AR-Péd-Obst
Hôpital Robert-Debré AP-HP

39e CONGRÈS ANNUEL DE L'ADARPEF
Association des Anesthésistes Réanimateurs Pédiatriques d'Expression Française

25 & 26 MARS 2022 MONTPELLIER Le Corum

ASSISTANCE PUBLIQUE HÔPITAUX DE PARIS

FHU i2d2

Université de Paris

Groupement Hospitalier de Territoire Grand Paris Nord-Est
Aulnay-sous-Bois - Le Raincy-Montfermeil - Montreuil

Monitorage en chirurgie néonatale : à quoi se fier ?

Pr Souhayl DAHMANI. Université de Paris,
DAR Robert Debré (Paris) & Robert Ballanger (Aulnay /s Bois).



Conflits d'intérêt

Medtronic
Drager (Chair d'innovation APHP: BOPA)
Edouards (Chaire d'innovation APHP: BOPA)

NECTARINE



6000 infants < 60 wks postconeptual age

Factor	French cohort (N = 926)	European Cohort (N = 5609)
Follow up at day 30	835 (90.2 %)	5510 (93.3 %)
Mortality ay day 30	**15 (1.8 %)**	**105 (1.9 %)**
Location at day 30		
- Home	648 (77.6 %)	
- Hospital	69 (8.3 %)	
- Other hospital	46 (5.5 %)	
- ICU	57 (6.8 %)	
Complications at day 30	117 (14.4 %)	850 (16.3 %)
- Neurological	**14 (1.7 %)**	**146 (2.6 %)**
- Surgical	14 (1.7 %)	329 (6 %)
- Respiratory	**54 (6.6 %)**	**457 (8.3 %)**
- Cardio-vascular	**32 (3.9 %)**	**315 (5.7 %)**
- Renal complications	10 (1.3 %)	98 (1.8 %)
- Liver complications	7 (0.9 %)	51 (0.9 %)
Overall mortality at day 90	**19 (2 %)**	**136 (2.4 %)**

Dahmani s et al. ACCPM 2021

NECTARINE



Factor	French cohort (N = 926)	European Cohort (N = 6542)
Intervention critical events	352 (38 %)	2306 (35.2 %)
Mean Blood pressure		
- Baseline	54.9 ± 14.5	54.8 ± 14.2
- Threshold for intervention	31.9 ± 6.7	32.5 ± 6.7
- Threshold for drug administration	32.1 ± 6.9	-
- Number of intervention	144 (15.5 %)	558 (8.5 %)
- Number of drug administration		373 (5.7 %)
Drug administration for		
- Ephedrin		
- Phenylep		
- Norepin		
- Dopamine		
- Dobutamine		
- Epinephrin		
Oxygen saturation		
- Baseline		98 ±4
- Threshold for intervention on SpO2< 90 %	48 (41.7 %)	40.6 %
- Threshold for intervention on SpO2 < 85 %	22 (19.1 %)	18.9 %
- Threshold for intervention on SpO2 < 80 %	45 (39.1 %)	40.5 %
- Number of intervention	115 (12.4 %)	830 (12.7 %)
Haemoglobin		
- Baseline	12.2 ±2.8	12.3 ±3.0
- Threshold for intervention	8.4 ±1.4	8.6 ±1.7
- Number of interventions	43 (4.6 %)	334 (5.1 %)
Near-infrared spectroscopy		
- Baseline	78.8 ±11.6	72.3 ±15
- Threshold for intervention (absolute)	52 ±12.8	45.2 ±13.4
- Threshold for intervention (change)	29 ±18.6	30.4 ±16.7
- Number of interventions	33 (3.5 %)	147 (2.2 %)

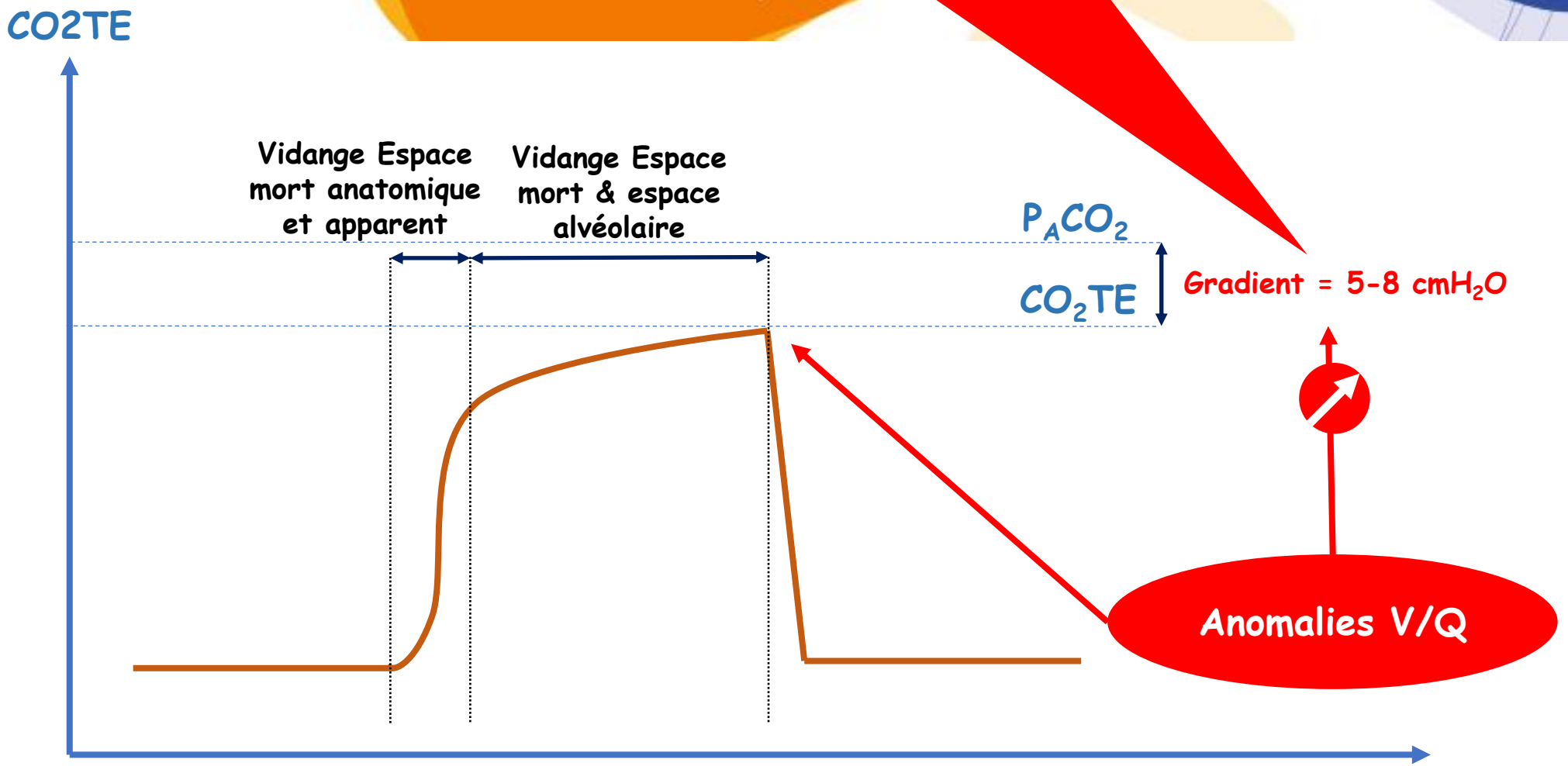
Intervention = FDR complications !

