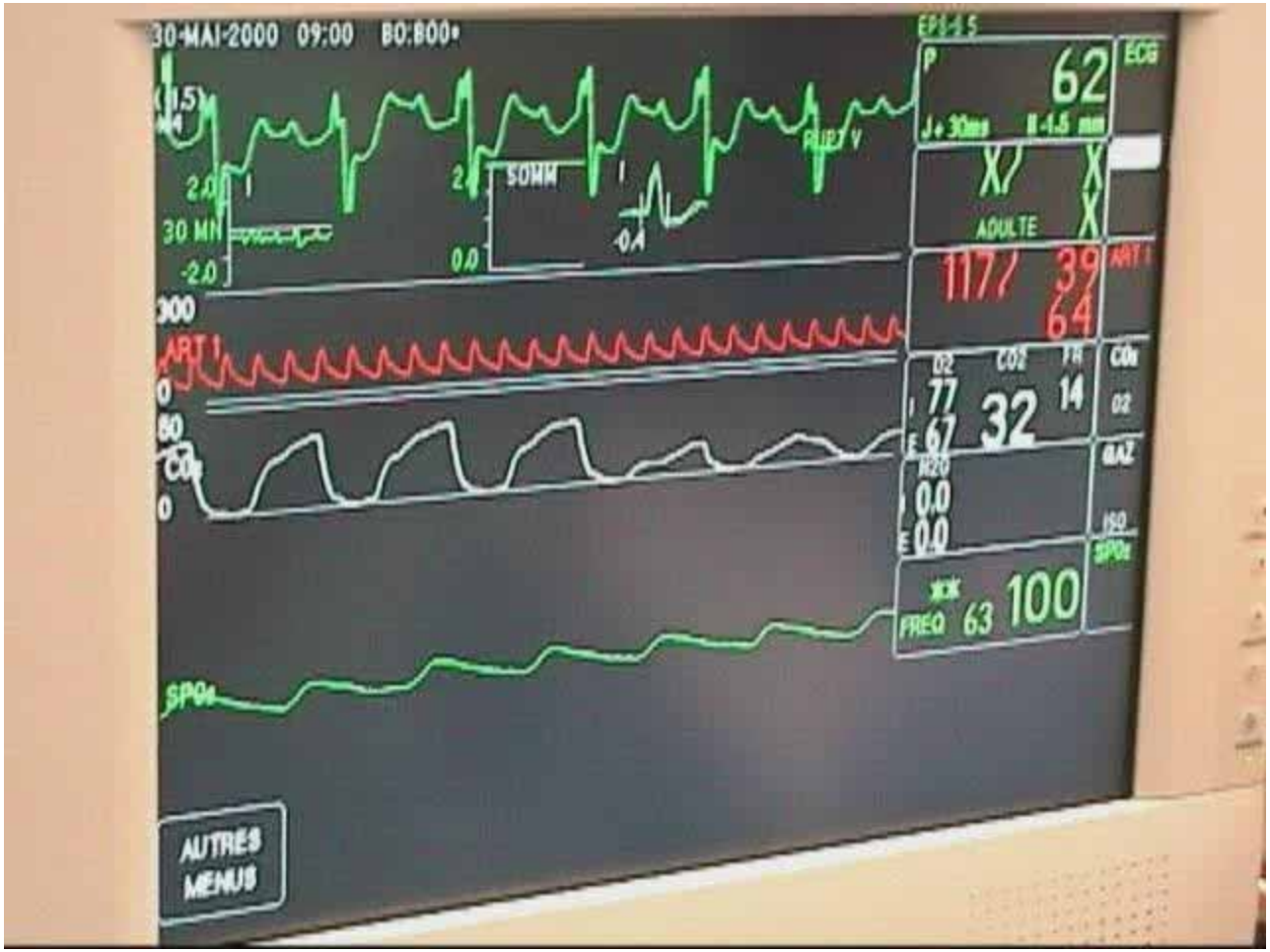
Intubation et capnographie

- TET malpositionné en pré-hospitalier:
  - 7-25% (66% esophage et 33% hypopharynx) (Silvestri 2003;Acad Emer med 10:445)
  - Intubation à l'aveugle

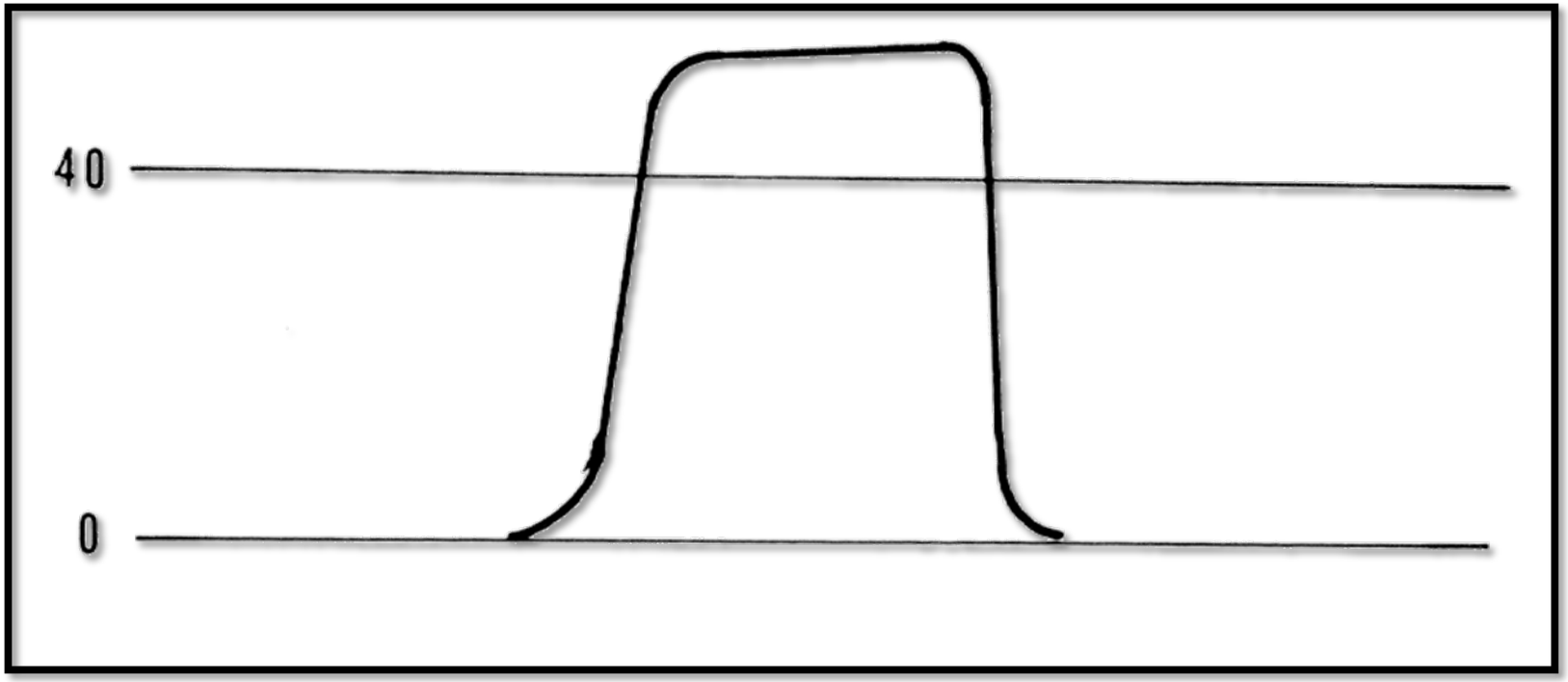


- Intubation esophage:
  - Mouvement epigastrique normal 90%
  - Condensation TET 85%

Que se passe-t-il?



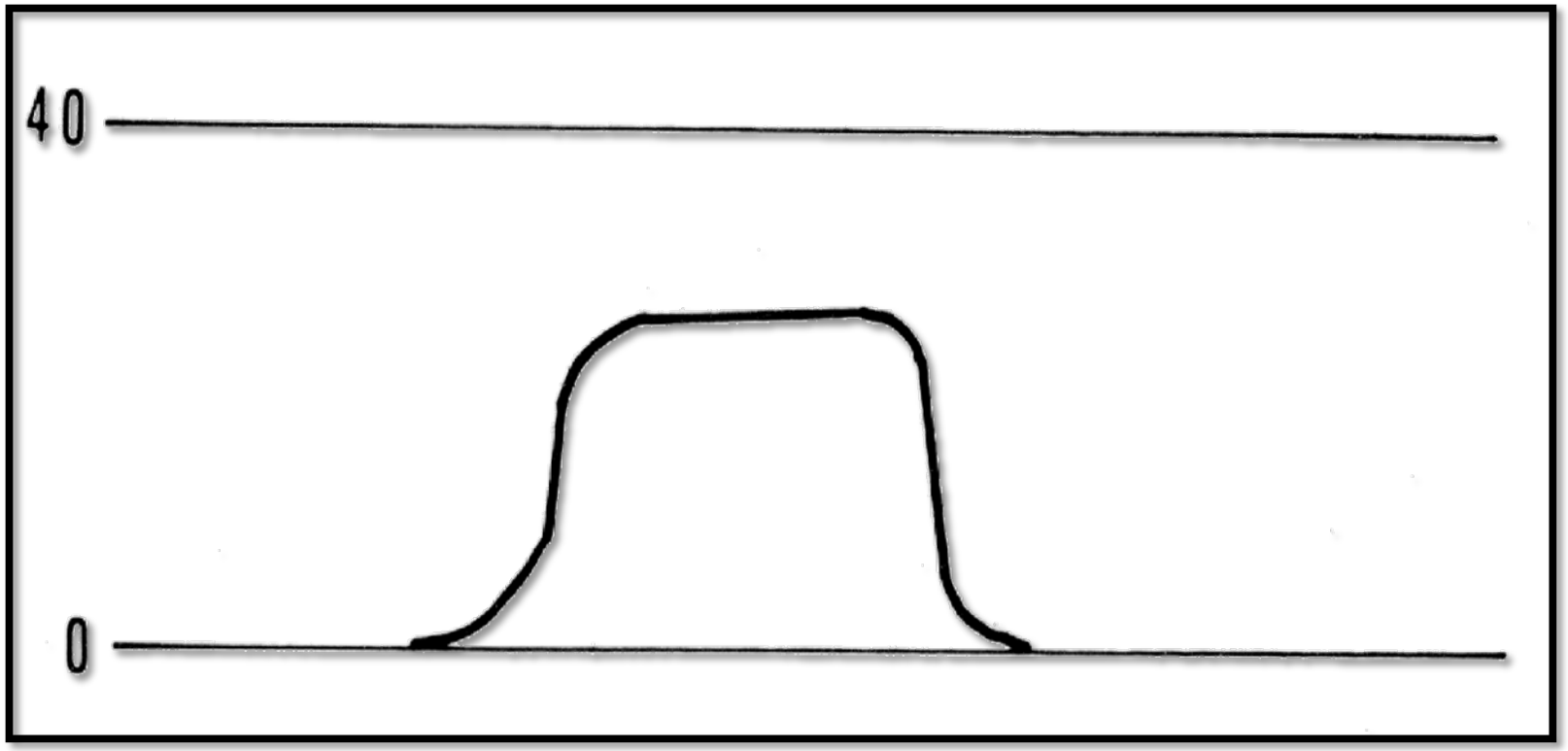
Exemple: à la fin d'une HAT



Exemple: à la fin d'une prostatectomie

Photo Diagnosis 1996

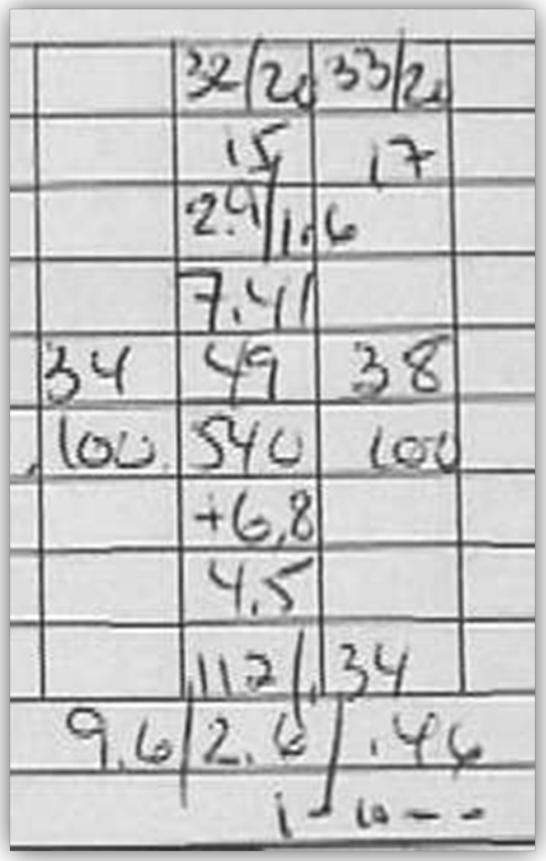
Exemple: patiente de 85 ans



Différence PaCO2-ETCO2: 1.5 mmHg / décade

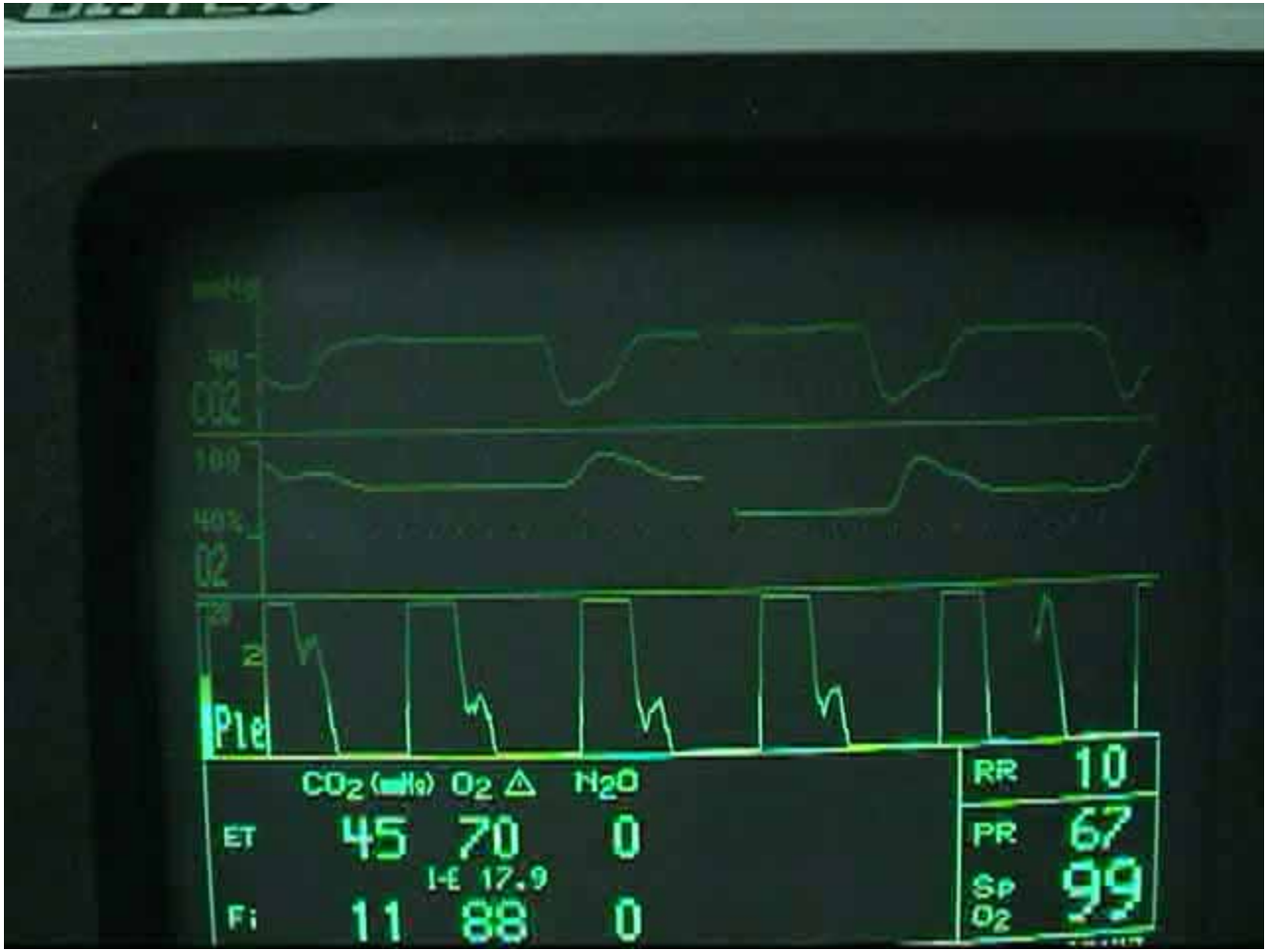
Quel est le problème et conséquence?

Résultat

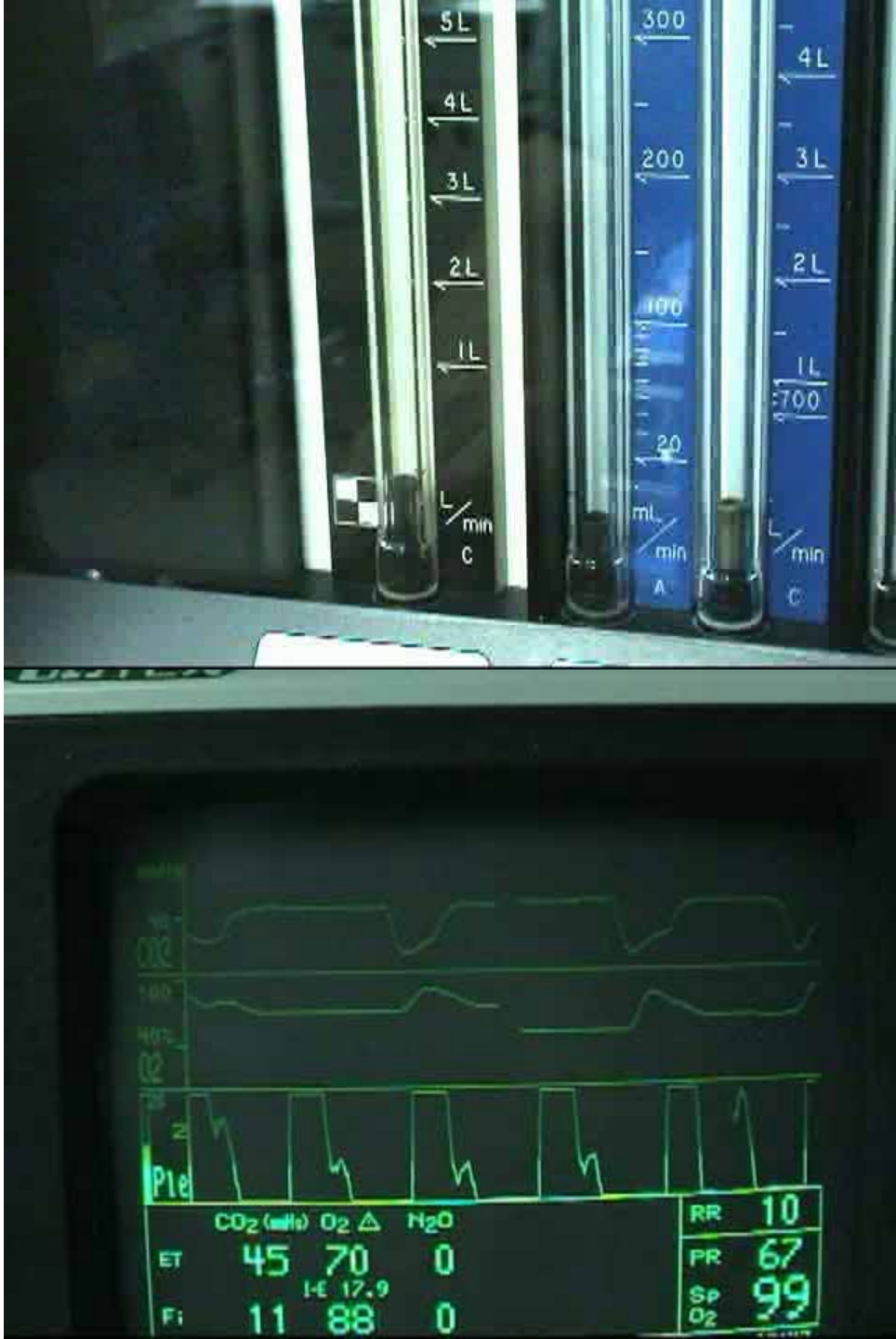

32/26
33/24
15
17
29/1.6
7.41
34
49
38
100
540
100
+6,8
4,5
112/34
9.6
2.6
.46


Adult / Pediatric
SYSTEM SIGNAL OK
L
79
BASELINE
74
SYSTEM SIGNAL OK
R
74
BASELINE
70
OPTIONS MENU

Ou est le problème?



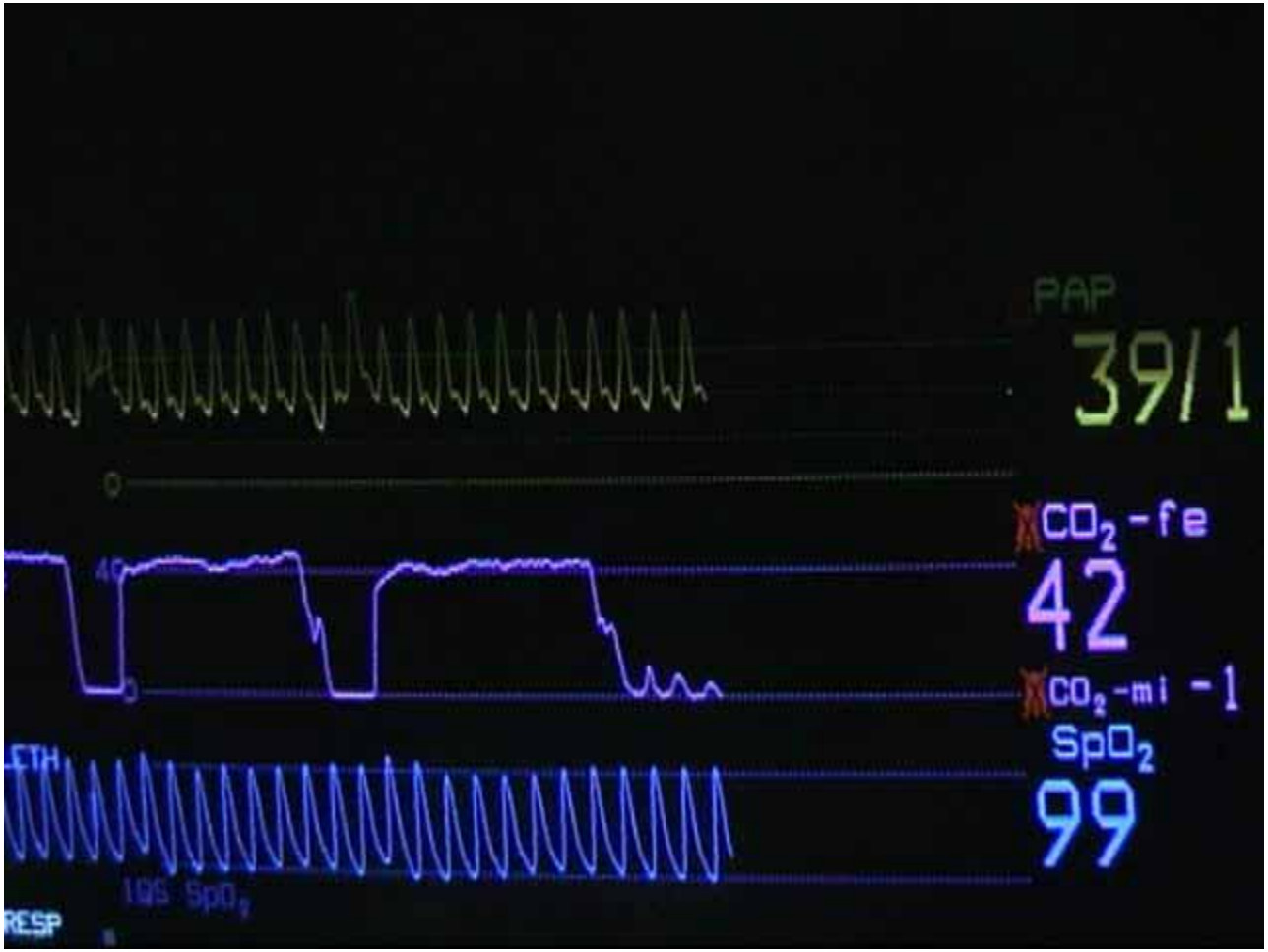
Masque laryngé



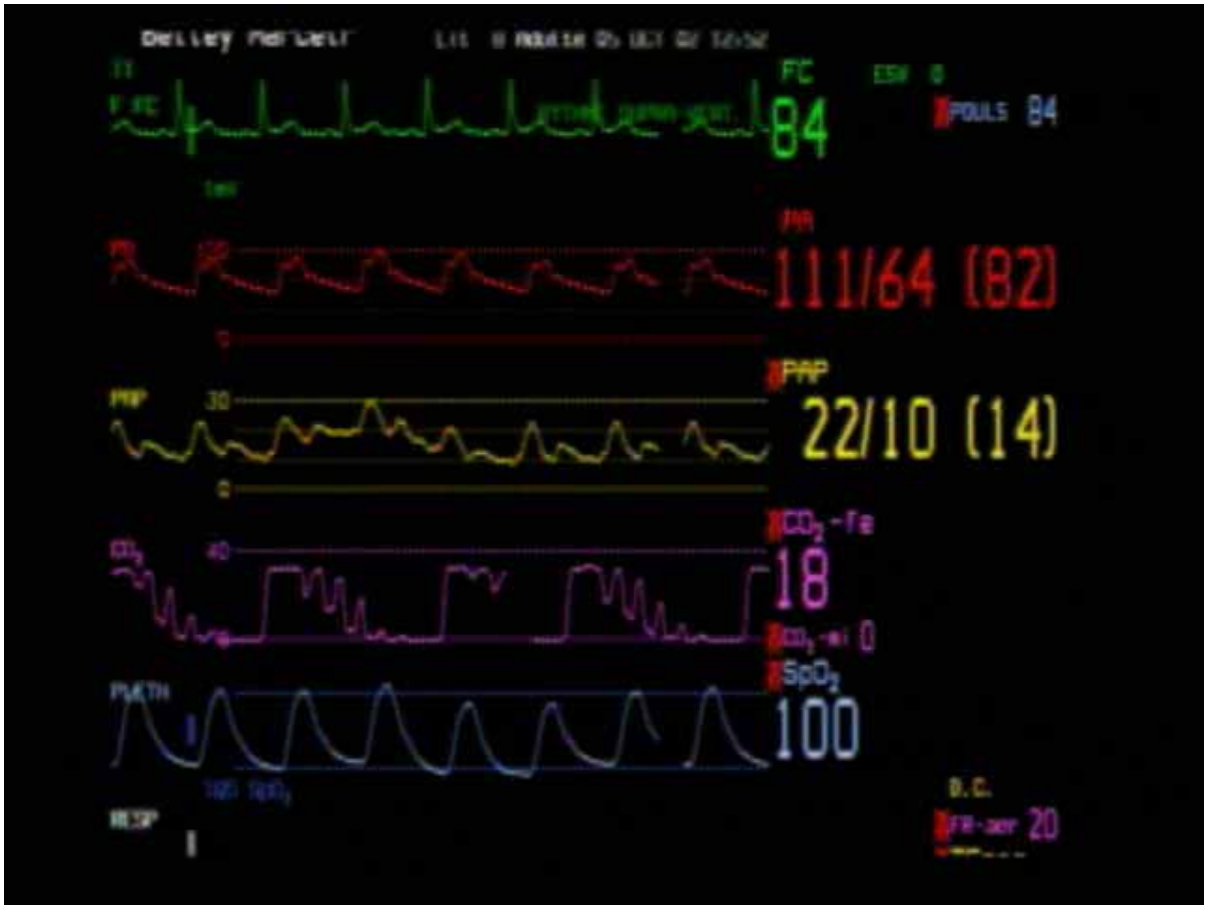
Quel est le diagnostique: preuve?

