Université de Lille

Physiopathologie: pourquoi le clampage tardif est-il davantage physiologique?

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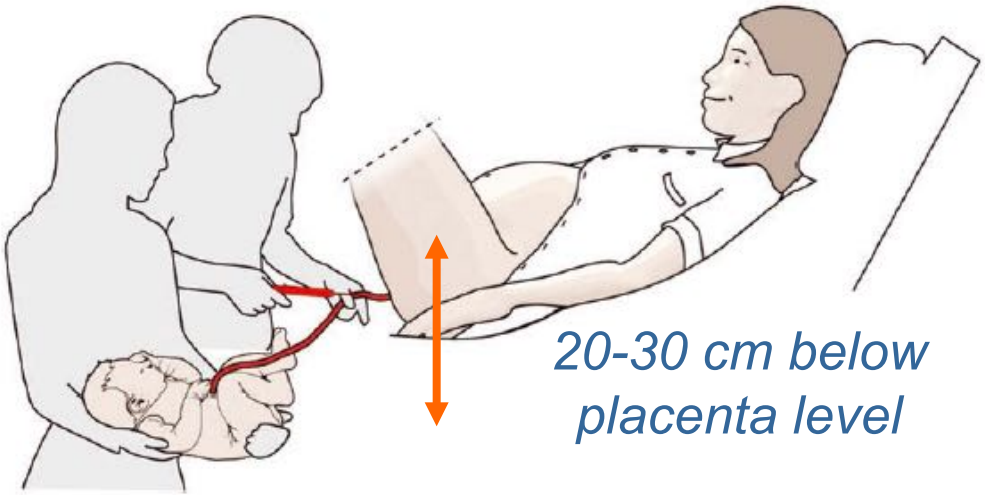
Andersson O, AOGS 2012

Procédure:

- Clampage immédiat : < 20 sec
- Clampage retardé: 30 – 180s

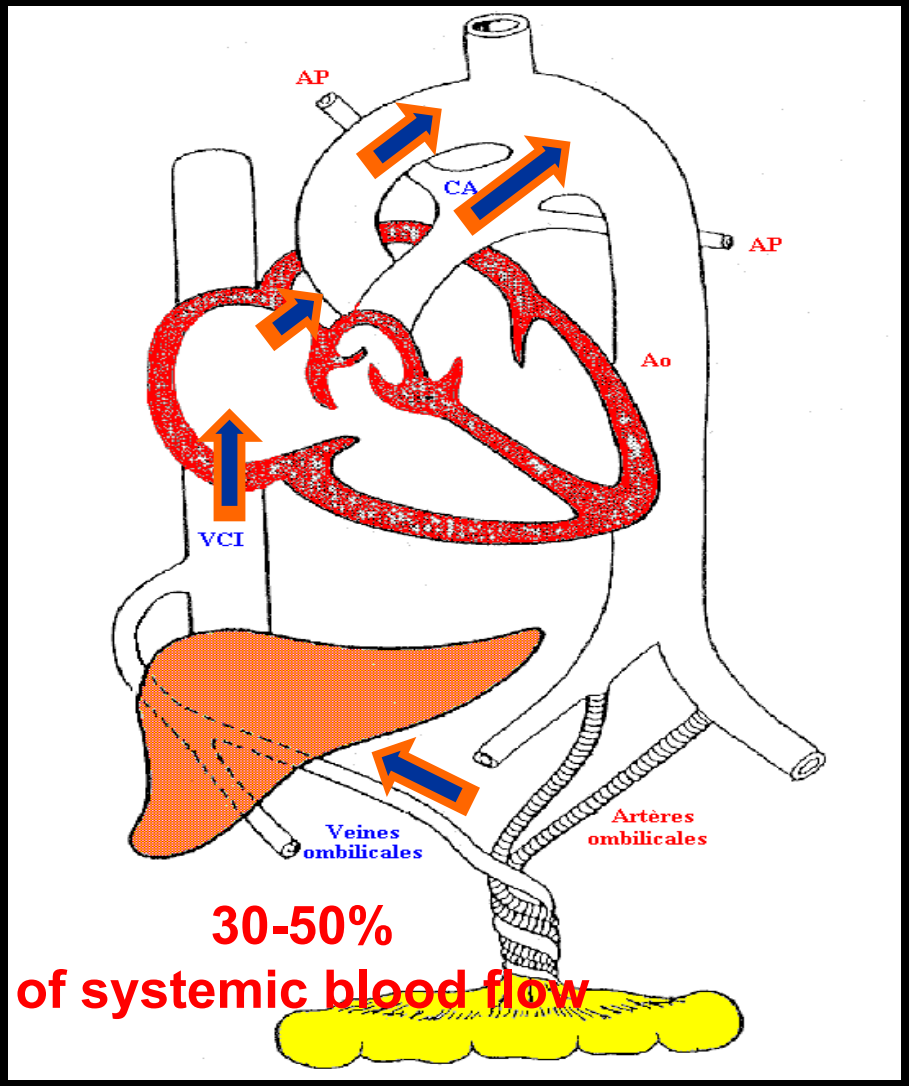


- Traite du cordon : 1 to 4 fois, durée 10-15s

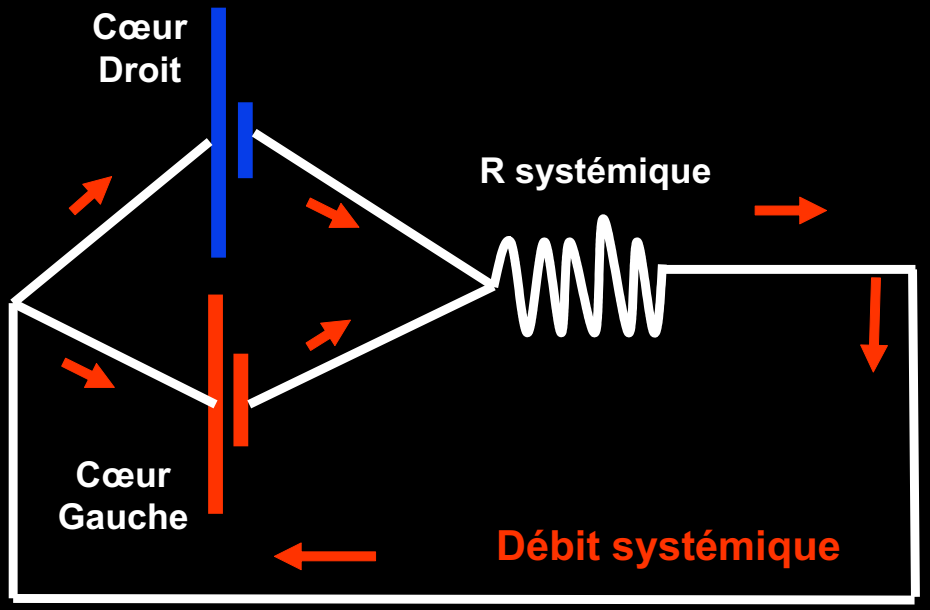
Plan

1. **Effets du clampage immédiat du cordon à la naissance**
2. **Effets du clampage « physiologique » du cordon:**
   - Transfusion placentaire (GR, cellules souches);
   - Adaptation cardiorespiratoire physiologique
   - Oxygénation placentaire ?
3. **Conclusion**