Dahmani s et al, ACCPM 2021

CO_2TE

25 & 26 MARS 2022 MONTPELLIER Le Corum

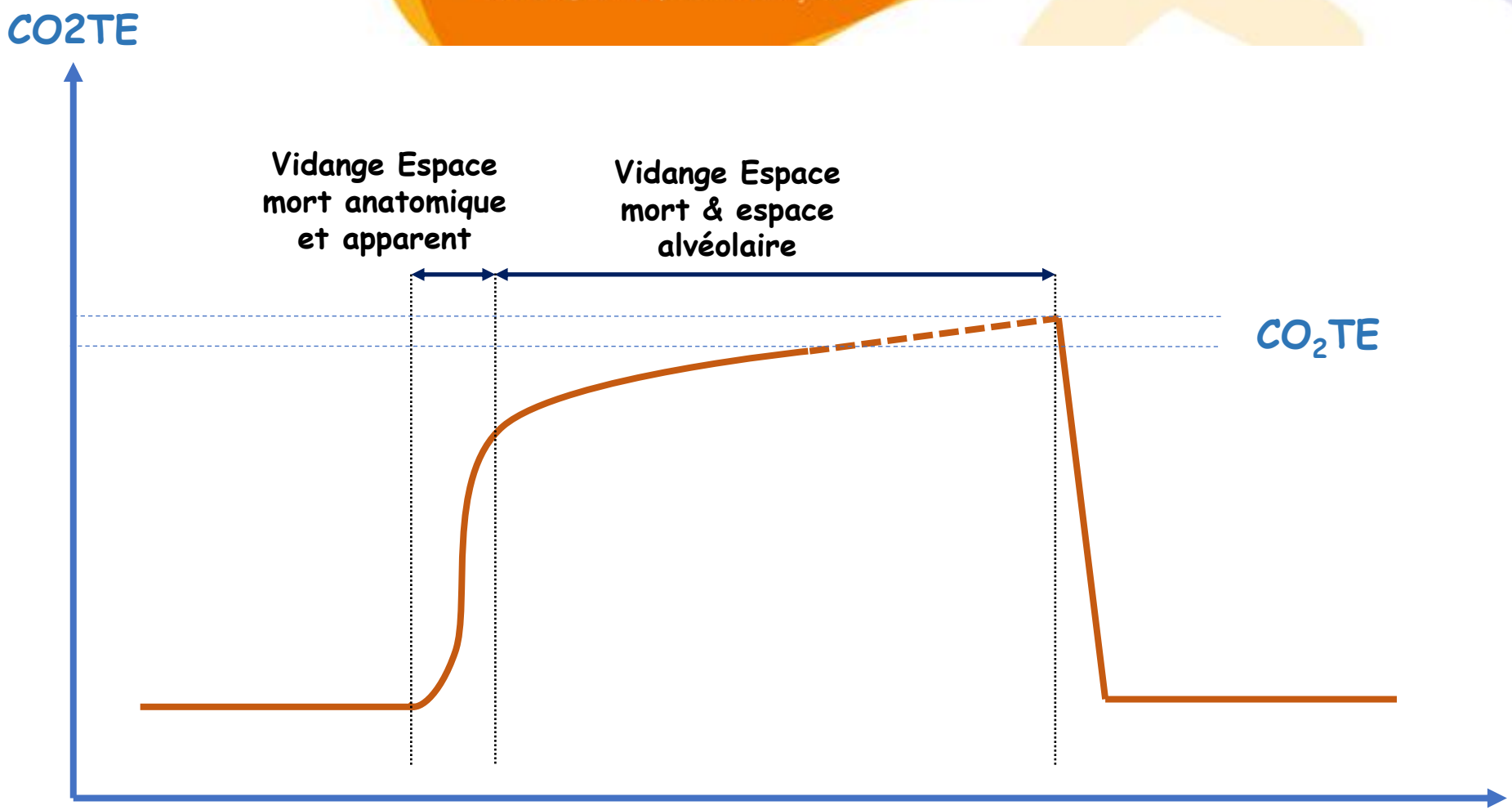
Vidange inhomogène
Fréquence respiratoire trop élevée ?