10 ml de volume

Oscillations cardiaques



Homme de 45 ans après greffe pulmonaire.



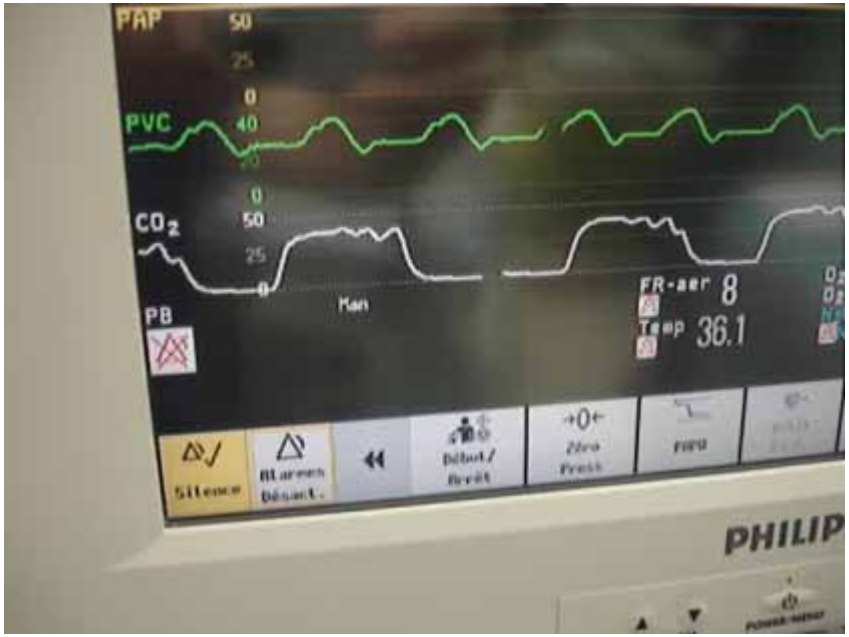
Forme de la courbe?

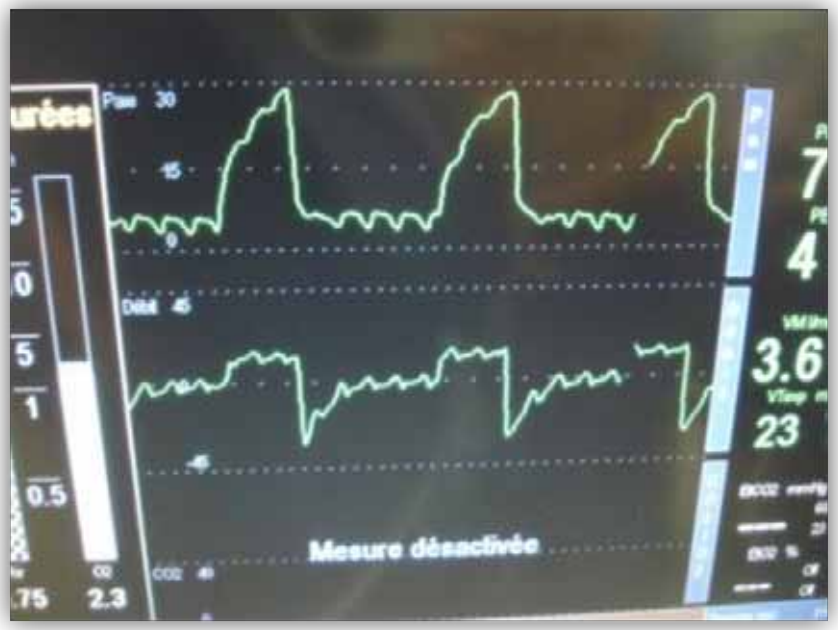
Autre exemple

72 ans débridement de plaie sternale

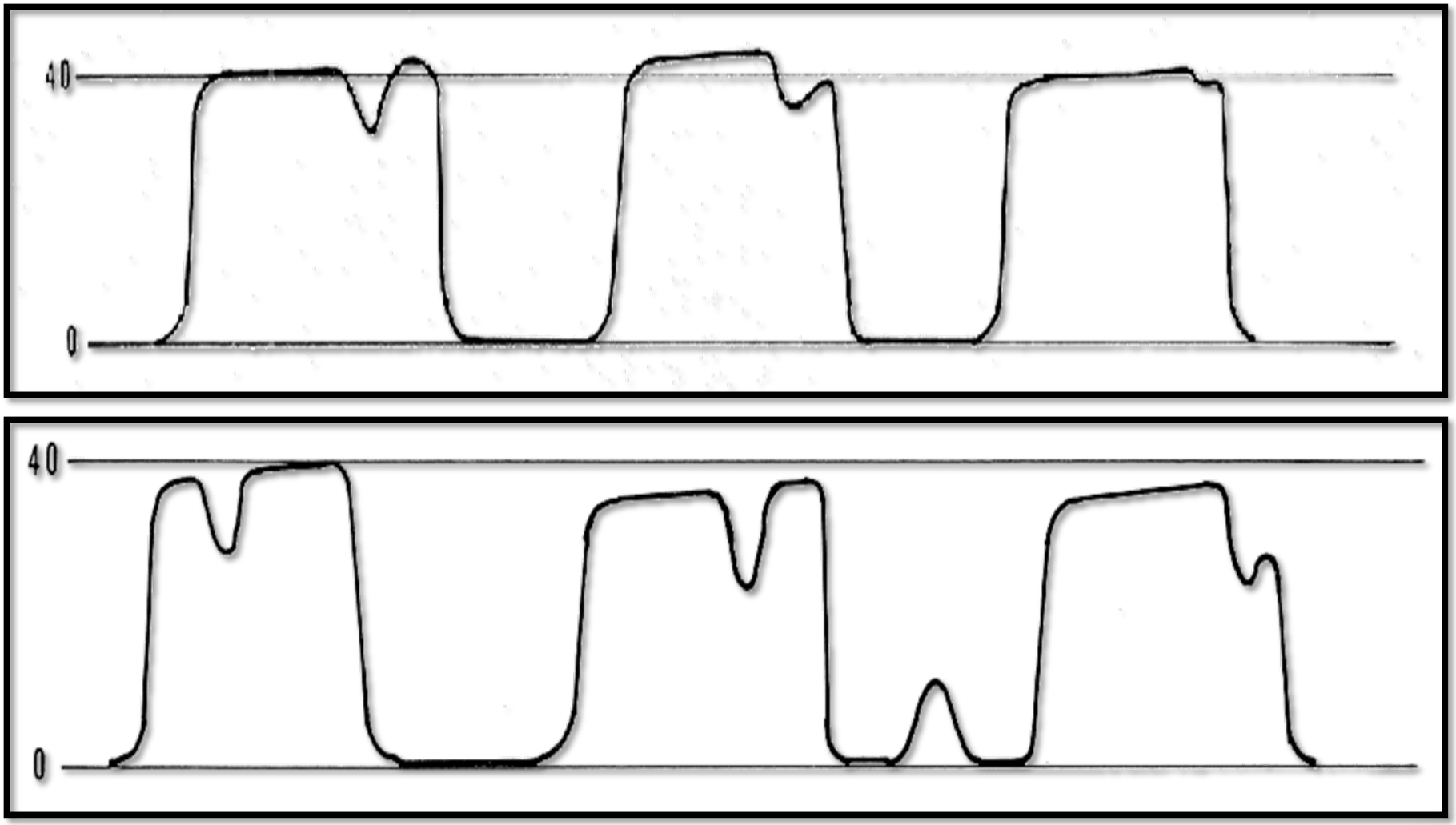
Autre exemple:

37 ans redo plastie tricuspide





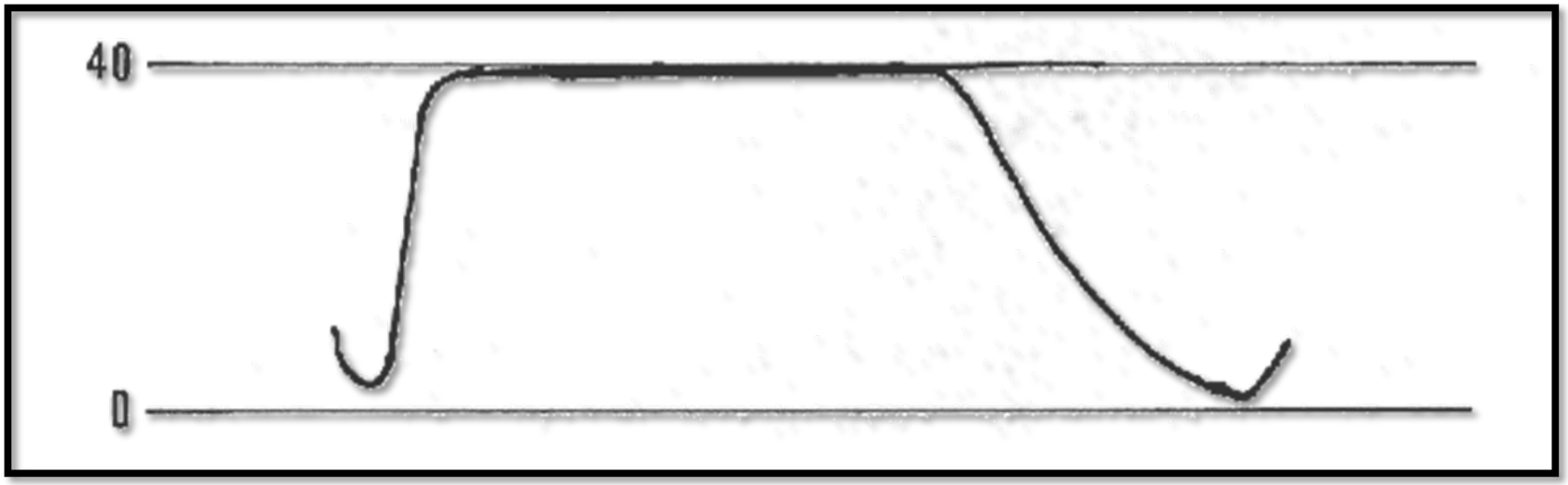
Exemple: que s'est-il passé et pourquoi le CO_2 expiré augmente?



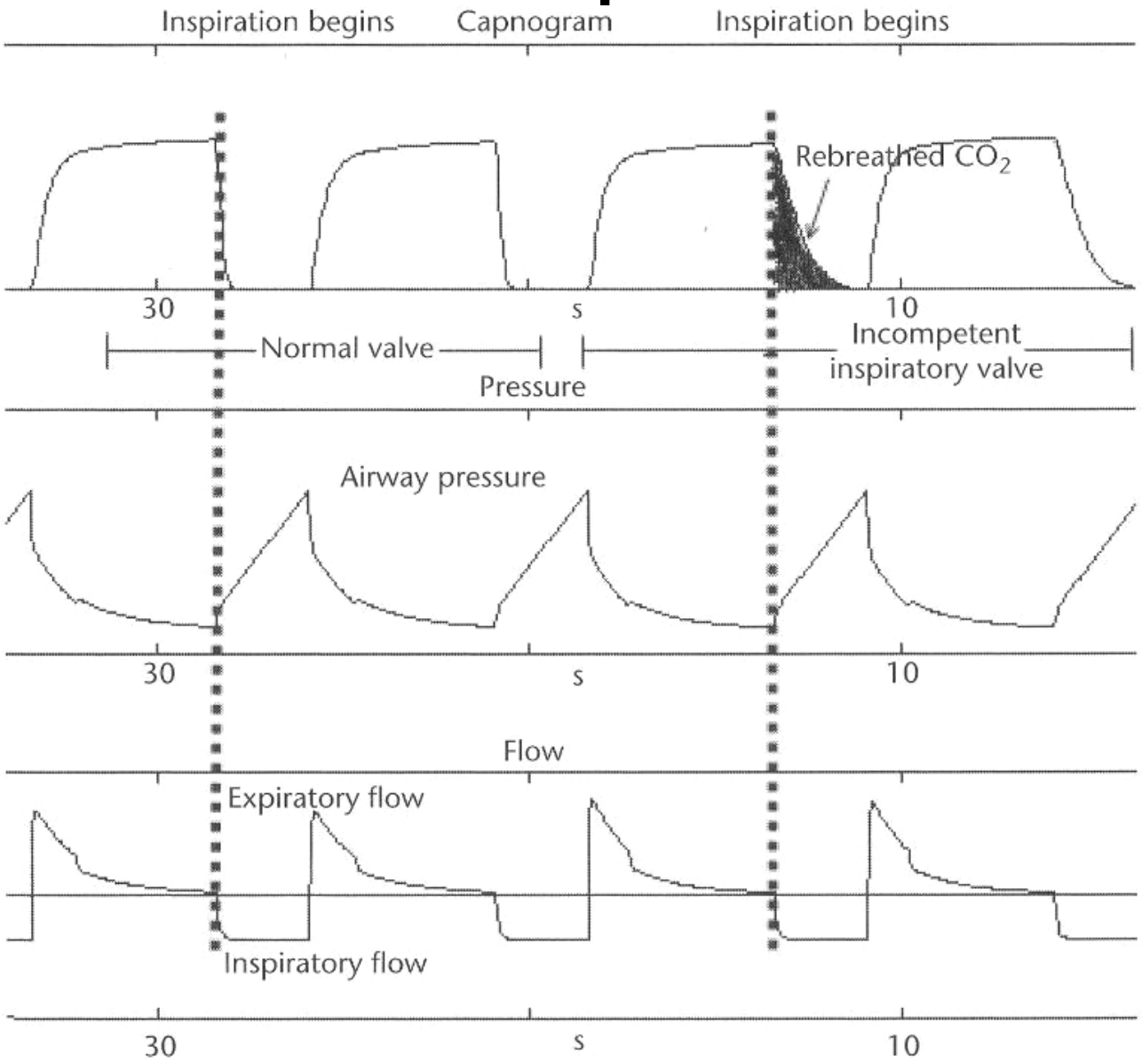
"Curare cleft“ danger!!!

- Hypercapnie
- Douleur
- Pousser sur thorax
- Hocquet

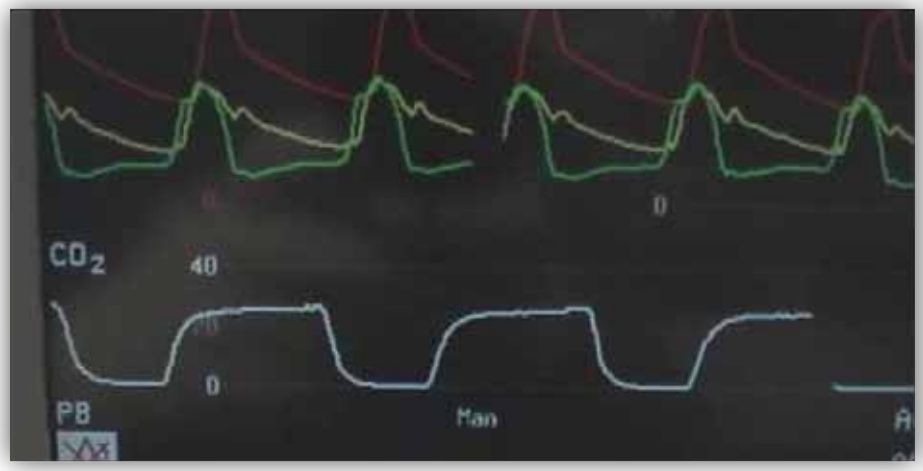
Exemple: après une thoracotomie...

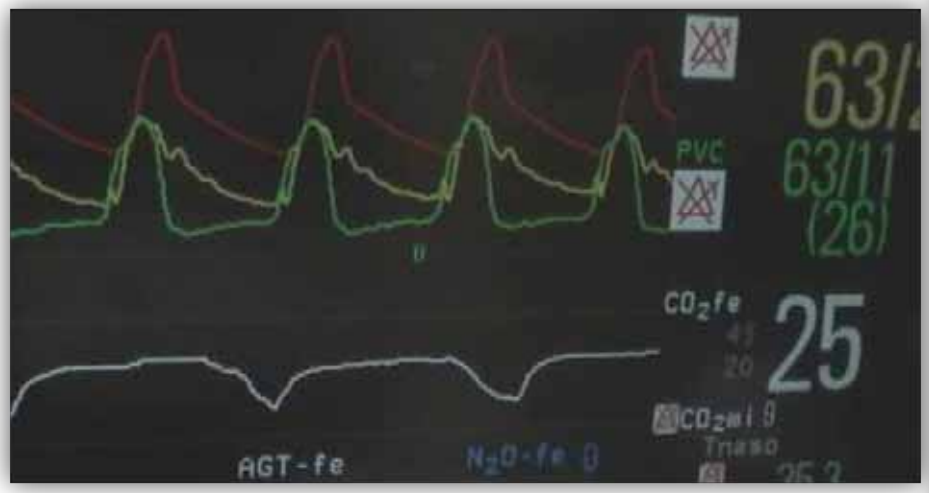


Le drain thoracique suctionne trop



Réinspiration





Exemple: les pressions de pointe augmentent hypotension sévère!

Femme de 56 ans encéphalopathie hypercapnique et hypotendue après introduction de la ventilation mécanique

Femme de 56 ans encéphalopathie hypercapnique et hypotendue après introduction de la ventilation mécanique

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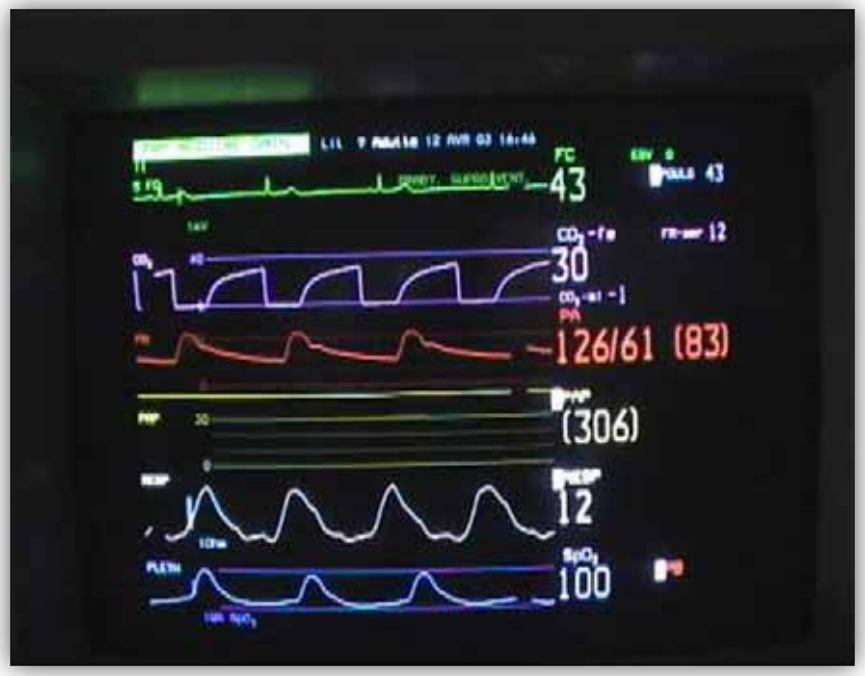
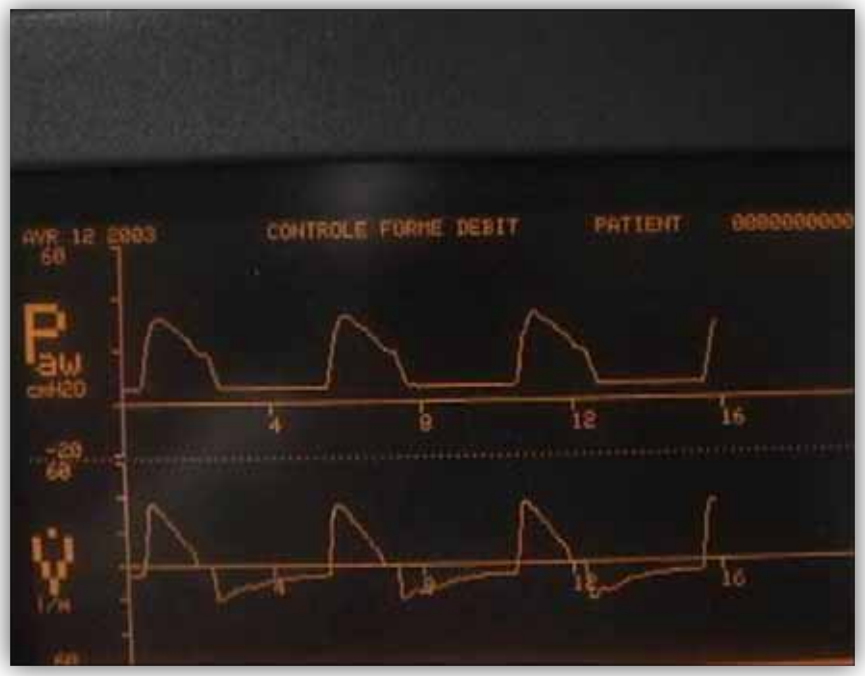
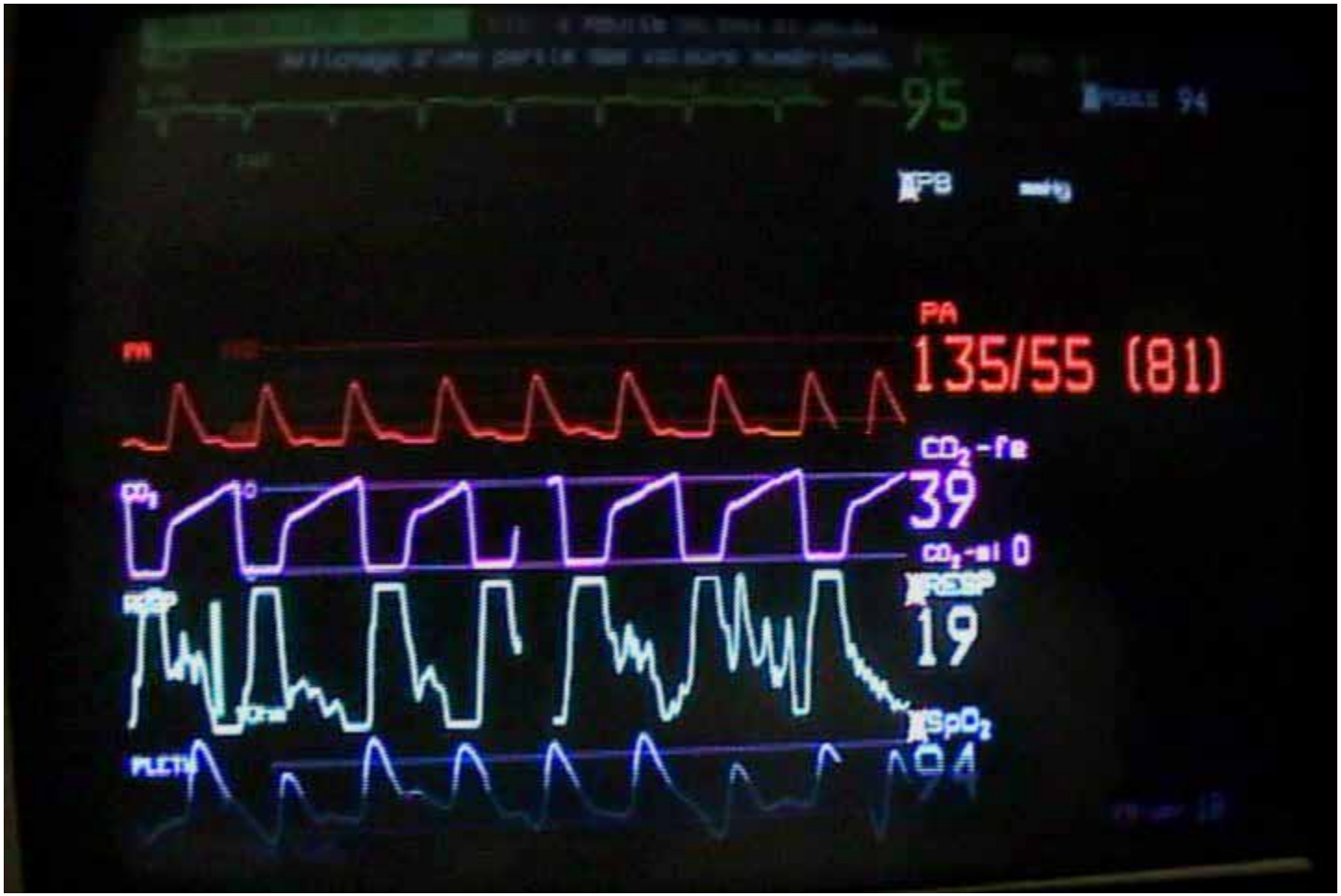
Femme de 56 ans encéphalopathie hypercapnique et hypotendue après introduction de la ventilation mécanique