Circulation foetale

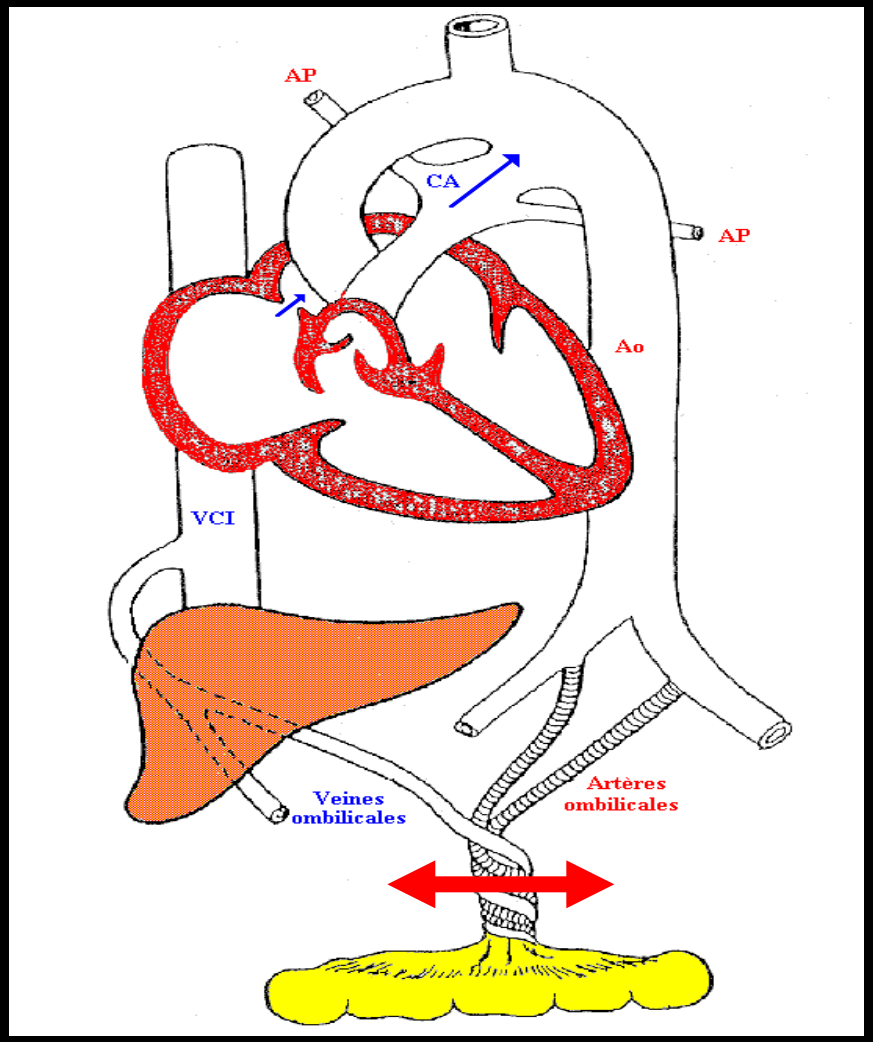


Débit systémique = $Q_{LV} + Q_{DA}$



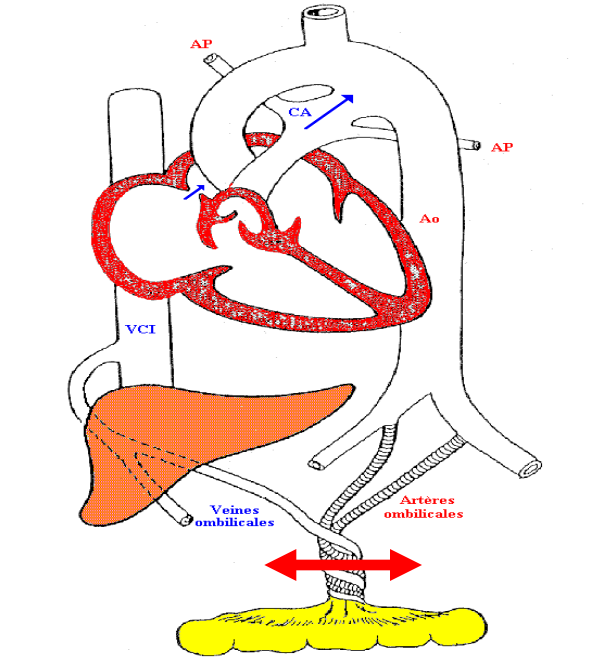
Effets du clampage du cordon

⇓ précharge VG



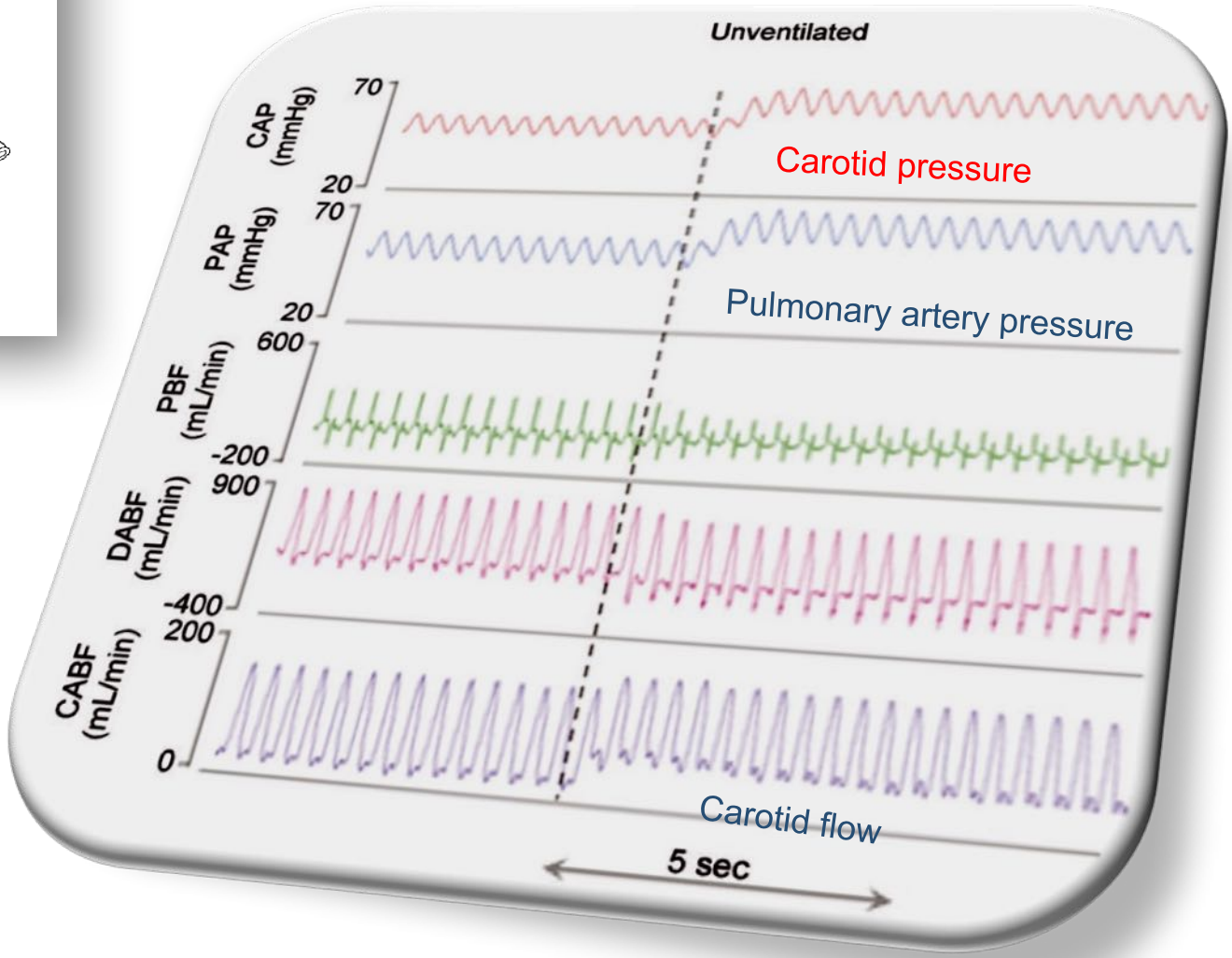
⇑ postcharge VG et VD

S Bhatt, J Physiol 2013

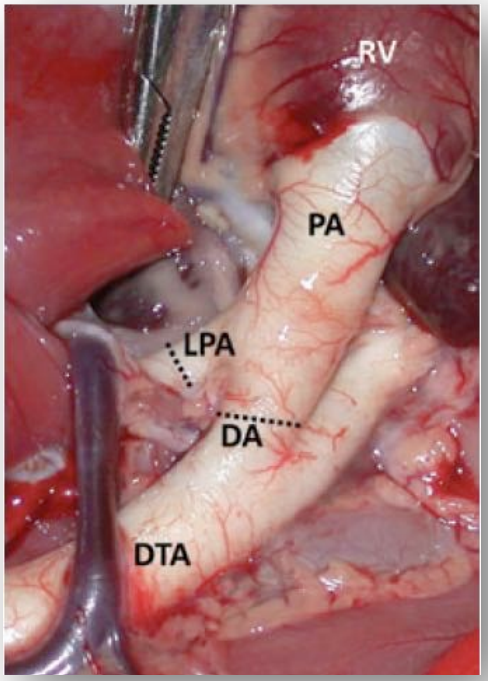


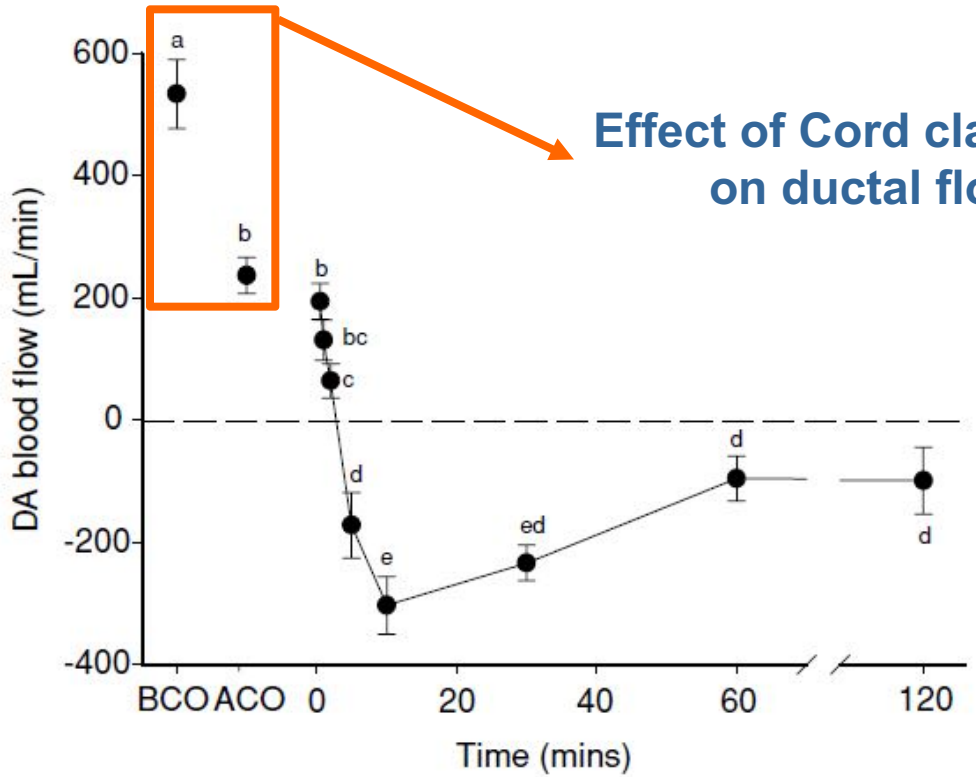
Clampage du cordon:

- ↑ VG + ↑ VD postcharge
- ↓ précharge du VG



S Bhatt, J Physiol 2013



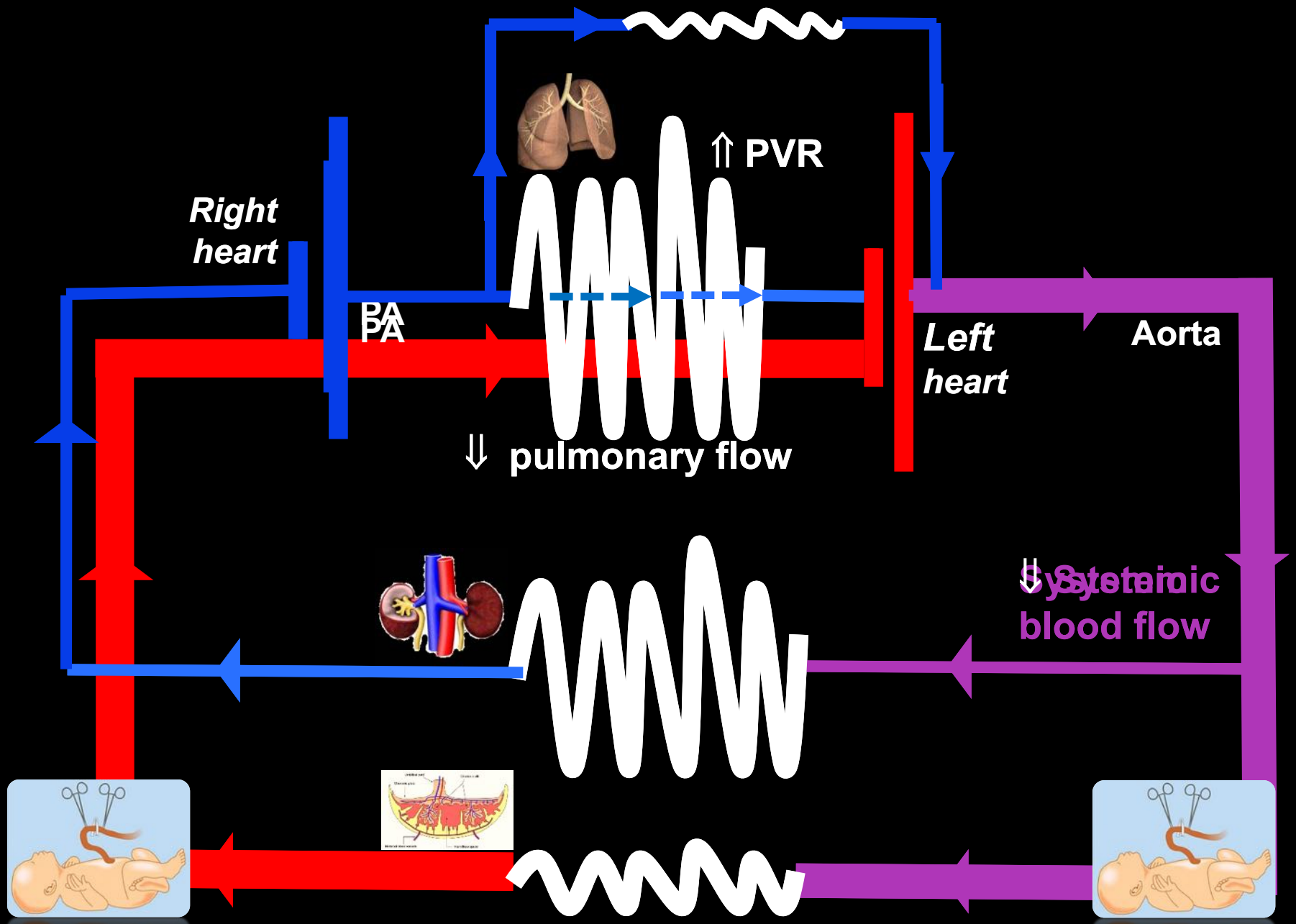


Effect of Cord clamping on right ventricle output

Time	HR (beats min^{-1})	RVO (ml min^{-1})
BCO	167 ± 9	623 ± 55[a]
ACO	166 ± 18	315 ± 14[b]