Sankaran D et al. J Perinatol 2021

CO_2TE

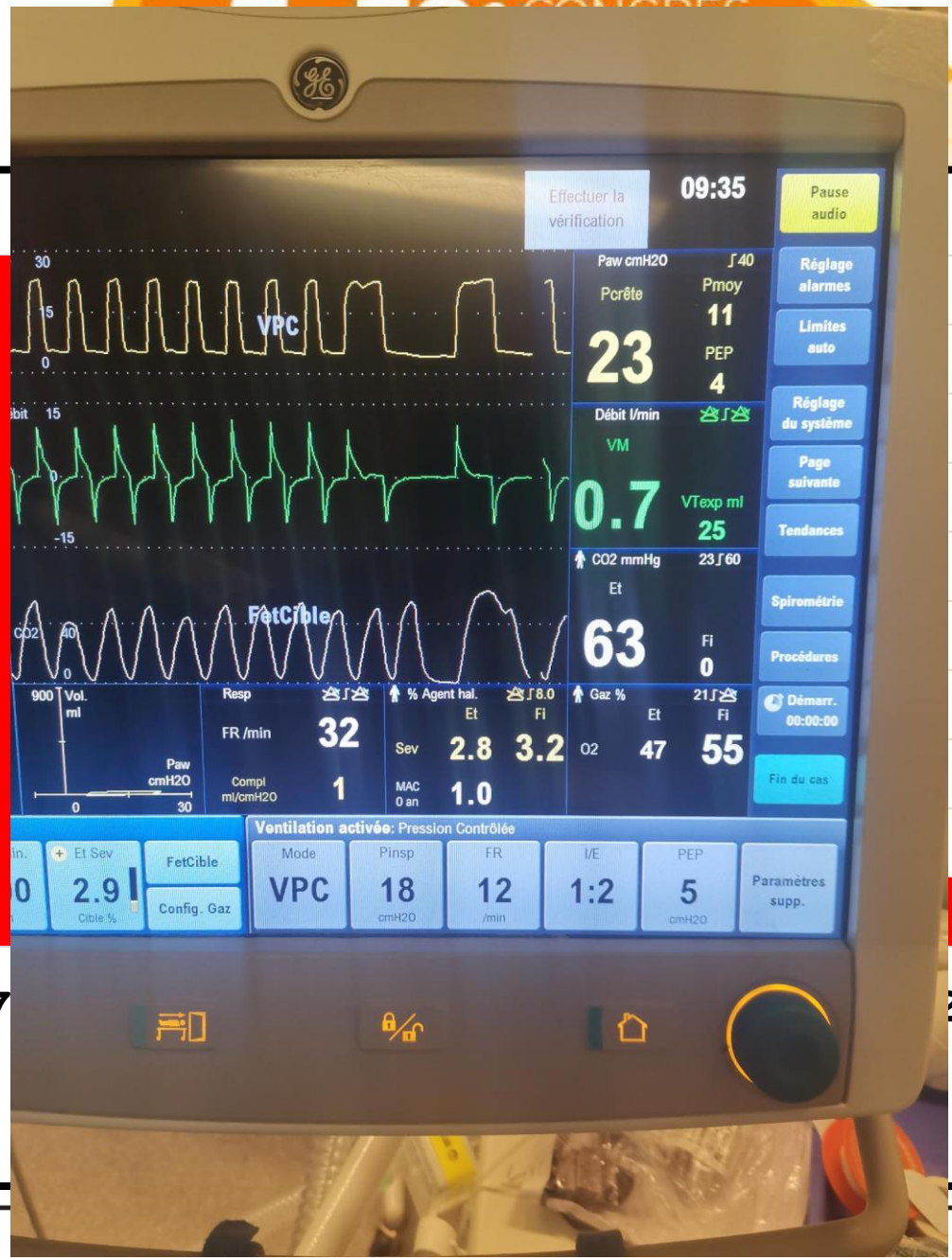
39e CONGRÈS ANNUEL DE L'ADARPEF
Association des Anesthésistes Réanimateurs Pédiatriques d'Expression Française
25 & 26 MARS 2022
MONTPELLIER
Le Corum



Sankaran D et al. J Perinatol 2021

25 & 26
MARS 2022
MONTPELLIER
Le Corum

ΔPAO2-CO2TE
= 3 mmHg



Pourcentage de non-concordance

100
90
80
70
60
50
40
30
20
10
0

ΔPA

< 17

250 ms

> 250 ms

PIP, cm H$_2$
PEEP, cm
MAP, cm H
VT/kg, mL
C_{stat}, (mL/c
OI
VEI
Pa_{O_2}, torr
Pa_{CO_2}, torr
pH
HR,
Mea
Pet_{CO_2}, tor
aA_{CO_2}, torr
V_{CO_2}, mL/k
$V_{D_{alv}}/V_T^c$
$V_{D_{ana}}/V_T^c$
$V_{D_{phys}}/V_T^c$

± 0.2)^a
± 0.0)^a
± 0.1)^a
± 6.4)^a
1.9)
g
1.2)^d
1.10)

