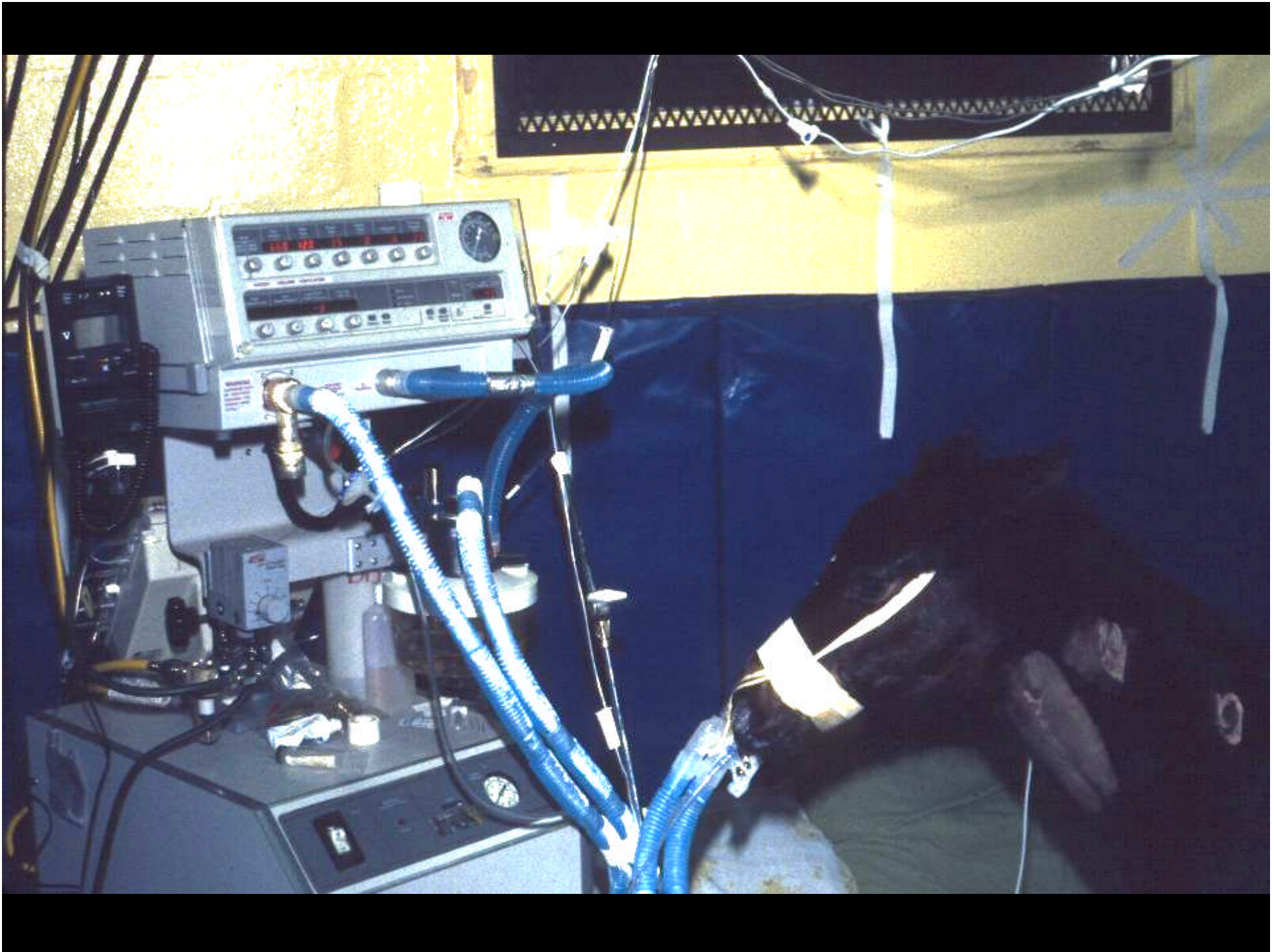




Blood Gas Interpretation



Oxygen Therapy Monitoring

- Pa_{O_2}
- Saturation (SaO_2)
- Oxygen content ($\text{O}_2 \text{ Ct}$)