Crossley J, J Physiol 2009

Immediate cord clamping
Fetal circulation

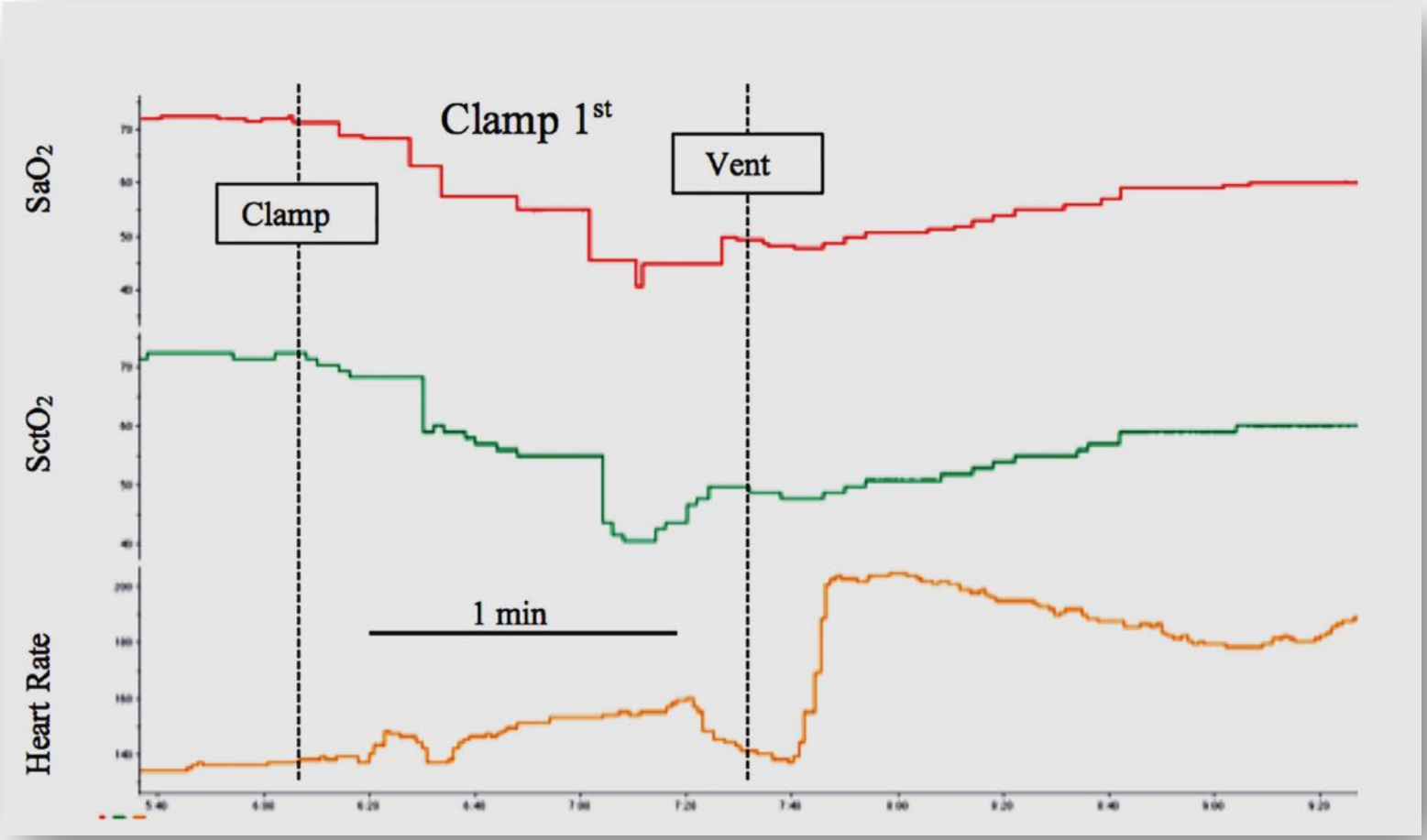


Effet du clampage immédiat du cordon avant le début de la ventilation

SaO2

ScO2

FC



Polglase, Plos One 2015

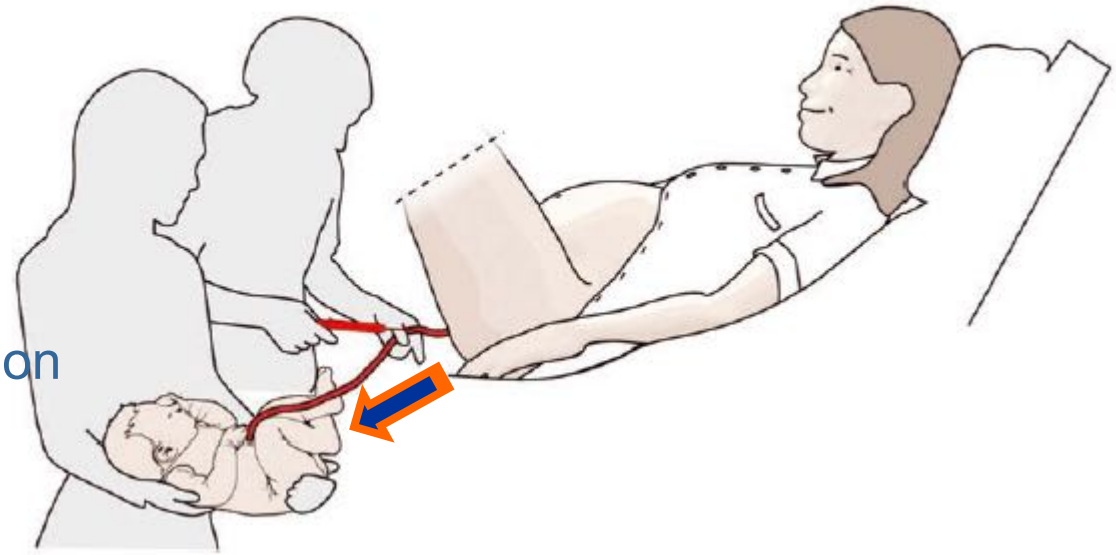
Plan

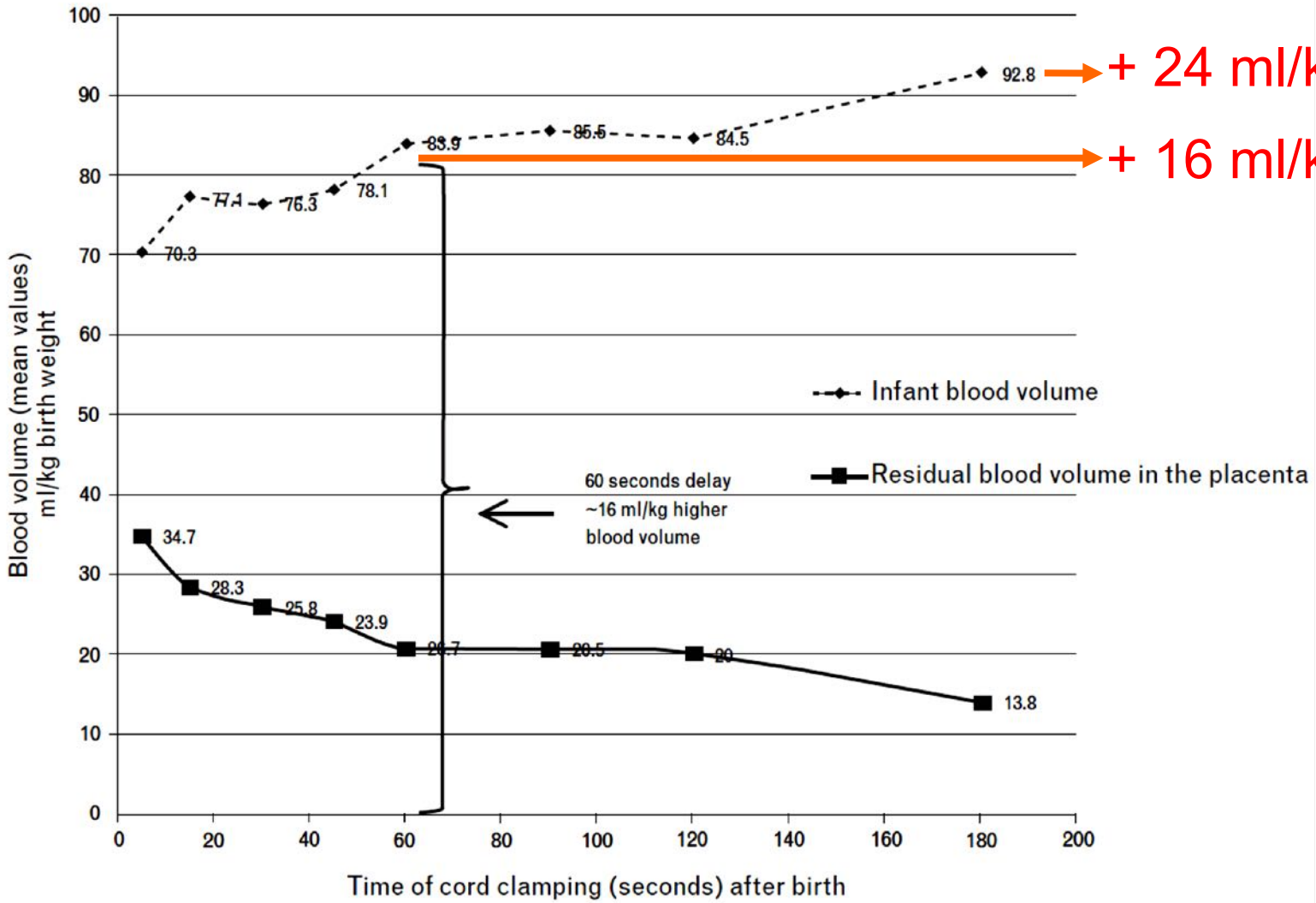
1. **Effets du clampage immédiat du cordon à la naissance**
2. **Effets du clampage « physiologique » du cordon:**
   - Transfusion placentaire (GR, cellules souches);

Physiologie de l'adaptation à la naissance

120 ml/kg de sang
dont 40-50 ml/kg
dans le placenta et le cordon

After birth:
Placento-fetal transfusion





N=111 full-term newborns, 10 cm below placenta

Raju, Current Opinion in Pediatrics 2013

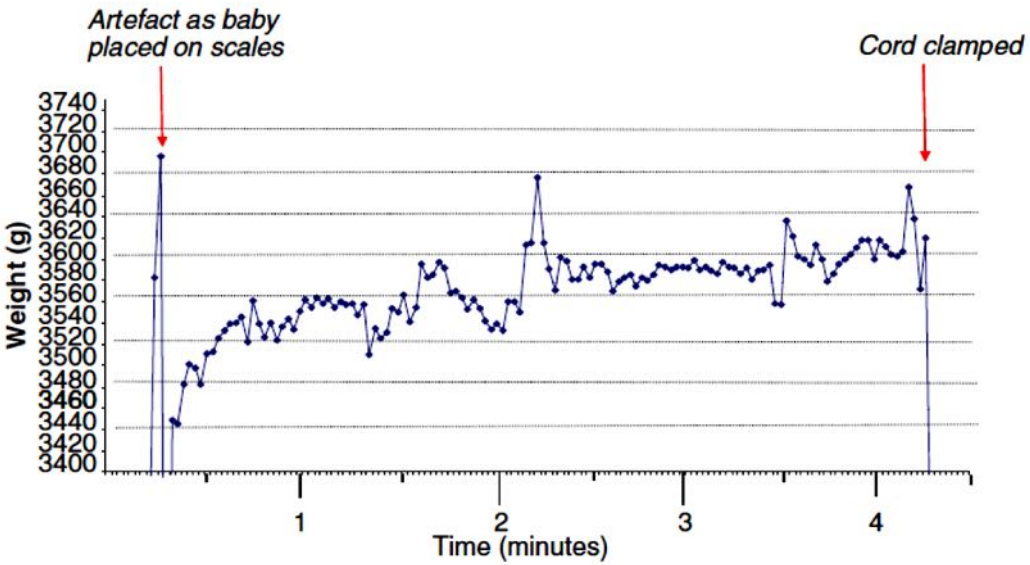


Figure 1. Weight change from birth to cord clamping.

Table 2. Weight and weight change at birth using a B-spline and inspection of the graphs

	n	Start mean weight (g)	End mean weight (g)	Mean difference in weight (g) (95% CI)	t (*df*)*	*P*
B-spline						
Total	26	3295	3411	116 (72–160)	5.44 (25)	<0.001
Mode of birth						
caesarean section	13	3466	3597	131 (64–198)	0.69 (24)	0.5
Vaginal	13	3124	3225	101 (36–167)		
Position of baby						
Above bed	14	3235	3332	96 (38–154)	−0.99 (22)	0.3
On bed	12	3364	3504	139 (64–214)		
Uterotonic drug**						
Yes	21	3408	3530	122 (69–174)	−0.60 (8)	0.6
No	5	2820	2913	93 (-17–204)		

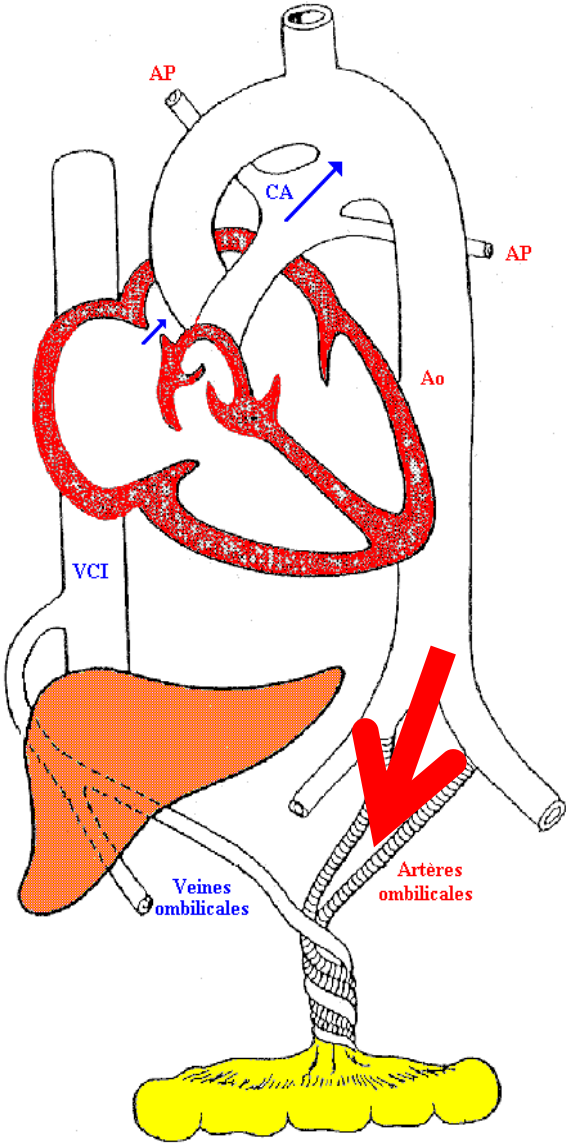
Farrar D, BJOG 2011

Le volume de sang placentaire transfusé est similaire que l'enfant soit positionné au niveau du placenta ou sur l'abdomen de la mère

	Introitus group		Abdomen group		Difference, g (mean, 95% CI)
	n	Mean weight change, g (SD, 95% CI)	n	Mean weight change, g (SD, 95% CI)	
All women	197	56 (47, 50-63)	194	53 (45, 46-59	3 (-5·8 to 12·8)
Semi-sitting or sitting position	81	52 (48, 42-62)	74	54 (47, 43-65)	1·6 (-16·0 to 13·0)
Lying down position	114	59 (48, 50-68)	120	52 (45, 44-60)	6·7 (-5·0 to 18·0)