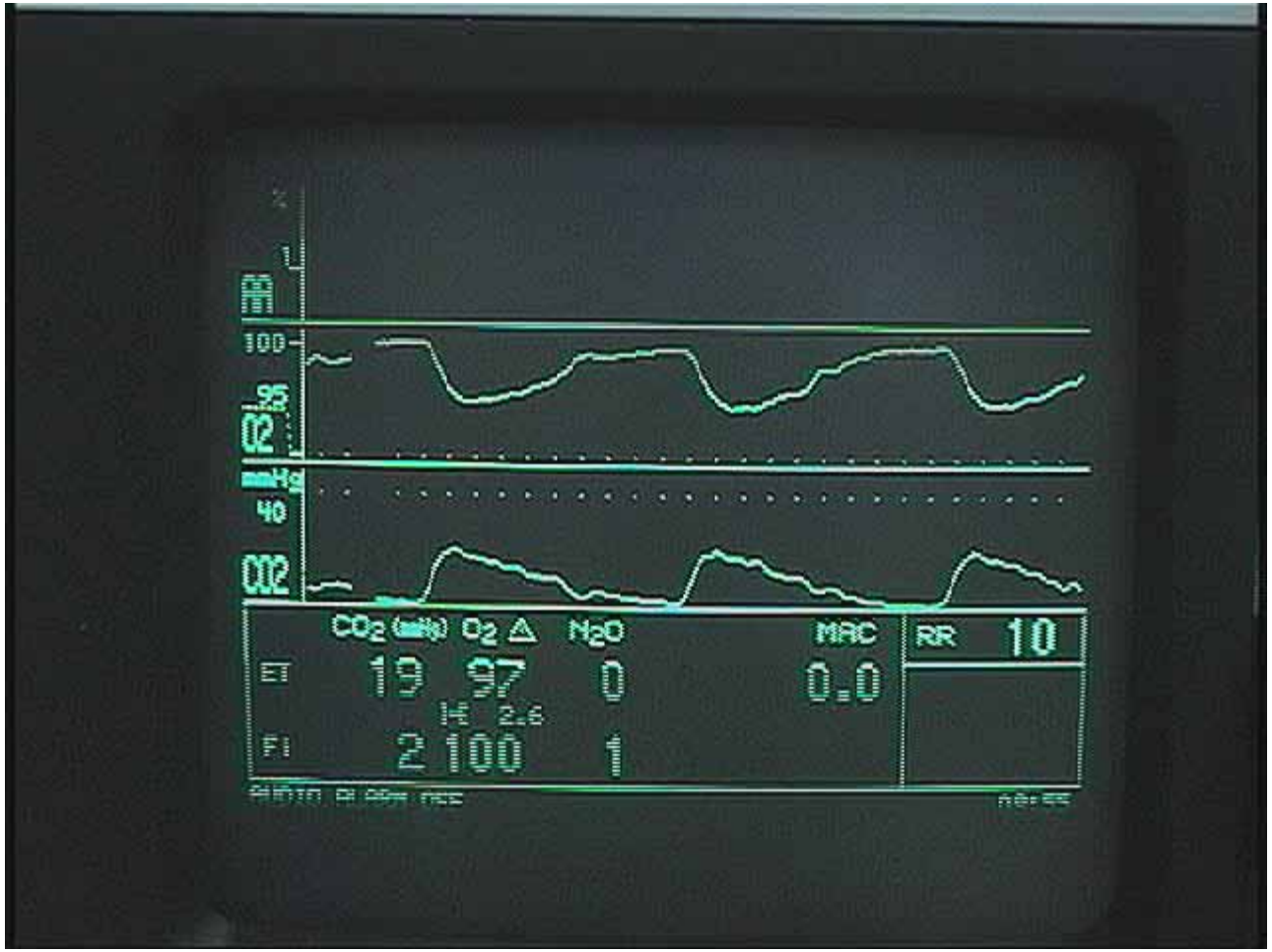




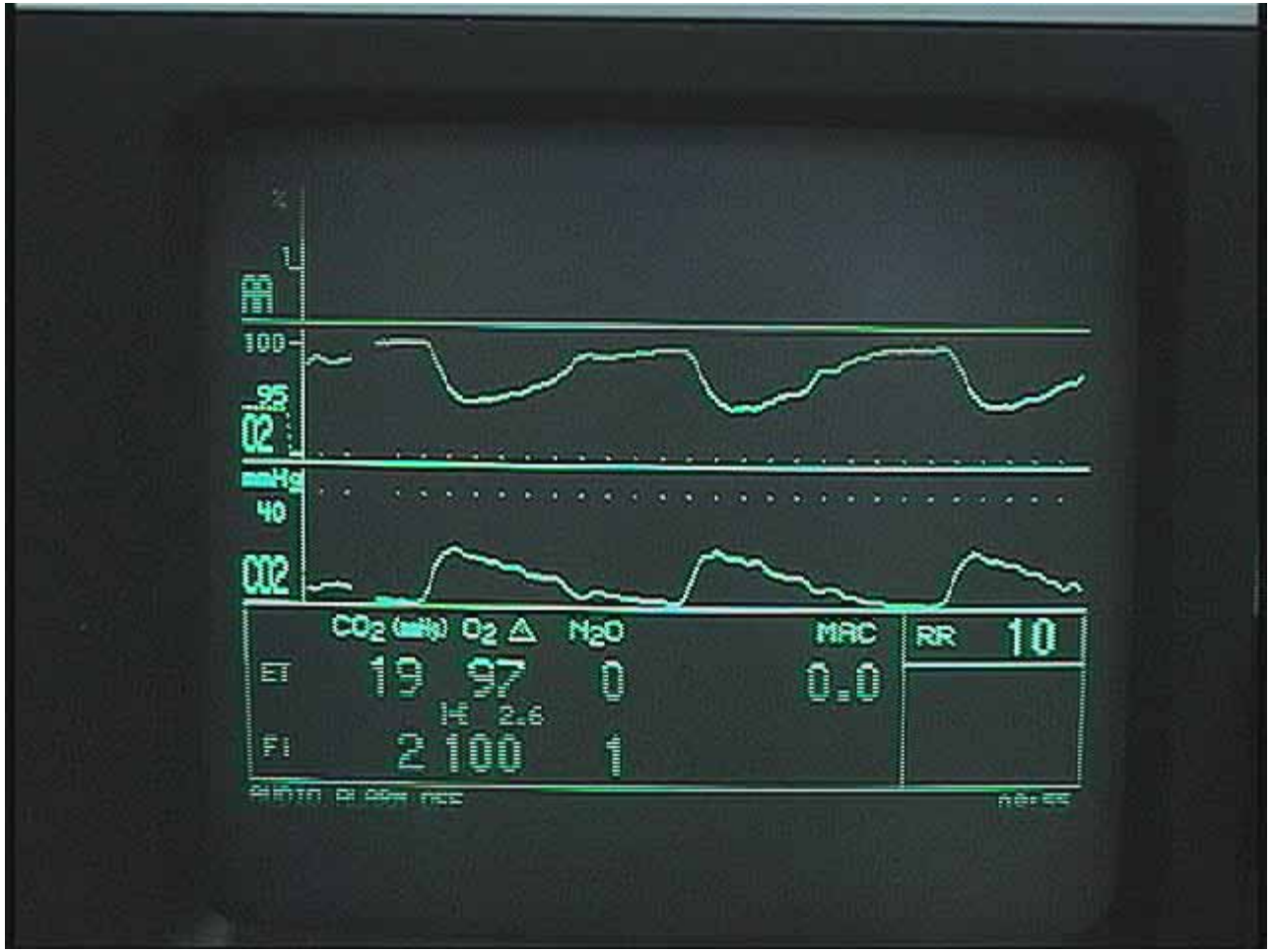
Homme de 69 ans MPOC



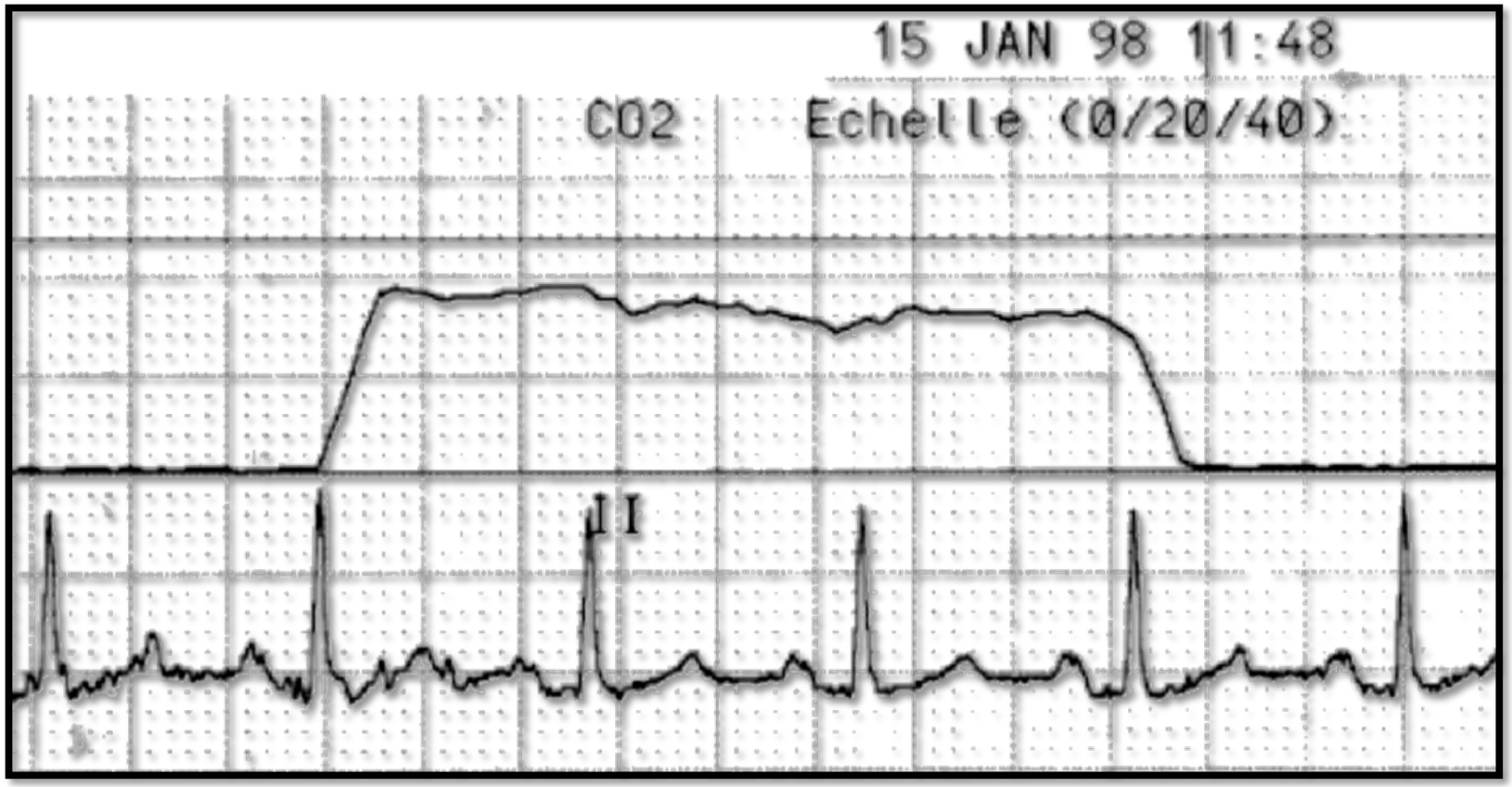
Exemple: que s ’est-il passé?



Administration de flolan par inhalation par débit secondaire

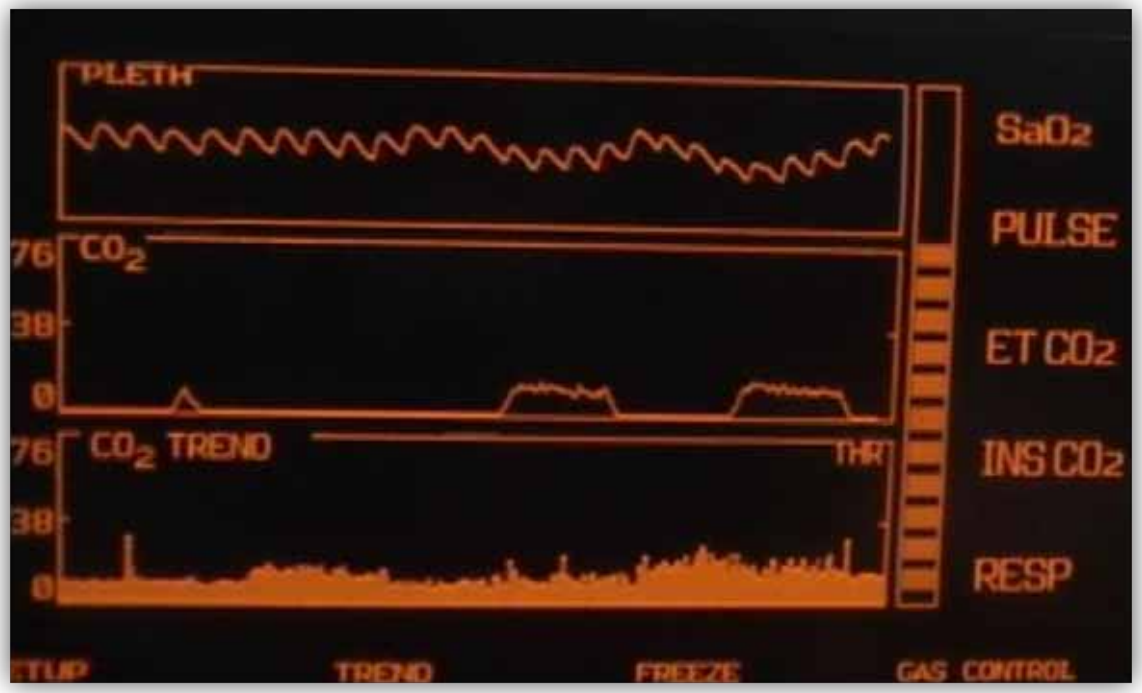


Exemple: CHUM-HND un soir….
Je suis inquiet!



Échantillonnage central

Je suis <u>très</u> inquiet!



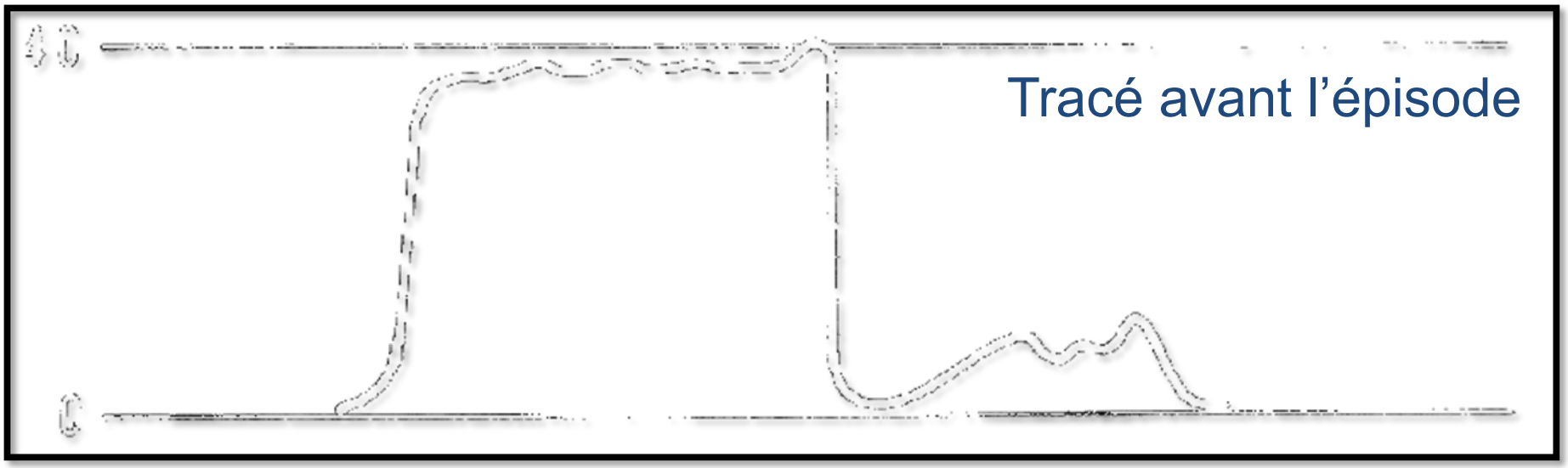
SaO2 Capno ECG PA NIBP Temp Protect cath

CONDITIONS D'INTUBATION FIBRE OPTIQUE

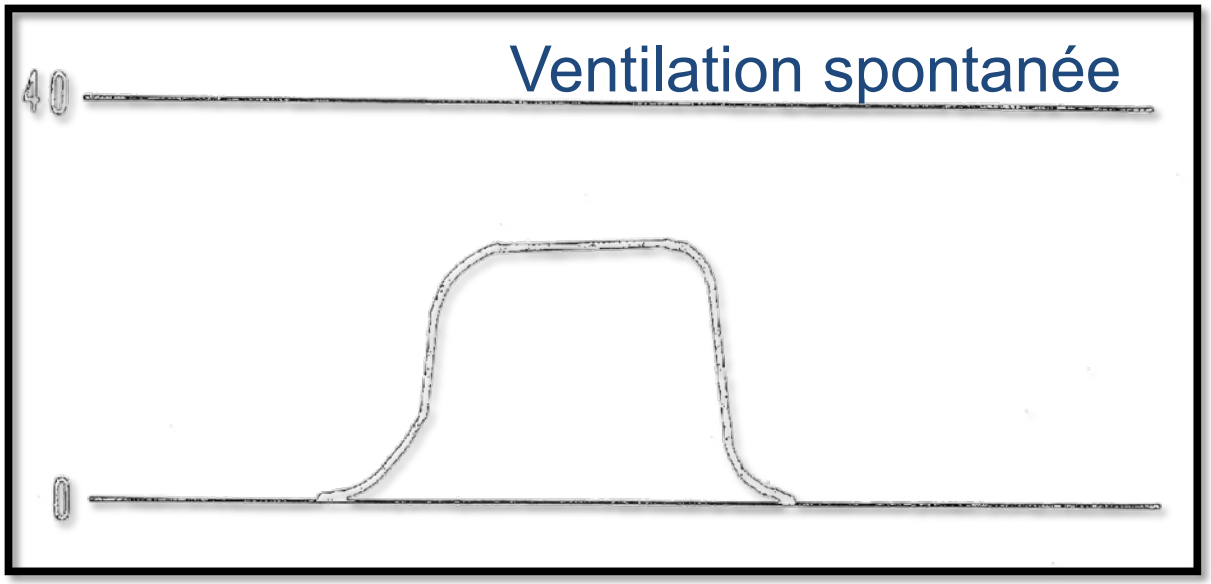
GRADE I - II - III - IV

Explication du tracé?

Désaturation et perte du CO_2 intubation difficile



Exemple: HMR un soir….



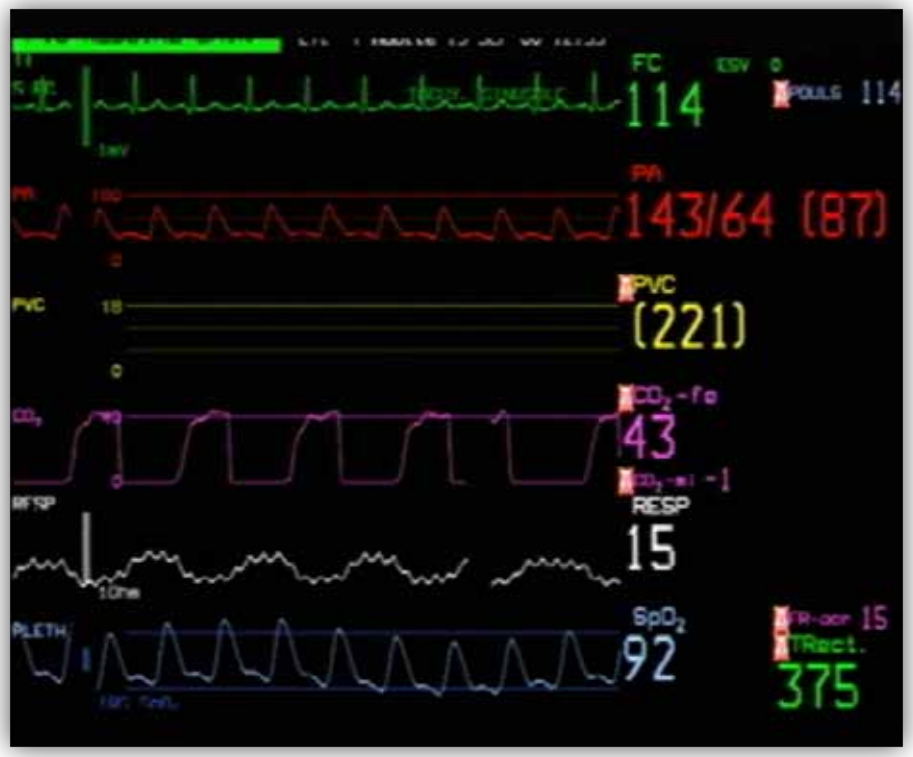
Quel est le problème?

Solution?

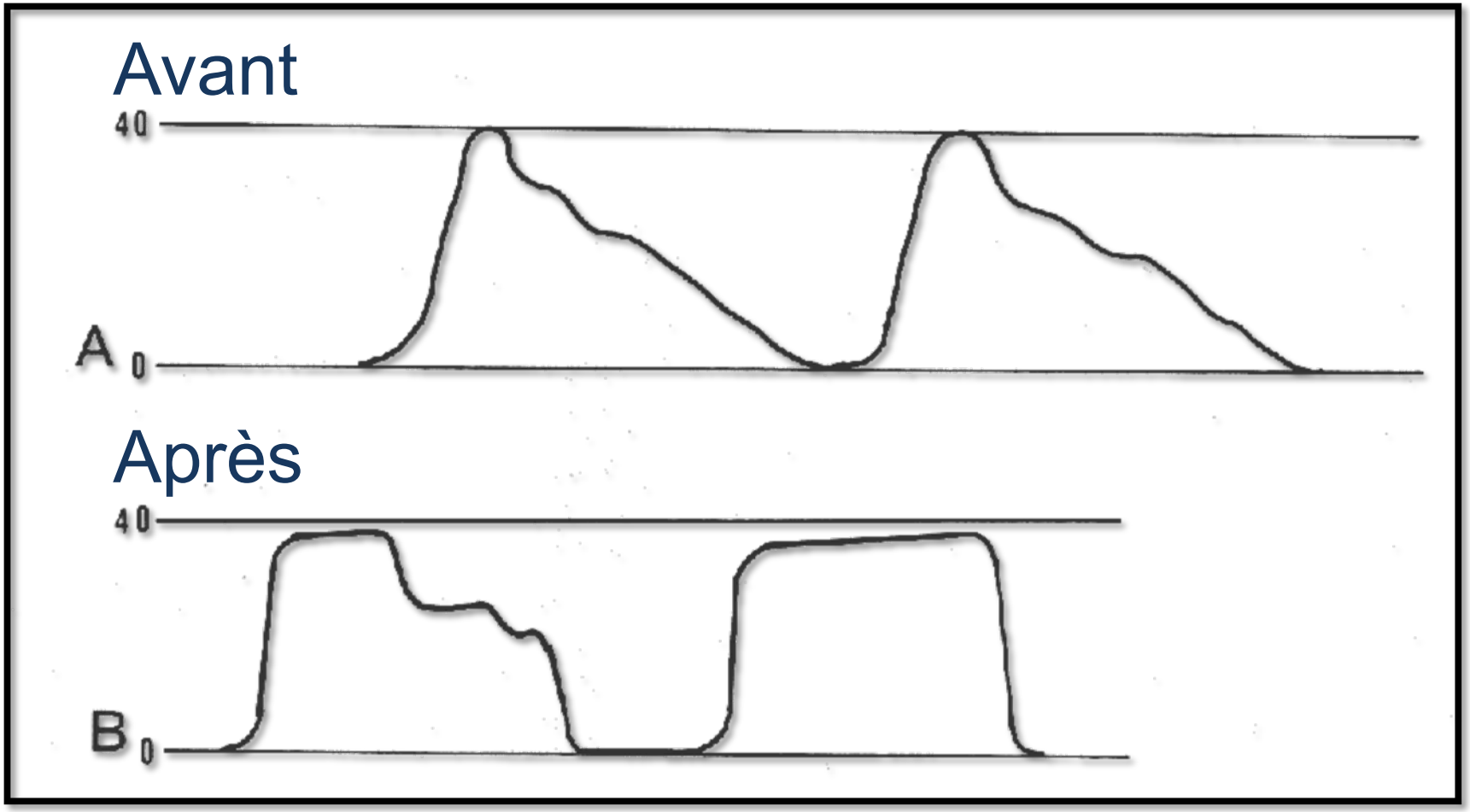

Lit 6 Adulte 27 OCT 02 17:00
FC
75
Mode non-stimulé
POULS 74
PA
129/66 (88)
CO2 -fe
46
CO2 -mi 0
SpO2
97
RLETH
RESP
FR-aer 15

Comment expliquer?

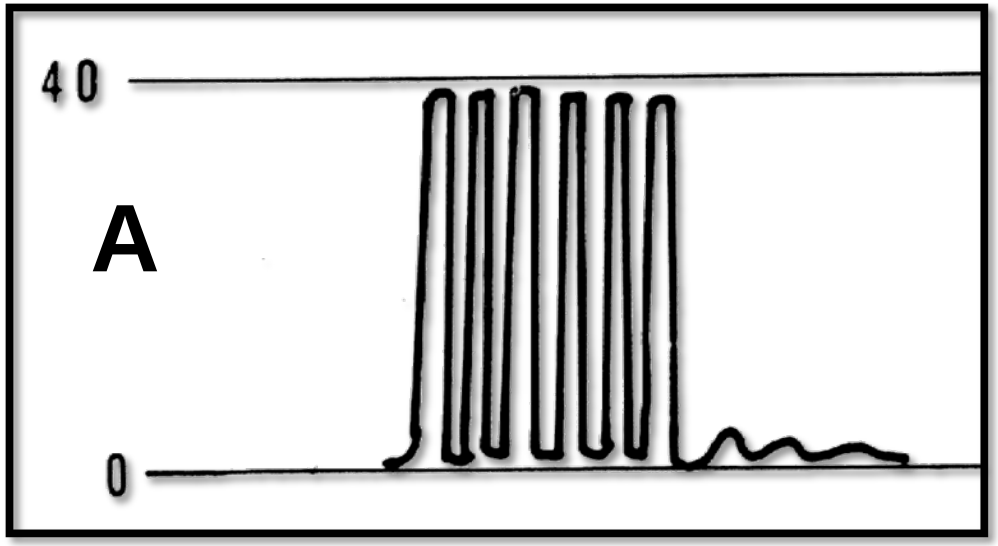
Pourquoi la pression artérielle et le CO_2 expiré sont plus basses?