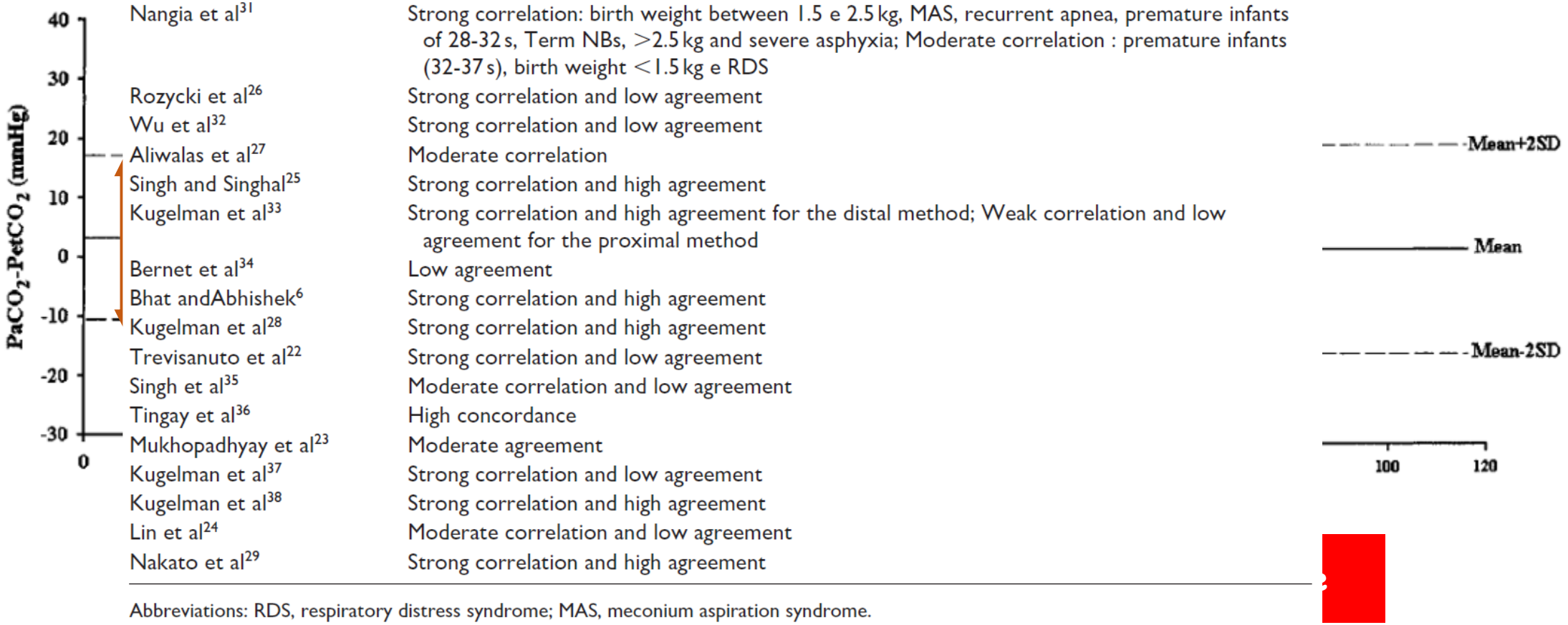
Proquité H et al. Pediatr Crit Care Med 2004

61 nourrissons : soins critiques
20 à terme
41 prématurés: 32-42 SA

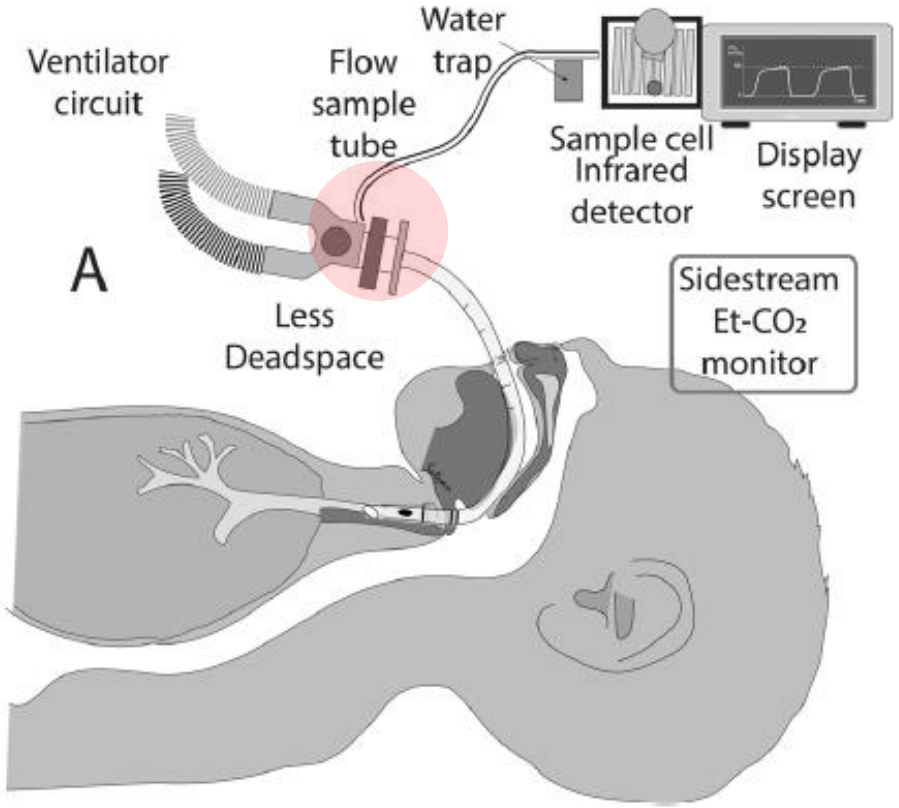
39e CONGRÈS ANNUEL DE L'ADARPEF
Association des Anesthésistes Réanimateurs Pédiatriques d'Expression Française
25 & 26 MARS 2022
MONTPELLIER
Le Corum