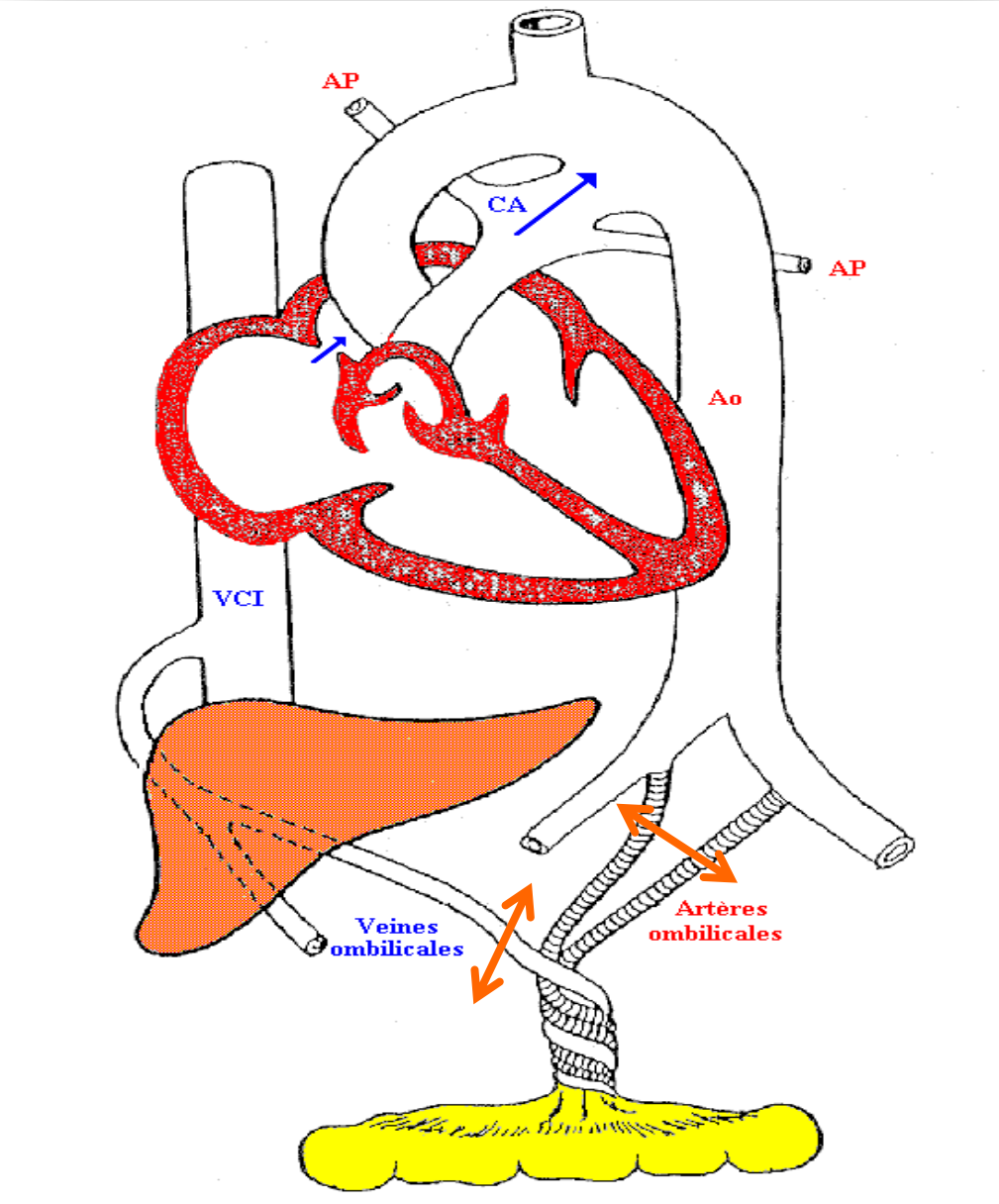
Data are mean (SD), 95% CI.

Table 2: Weight increase in the first 2 min after birth and mother's position during delivery



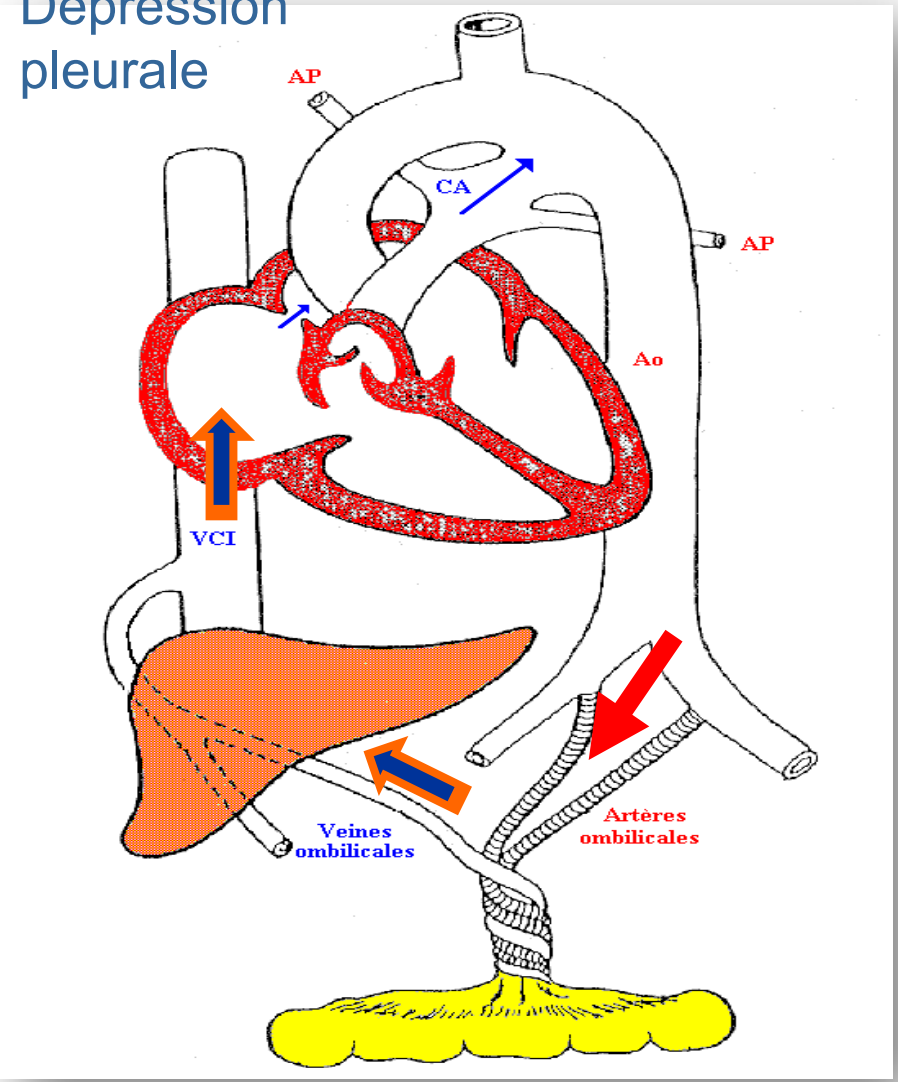
Vain N, Lancet 2014

Effet des contractions utérines



Effet de la ventilation / vasodilatation pulmonaire

Dépression pleurale



Vasodilatation pulmonaire

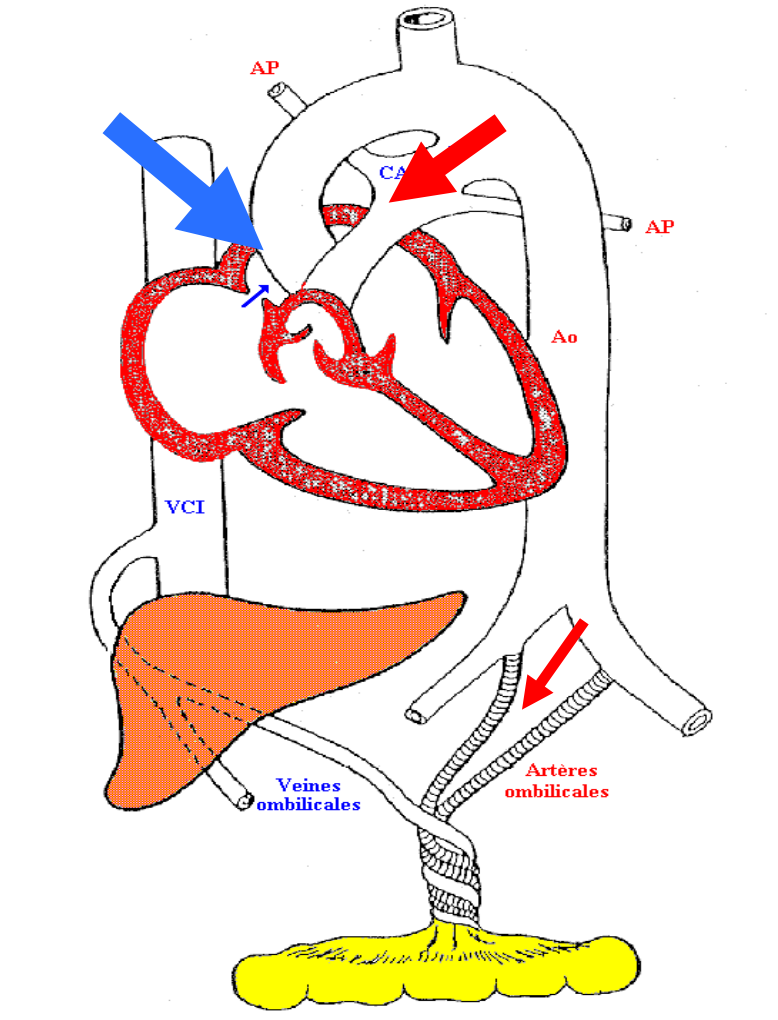
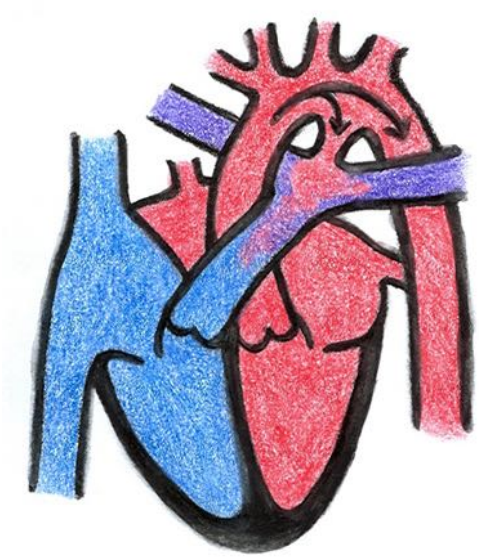
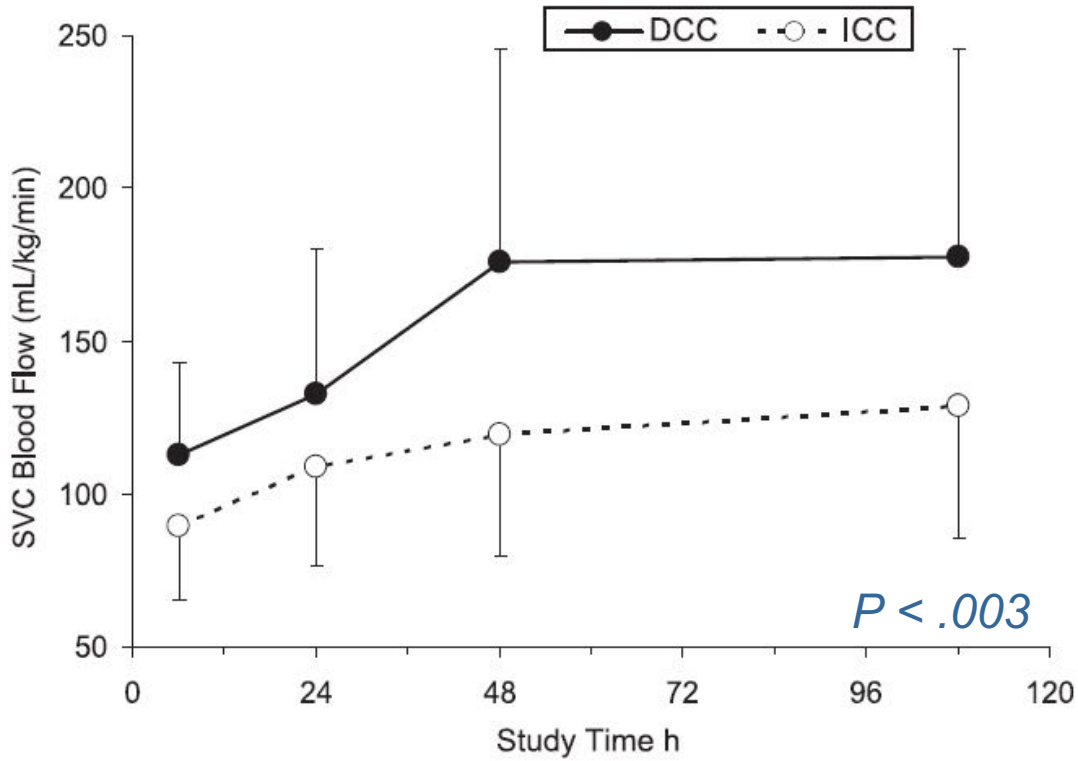


TABLE 2 Infants' Demographic and Clinical Characteristics after Delivery

	DCC, $n = 25$	ICC, $n = 26$	P
Gestation wk, mean (SD)	28.3 (2.3)	27.7 (2.0)	.4
Birth weight, g, mean (SD)	1204 (394)	1116 (467)	.5
Cesarean delivery, n (%)	9 (36.0)	14 (53.9)	.3