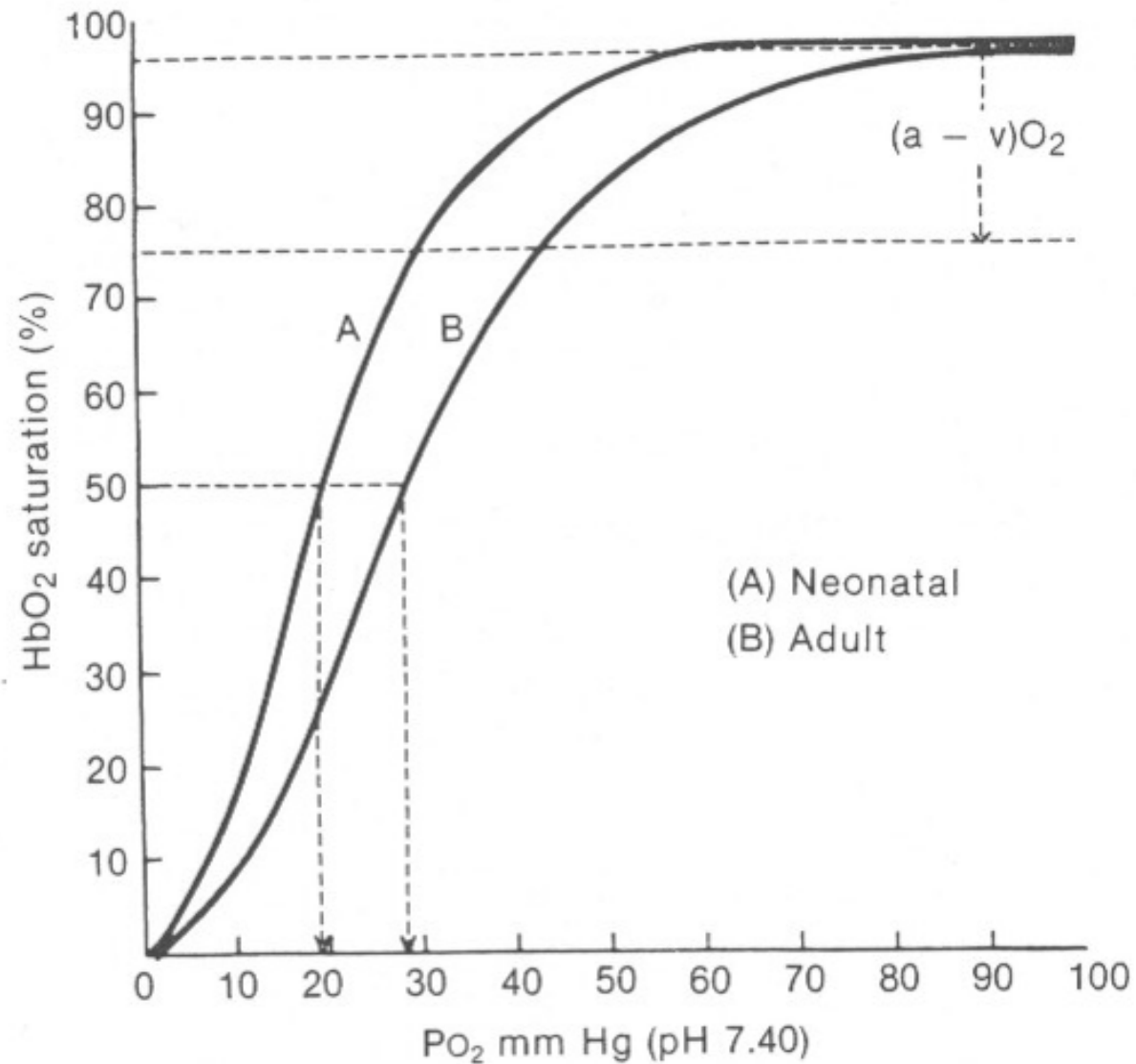
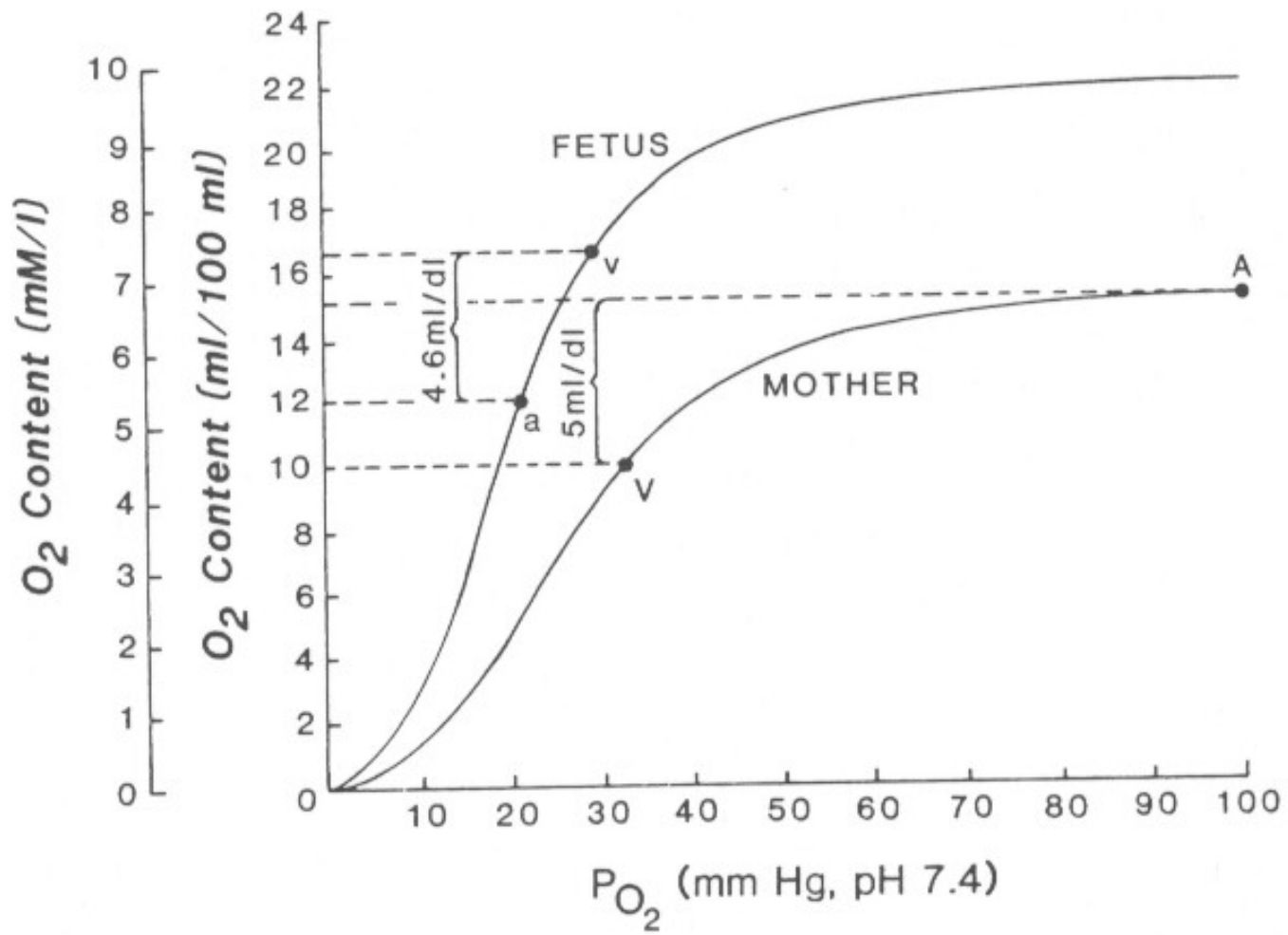


Figure 102-5. Oxyhemoglobin equilibrium curves of blood from term infants at birth and from adults.