Author	Conclusion
Meredith and Monaco[30]	Strong correlation and high agreement
Nangia et al[31]	Strong correlation: birth weight between 1.5 e 2.5 kg, MAS, recurrent apnea, premature infants of 28-32 s, Term NBs, >2.5 kg and severe asphyxia; Moderate correlation : premature infants (32-37 s), birth weight <1.5 kg e RDS
Rozycki et al[26]	Strong correlation and low agreement
Wu et al[32]	Strong correlation and low agreement
Aliwalas et al[27]	Moderate correlation
Singh and Singhal[25]	Strong correlation and high agreement
Kugelman et al[33]	Strong correlation and high agreement for the distal method; Weak correlation and low agreement for the proximal method
Bernet et al[34]	Low agreement
Bhat andAbhishek[6]	Strong correlation and high agreement
Kugelman et al[28]	Strong correlation and high agreement
Trevisanuto et al[22]	Strong correlation and low agreement
Singh et al[35]	Moderate correlation and low agreement
Tingay et al[36]	High concordance
Mukhopadhyay et al[23]	Moderate agreement
Kugelman et al[37]	Strong correlation and low agreement
Kugelman et al[38]	Strong correlation and high agreement
Lin et al[24]	Moderate correlation and low agreement
Nakato et al[29]	Strong correlation and high agreement

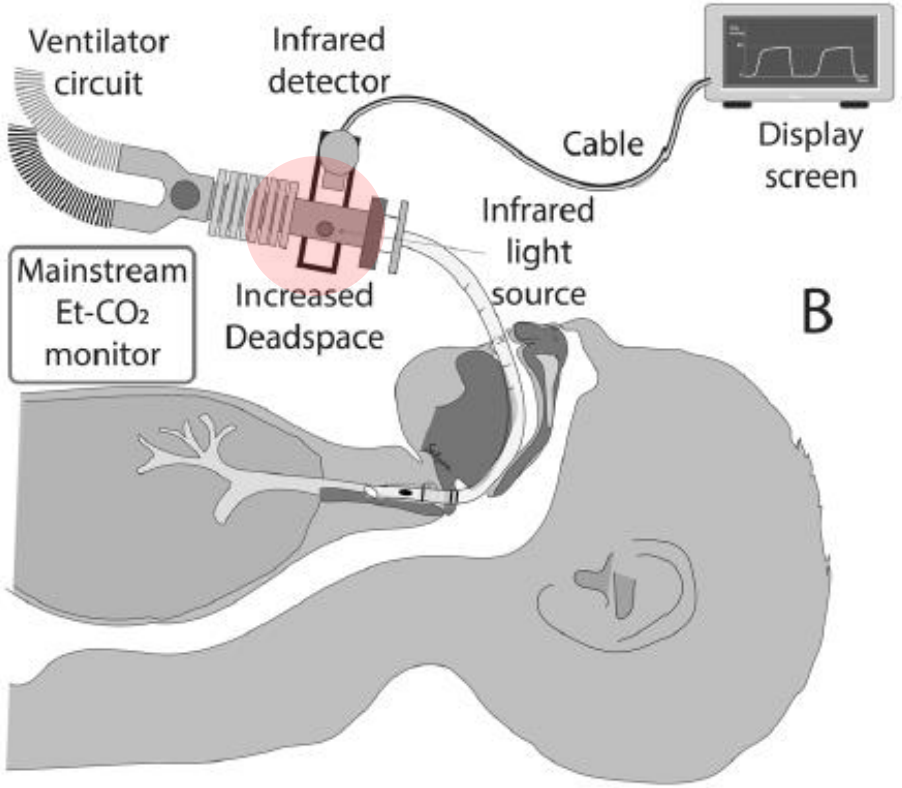
Abbreviations: RDS, respiratory distress syndrome; MAS, meconium aspiration syndrome.



Wu C et al. Pediatr Pulm 2003
Martins IPM et al. Glo Pediatr Health 2021.



- Meilleure estimation CO_2TE
- Problème occlusion par secrétions
- Délai 1 à 4 secondes pour analyse