Superior
Vena cava
Blood flow





Sommers R, Pediatrics 2012

Plan

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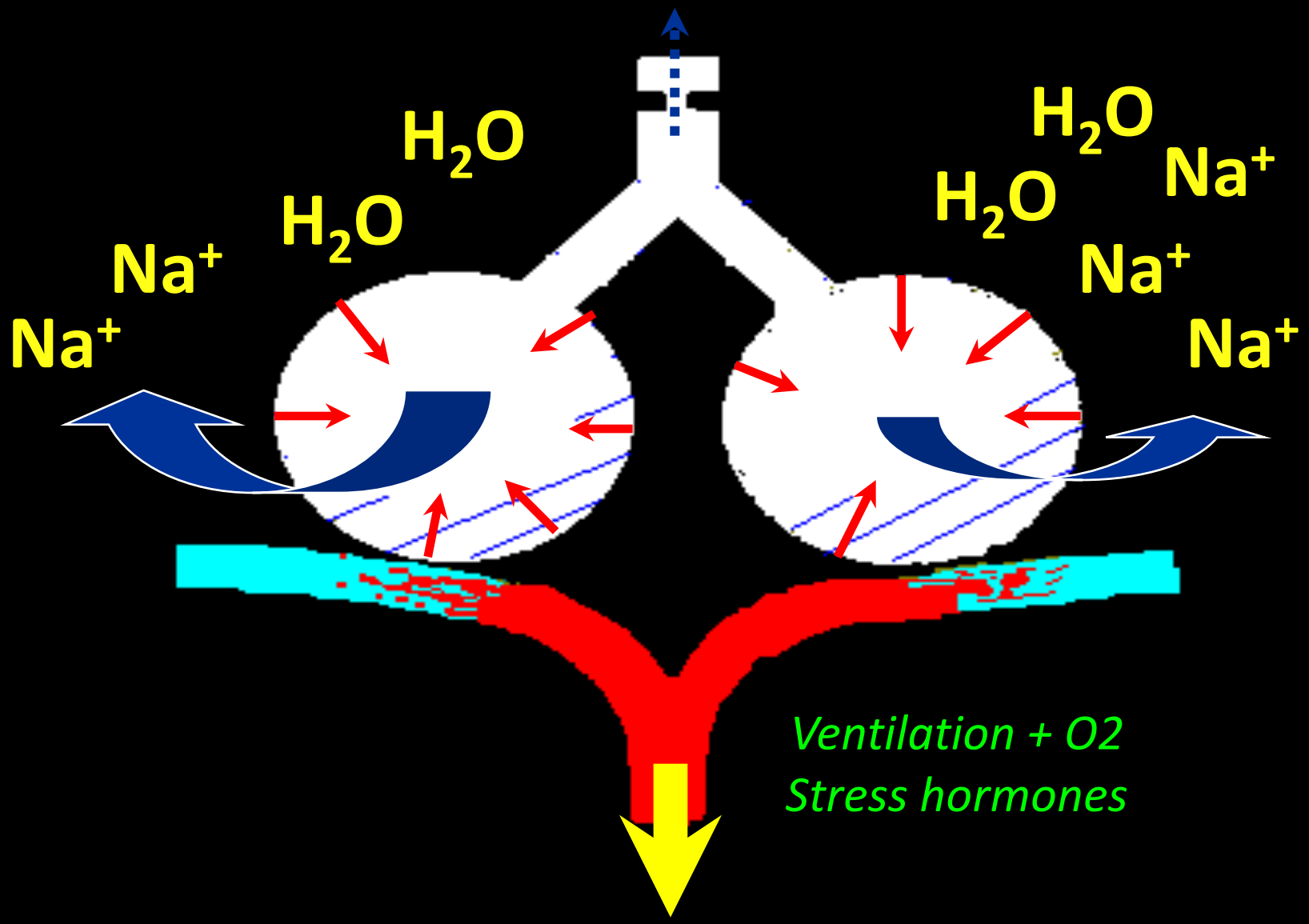
2. **Effets du clampage « physiologique » du cordon:**
   - Transfusion placentaire (GR, cellules souches);
   - Adaptation cardiorespiratoire physiologique

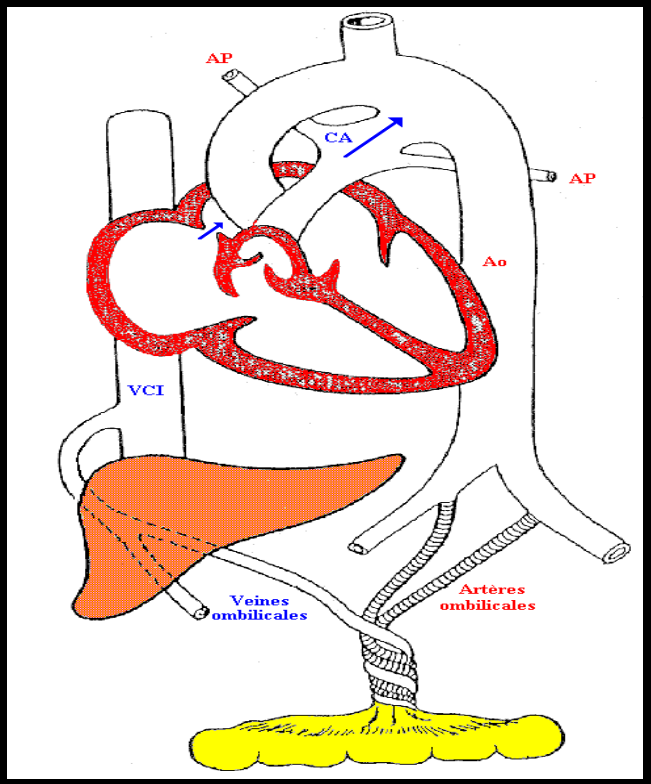
Clearance du liquide pulmonaire



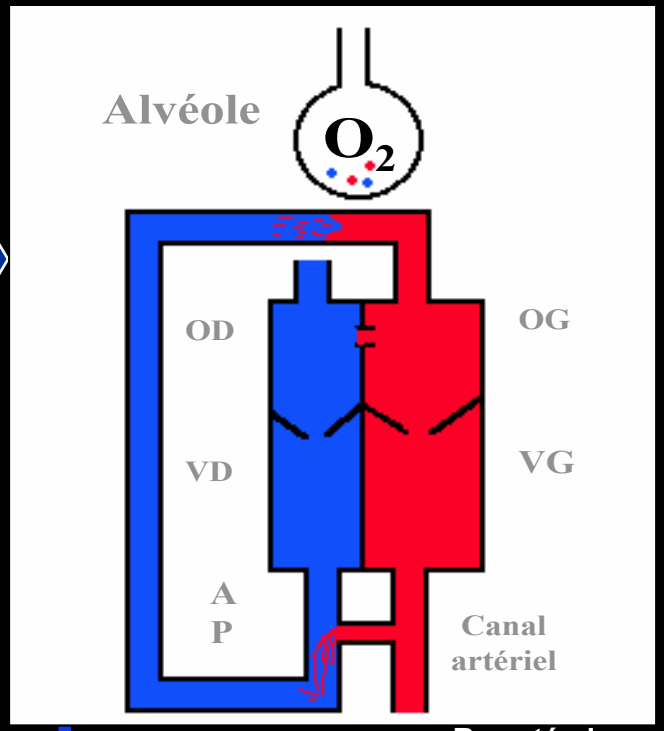
De 0 à 30 min après la naissance

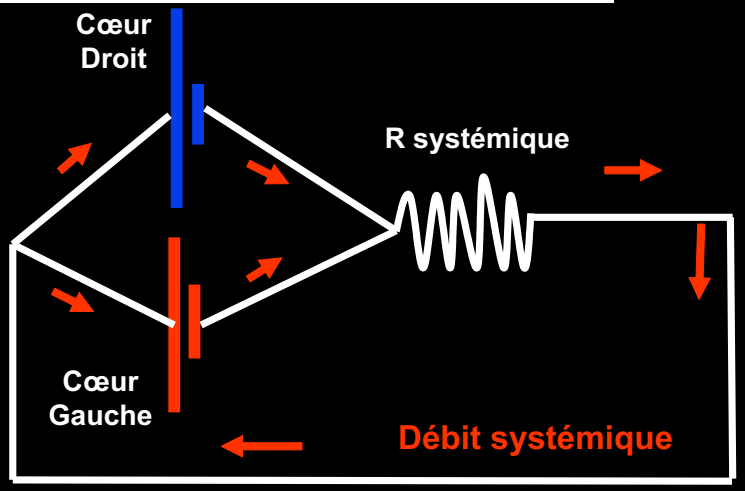
Adaptation circulatoire à la naissance

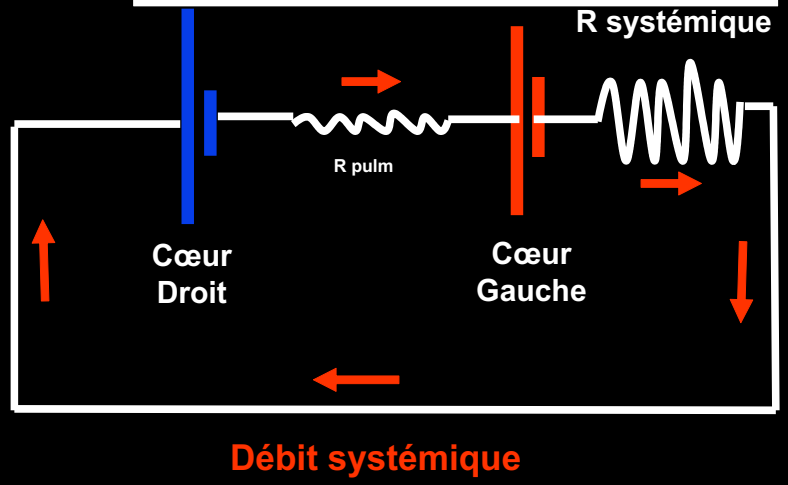
Vasodilatation pulmonaire



1. Ventilation/O_2
2. Catecholamines
3. Shear-stress

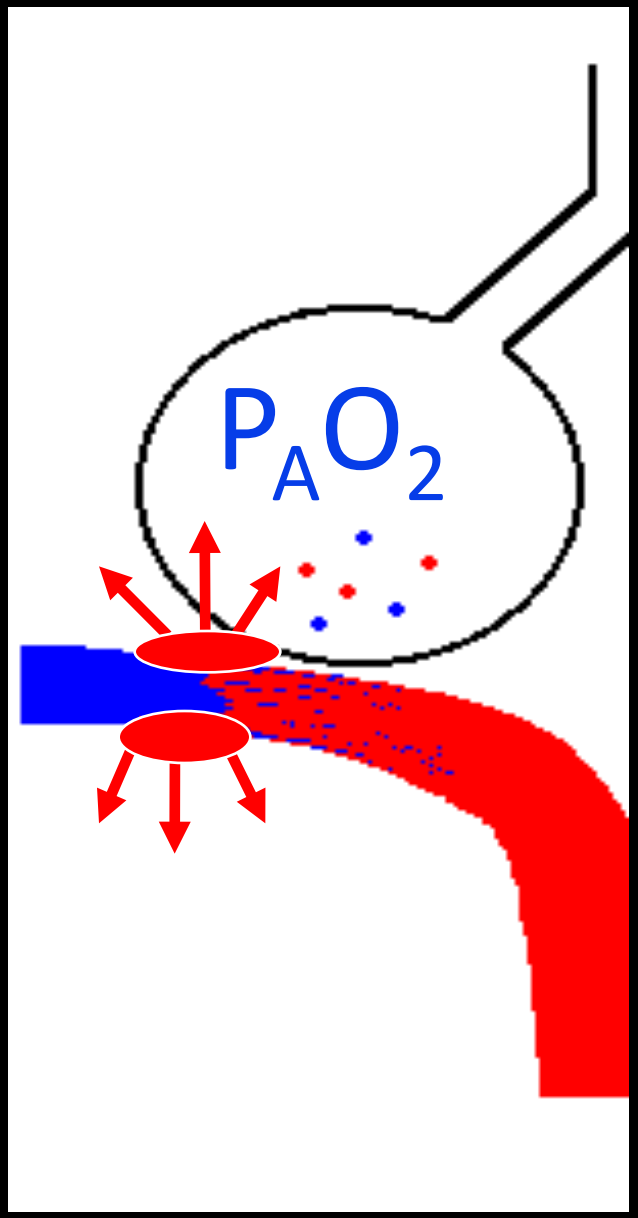






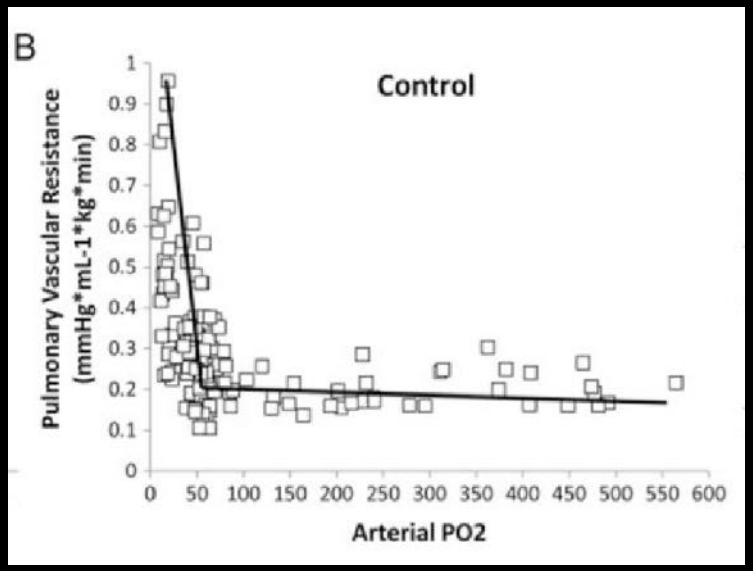
Effets de l'O2 sur les résistances vasculaires pulmonaires