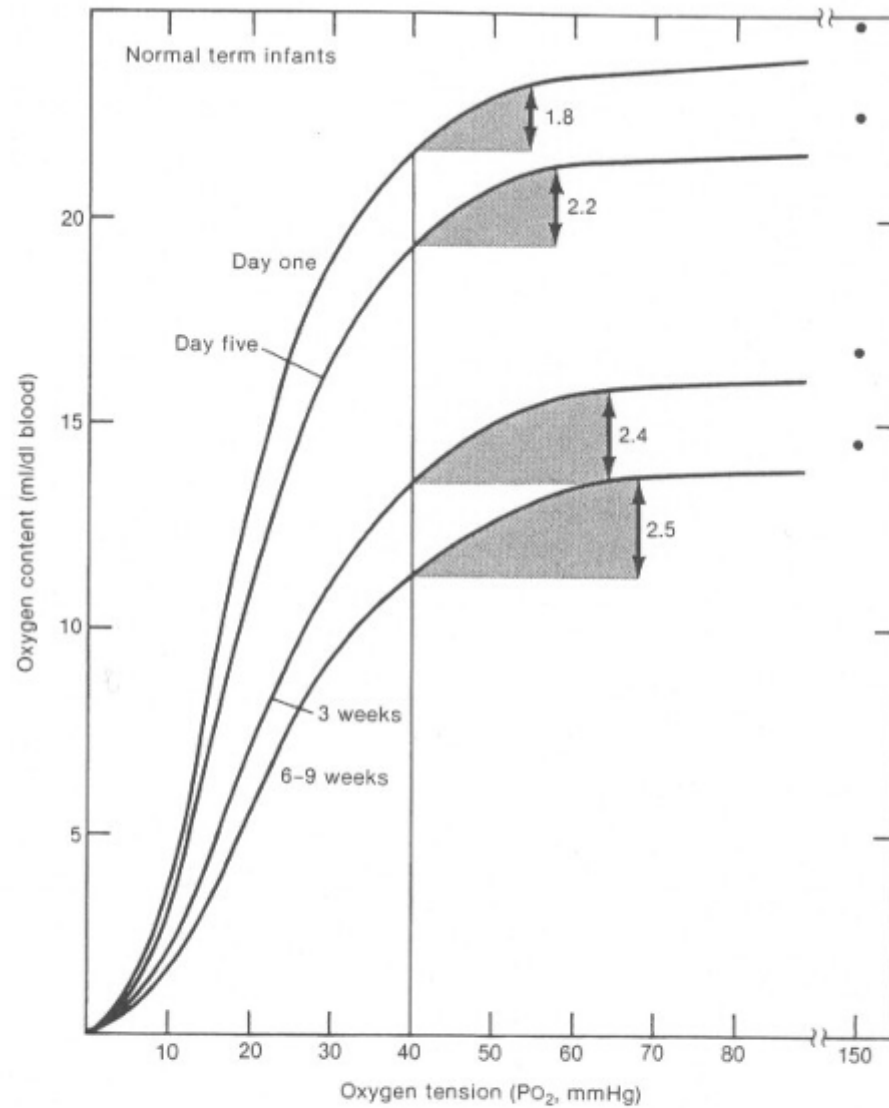


Figure 102-9. Oxygen equilibrium curves of blood from term infants at different postnatal ages. Double arrows represent the oxygen-unloading capacity between a given "arterial" and "venous" PO₂. Points corresponding to 150 mm Hg on the abscissa are the O₂ capacities; each curve represents the mean value of the infants studied in each age group.



Venous Oximetry

- Mixed venous oxygen saturation
 SvO_2
Surrogate for
 - Systemic oxygen delivery and consumption
- Central venous oxygen saturation
 $ScvO_2$
Oxygen extraction
 - Brain and the upper part of the body
- Low SvO_2 or $ScvO_2$
Mismatch between O_2 delivery/tissue O_2 need

Venous Oximetry

- O_2 consumption independent of delivery
 - More can be extracted as needed
 - Fails when delivery drops low enough
- With decreased delivery
 - Compensation fails
 - More extraction
 - Low $ScvO_2$ means tissue hypoxia
 - Increased metabolic stress

Venous Oximetry

- Low SvO₂
 - Delivery not increase as tissue needs increase
 - Delivery decreases for some reason
 - Decrease arterial O₂ content
 - Decrease CO
- Response to tissue hypoxia
 - Increase CO
 - Increase extraction
 - Decrease SvO₂
 - Normal response as in exercise
 - Drop SvO₂
 - Not mean tissue hypoxia
 - Response to prevent hypoxia
 - Compensation

Venous Oximetry

- $ScvO_2 < Svo_2 = 2-3\%$
Normal individuals
Lower body blood supply not just O₂ delivery
 - Kidneys
 - GI
 - Liver
- $ScvO_2 > Svo_2 = 8\%$
Shock
Less blood delivered lower body
Higher extraction O₂
- $ScvO_2$ is equivalent to SvO_2
In clinical decisions

Venous Oximetry

- Low ScvO₂ in shock

Global increase oxygen extraction

Compensation failing

- In face of adequate loading ($P_{aO_2} > 80$)