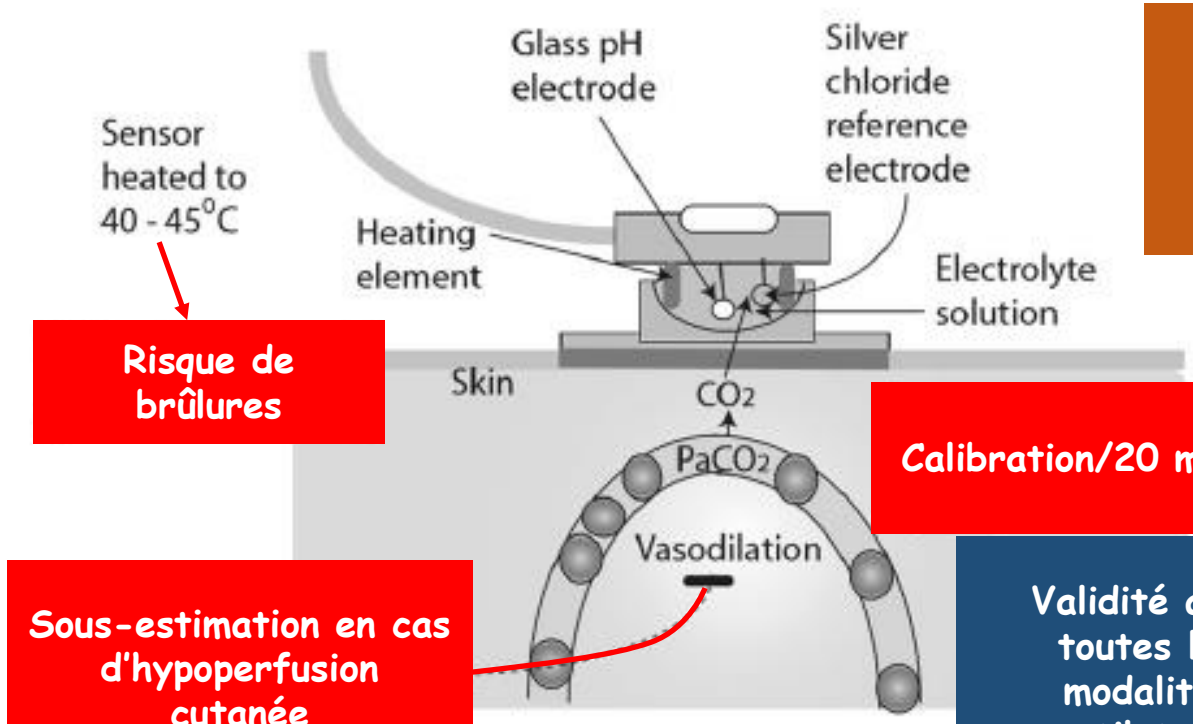


- Rapide
- Sous-estimation CO_2TE : pollution par espace mort

Sankaran D et al. J Perinatol 2021

CO_2 Trans-cutané

39e CONGRÈS ANNUEL DE L'ADARPEF
Association des Anesthésistes Réanimateurs Pédiatriques d'Expression Française
25 & 26 MARS 2022 MONTPELLIER Le Corum



Risque de brûlures

Idéal en situation de ventilation à haute fréquence

Calibration/20 mn

Sous-estimation en cas d'hypoperfusion cutanée

Validité avec toutes les modalités ventilatoires

Débit sanguine pulmonaire par capnopgrapphie dynamique

39e CONGRÈS ANNUEL DE L'ADARPEF

Association des Anesthésistes Réanimateurs Pédiatriques d'Expression Française

25 & 26 MARS 2022 MONTPELLIER Le Corum

15 enfants: 5 à 36 mois

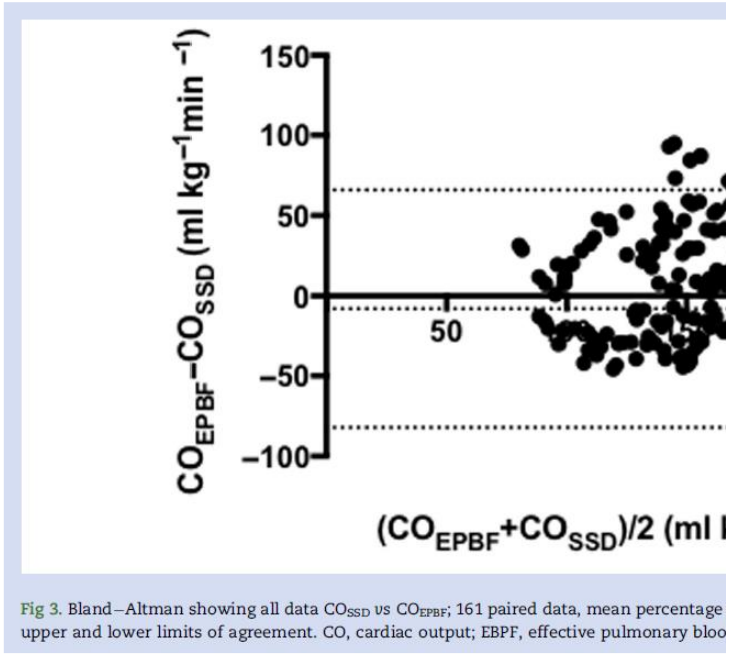
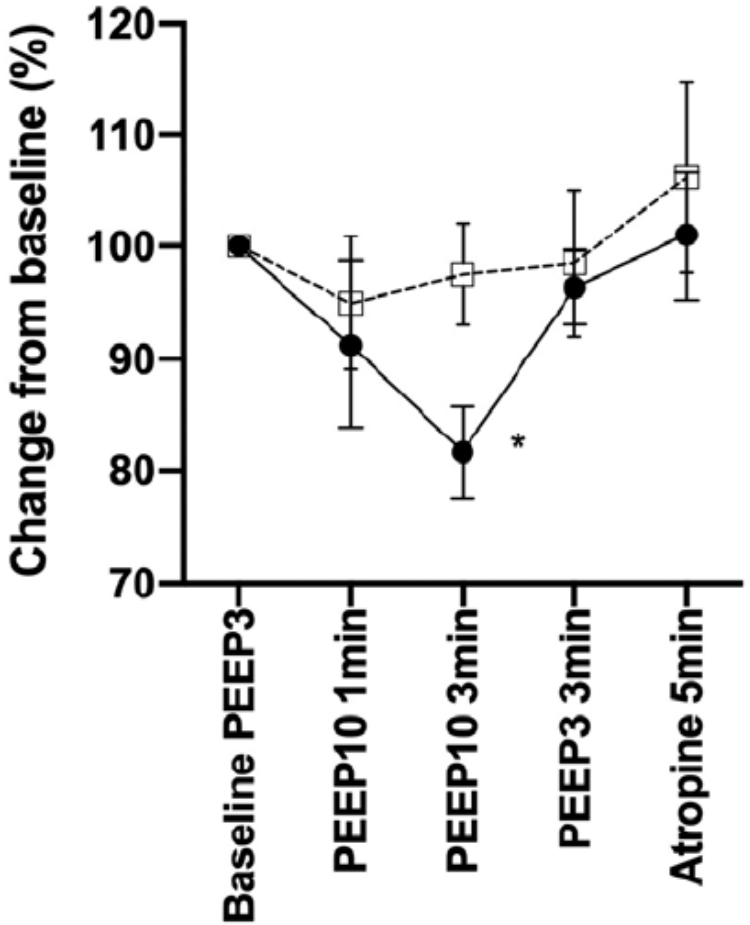
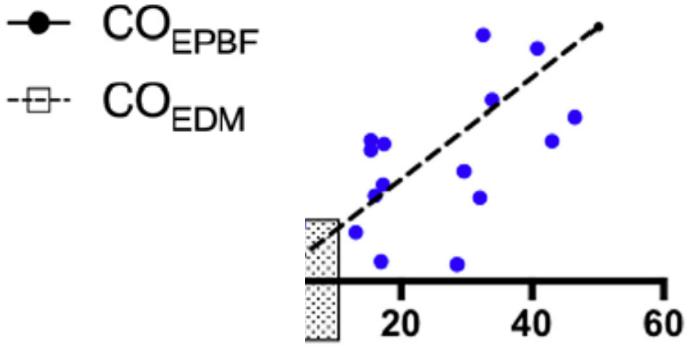