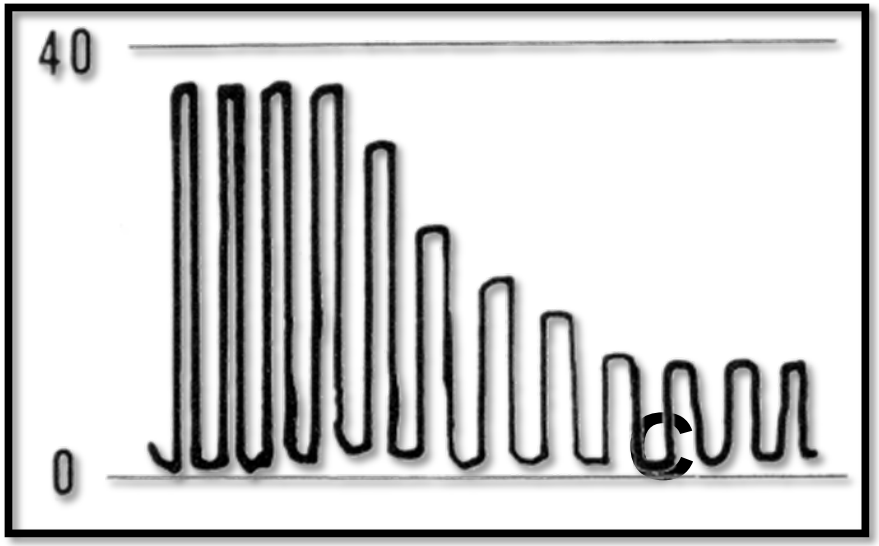


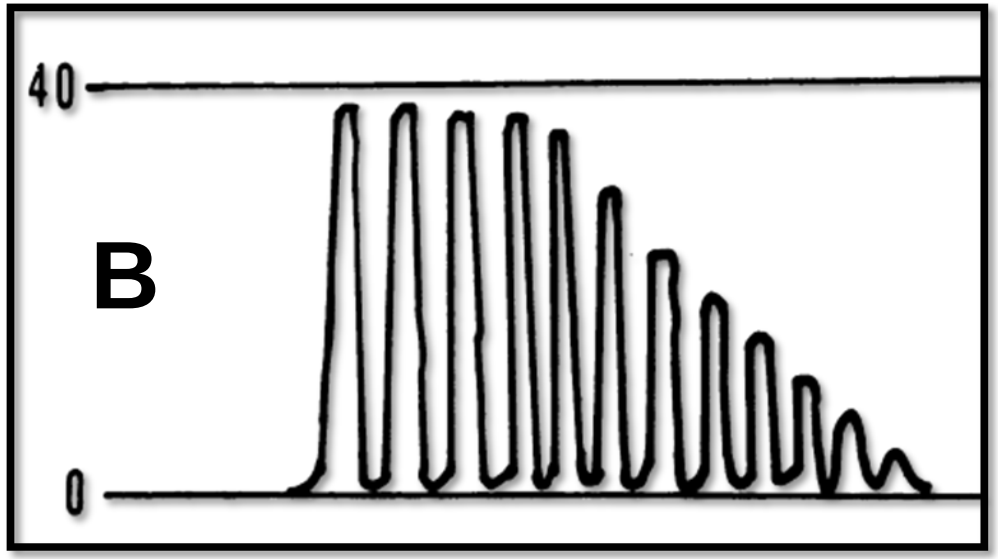
Exemple: que s ’est-il passé?

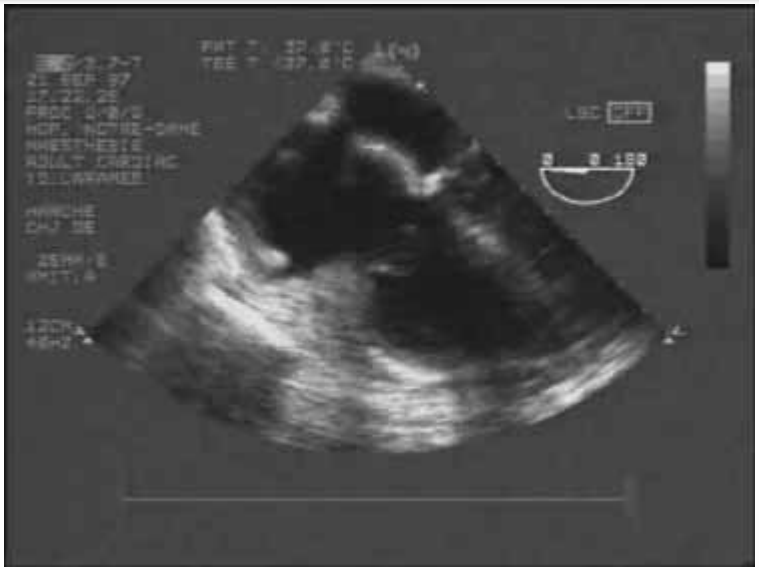


Exemple: prothèse de genou:↓TA après relâche du garrot

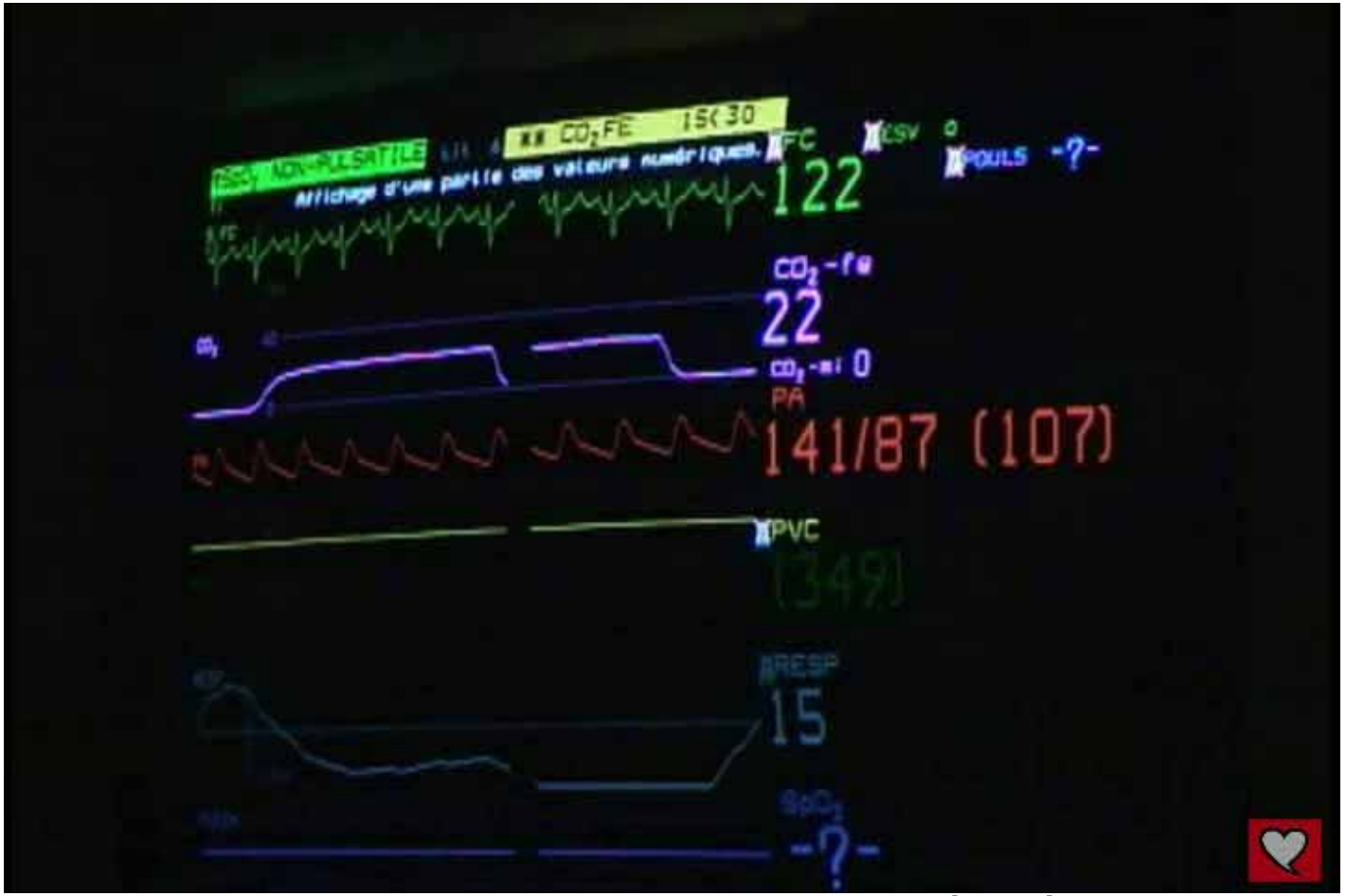






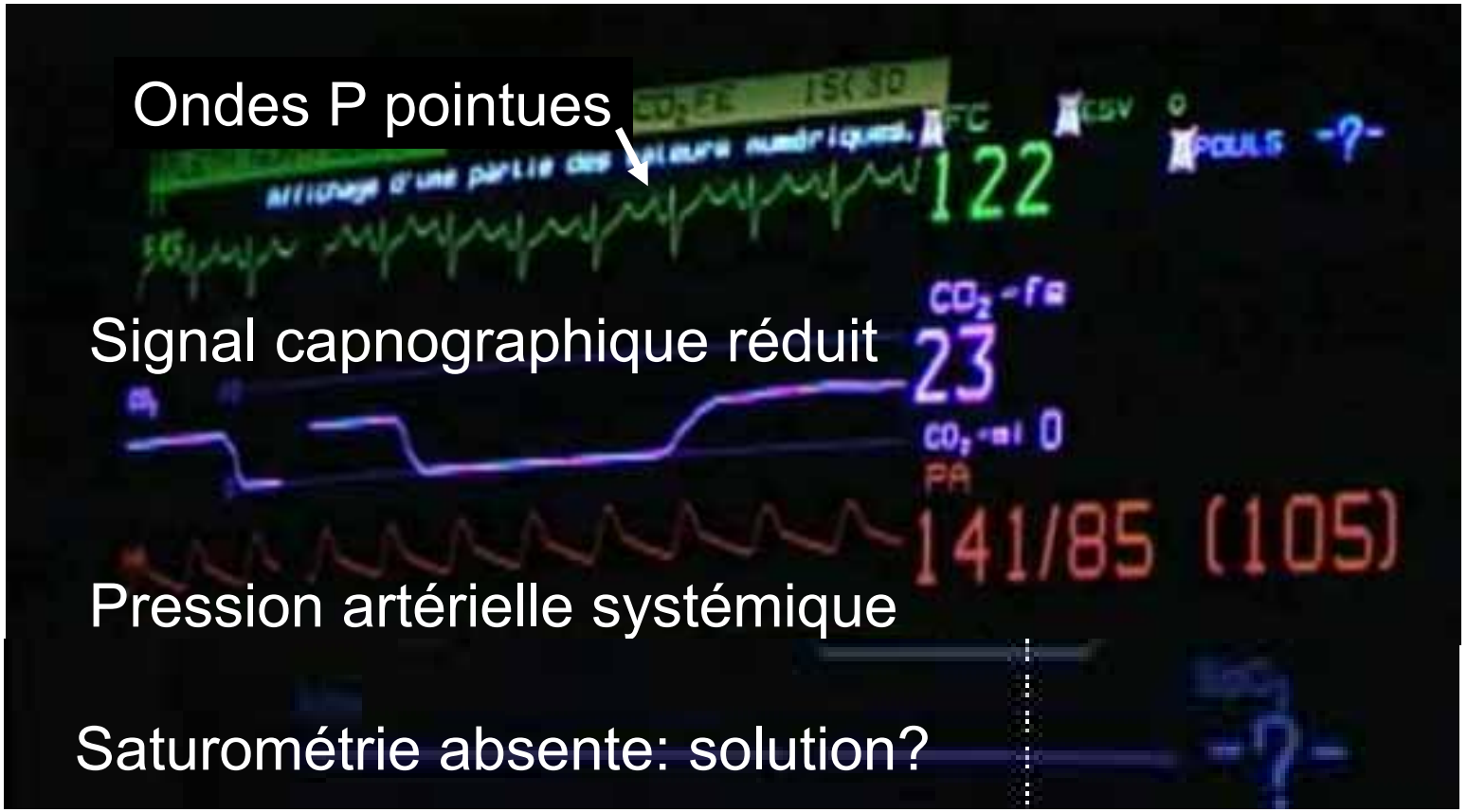


Hypotendu à l'urgence
3 semaines après chirurgie pour méningiome.



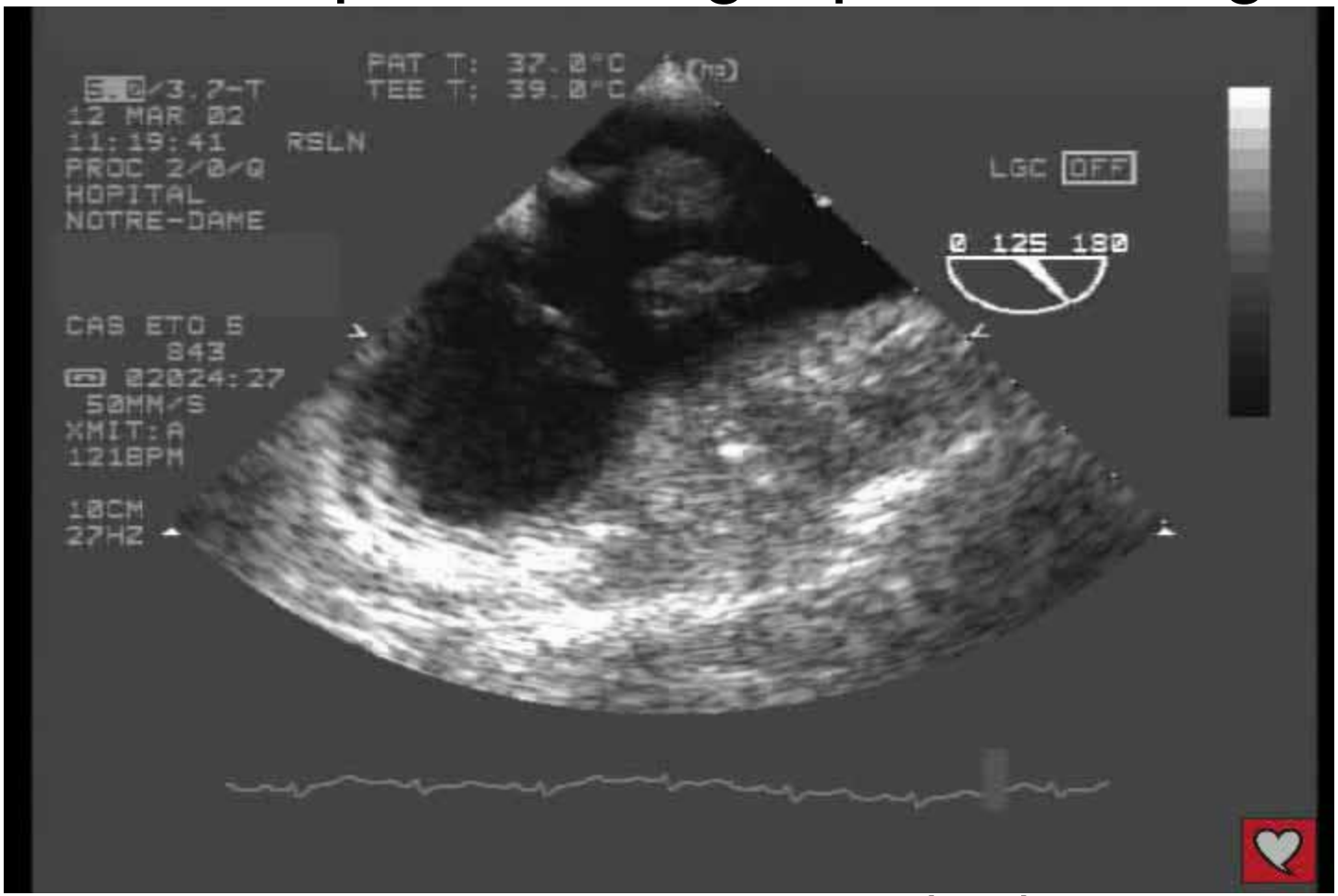
Noradrénaline à 0.15 µg/kg/min
(40 ml/h de 4mg/250ml)

Hypotendu à l'urgence
3 semaines après chirurgie pour méningiome.

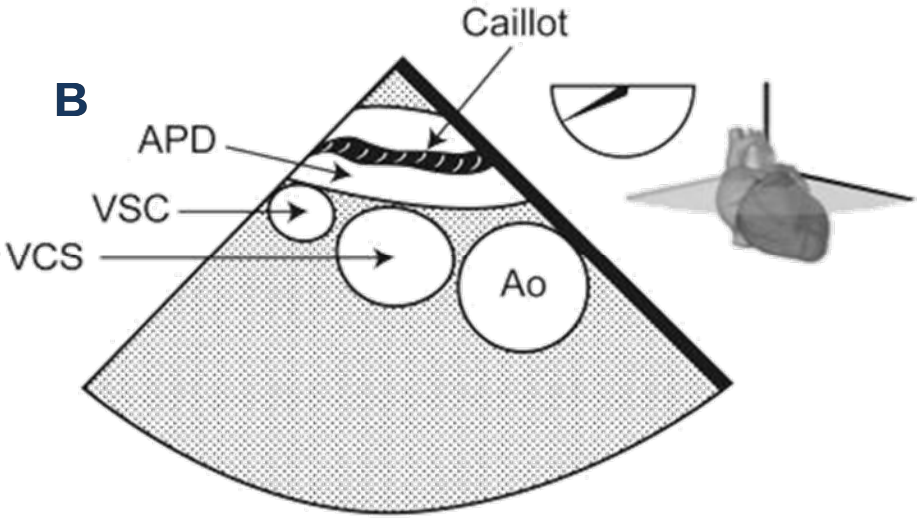


Noradrénaline à 0.15 µg/kg/min
(40 ml/h de 4mg/250ml)

Hypotendue à l'urgence
3 semaines après chirurgie pour méningiome.

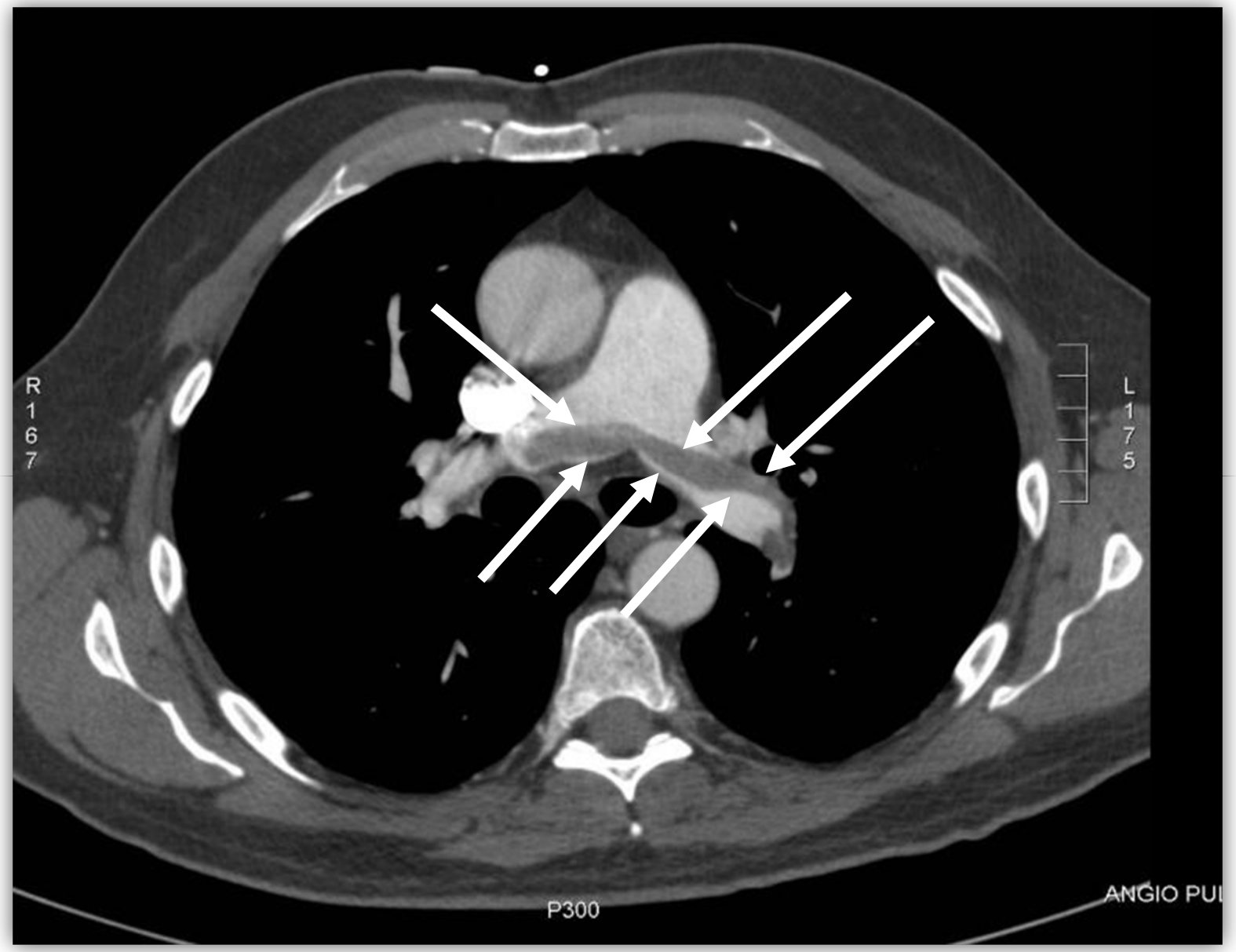


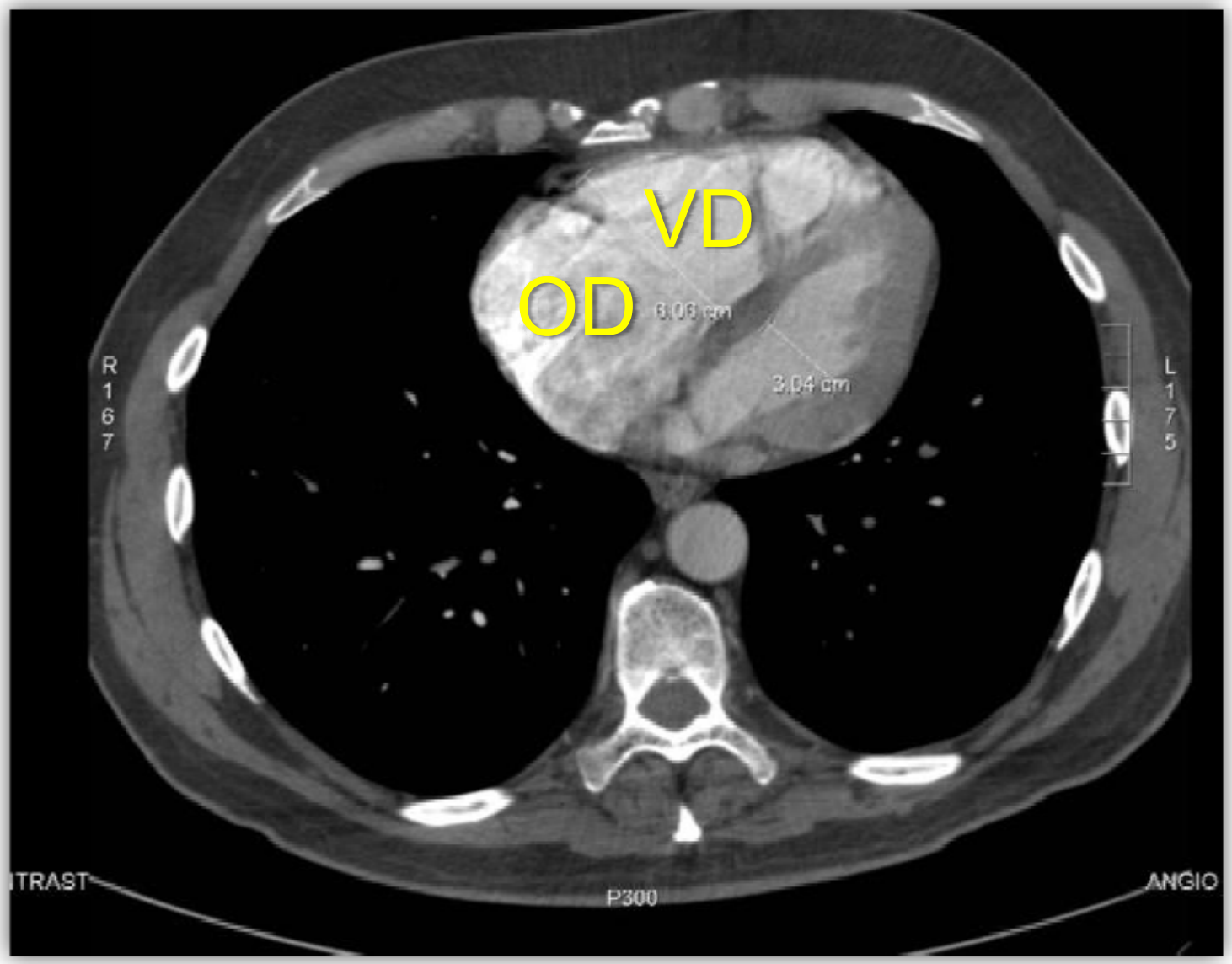
Noradrénaline à 0.15 µg/kg/min
(40 ml/h de 4mg/250ml)



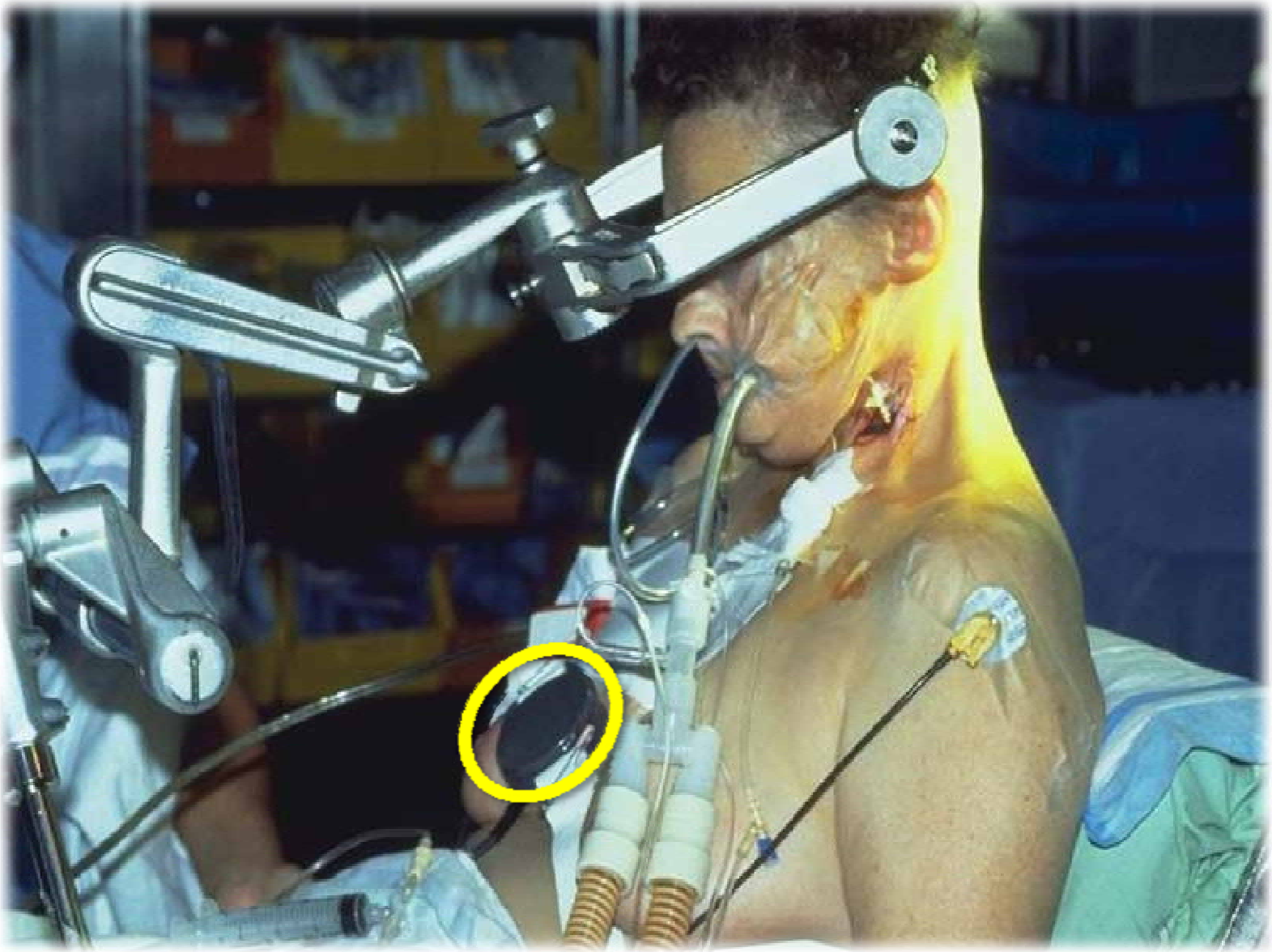
Courtoisie Dr. David Braco and Dr. Nicolas Noiseux