Causes

- Decreased CO
- Inadequate PCV

Venous Oximetry

Goal

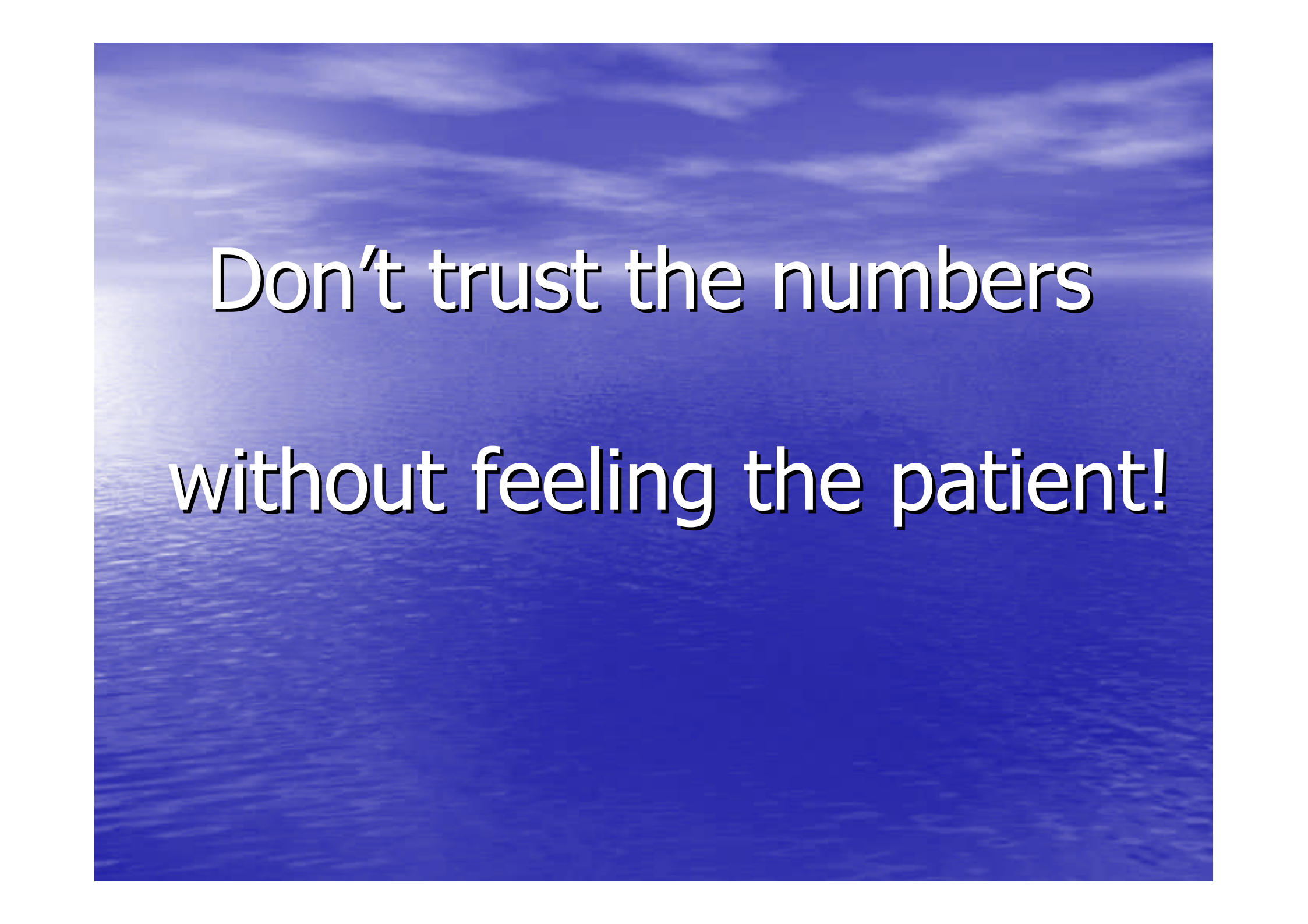
- ScvO₂ > 70%
- Pao₂ > 80

Cure

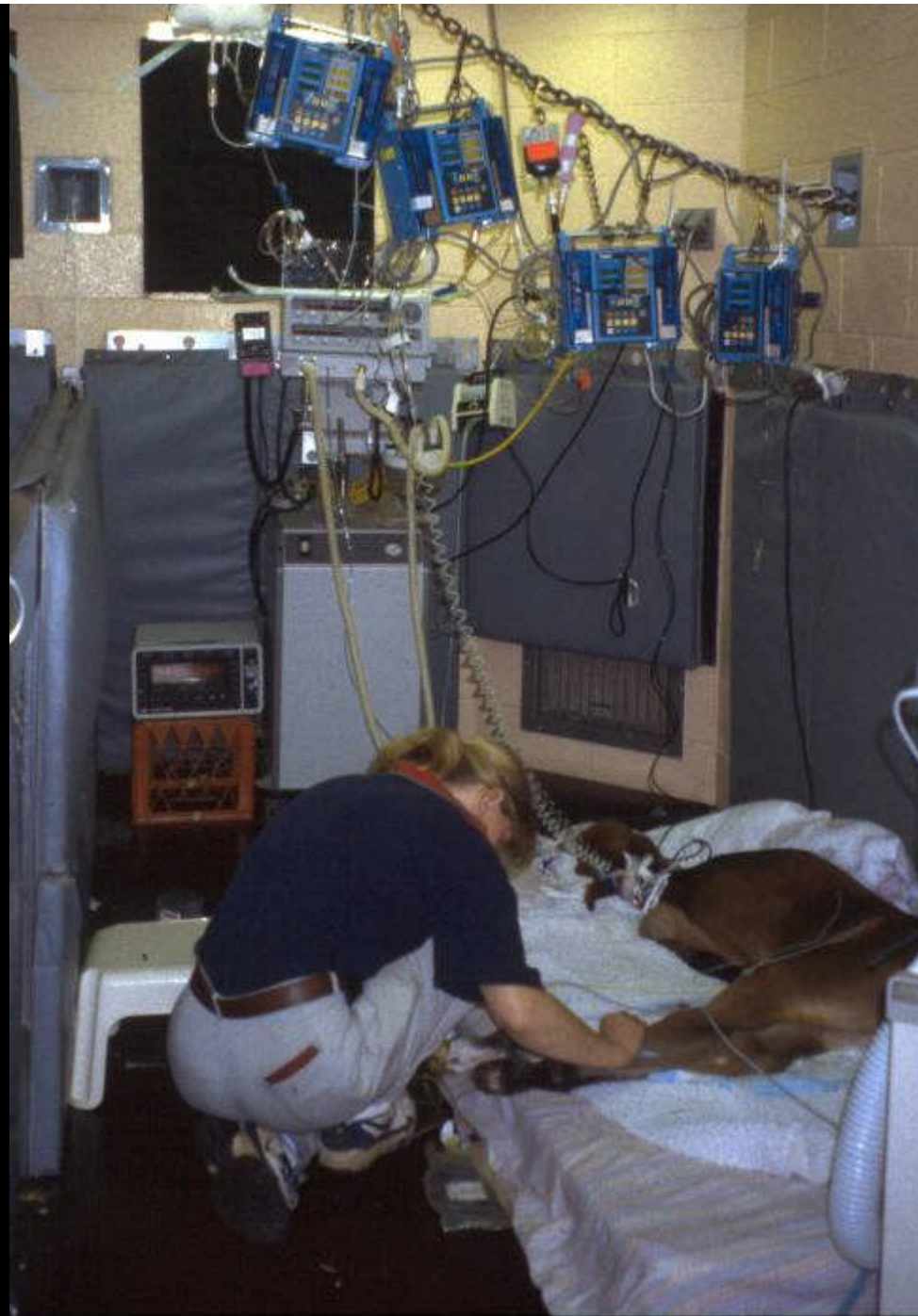
- Fluid therapy
- Inotrope - dobutamine
- Blood transfusion

Only guide – it can lie

- Low – insufficient O₂ delivery, poor lung loading
- High – good delivery but many not be everywhere



Don't trust the numbers
without feeling the patient!



Warm Thoughts 09

	10 min
pH	7.149
Pco ₂	104.2
Po ₂	11.2
SAT	??
Cont	??
HCO ₃	36.5
BE	4.3
FIO ₂	Ambu RA
Lac	6.8

Warm Thoughts 09

	10 min	23 min
pH	7.149	7.199
Pco ₂	104.2	64.3
Po ₂	11.2	382
SAT	??	99.9
Cont	??	18.6
HCO ₃	36.5	25.3
BE	4.3	-3.3
FIO ₂	Ambu RA	Ambu O ₂
Lac	6.8	7.7

Warm Thoughts 09

	10 min	23 min	30 min
pH	7.149	7.199	7.217
Pco ₂	104.2	64.3	71
Po ₂	11.2	382	77.2
SAT	??	99.9	91.6
Cont	??	18.6	??
HCO ₃	36.5	25.3	29.1
BE	4.3	-3.3	0.5
FIO ₂	Ambu RA	Ambu O ₂	10 lpm
Lac	6.8	7.7	7.4

Warm Thoughts 09

	10 min	23 min	30 min	1 hr
pH	7.149	7.199	7.217	7.267
Pco ₂	104.2	64.3	71	53.3
Po ₂	11.2	382	77.2	121.2
SAT	??	99.9	91.6	98.4
Cont	??	18.6	??	16.9
HCO ₃	36.5	25.3	29.1	24.5
BE	4.3	-3.3	0.5	-2.4
FIO ₂	Ambu RA	Ambu O ₂	10 lpm	10 lpm
Lac	6.8	7.7	7.4	9.3



Banana Cake 09

	Adm
pH	7.449
Pco ₂	26.1
Po ₂	58.4
SAT	91.7
Cont	10.8
HCO ₃	18.3
BE	-4.2
FIO ₂	RA
Lac	