Fig 3. Bland–Altman showing all data CO_{SSD} vs CO_{EPBF}; 161 paired data, mean percentage upper and lower limits of agreement. CO, cardiac output; EBPF, effective pulmonary bloo





$kg^{-1}min^{-1}$)

enty-seven paired delta values. The central boxed area rep-
ted line represents line of identity. CO, cardiac output; EBPF,

Karlsson D et al. Brit J Anaesth 2021.
Karlsson D et al. Anesth Analg 2021.

Pression artérielle



	AUC	Cut off (mmHg)	Sensitivity (%)	95% CI	Specificity (%)	95% CI
MAP under anesthesia						
All the population	0.904	39	78	71–84	90	69–98
Children <6 months	0.808	33	71	58–81	83	58–96
Children >6 months	0.944	43	83	75–90	100	30–100
	AUC	Cut off (%)	Sensitivity (%)	95% CI	Specificity (%)	95% CI
MAP variation						
All the population	0.8	−37	75	68–82	76	52–91

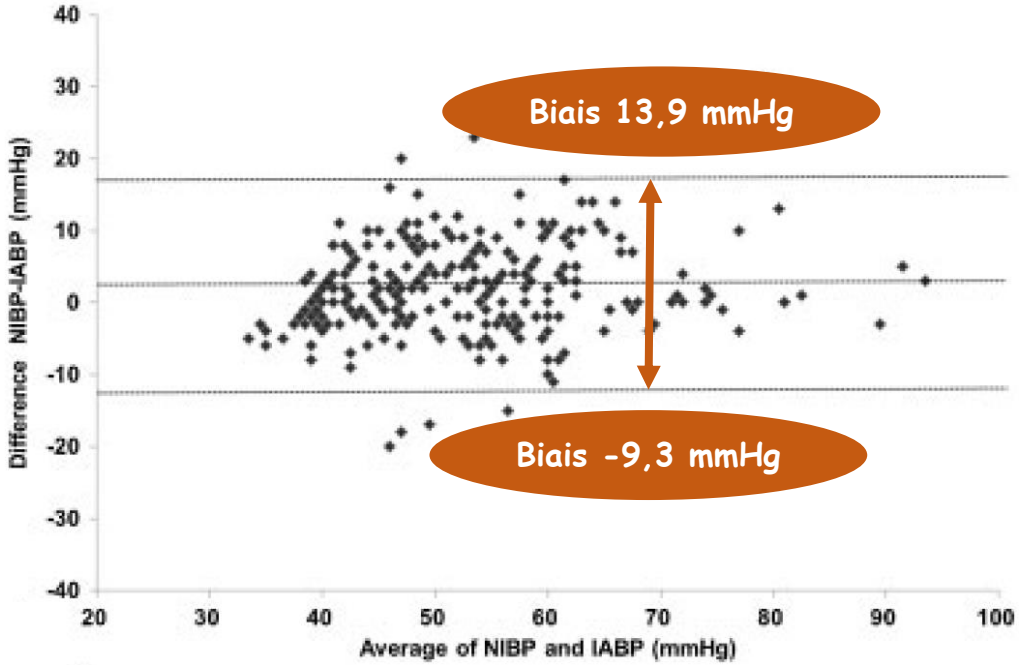
SBP	AUC	J point	Se J	Sp J	Gray zone
All patients	0.79 [0.74 - 0.84]	28.5 %	0.7 [0.6 - 0.8]	0.75 [0.72 - 0.77]	20.5 % - 37.5 %
Preterm	0.84 [0.77-0.88]	31.5 %	0.74 [0.6 - 0.8]	0.74 [0.7 - 0.78]	32.5 % - 39.5 %
Term	0.76 [0.7 - 0.83]	28.5 %	0.63 [0.57 - 0.80]	0.7 [0.77 - 0.8]	20.5 % - 36.5 %

MBP	AUC	J point	Se J	Sp J	Gray zone
All patients	0.67 [0.6 - 0.75]	40.5 %	0.4 [0.33 - 0.59]	0.83 [0.81 - 0.86]	15.5 % - 44.5 %
Preterm	0.72 [0.6-0.83]	40.5 %	0.5 [0.3 - 0.7]	0.8 [0.74 - 0.85]	30.5 % - 47.5 %
Term	0.65 [0.55 -0.75]	42.5 %	0.4 [0.3 - 0.6]	0.87 [0.85 - 0.9]	13.5 % - 42.5 %