CT-angio

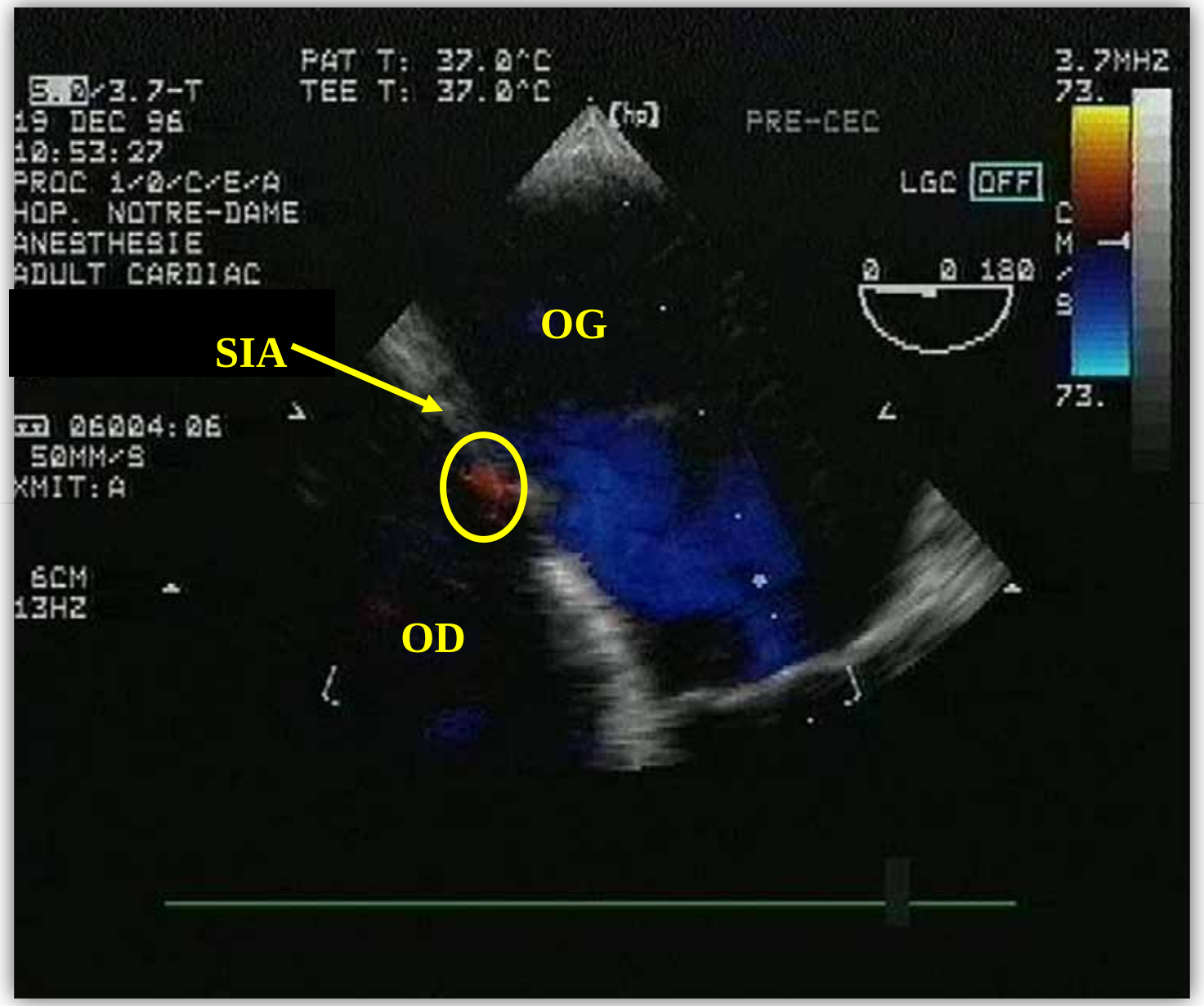



VD
OD
3.06 cm
3.04 cm
R
1
6
7
L
1
7
5
TRAST
P300
ANGIO

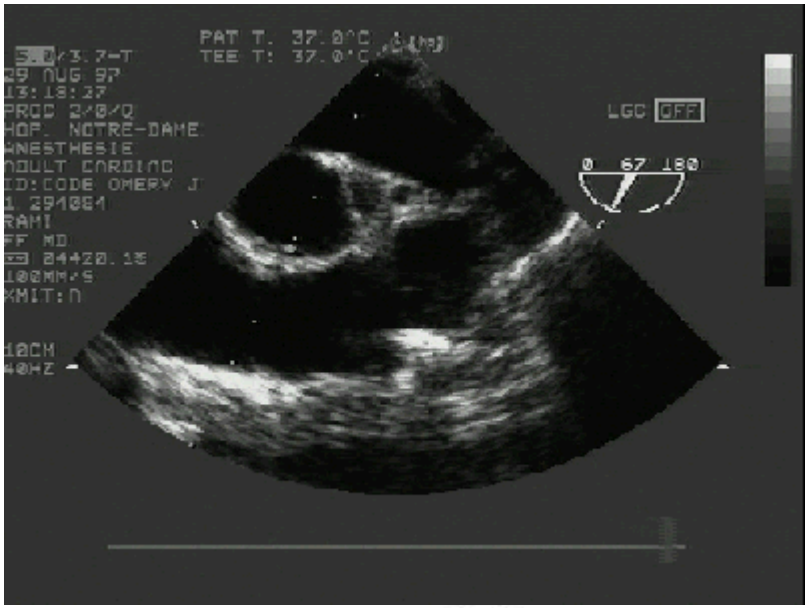
Chirurgie en position assise

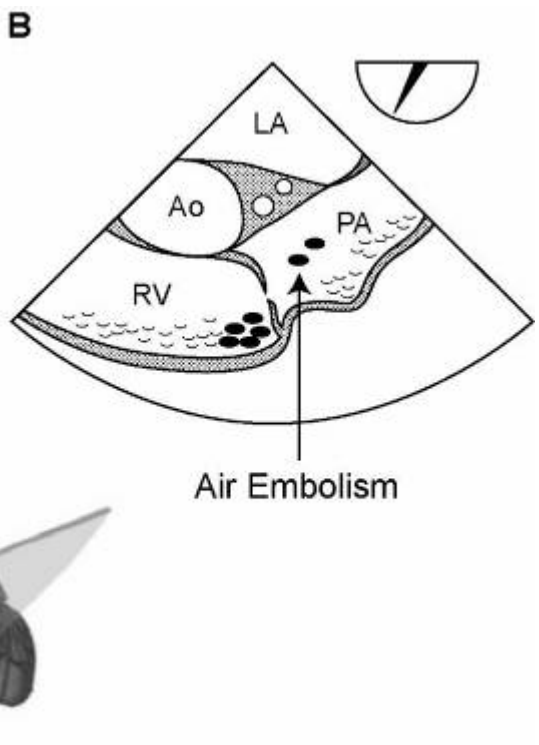


Chirurgie en position assise



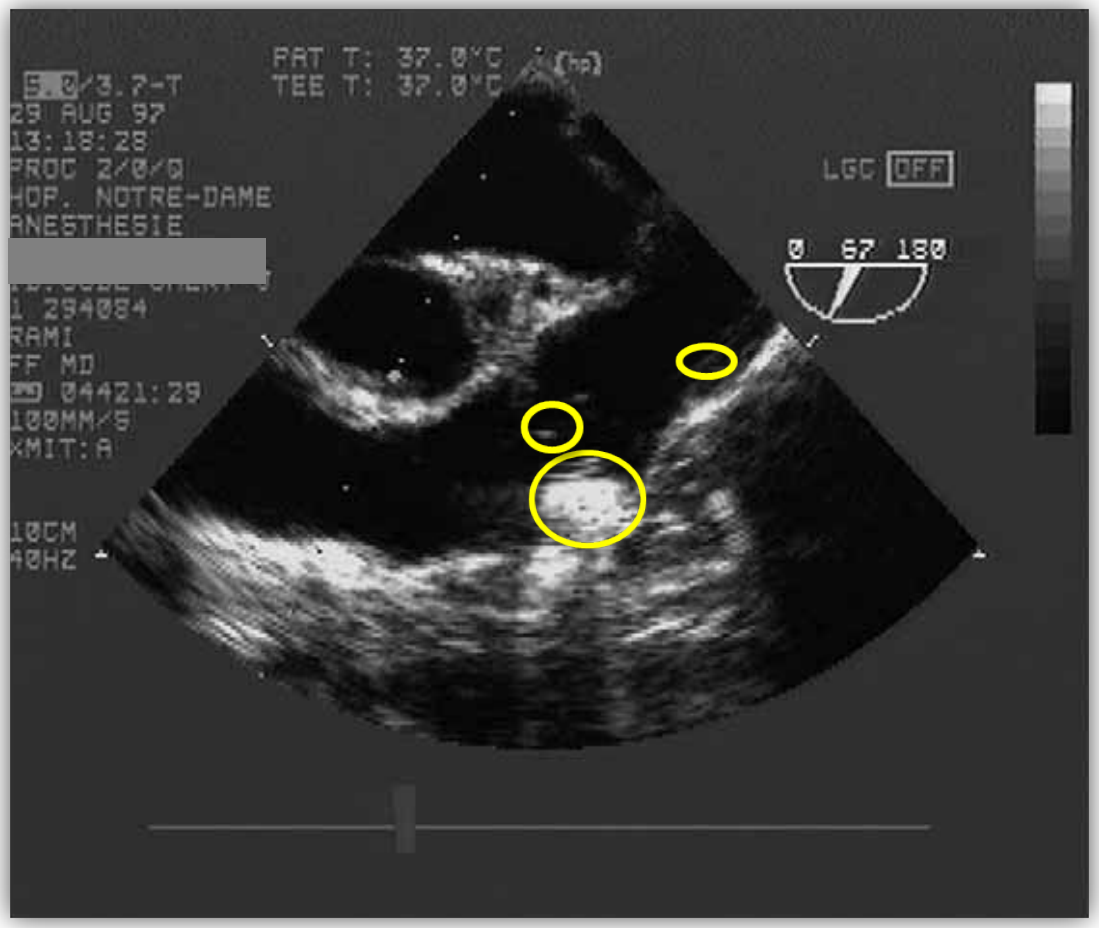
Hypotension lors d'une chirurgie de scoliose en position ventrale





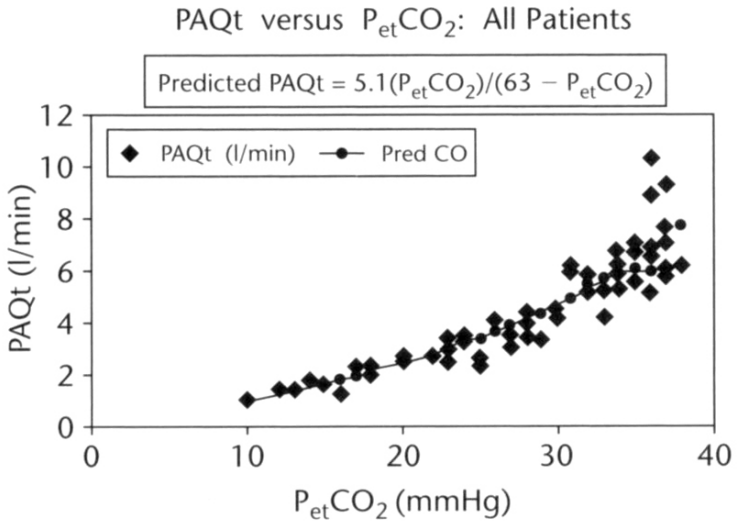
Denault TEE manual 2005

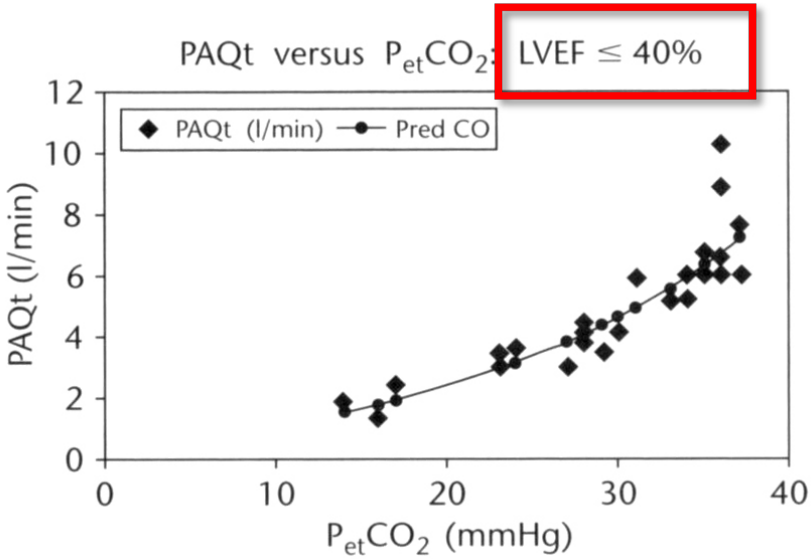
Hypotension lors d'une chirurgie de scoliose en position ventrale

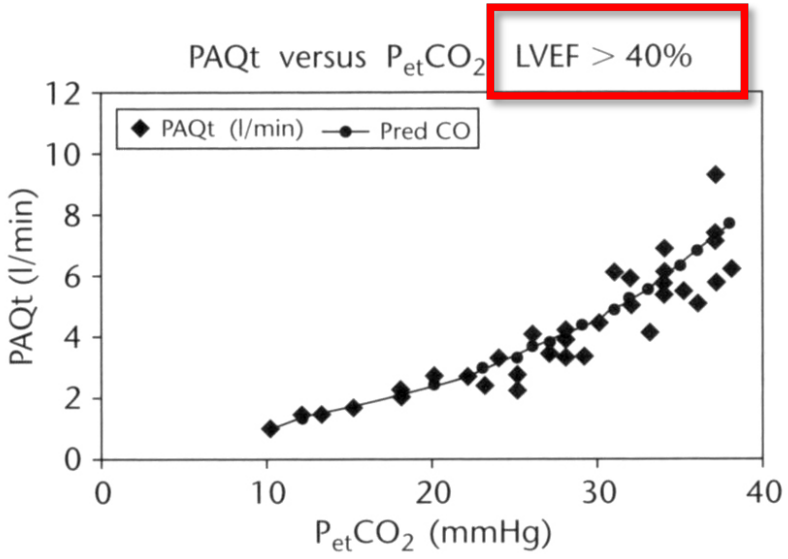


Moniteur de débit cardiaque

$ETCO_2$ et fonction cardiaque







Maslow et al Anesth Analg 2001;92:306-313

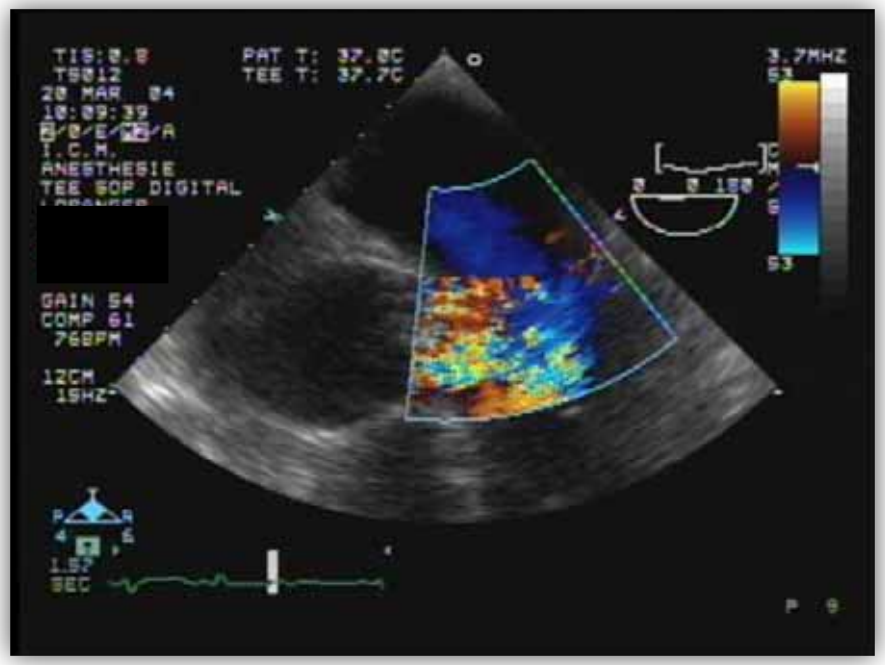
Quel médicament a été donné?

Avant

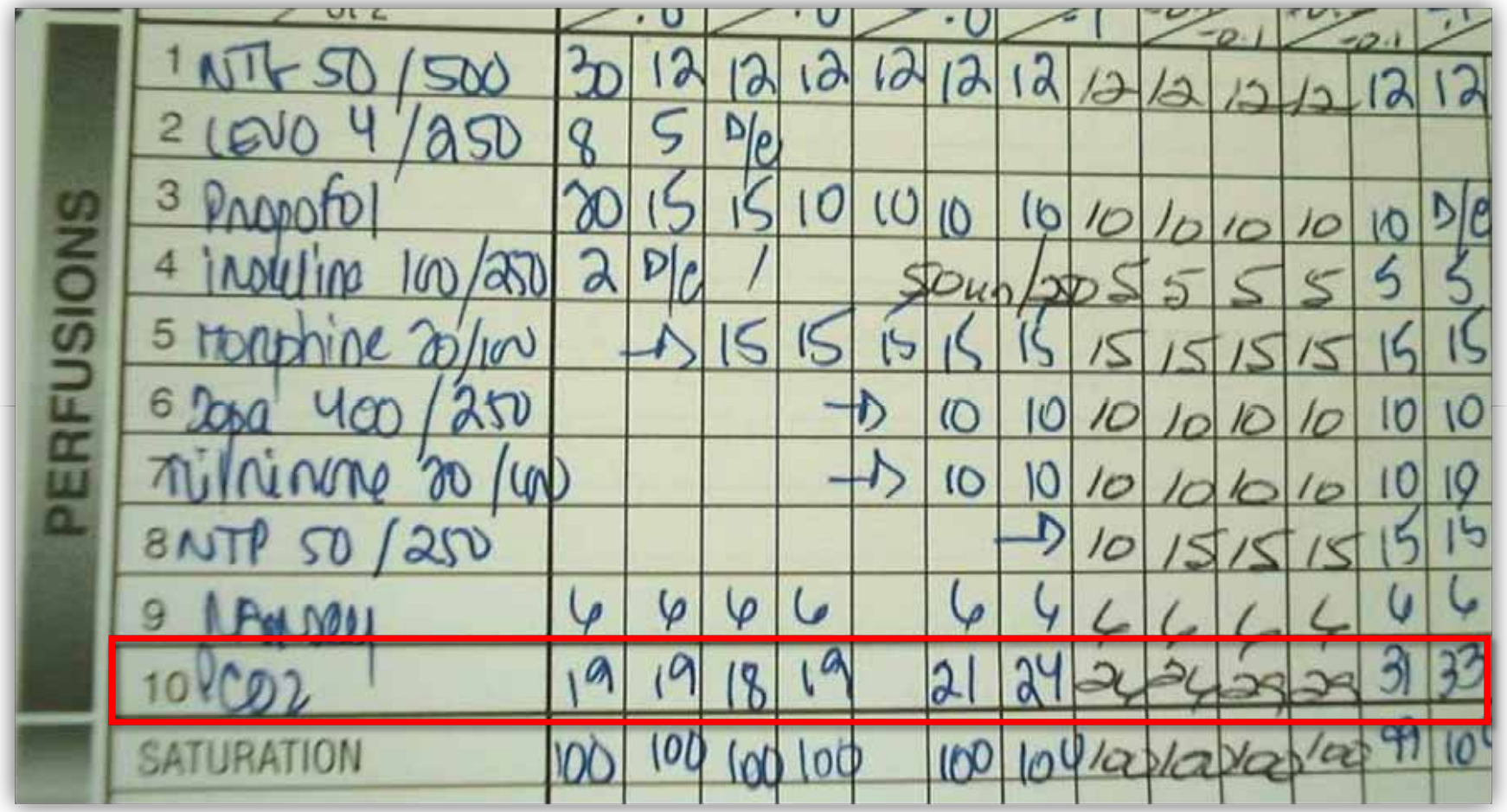
Après

Homme de 61 ans avec régurgitation aortique sur endocardite

	Pré-CEC	**Post-CEC**
Index cardiaque	1.8 L/m/m^2	3.2 L/m/m^2
Fraction d'éjection	20%	40%
ETCO2	31 mmHg	37 mmHg

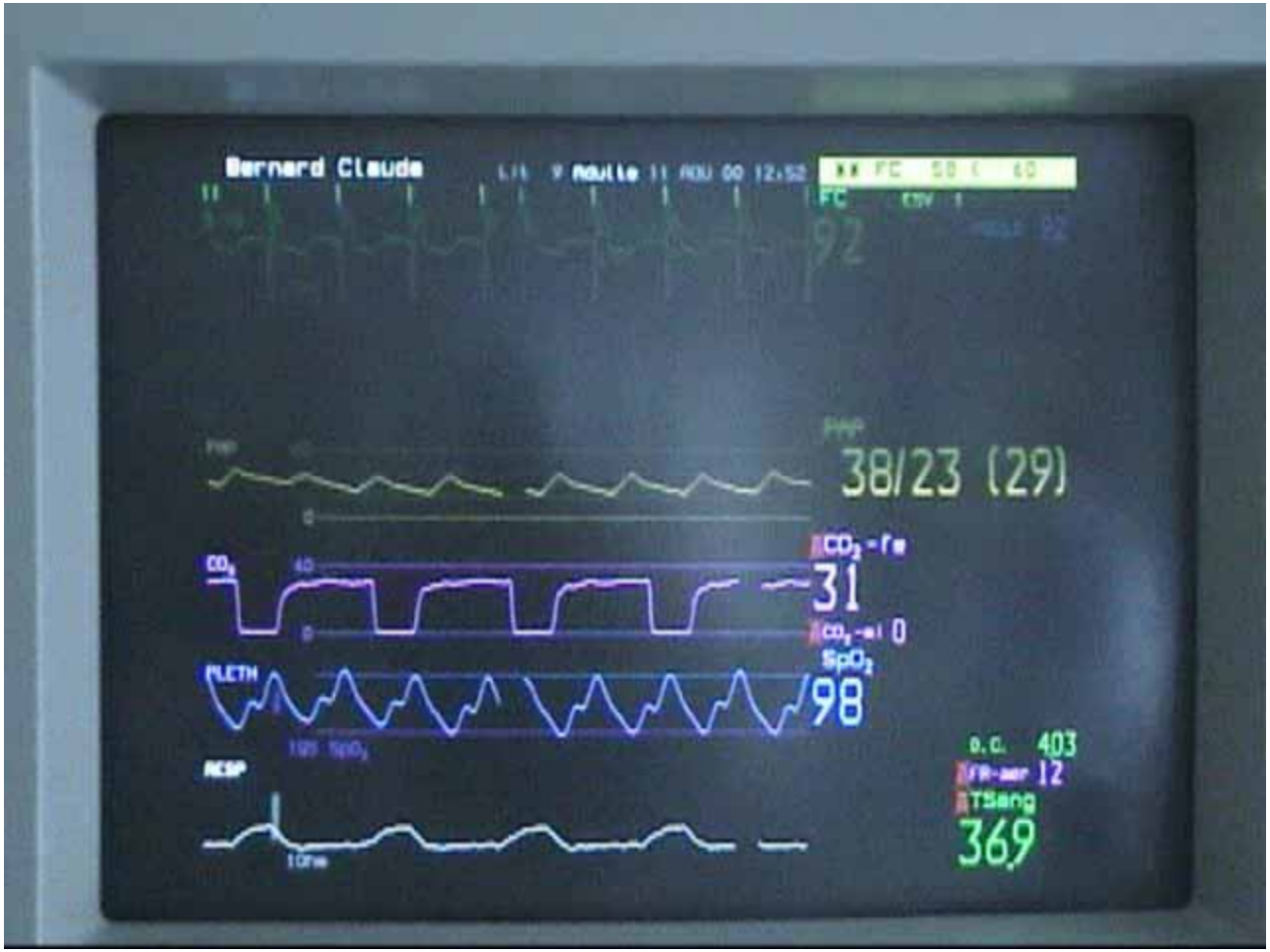


Évolution post-opératoire typique



Hypothèse unifiante?