Banana Cake 09

	Adm	1 hr
pH	7.449	7.433
Pco ₂	26.1	28.8
Po ₂	58.4	135.6
SAT	91.7	99.4
Cont	10.8	9.4
HCO ₃	18.3	19.4
BE	-4.2	-3.7
FIO ₂	RA	5 lpm
Lac		5.7

Banana Cake 09

	Adm	1 hr	4 hr
pH	7.449	7.433	7.471
Pco ₂	26.1	28.8	32.5
Po ₂	58.4	135.6	136.3
SAT	91.7	99.4	99.6
Cont	10.8	9.4	10.1
HCO ₃	18.3	19.4	23.9
BE	-4.2	-3.7	1
FIO ₂	RA	5 lpm	5 lpm
Lac		5.7	6.2

Banana Cake 09

	Adm	1 hr	4 hr	24 hr
pH	7.449	7.433	7.471	7.452
Pco ₂	26.1	28.8	32.5	28.3
Po ₂	58.4	135.6	136.3	127.7
SAT	91.7	99.4	99.6	99.4
Cont	10.8	9.4	10.1	10.1
HCO ₃	18.3	19.4	23.9	20
BE	-4.2	-3.7	1	-2.9
FIO ₂	RA	5 lpm	5 lpm	3 lpm
Lac		5.7	6.2	6.5

Banana Cake 09

	Adm	1 hr	4 hr	24 hr	60 hr
pH	7.449	7.433	7.471	7.452	7.474
Pco ₂	26.1	28.8	32.5	28.3	33.9
Po ₂	58.4	135.6	136.3	127.7	68.8
SAT	91.7	99.4	99.6	99.4	94.9
Cont	10.8	9.4	10.1	10.1	9.2
HCO ₃	18.3	19.4	23.9	20	25.1
BE	-4.2	-3.7	1	-2.9	2.1
FIO ₂	RA	5 lpm	5 lpm	3 lpm	RA
Lac		5.7	6.2	6.5	3.7





Parisian Deputy 09

30 MIN

pH	7.099
Pco ₂	34.6
Po ₂	97.9
SAT	?
Cont	?
HCO ₃	10.8
BE	-17.3
FIO ₂	RA
Lac	24.4

Parisian Deputy 09

	30 MIN	2 HR
pH	7.099	7.335
Pco ₂	34.6	43
Po ₂	97.9	133.8
SAT	?	?
Cont	?	?
HCO ₃	10.8	23.2
BE	-17.3	-1.9
FIO ₂	RA	5 lpm
Lac	24.4	13.2

Parisian Deputy 09

	30 MIN	2 HR	12 HR
pH	7.099	7.335	7.440
Pco ₂	34.6	43	45.2
Po ₂	97.9	133.8	168.7
SAT	?	?	?
Cont	?	?	?
HCO ₃	10.8	23.2	31
BE	-17.3	-1.9	3.4
FIO ₂	RA	5 lpm	5 lpm
Lac	24.4	13.2	6.8



She's Jane 09

pH 7.200

Pco₂ 67.0

PO₂ 35.9

SAT ?

Cont ?

HCO₃ 26.4

BE -2.2

FIO₂ RA –
ambu

Lac 9.3

She's Jane 09

pH	7.200	7.172
Pco ₂	67.0	89.2
Po ₂	35.9	104.6
SAT	?	?
Cont	?	?
HCO ₃	26.4	33
BE	-2.2	2.9
FIO ₂	RA – ambu	>15 lpm
Lac	9.3	7.6

Kool Kat Katie 09

pH	7.424
Pco ₂	62.4
Po ₂	125.6
SAT	98.4
Cont	6
HCO ₃	41.2
BE	16.2
FIO ₂	10 lpm
Lac	2.8
PCV	28-6%



Lady Is A Pro 09

pH	6.682
Pco ₂	64.9
Po ₂	95.2
SAT	80.9
Cont	16.9
HCO ₃	7.8
BE	-29.4
FIO ₂	RA
Temp	29.4 (32)

Lady Is A Pro 09

pH	6.682	6.791
Pco ₂	64.9	59.6
Po ₂	95.2	248.2
SAT	80.9	99.4
Cont	16.9	14.9
HCO ₃	7.8	9.2
BE	-29.4	-24.4
FIO ₂	RA	5 lpm
Temp	29.4 (32)	29.4