$P_{AP}O_2$

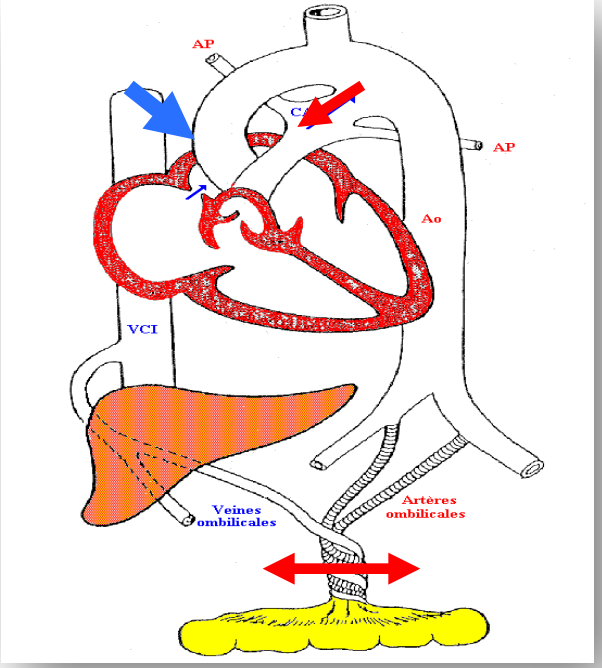


RVP

Max effects
at PAO_2 = 80 mmHg



Pediatr Res 2009, 66;539

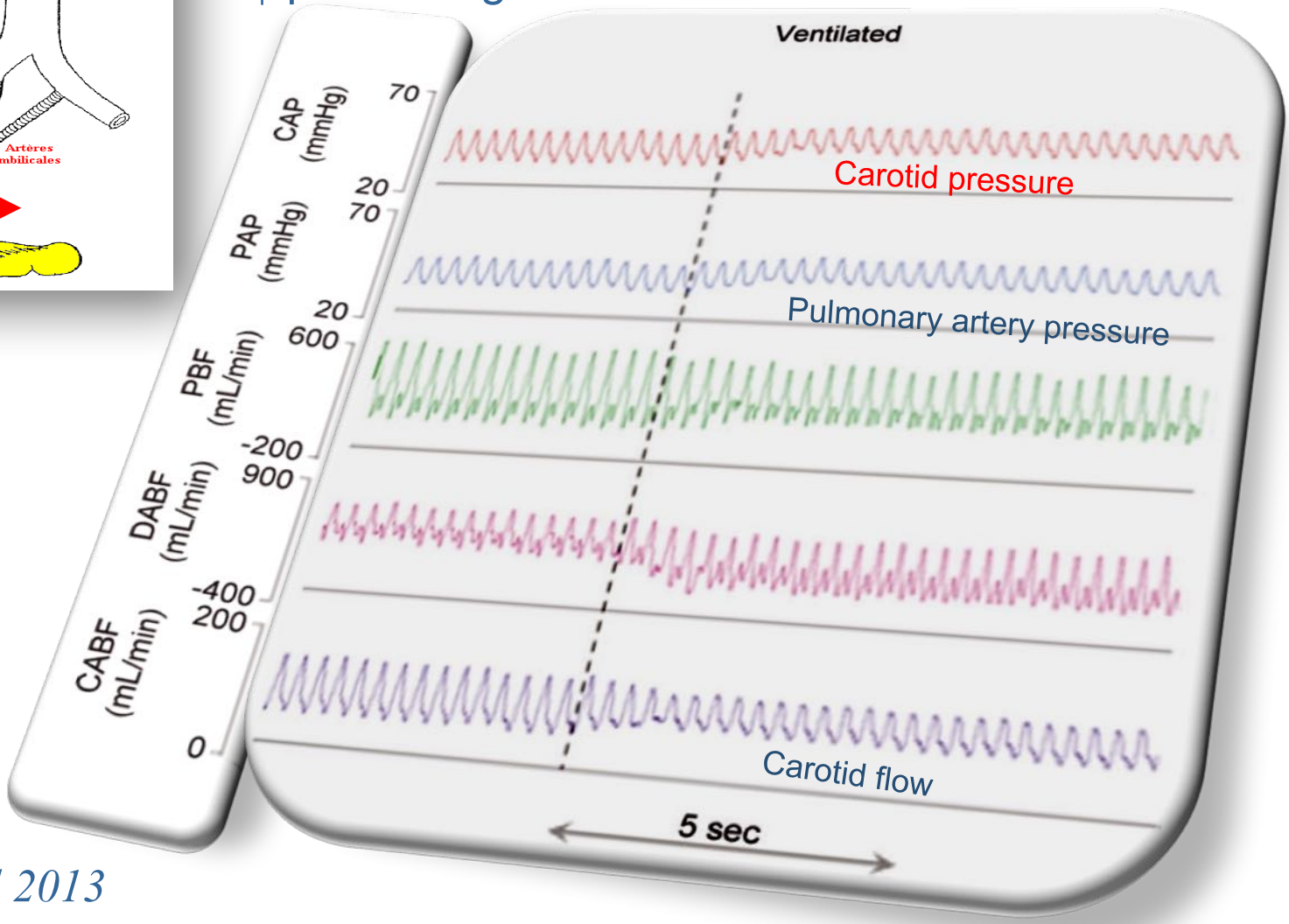


Effet de la ventilation:

- ↑ débit pulmonaire and ↓ PAP
- ↑ VG précharge

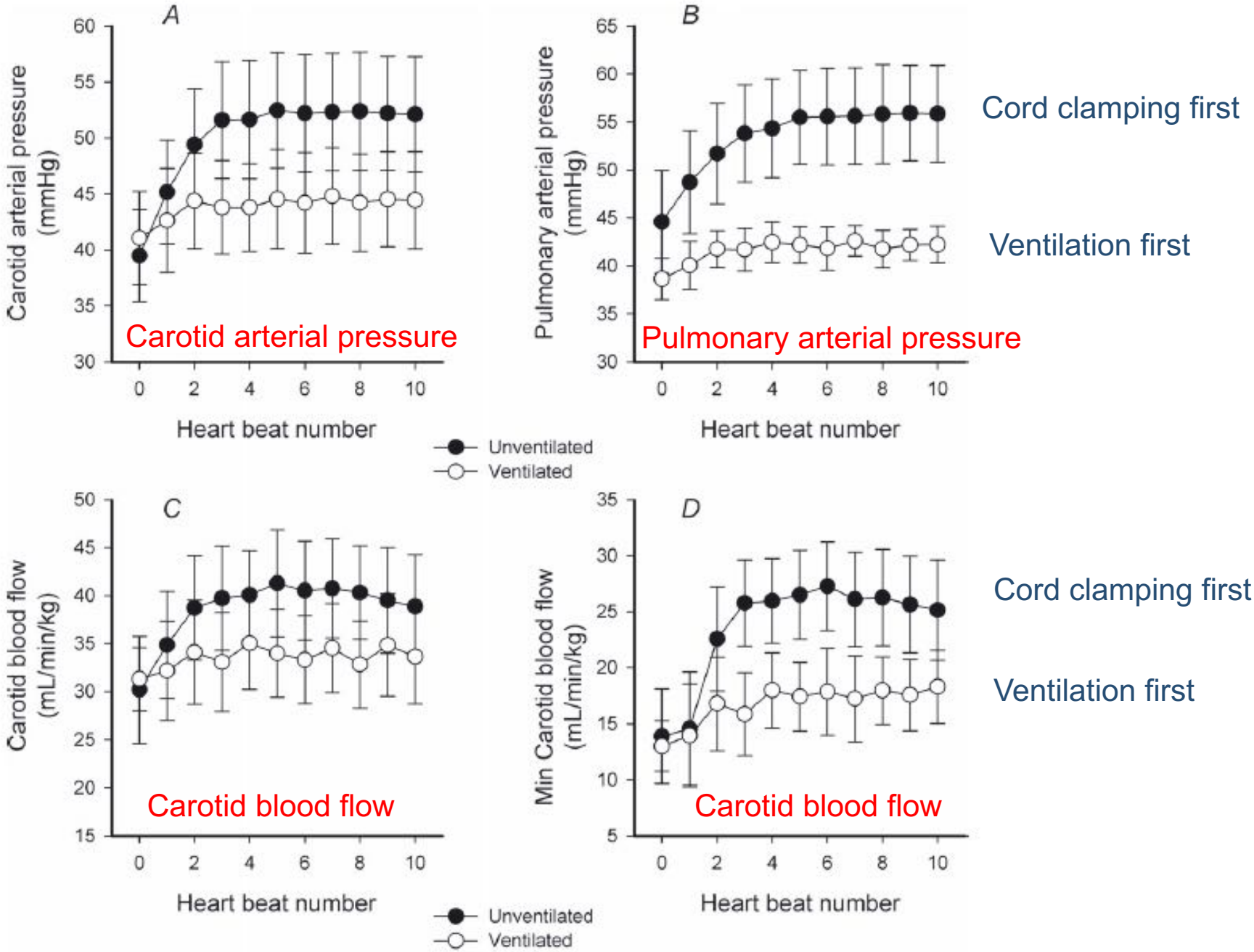
Puis clampage du cordon:

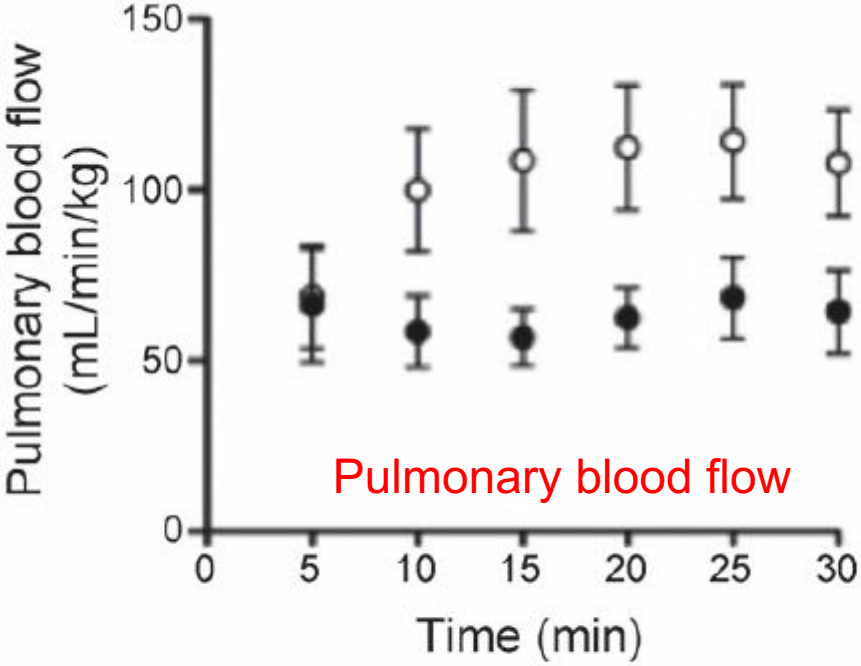
- ↑ post-charge du VG



S Bhatt, J Physiol 2013

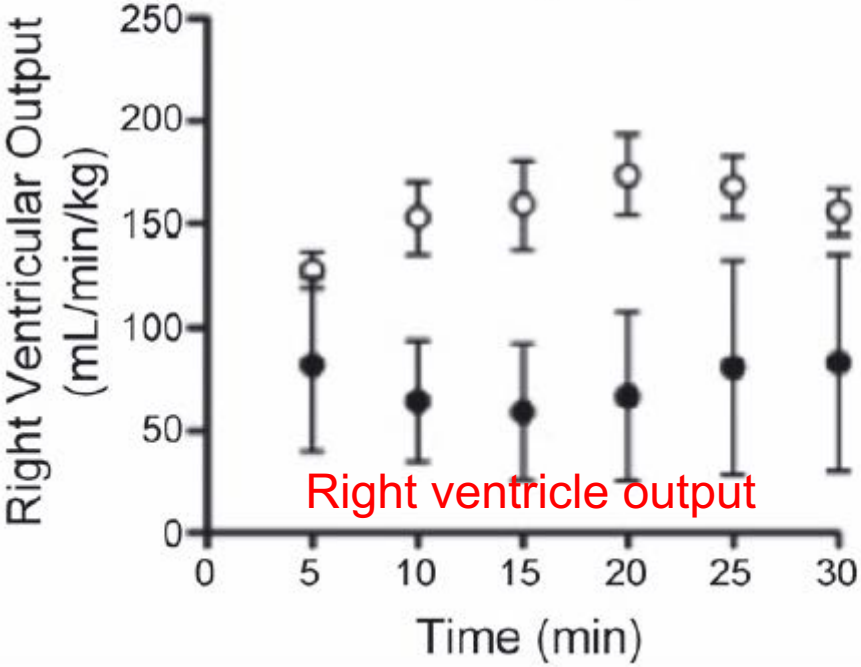
S Bhatt, J Physiol 2013





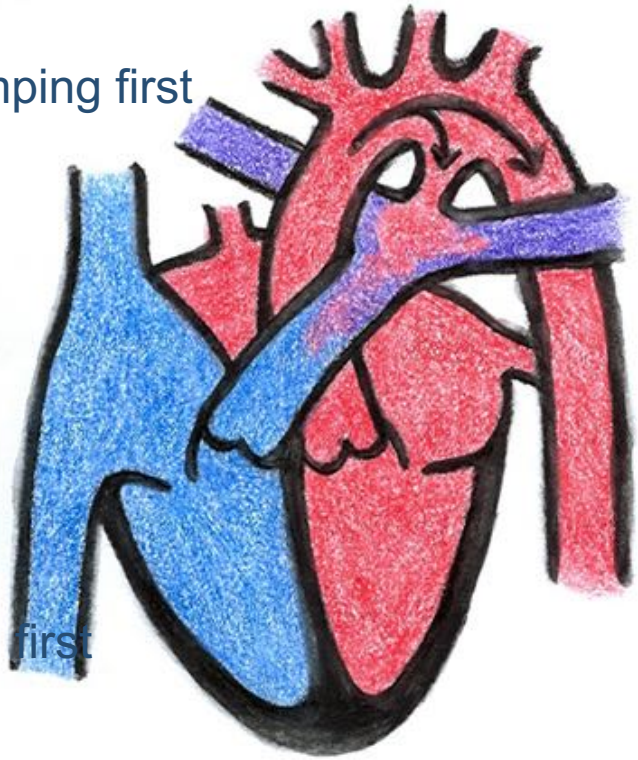
Ventilation first

Cord clamping first



Ventilation first

Cord clamping first



S Bhatt, J Physiol 2013

Effet du timing Du clampage du cordon / ventilation

SaO2

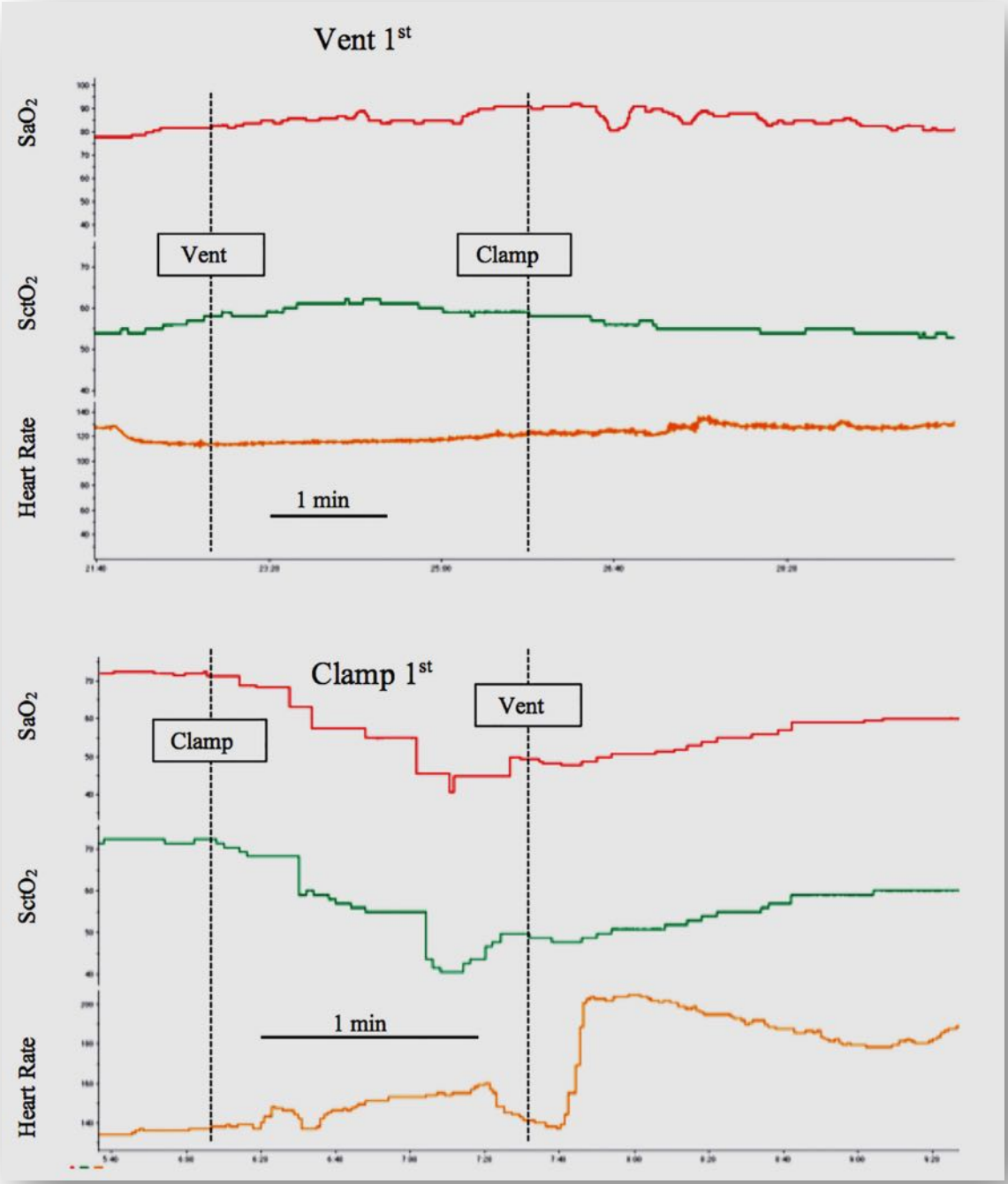
ScO2

FC

SaO2

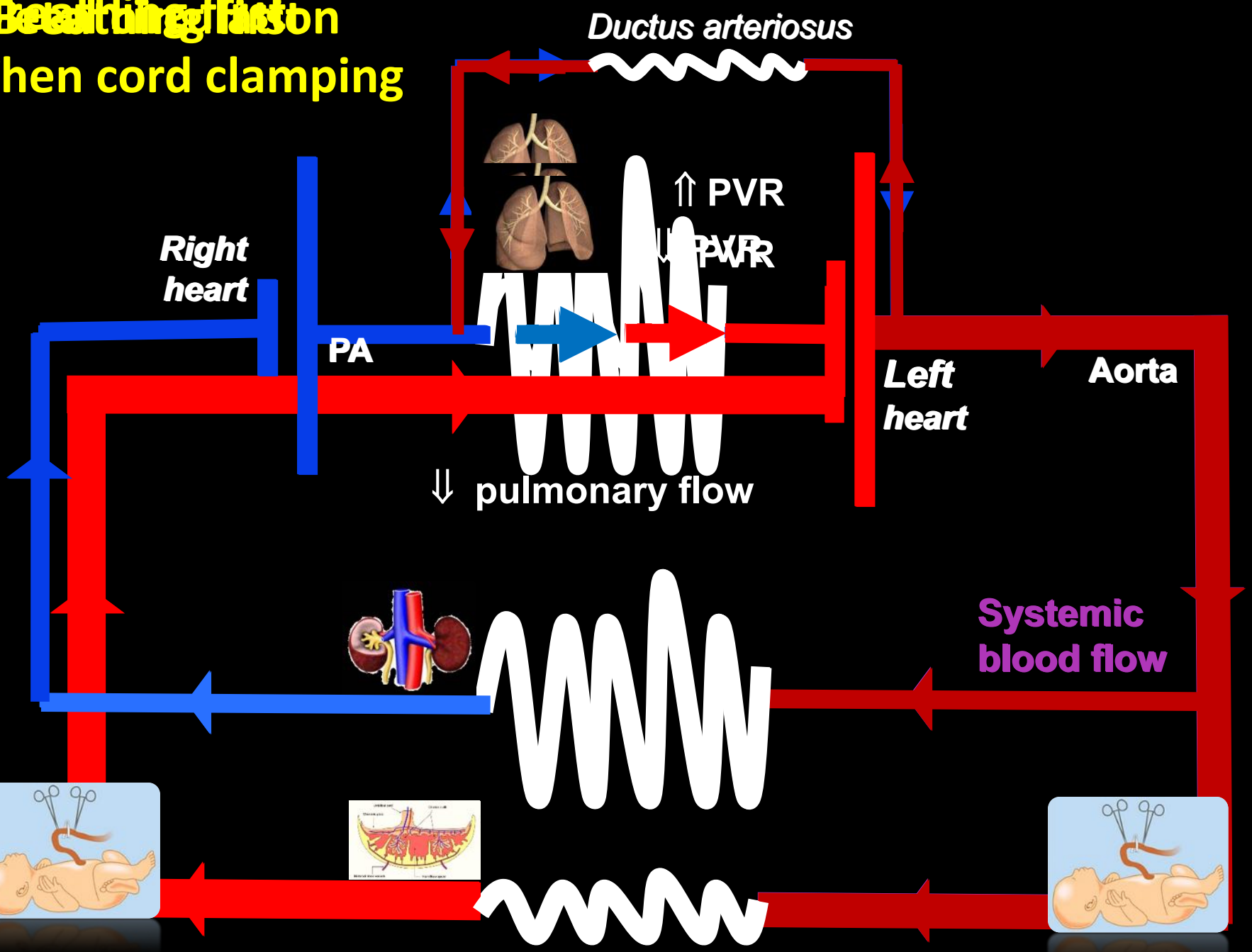
ScO2

FC



Polglase, Plos One 2015

Breathing first
Then cord clamping



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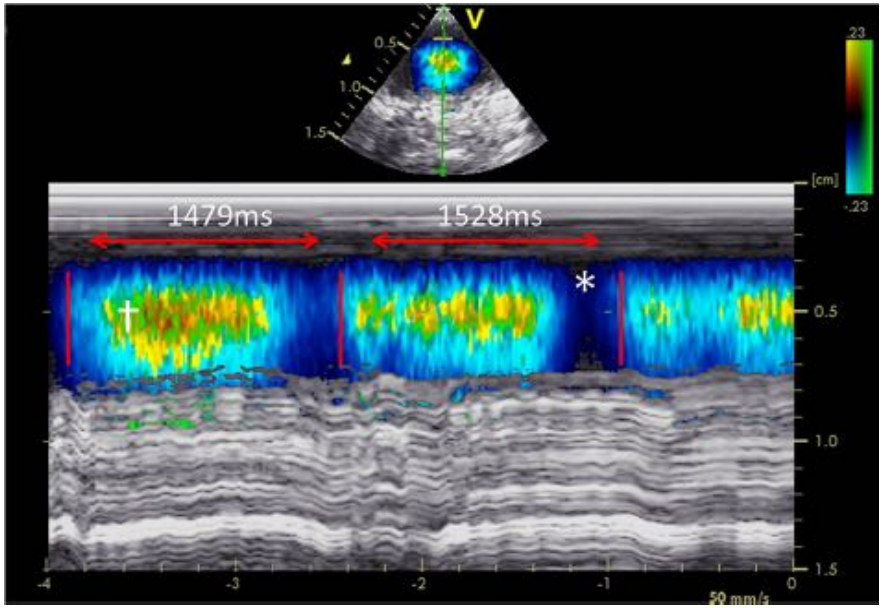
2. **Effets du clampage « physiologique » du cordon:**
   - Transfusion placentaire (GR, cellules souches);
   - Adaptation cardiorespiratoire physiologique
   - Oxygénation placentaire ?

Ex utero intrapartum treatment
EXIT Procedure

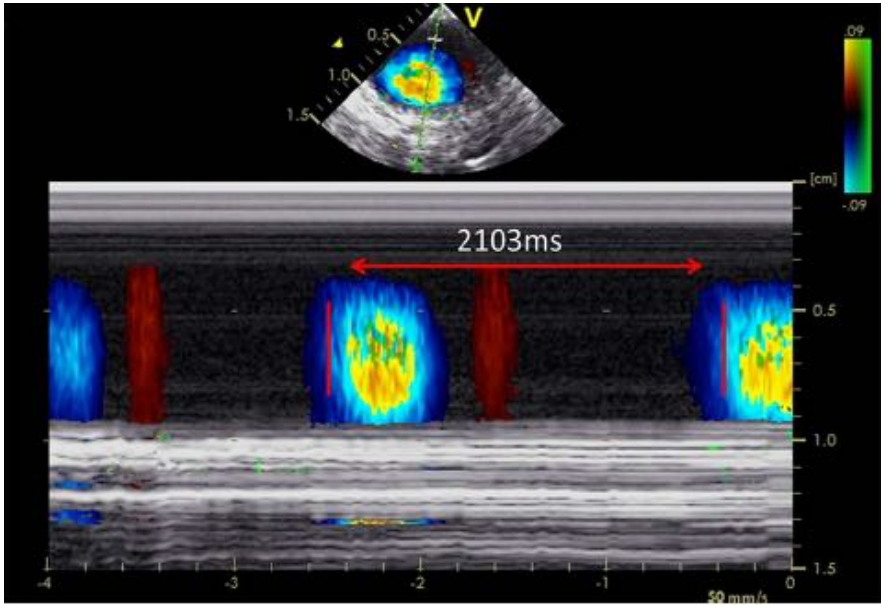
- Fetal neck malformation or masses
- Surgery for 10 to 150 min with placental support

Prolongation des échanges foeto-placentaires après la naissance ?