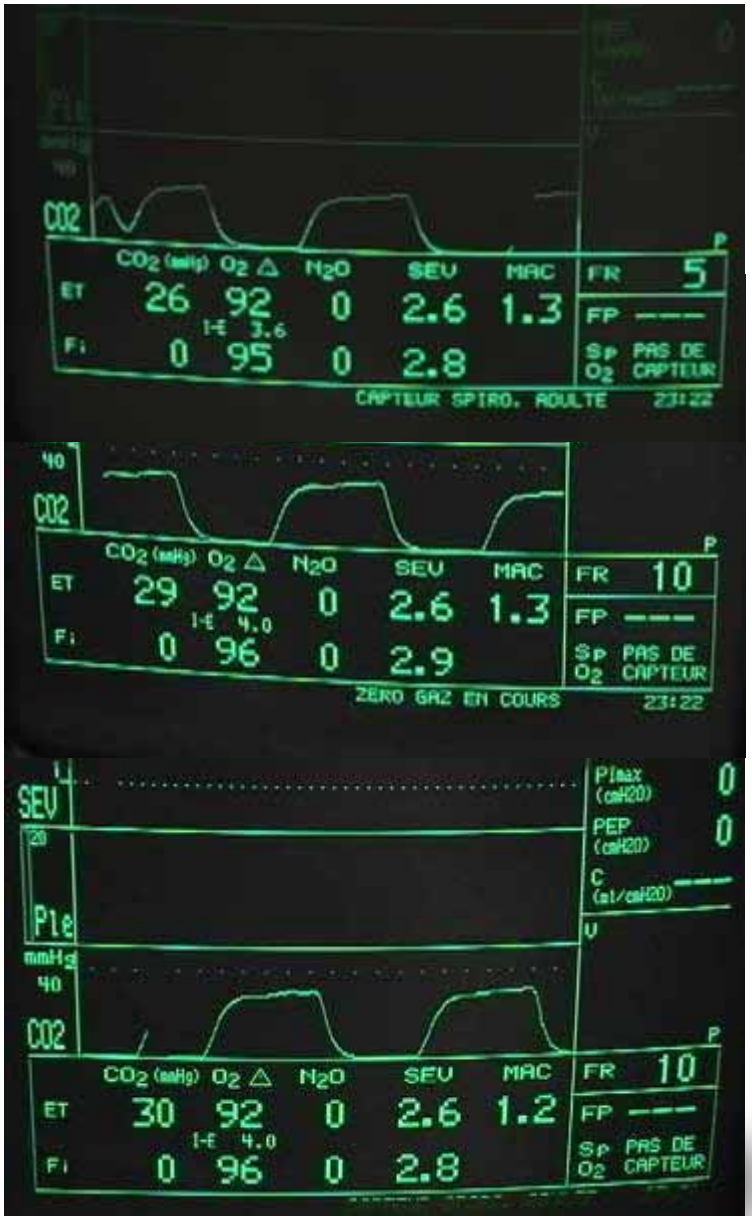
Pacemaker et capnographie



Homme de 76 ans
post remplacement aorte ascendante

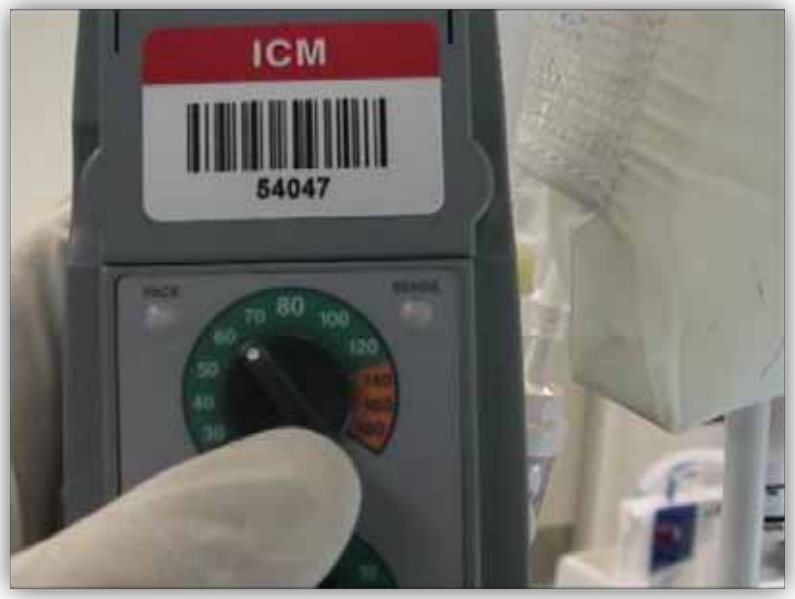
Retour d'urgence en SOP pour saignement médiastinal

Homme de 76 ans instable après chirurgie cardiaque
Effet de la fréquence cardiaque



Homme de 70 ans instable après RVA

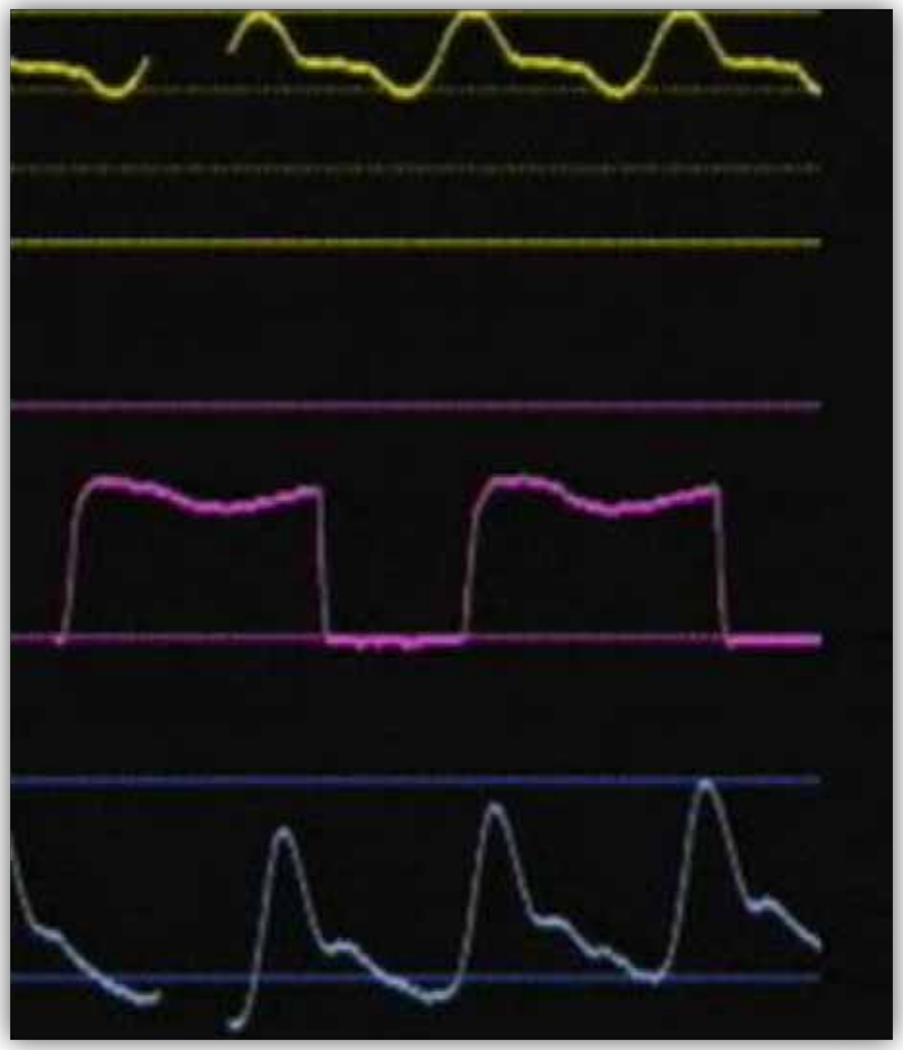
Noradrenaline 4ug/min



Noradrenaline 0.5 ug/min

Quel type de chirurgie?

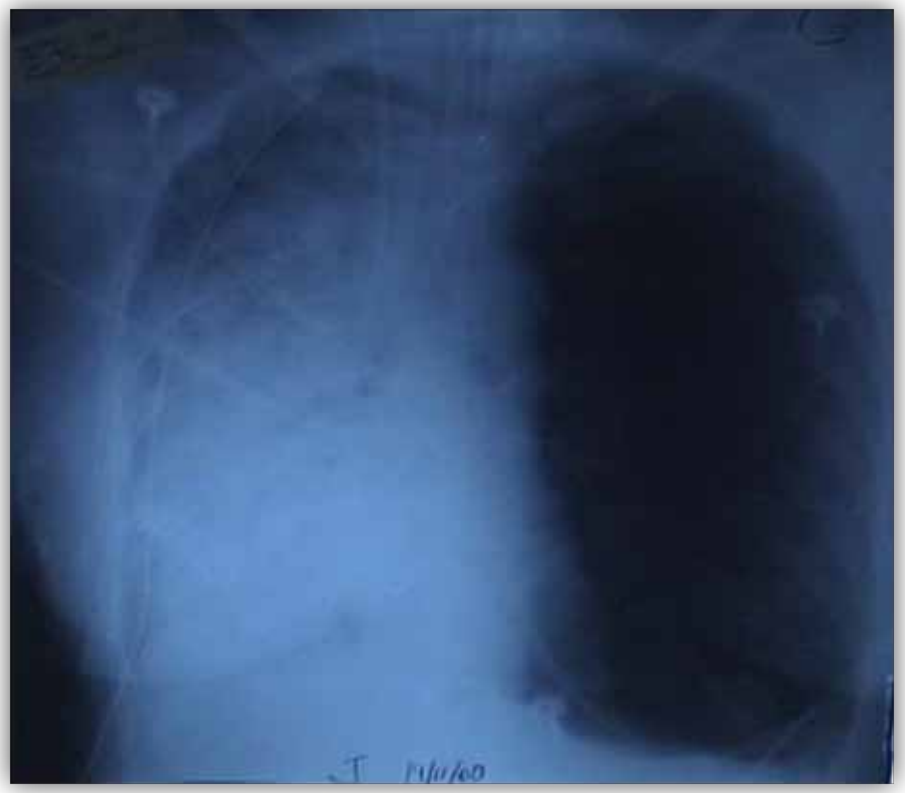
Quel type de chirurgie?



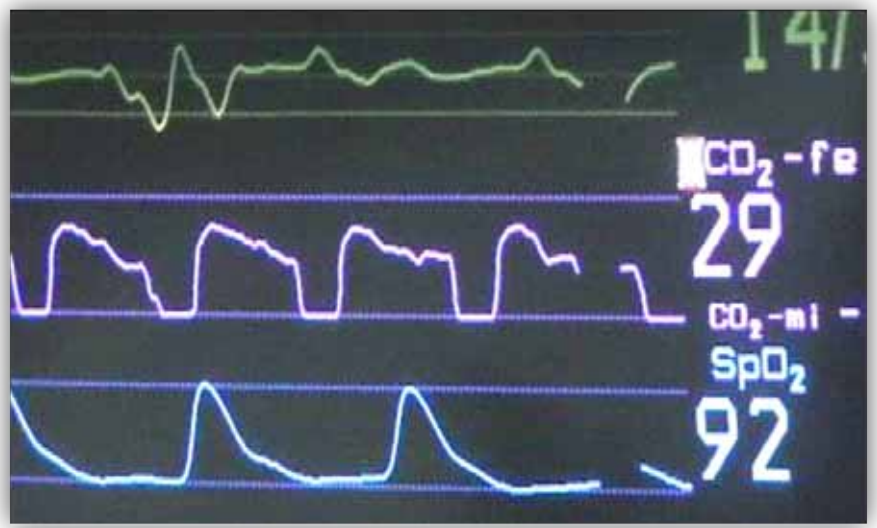
RX poumons

Pré-transplantation

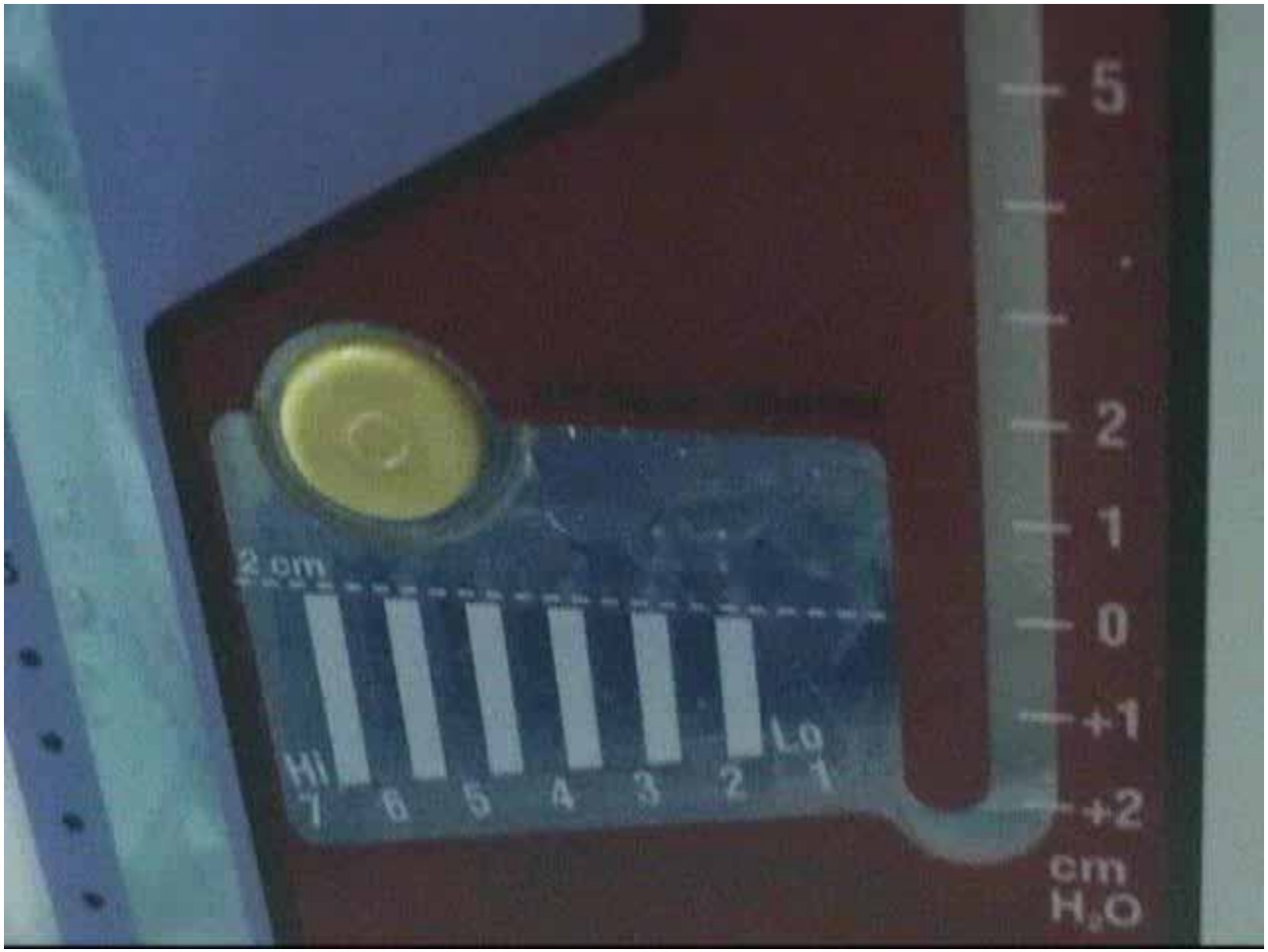
Post-transplantation



Gazométrie: pH : 7.26
PCO_2: 54
PO_2 : 166


CO_2 - fe
29
CO_2 - mi -
SpO_2
92

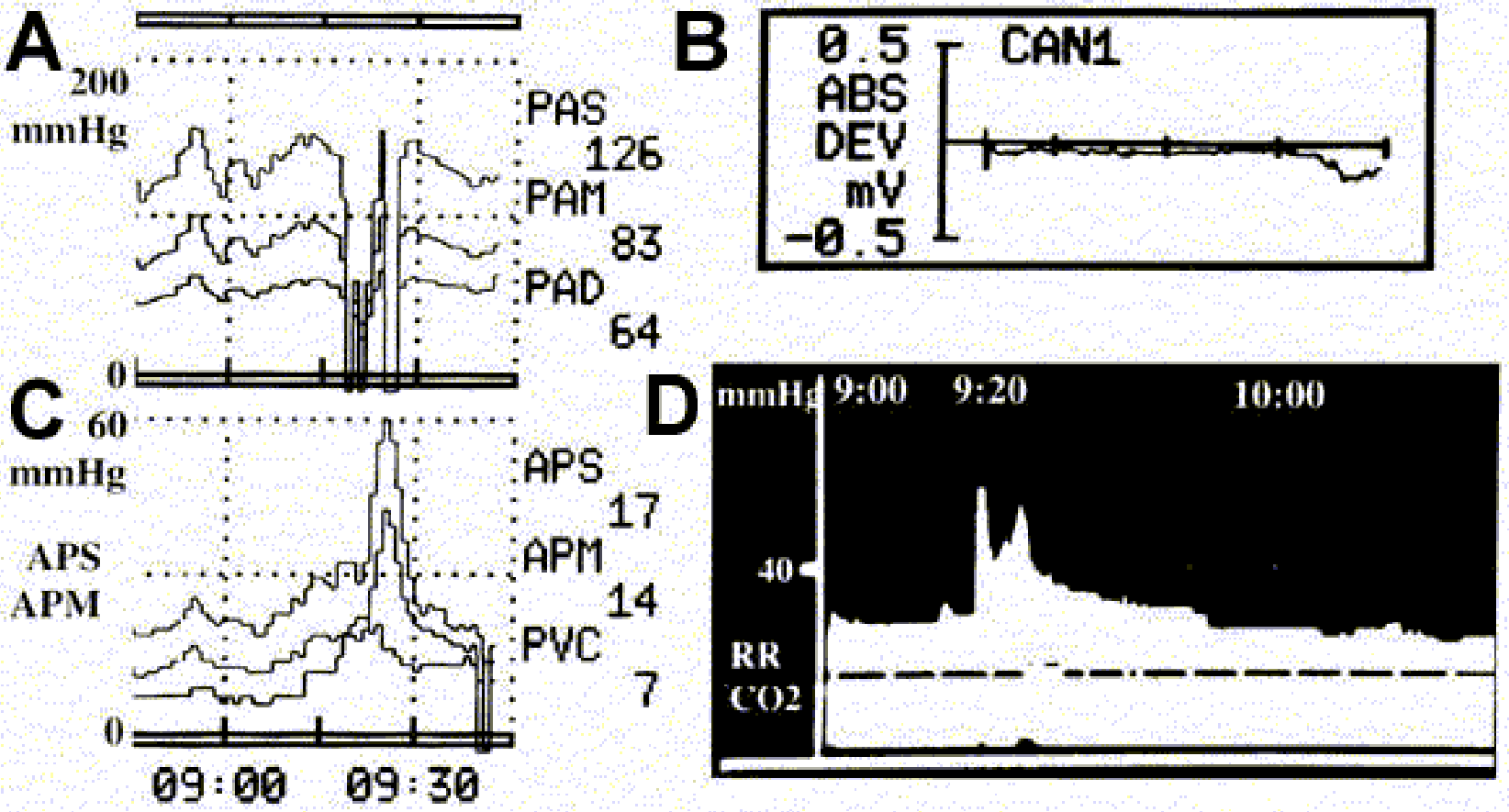
Pourquoi avons-nous un problème de saturation?



Pourquoi avons-nous un problème de saturation?

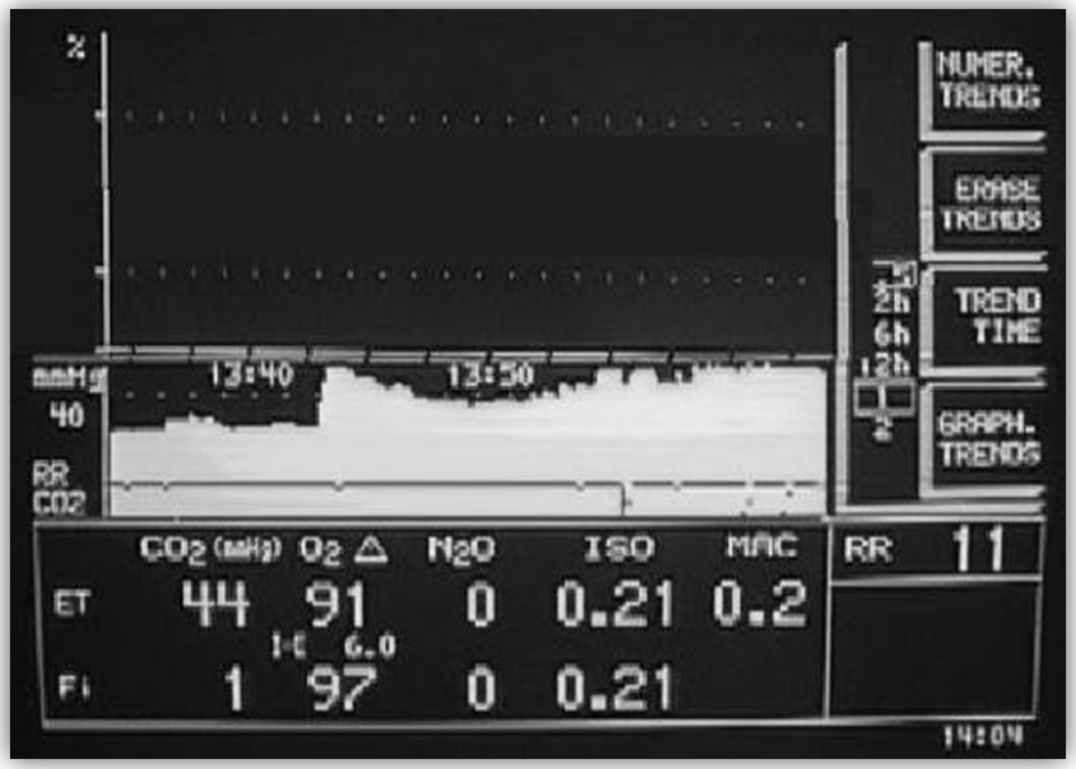
Détection de CO2

Carbon dioxide embolism during endoscopic saphenectomy for coronary artery bypass surgery

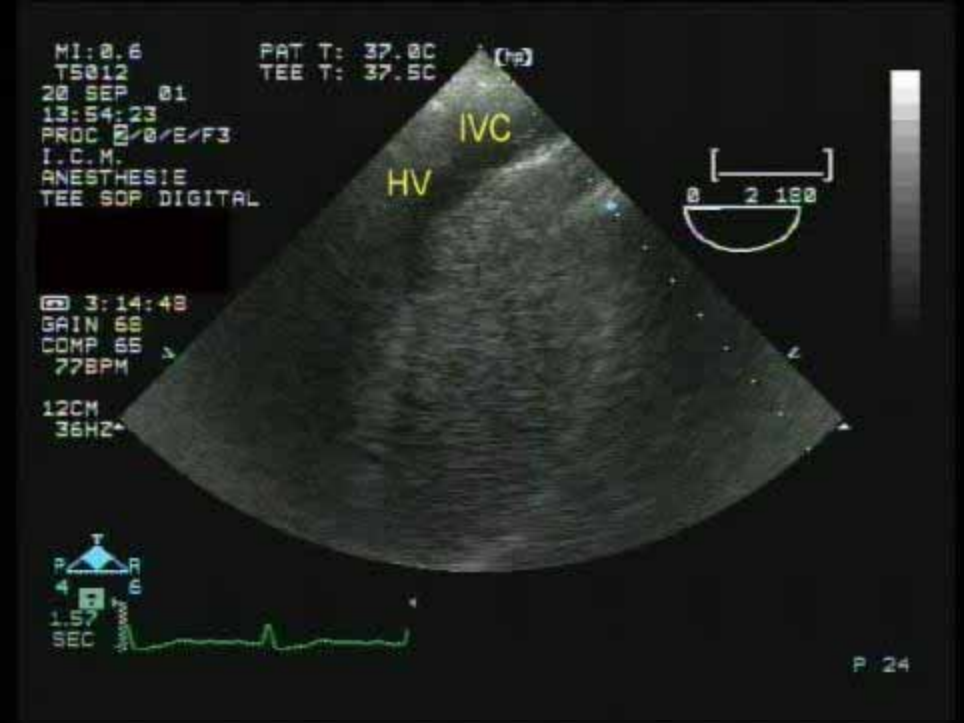


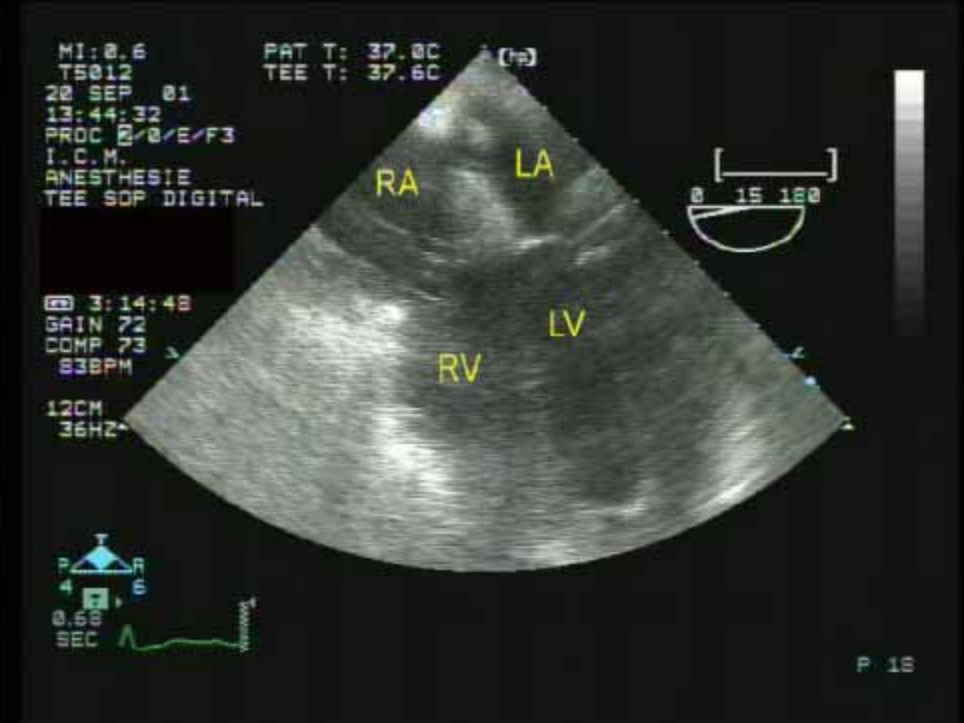
Chavanon et al. JCTVS 1999;118

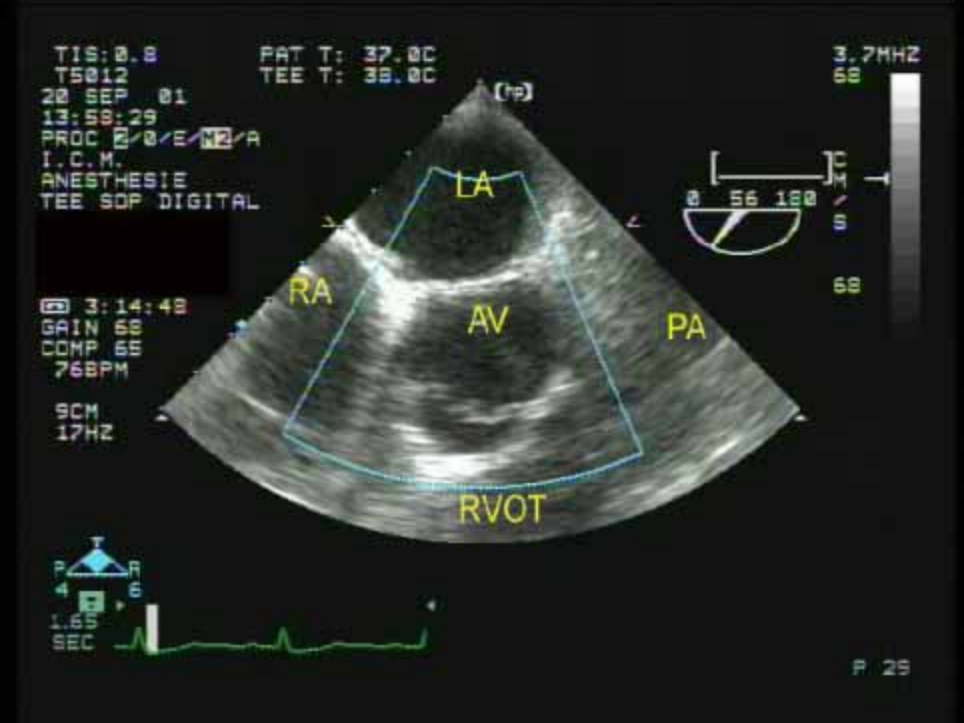
Inhaled Epoprostenol Treatment of Pulmonary Hypertension Secondary to Carbon Dioxide Embolism During Minimally Invasive Saphenous Vein Harvesting Diagnosed by Transesophageal Echocardiography