Daydream 07



Daydream 07



Daydream 07

adm

pH 7.369

Pco₂ 38.3

Po₂ 20.3

SAT <30

Cont 5.7

HCO₃ 22.3

BE -2.2

FIO₂ RA

Lac 12.7

PCV 0.40

Daydream 07

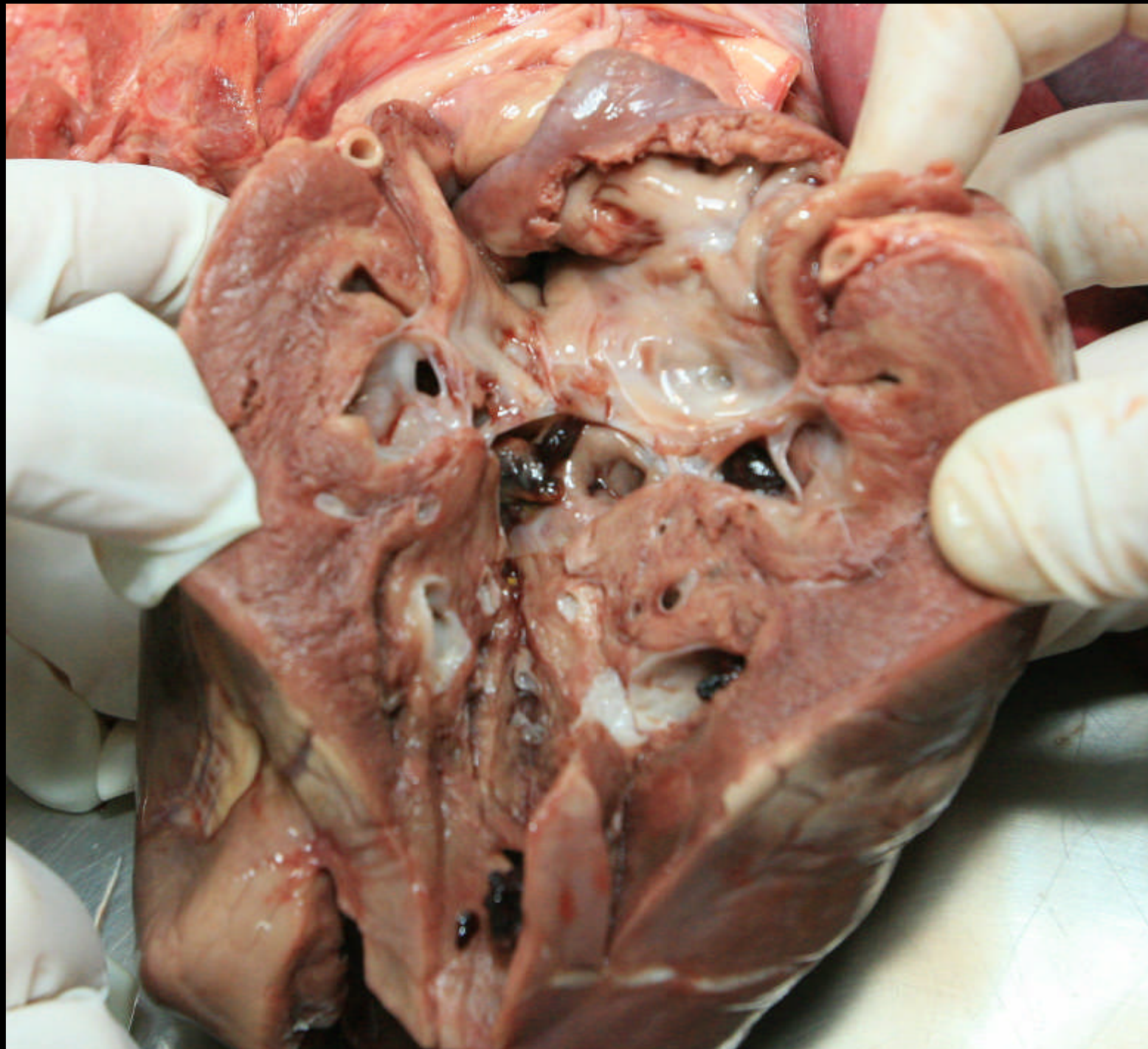
adm

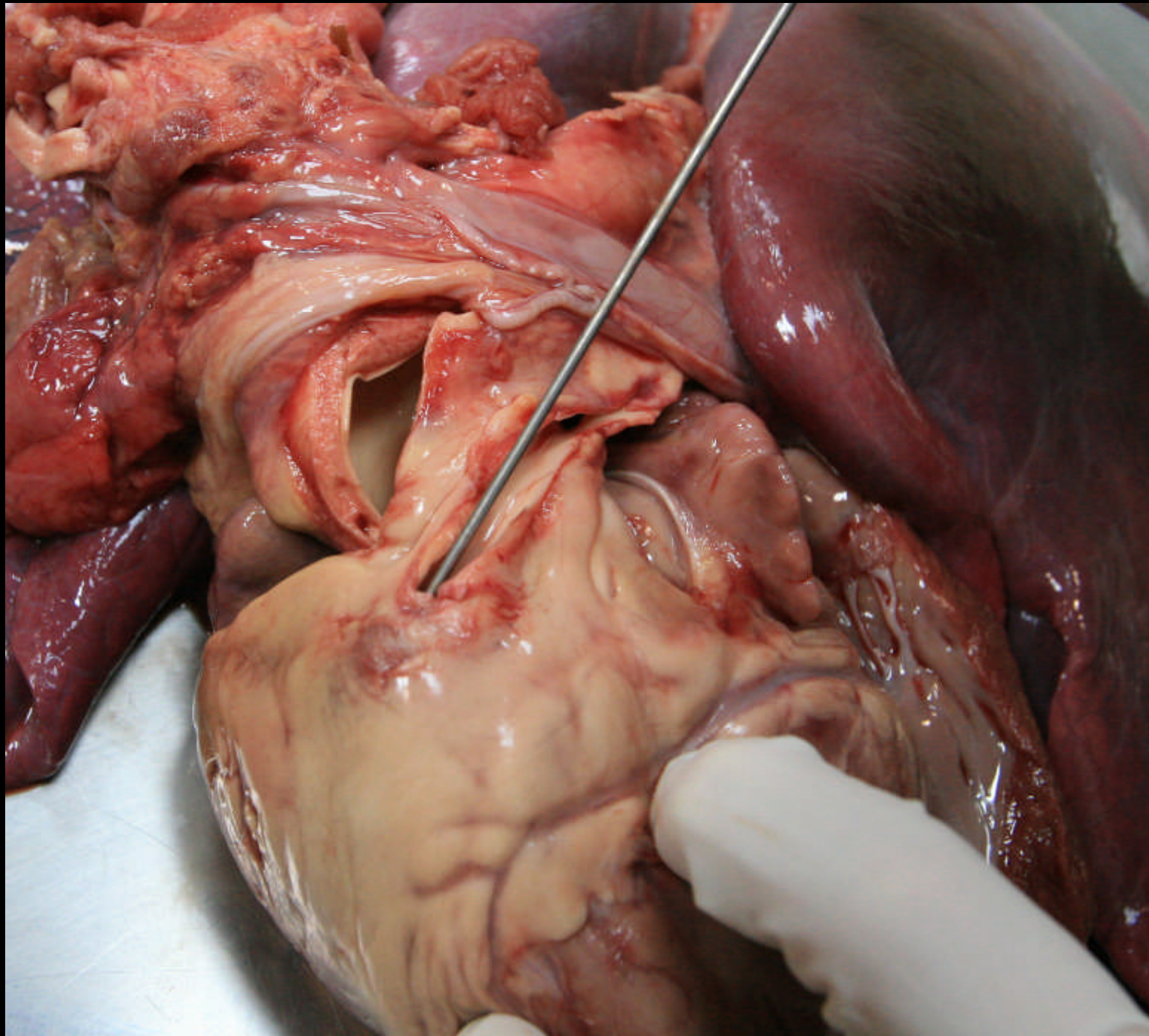
pH	7.369	7.356
Pco ₂	38.3	39.2
Po ₂	20.3	30.5
SAT	<30	50.4
Cont	5.7	9.0
HCO ₃	22.3	22.1
BE	-2.2	-2.5
FIO ₂	RA	> 15 lpm
Lac	12.7	9.0
PCV	0.40	