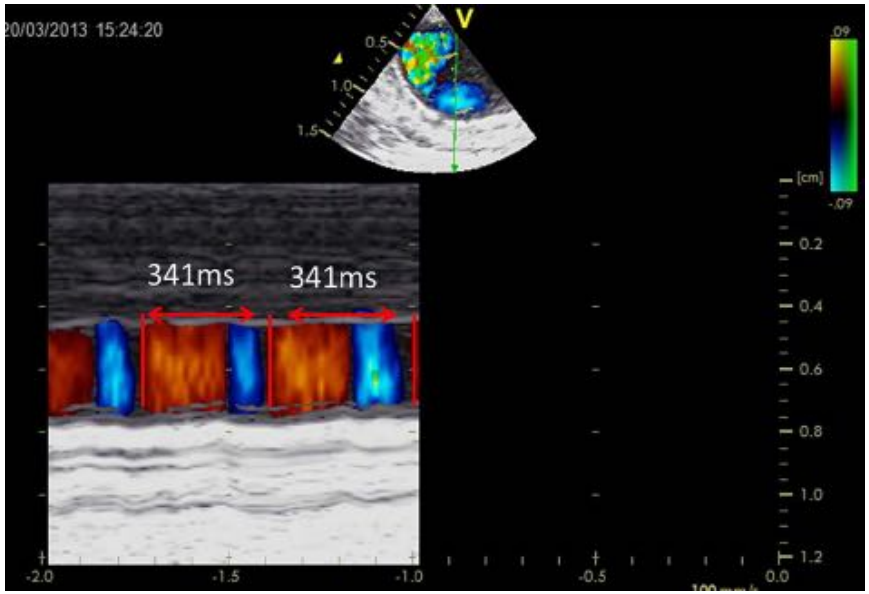
Laje P, J Pediatr Surg 2015



Venous flow



Venous flow



Arterial flow

- N=30, GA=39W
- Sur abdomen
- Doppler des vaisseaux ombilicaux

- Flux veineux et artériel > 80%
- Durée 2 à10 min
- Débit non lié à la pulsatilité du cordon

Boere I, Arch Dis Child 2015

Immediate cord clamping | Delayed cord clamping

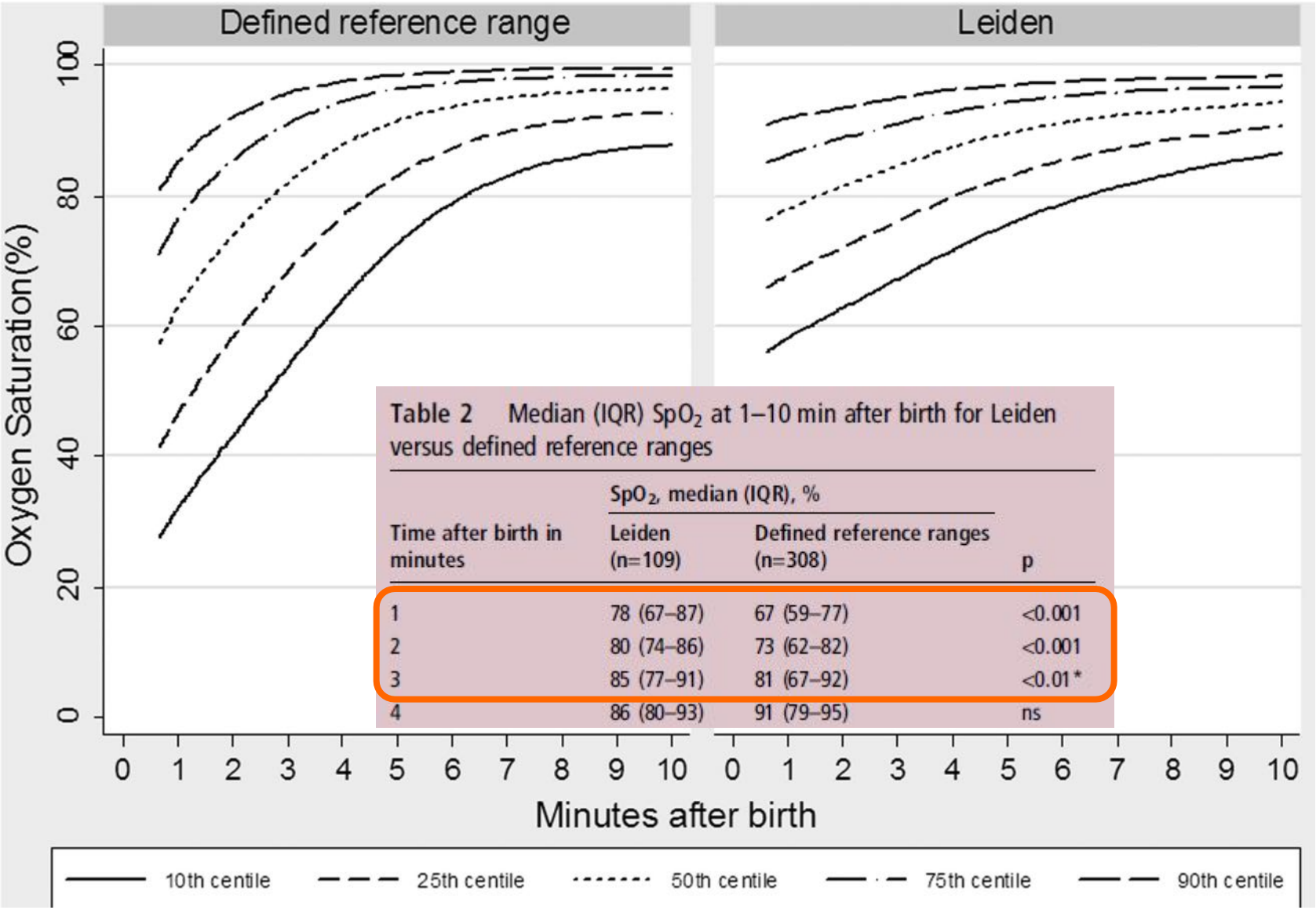


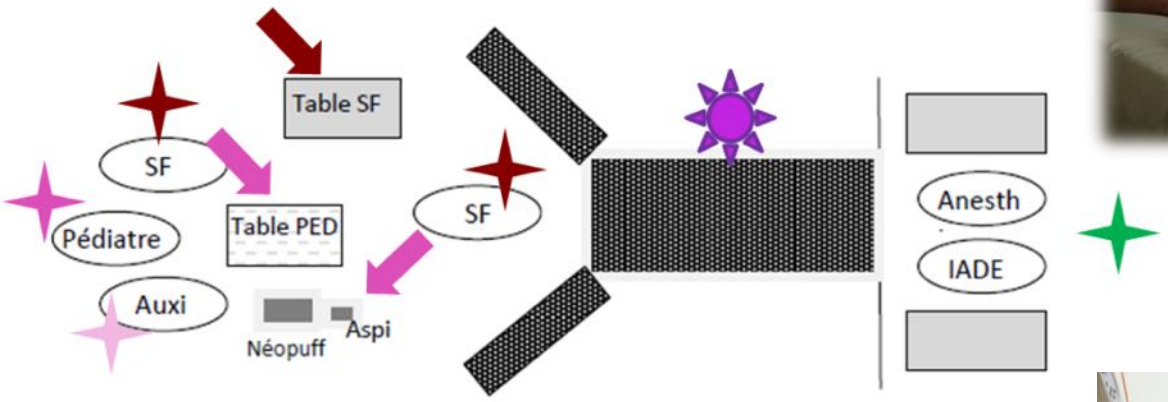
Table 2 Median (IQR) SpO_2 at 1–10 min after birth for Leiden versus defined reference ranges

Time after birth in minutes	SpO_2, median (IQR), % Leiden (n=109)	Defined reference ranges (n=308)	p
1	78 (67–87)	67 (59–77)	<0.001
2	80 (74–86)	73 (62–82)	<0.001
3	85 (77–91)	81 (67–92)	<0.01*
4	86 (80–93)	91 (79–95)	ns

N=109, GA=40 W

Smit M, Arch Dis Child 2014

Patients & Methods



C Lefebvre, Resuscitation 2017

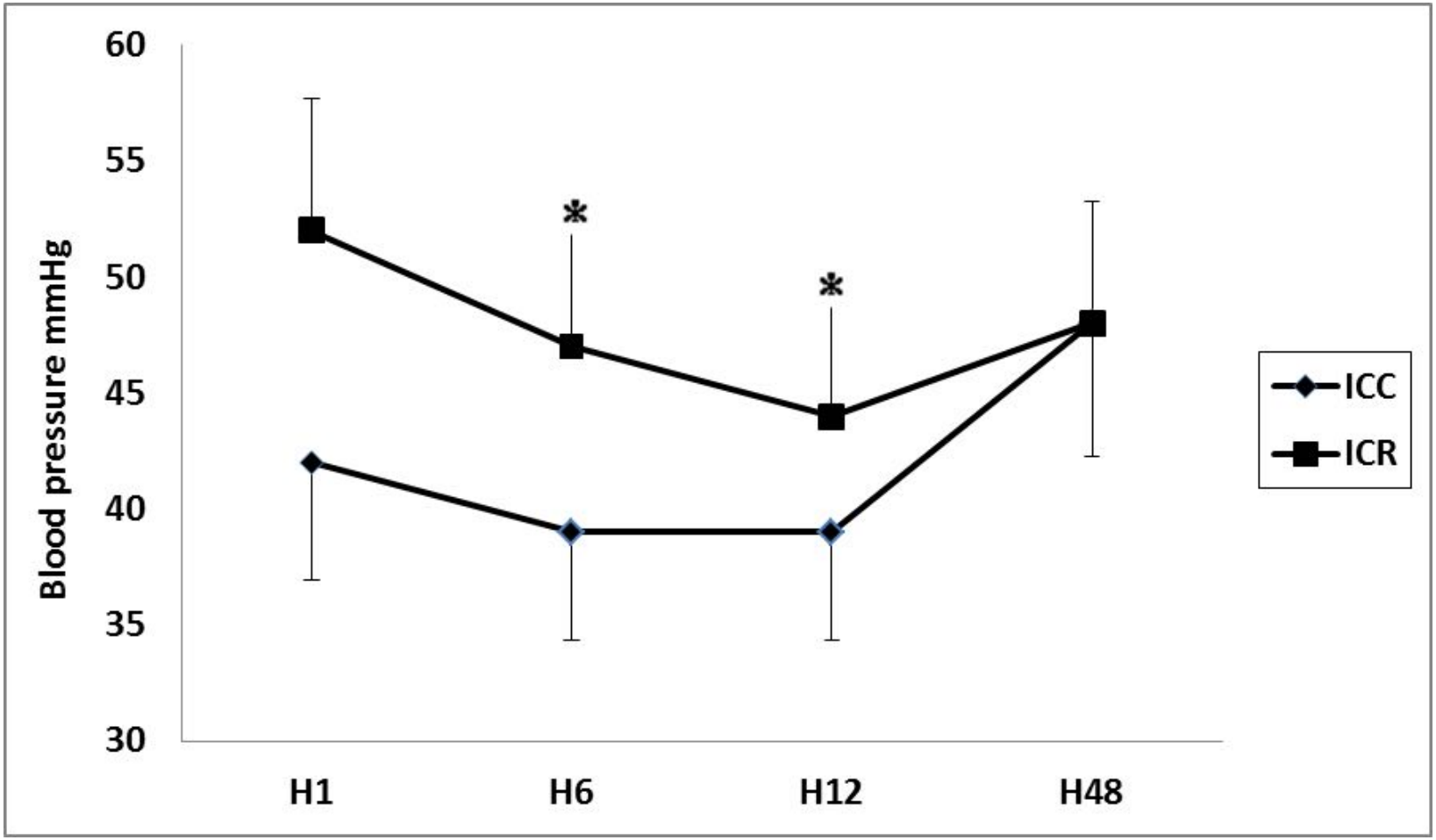
Results (2)

	Immediate cord clamping (n = 20)	Intact cord resuscitation (n = 20)	P value
Left CDH, n	19	19	NS
LHR o/e echography, %			
• 24-28 weeks GA	55 ± 20	55 ±20	NS
• 32-34 weeks GA	54 ± 14	45 ± 12	NS
Volume o/e MRI, %			
• 24-28 weeks GA	38 ± 22	33 ± 14	NS
• 32-34 weeks GA	52 ± 24	40 ± 14	NS
Gestational age, weeks	39 ± 3	38 ± 2	NS
Birth weight, g	3060 ± 710	3130 ± 660	NS
Male/female ratio	11/9	9/11	NS
Temperature at admission to NICU, °C	35.3 ± 1.1	35.7 ± 0.7	NS
Hemoglobin H24, g/dl	14.5 ± 1.4	19.4 ± 2.8	<0.05
Hematocrit H24, %	42.3 ±3.8	53.5 ± 7.6	<0.05
Transfusions, n	0.9 ± 1.6	0.8 ± 1.3	NS
Maximum serum bilirubin, µmol/l	110 ± 70	140 ± 76	NS

Results (3)

	Immediate cord clamping (n = 20)	Intact cord resuscitation (n = 20)	P value
Apgar score			
• 1 min	4.5 ± 2.1	7.7 ± 2.2	<0.05
• 5 min	6 ± 2.8	9.3 ± 1.1	<0.05
pH			
• Cord blood	7.29 ± 0.1	7.25 ± 0.1	NS
• H1	7.08 ± 0.2	7.17 ± 0.1	<0.05
• H6	7.27 ± 0.1	7.23 ± 0.1	NS
• H12	7.26 ± 0.1	7.24 ± 0.1	NS
• H48	7.22 ± 0.1	7.23 ± 0.1	NS
PCO_2, mmHg			
• H1	72 ± 24	79 ± 20	NS
• H6	51 ± 13	58 ± 21	NS
• H12	53 ± 12	57 ± 16	NS
• H48	58 ± 8	55 ± 15	NS
Lactate, mmol/l			
• H1	6.6 ± 4.3	3.6 ± 2.3	<0.05
• H6	1.6 ± 0.9	2.1 ± 2.4	NS
• H12	1.3 ± 0.7	2.1 ± 2.4	NS
• H48	1.3 ± 0.7	1.8 ± 1.5	NS
Heart rate, beats/min			
• H1	134 ± 13	143 ± 20	NS
• H6	121 ± 14	123 ± 19	NS
• H12	120 ± 11	123 ± 17	NS
• H48	132 ± 15	126 ± 13	NS

Results (4)



Take home messages

Le clampage physiologique du cordon chez le nouveau né ayant une bonne vitalité améliore l'adaptation cardiorespiratoire à la naissance par :

- ⇑ volume circulant (transfusion placentaire);
- Prévient la chute du débit VG lors du clampage;
- Prolongation de l'oxygénation placentaire ?

La traite du cordon avant clampage améliore l'adaptation cardiorespiratoire à la naissance par ⇑ volume circulant (transfusion placentaire);