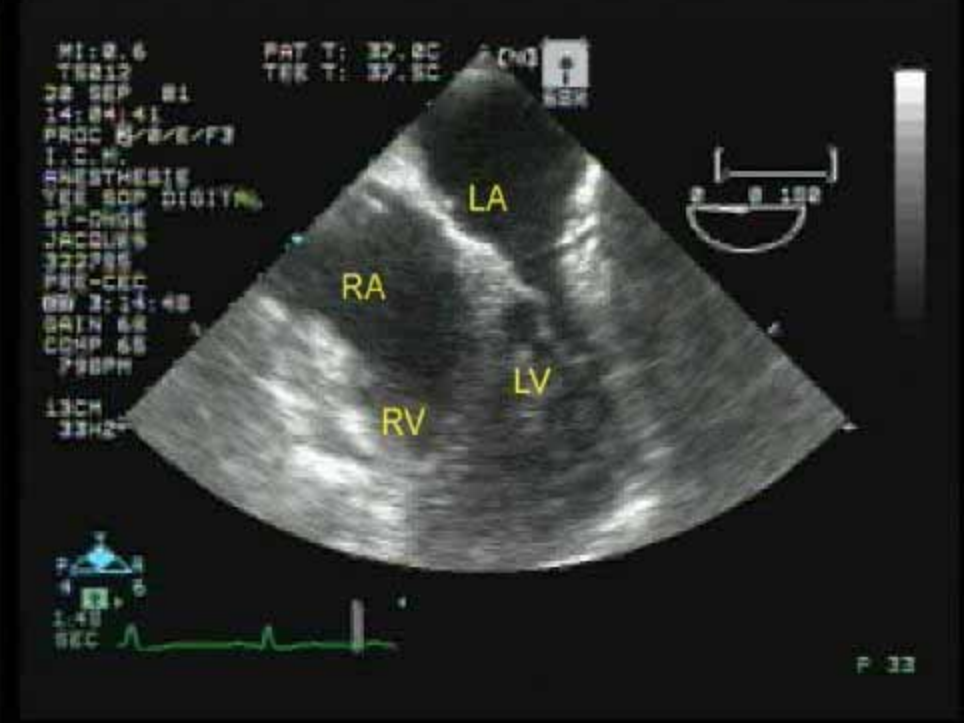


Martineau et al Anesth Anal 2001

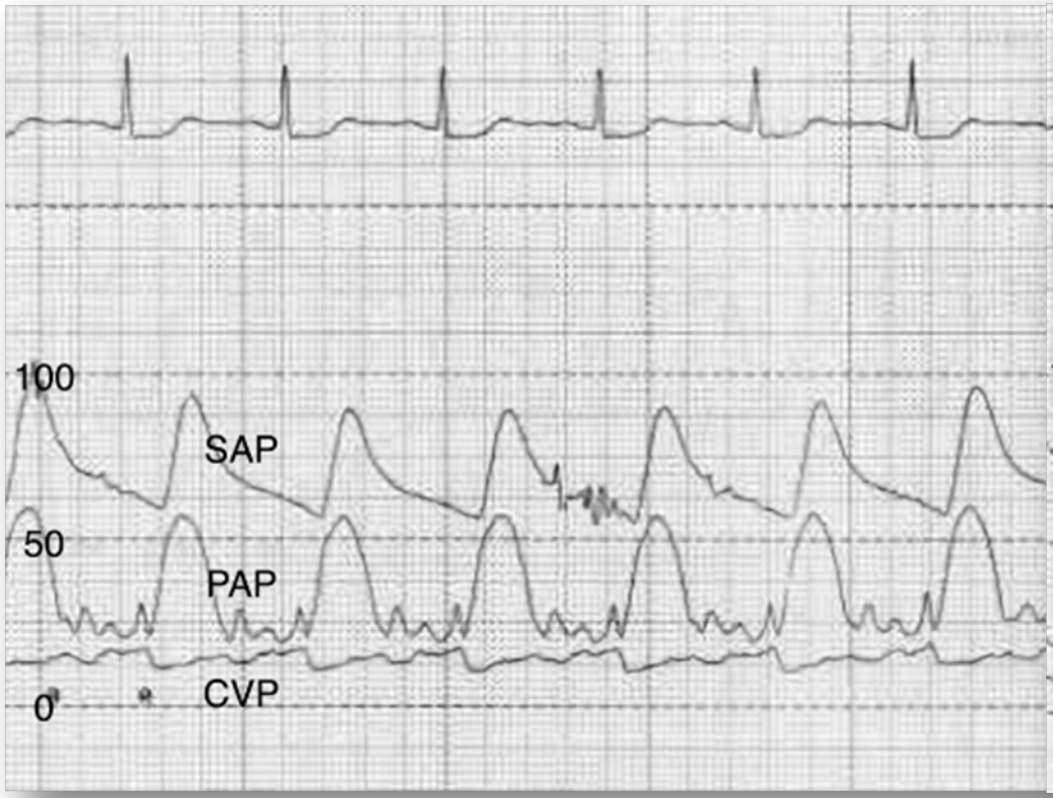

MI:0.6
T5012
20 SEP 01
13:54:23
PROC 2/0/E/F3
I.C.M.
ANESTHESIE
TEE SOP DIGITAL
PAT T: 37.0C
TEE T: 37.5C
IVC
HV
3:14:48
GAIN 68
COMP 65
77BPM
12CM
36HZ
1.57
SEC
P 24

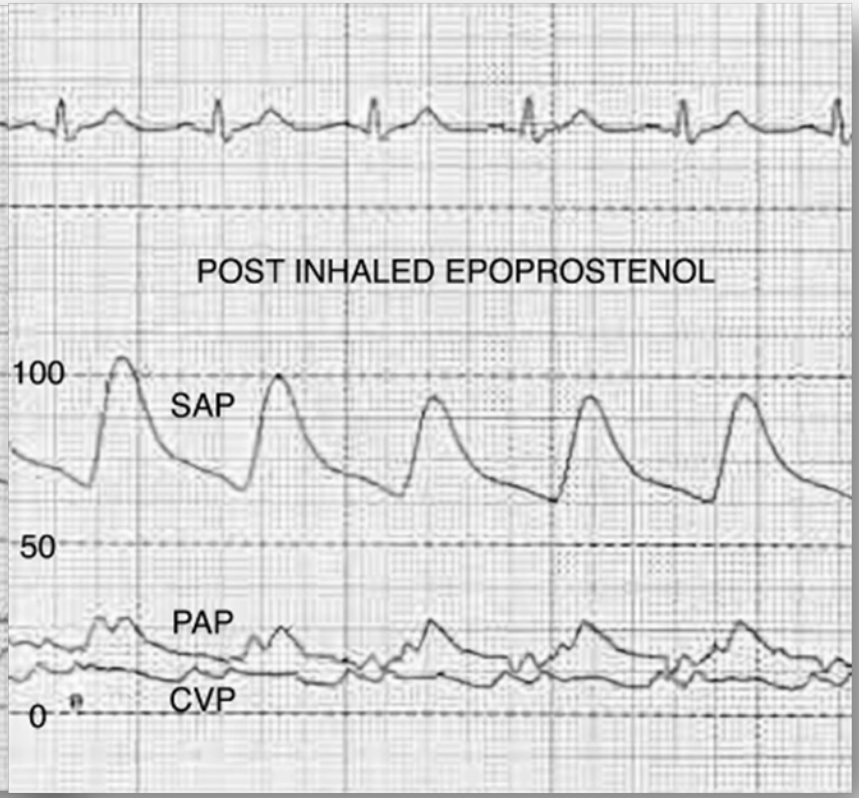

MI:0.6
T5012
20 SEP 01
13:44:32
PROC 2/0/E/F3
I.C.M.
ANESTHESIE
TEE SOP DIGITAL
PAT T: 37.0C
TEE T: 37.6C
RA
LA
LV
RV
3:14:48
GAIN 72
COMP 73
83BPM
12CM
36HZ
0.68
SEC
P 18


TIS:0.8
T5012
20 SEP 01
13:59:29
PROC 2/0/E/M2/A
I.C.M.
ANESTHESIE
TEE SOP DIGITAL
PAT T: 37.0C
TEE T: 38.0C
3.7MHZ
LA
RA
AV
PA
RVOT
3:14:48
GAIN 68
COMP 65
76BPM
9CM
17HZ
1.65
SEC
P 29


LA
RA
LV
RV
P 33

Ėvolution post-flolan





Plan

1-Méthodes et système de mesure

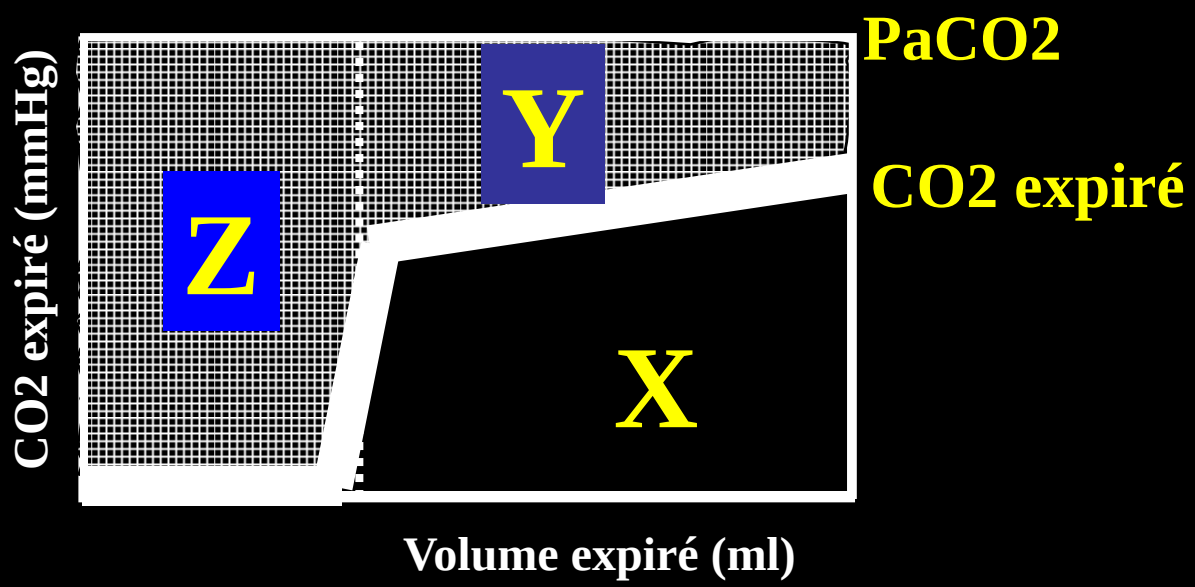
2-Physiologie du CO_2

3-Courbes de CO_2

4-CO_2 volumétrique

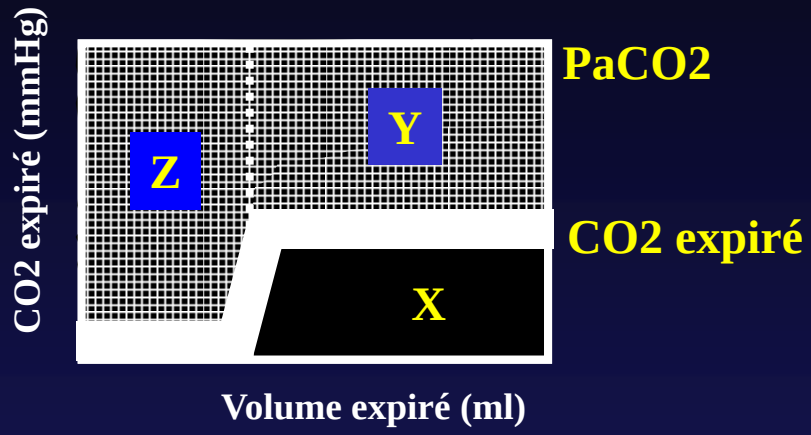
5-Autres applications

Capnographe volumétrique

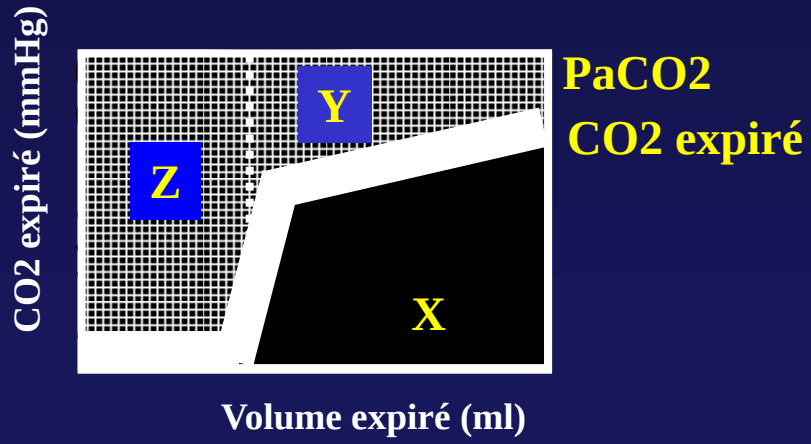


X:volume de CO2 = ventilation efficace
Y:volume d’espace mort physiologique
Z:volume d’espace mort anatomique

Différence PaCO2 et CO2 expiré

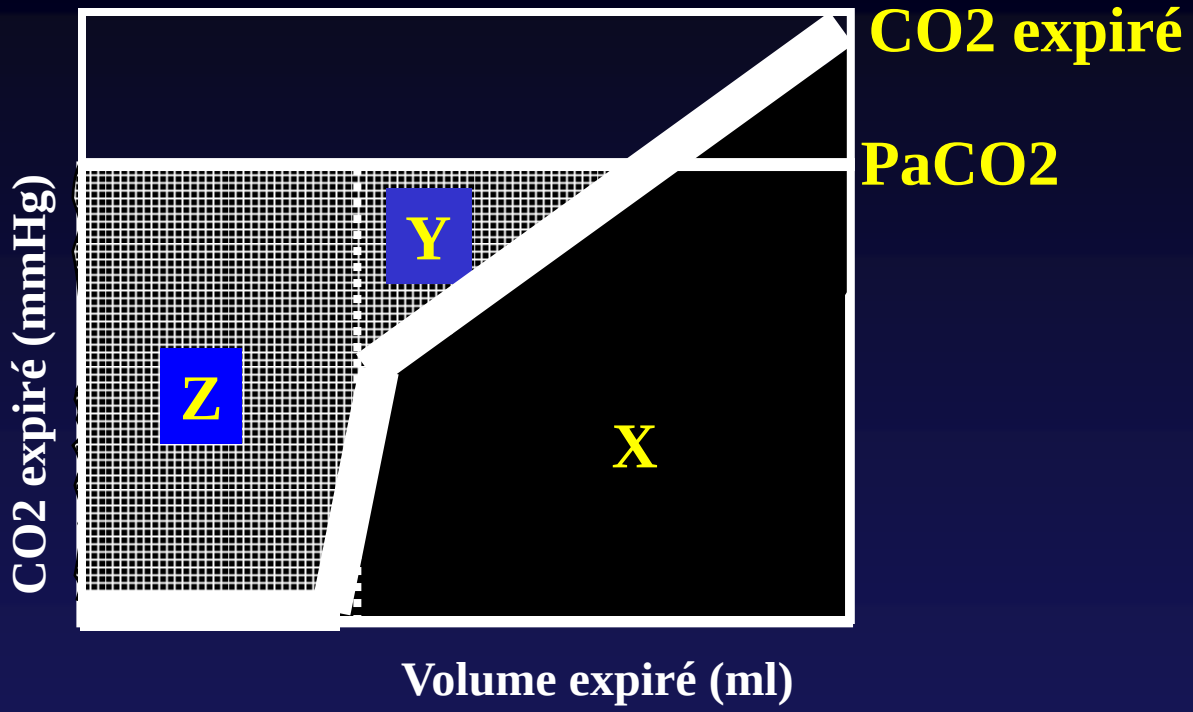


Espace mort augmenté



Espace mort diminué?

Différence PaCO2 et CO2 expiré négative



12 % des normaux (50% enfants et femmes enceintes)
Large volume courant, fréquence respiratoire lente et réduction CRF
Plus près de la PvCO2

Plan

1-Méthodes et système de mesure

2-Physiologie du CO_2

3-Courbes de CO_2

4-CO_2 volumétrique

5-Autres applications

Autre applications de la capnographie

1-Ventilatoire

- ventilation spontanée et profondeur anesthésie
- ajustement du débit de gaz frais
- guider l'intubation à l'aveugle
- ajustement du PEEP et recrutement alvéolaire
- tube double lumière
- ventilation par jet
- sevrage du ventilateur

2-Circulatoire

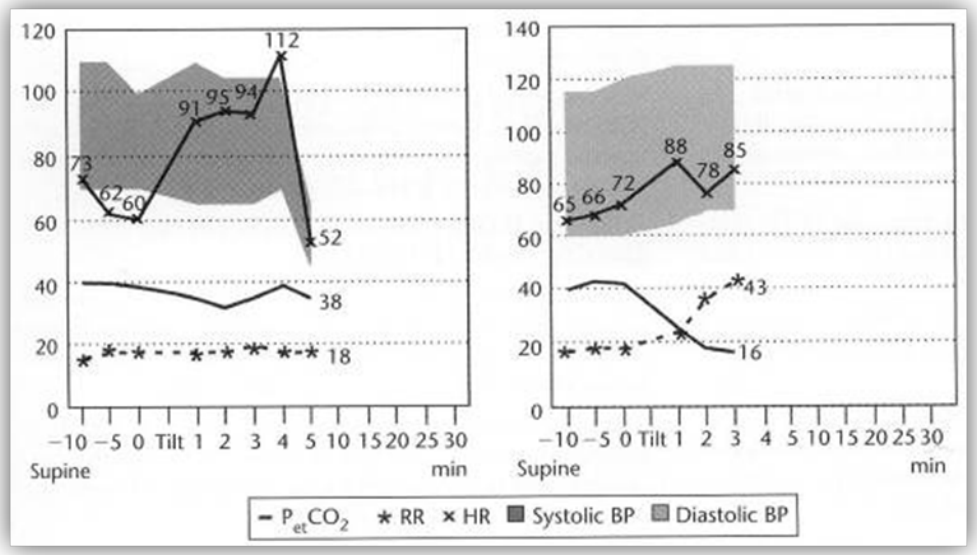
- moniteur de débit cardiaque
- sevrage de CEC
- détection d'embolie pulmonaire et gazeuse
- réanimation

3-Autre: états hypermétaboliques

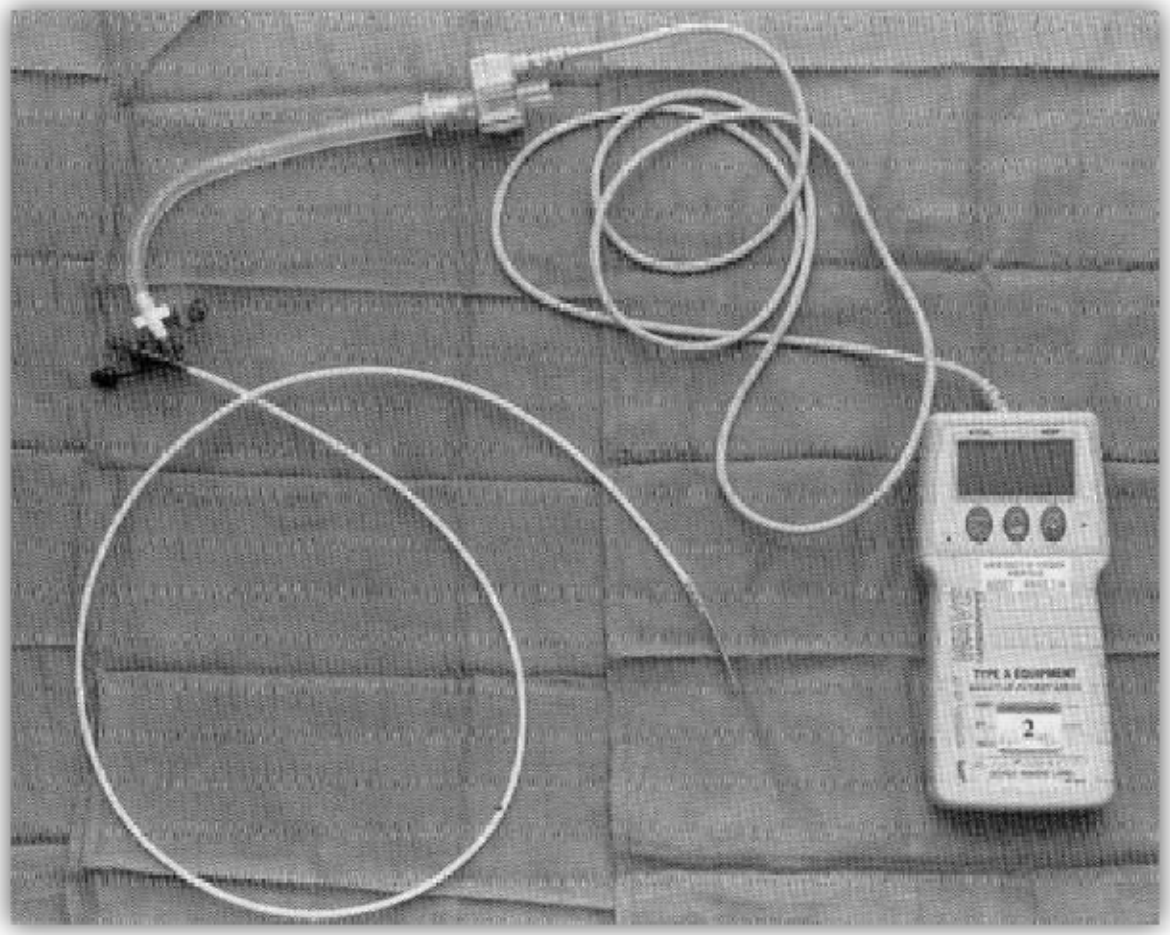
Autres applications

Sédation et endoscopie GI (Miner 2002 Acad. Emer. Med. 9;275-280 et Vargo Gas Endos 55;826-831)

Test pour syncope et hyperventilation (CHUTT) (Naschitz Pediatrics 1998, 101;1-6)



Positionnement du duotube



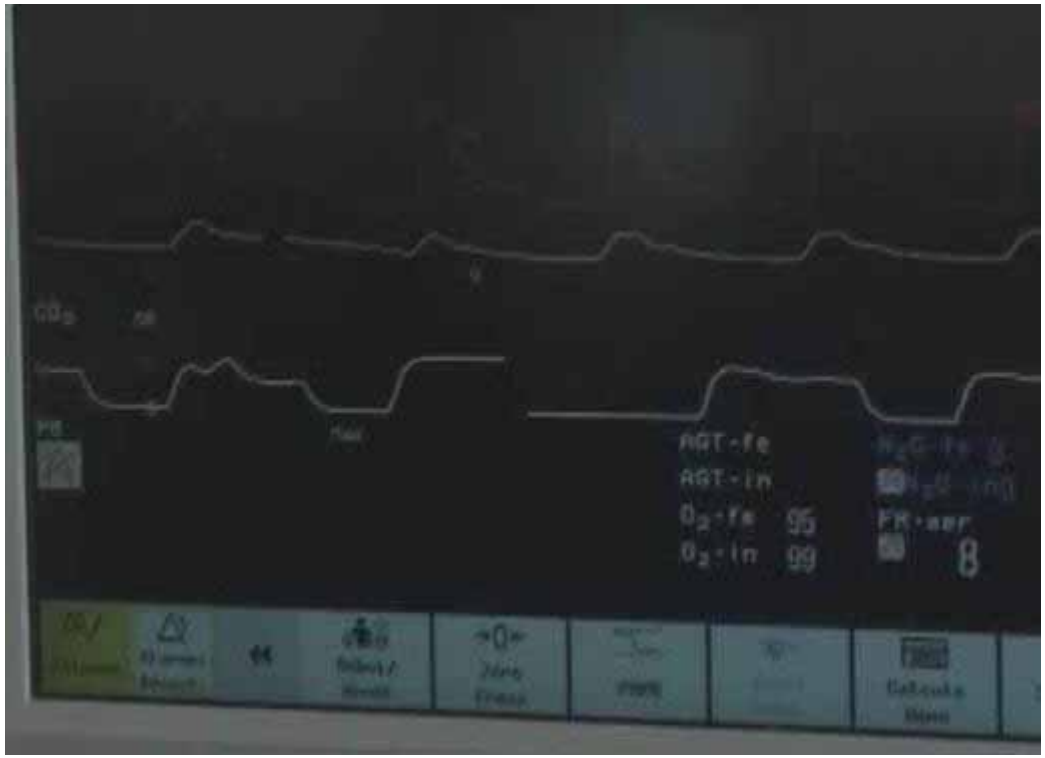
Sensibilité et spécificité 100%

Burns SM et al Crit Care Med 2001:29;936-939

Duotube pulmonaire

Autre application: 70 ans redo plastie mitrale et CIA: fin du cas

70 ans redo plastie mitrale et CIA



ARDS et espace-mort

PULMONARY DEAD-SPACE FRACTION AS A RISK FACTOR FOR DEATH IN THE ACUTE RESPIRATORY DISTRESS SYNDROME

THOMAS J. NUCKTON, M.D., JAMES A. ALONSO, R.R.T., RICHARD H. KALLET, R.R.T., M.S., BRIAN M. DANIEL, R.R.T., JEAN-FRANÇOIS PITTET, M.D., MARK D. EISNER, M.D., M.P.H., AND MICHAEL A. MATTHAY, M.D.