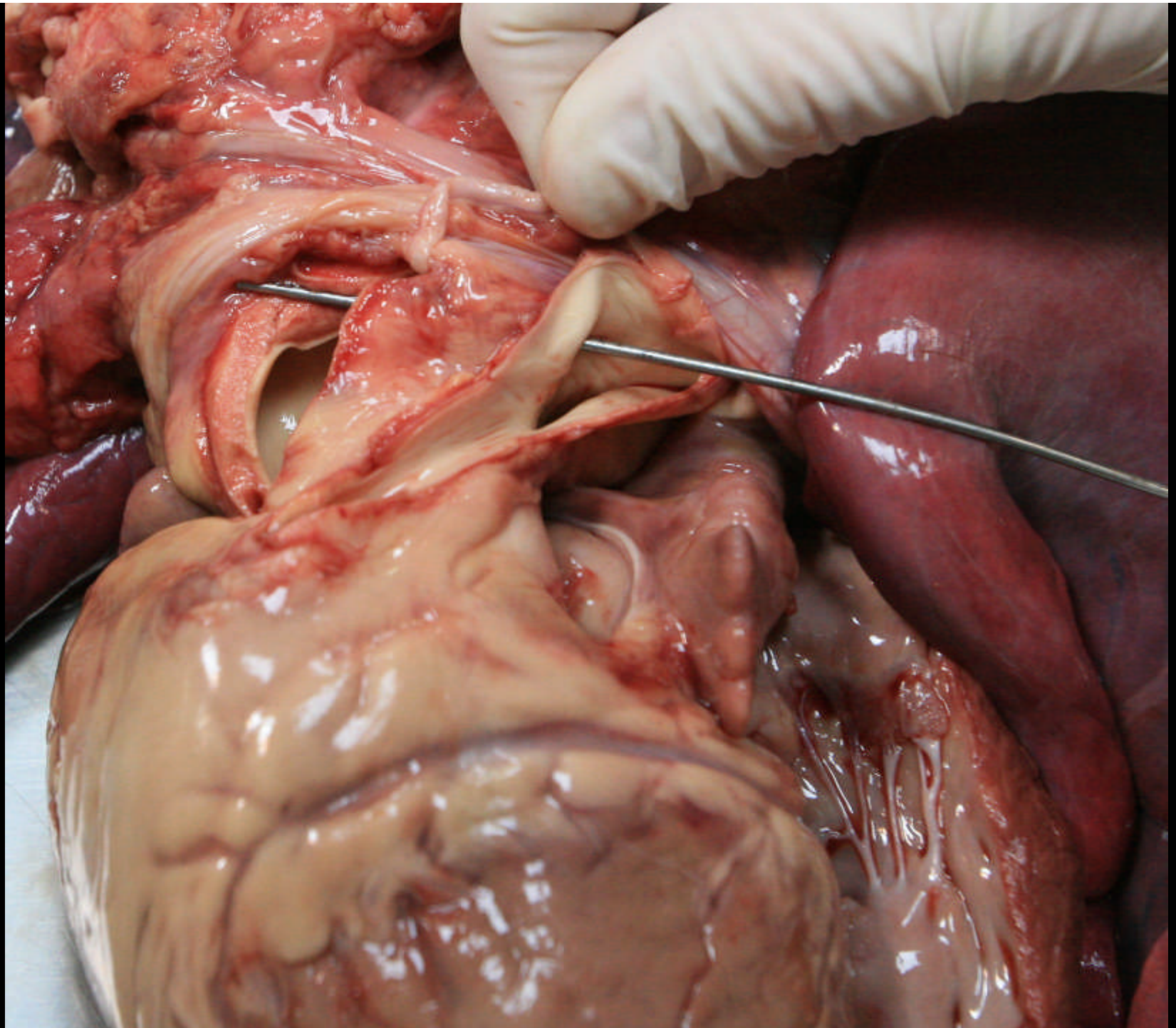
Daydream 07

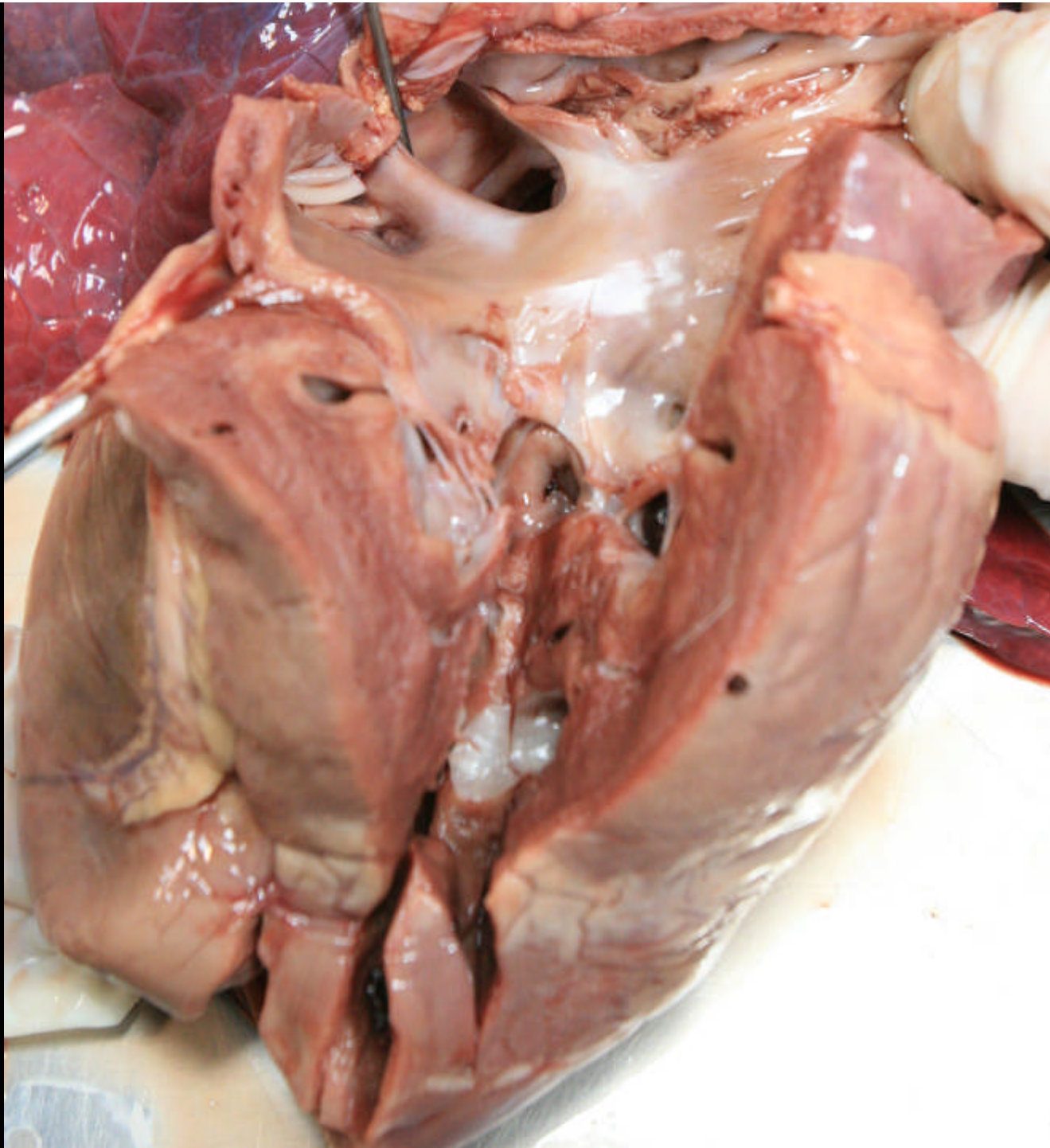
	adm		CV
pH	7.369	7.356	7.343
Pco ₂	38.3	39.2	44.2
Po ₂	20.3	30.5	28.6
SAT	<30	50.4	46.4
Cont	5.7	9.0	7.8
HCO ₃	22.3	22.1	24.2
BE	-2.2	-2.5	-1.1
FIO ₂	RA	> 15 lpm	> 15 lpm
Lac	12.7	9.0	11.4
PCV	0.40		