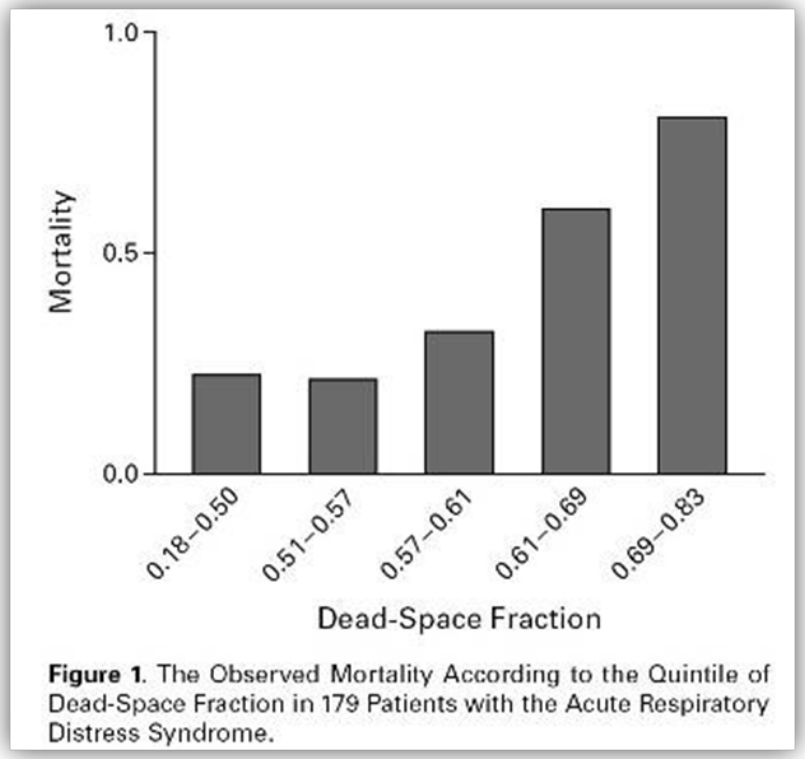
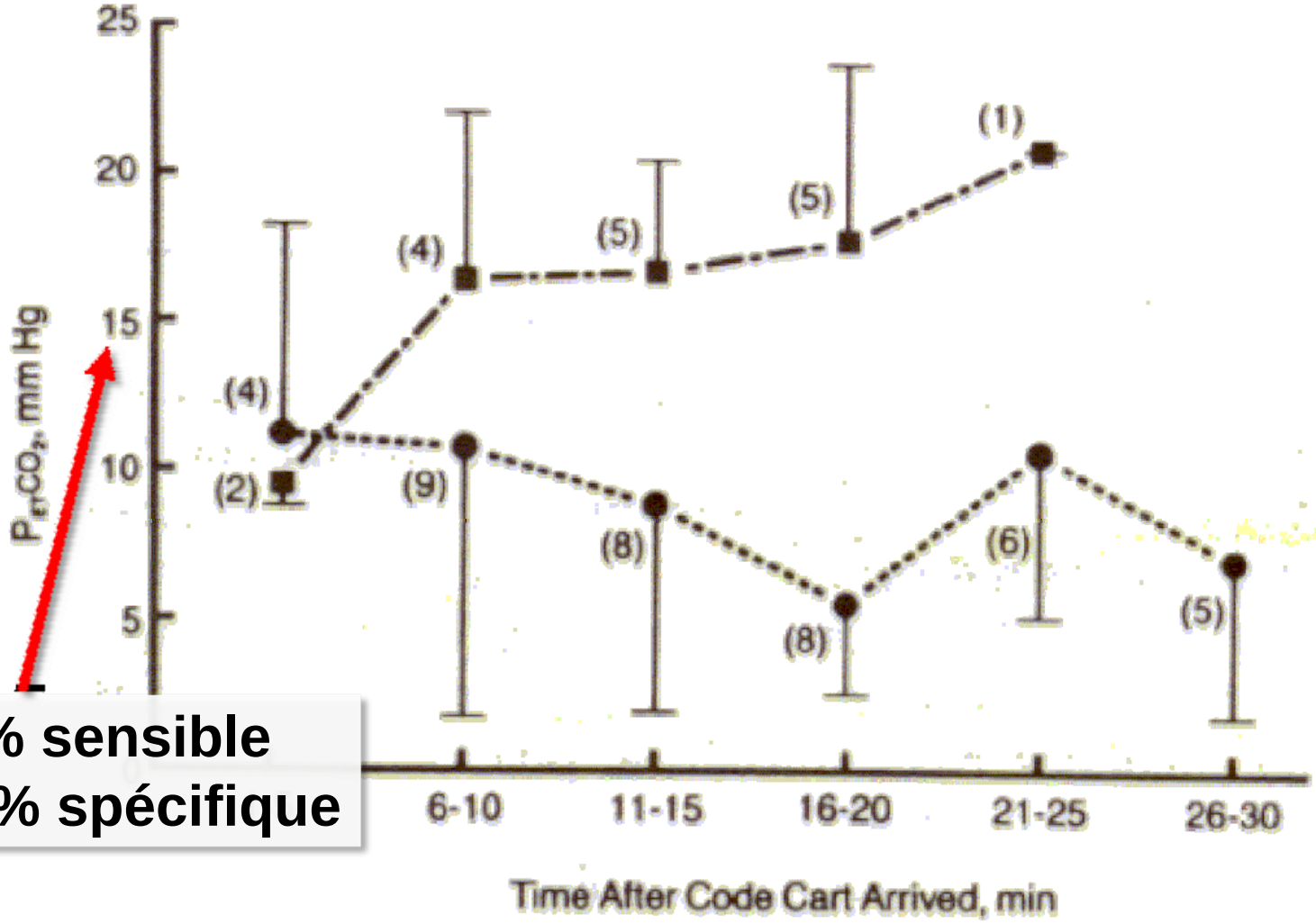


Figure 1. The Observed Mortality According to the Quintile of Dead-Space Fraction in 179 Patients with the Acute Respiratory Distress Syndrome.

« Elevated value are associated with an increase risk of death »

NEJM 2002;346:1281-6

Capnographie et réanimation



71% sensible
98% spécifique

Falk JL Adv Anesthesia 1993:10

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Previous Volume 337:301-306 July 31, 1997 Number 5 Next ▸

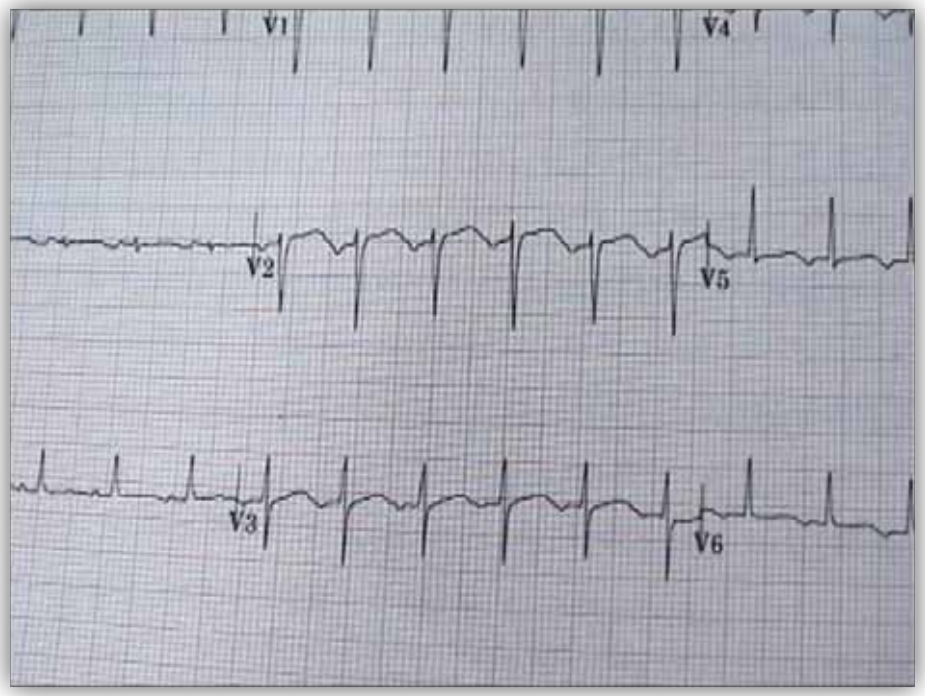
End-Tidal Carbon Dioxide and Outcome of Out-of-Hospital Cardiac Arrest

Robert L. Levine, M.D., Marvin A. Wayne, M.D., and Charles C. Miller, Ph.D.

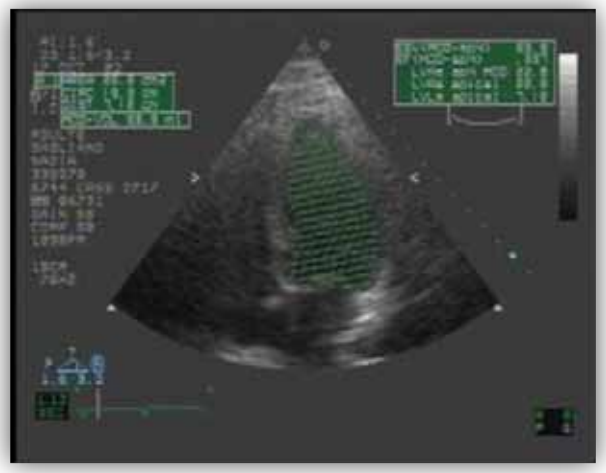
1-After 20 minutes of advanced cardiac life support, end-tidal carbon dioxide (SD) averaged 4.4 2.9 mm Hg in nonsurvivors and 32.8 7.4 mm Hg in survivors (P< 0.001).

Femme de 23 ans connue épileptique avec convulsions suivies d'arrêt cardiaque

QT prolongé



Femme de 23 ans arrêt cardiaque



- EEG pas de convulsion
- CTSCAN: œdème cérébral
- Décès et donneur d'organes

British Journal of Neurosurgery, April 2005; 19(2): 141 – 147

Taylor & Francis
Taylor & Francis Group

ORIGINAL ARTICLE

Early myocardial dysfunction following subarachnoid haemorrhage

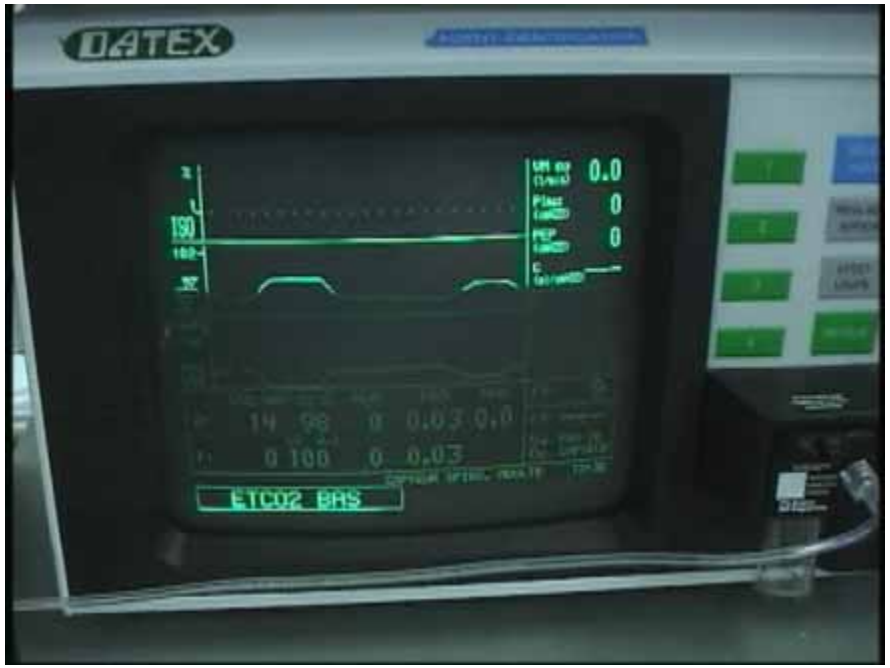
N. MCLAUGHLIN[1], M. W. BOJANOWSKI[1] & A. DENAULT[2,3]

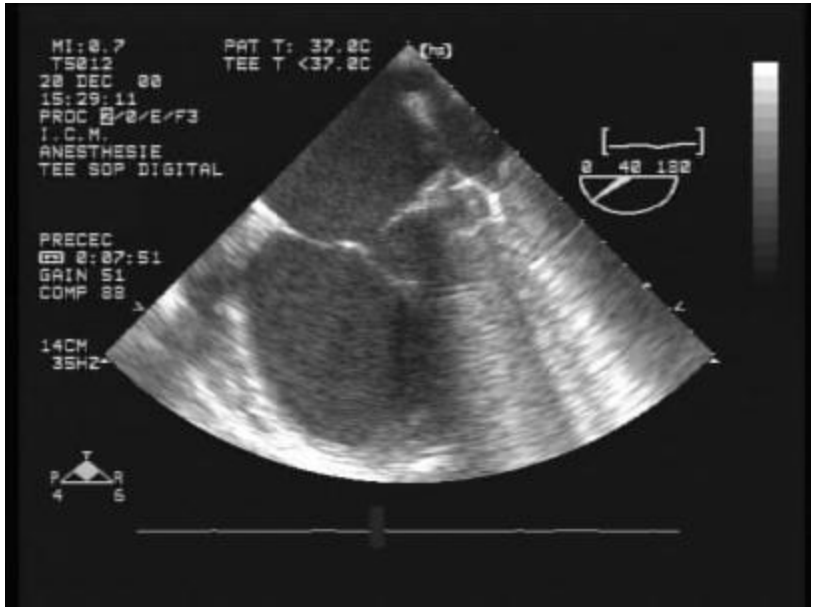
[1]*Department of Neurosurgery, and* [2]*Intensive Care Unit, Centre hospitalier de l'Université de Montréal (CHUM), Hôpital Notre-Dame, and* [3]*Department of Anesthesiology, Montreal Heart Institute, Montreal, QC, Canada*

Abstract
Like systolic dysfunction (SD), diastolic dysfunction (DD) has recently been proposed as a contributing factor in haemodynamic instability and in the genesis of pulmonary oedema, but its occurrence in subarachnoid haemorrhage (SAH) patients has not been described. Following aneurysmal SAH, three patients arrived at our institution with haemodynamic instability requiring vasoactive drugs and with pulmonary oedema. Transoesophageal echocardiographic study during aneurysm surgery documented as mild to severe left ventricular SD and DD. Right ventricular SD and DD were also present. Documented biventricular systolic and diastolic myocardial dysfunctions may contribute to haemodynamic instability and pulmonary oedema following SAH due to intracranial aneurysmal rupture.

Key words: *Cerebral aneurysm, diastolic dysfunction, echocardiography, heart failure, subarachnoid haemorrhage, surgery timing.*

Femme de 82 ans…pronostique?





Limitations de la capnographie

1-Calibration et vérification

2-TET dans le pharynx (œil de Murphy)

3-Si intubation difficile: air riche en CO_2 dans l'estomac (sphincter GE incompétent) et si TET esophagien $ETCO_2$ positif initialement

4-Hypoventilation: débit expiratoire < debit d 'aspiration

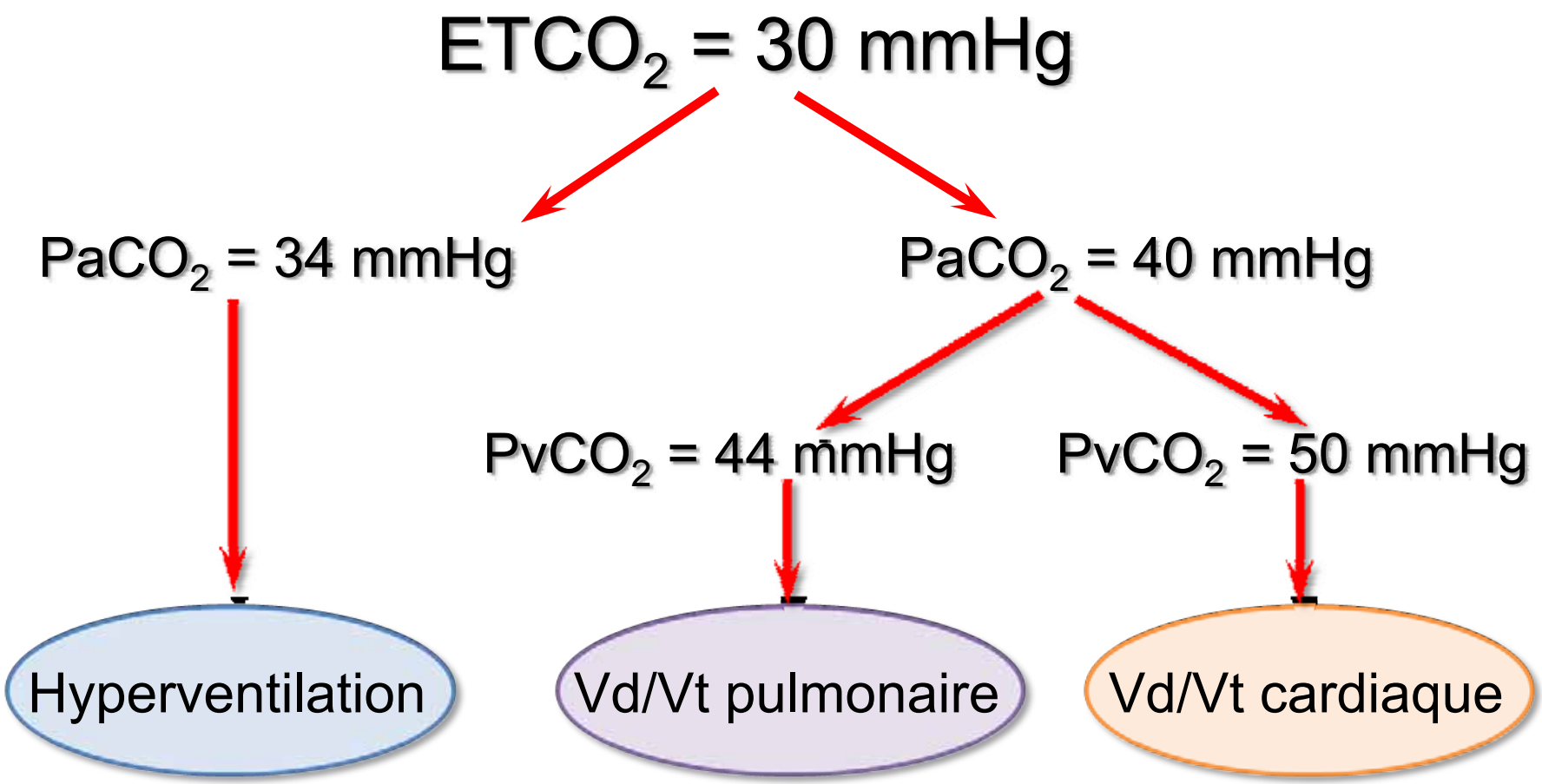
5-Choisir le type de capnographe ou capnomètre

6-Mal interpréter le CO_2 expiré

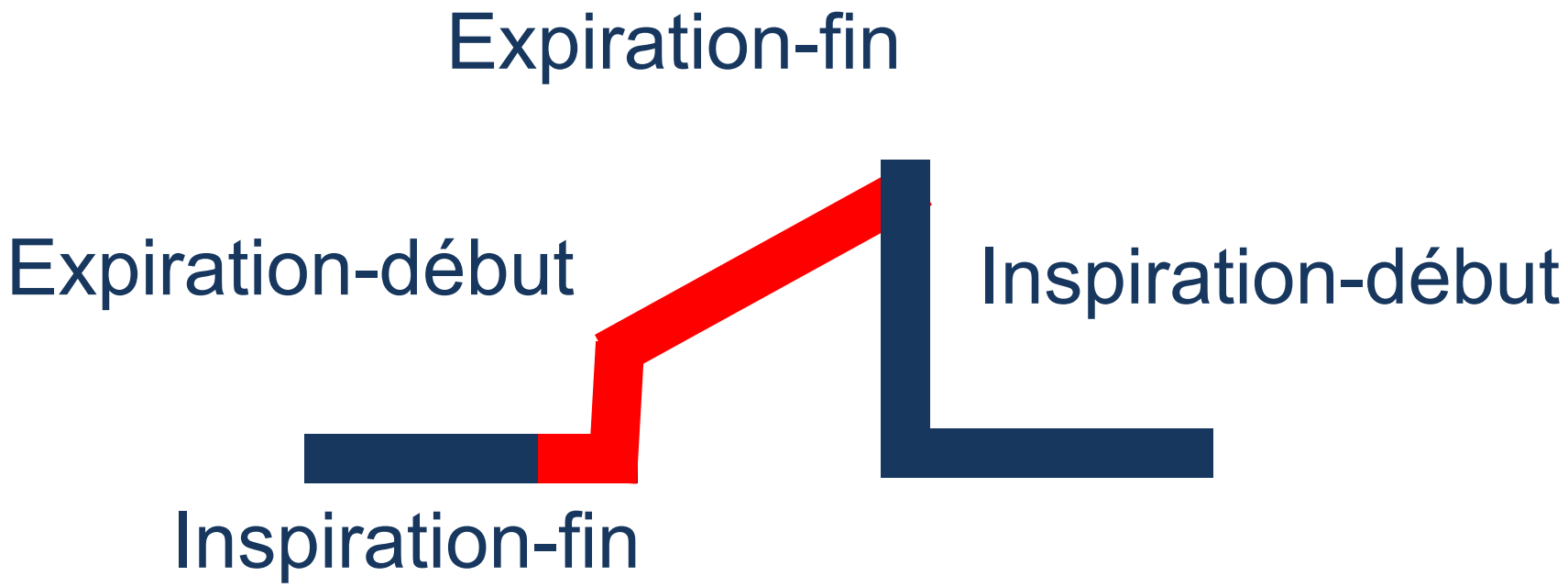
7-Si TET endobronchique: $ETCO_2$ normal (15%), diminue (6%) et augmente (5%)

8-Tachypnée: cycle respiratoire > temps de réponse du capnographe (problème si > 30/min)

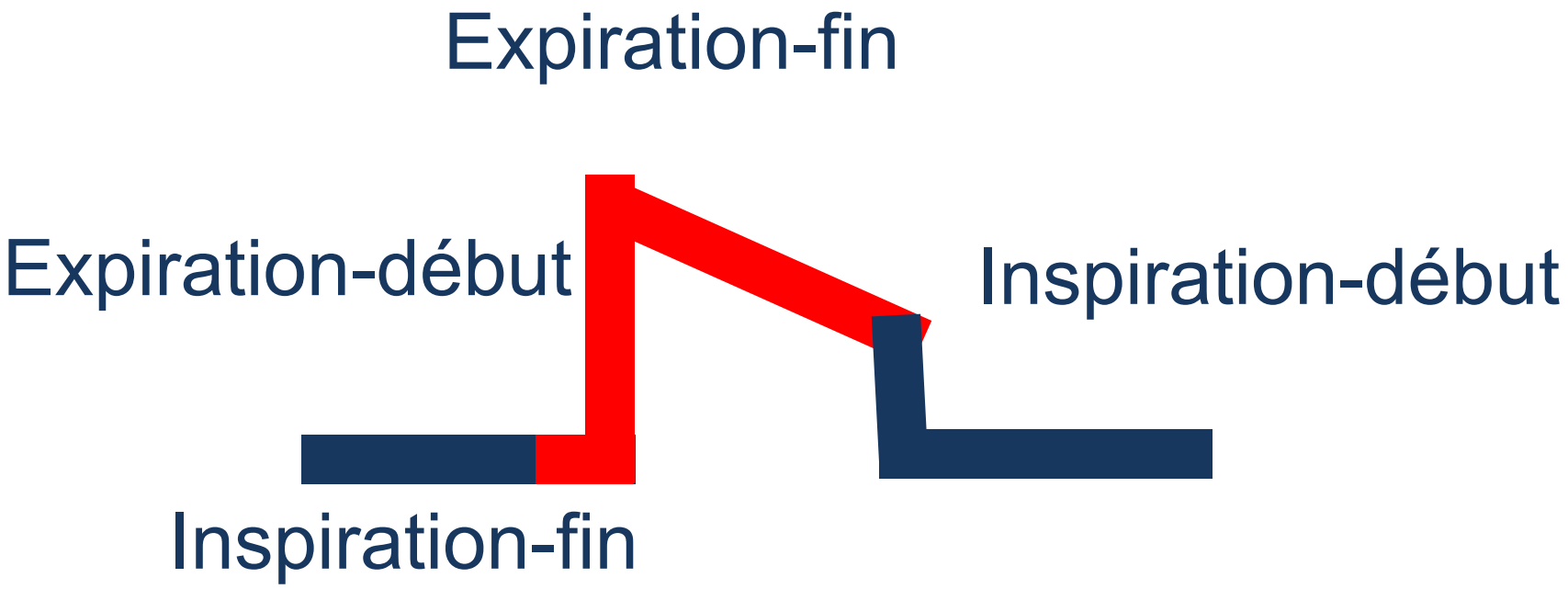
Capnographie et gradient AV PCO_2



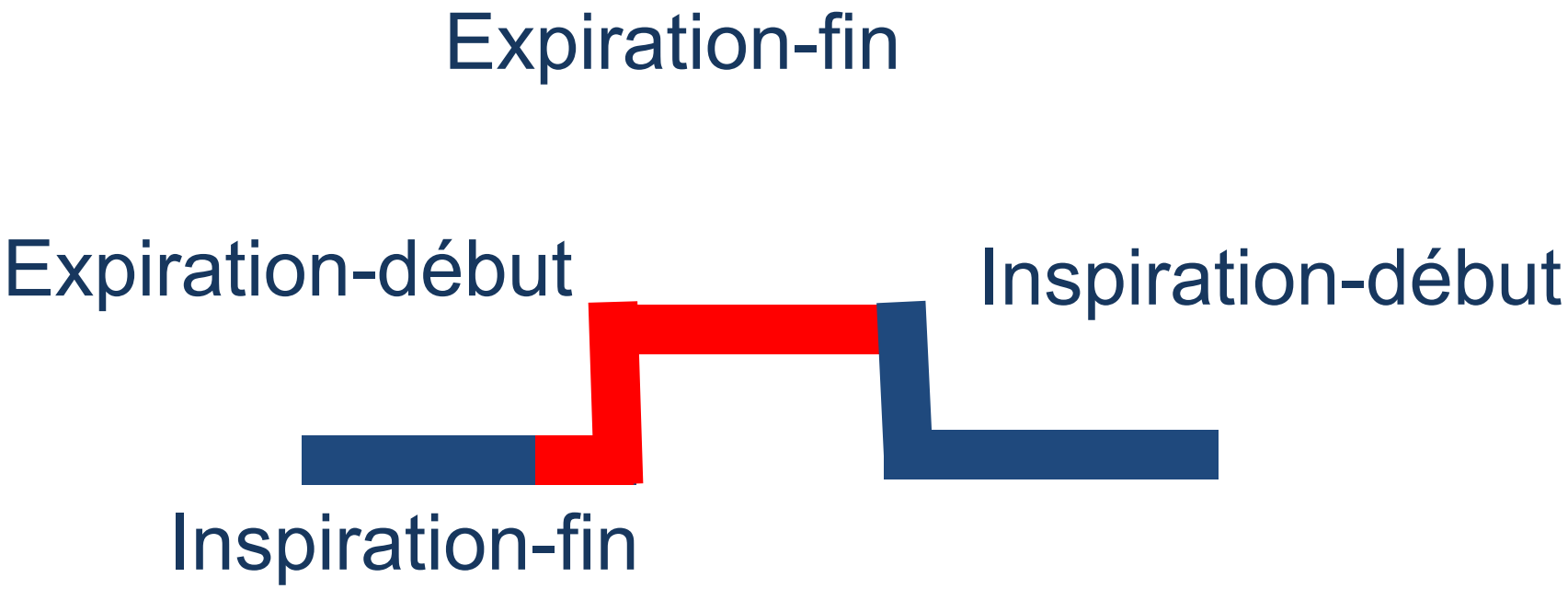
Tracé capnographique I
Bronchospasme



Tracé capnographique II: fuite de gaz expiré



Tracé capnographique III: baisse de débit cardiaque



Résumé: Rôle de la capnographie

A: « Airway » ou détecteur du le positionnement du TET

B: « Breathing » ou détecte la présence d'une ventilation, sa fréquence, le type de ventilation, les anomalies V/Q, estime la $PaCO_2$ et la profondeur de l'anesthésie ou de la sédation

C: Circulation sanguine pulmonaire et systémique: moniteur de débit cardiaque et des interventions hémodynamiques

D: Diagnostique: MPOC, le CO_2 dans le circuit d'anesthésie (intrinsèque ou extrinsèque), fuite du ballonet, fistule broncho-pleurale, extubation imminente, duotube pulmonaire

E: Espérance de survie dans l'ARDS et arrêt cardiaque