Pulmonary Hypertension

- Sequela to many cases of ALI
- Increased pulmonary vascular resistance

Inflammatory mediators

Severe hypoxemia

Persistent Pulmonary Hypertension of the Neonate

- PPH-N
- Right to left shunting
 - Foramen ovale
 - Ductus arteriosus
- Reversion to fetal circulation
 - Adaptive advantage
 - Achieve adequate systemic cardiac output
- Neonate's unique ability
 - Exist in a hypoxemic state
 - Regain CO by shunting
 - Survive pulmonary hypertension without systemic ischemia

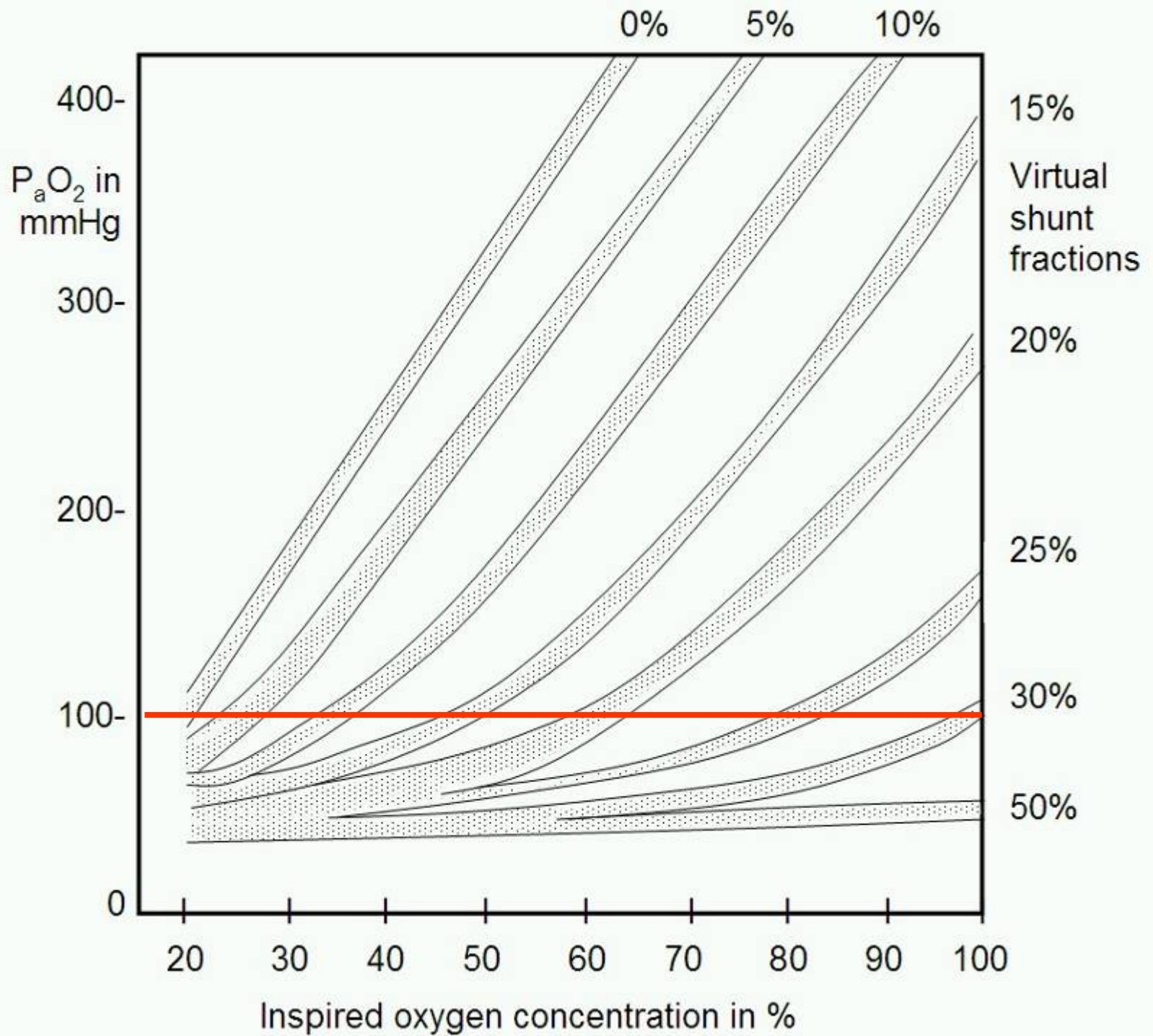
Pulmonary Hypertension

1.0 F_{IO_2} trial

- $P_{aO_2} < 100$ torr after 15-20 min
- Shunt fraction $> 30\%$
- Cause of the hypoxemia extrapulmonary

Large cardiac shunt

PPHN



Ref.: Nunn's Applied Physiology

Pulmonary Hypertension

Pulmonary hypertension

- Failure to make the birth transition – PPHN
 - Imbalance of vasodilators and vasoconstrictors
 - Nitric oxide and endothelin
- Regression to fetal circulation – PPHN
 - Perinatal hypoxemia
 - Cytokine showers
- Secondary
 - Pulmonary disease
 - Septic shock
 - ALI

Pulmonary Hypertension Therapy

Traditional therapy

- Maximize exposure to O₂
Ventilation with 100% oxygen
- Alkalinize arterial pH
Mild hyperventilation
Treatment with bases
- Maintain systemic blood pressure
Counterbalance the pulmonary pressure
- ALI will counteract these approaches

Inhaled NO therapy

- 5 to 20 ppm
- Immediate effect
- Significant pulmonary toxicity possible
Free radicals



Pulmonary Hypertension Therapy

NO - Mechanism of action

- Vasodilation

 - Increasing cGMP levels

 - Relaxation of the pulmonary vasculature

Type V phosphodiesterase inhibitors

- Selectively prevent cGMP destruction
- Endogenous nitric oxide
- Pulses of exogenous nitric oxide
- Currently available

 - Sildenafil

 - Vardenafil

 - Tadalafil