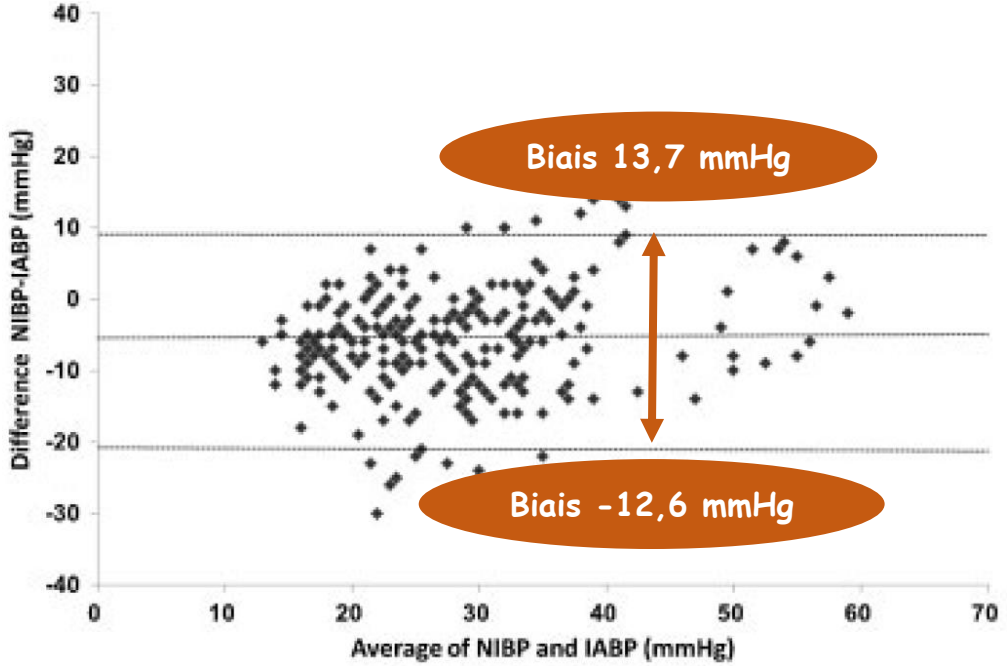
Rhondali O et al. Pediat Anesth 2014; 24: 734.
Michelet D et al. Br J ANaesth : submited.

	n (%)
Gestational age (wk)	31.2 ± 5.8
Age at measurement (d), median (IQR)	2.0 (1.0–4.0)
Male	36 (48.6)
Body weight (g), median (IQR)	1453 (916–2204)
Heavy for gestational age	3 (4.1)
Light for gestational age	10 (13.5)

39e CONGRÈS ANNUEL DE L'ADARPEF
Association des Anesthésistes Réanimateurs Pédiatriques d'Expression Française
25 & 26 MARS 2022 MONTPELLIER Le Corum



PA systolique



PA moyenne

Shimokaze T et al, Am L Perinatol 2015

54 nourrissons < 6 mois
Age : 10 ± 9,8 semaines.
Poids : 4,1 ± 1,4 kg
77,7 % ASA I ou II.



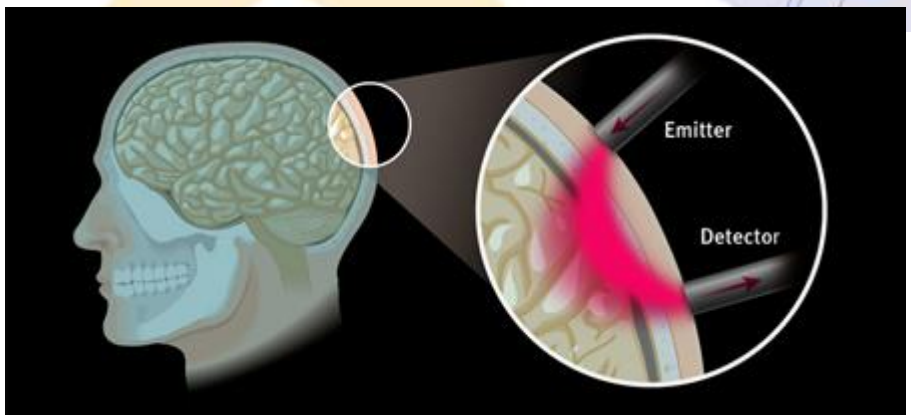
Valeurs de pression artérielle	Moyenne	Ecart-type
PAS en visite pré-anesthésique	88	19
PAS avant induction	104	19
PAS après induction	85	18
PAM en visite pré-anesthésique	65	14

Bland & Altman	Biais	Ecart-type	Limites d'agrément inférieures	Limites d'agrément supérieures
PAS VPA vs Pré	- 16,4 %	21,6 %	- 58,7 %	25,9 %
PAM VPA vs Pré	15,4 %	24,6 %	- 32,9 %	63,7 %
PAD VPA vs Pré	13,7 %	31,7 %	- 48,4 %	75,8 %

Mangelle C et al. SFAR 2017

- Comment ?

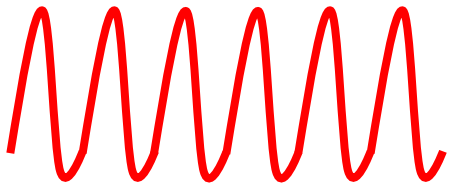
Spectroscopie Proche de l'infra-rouge (NIRS)



ScO2

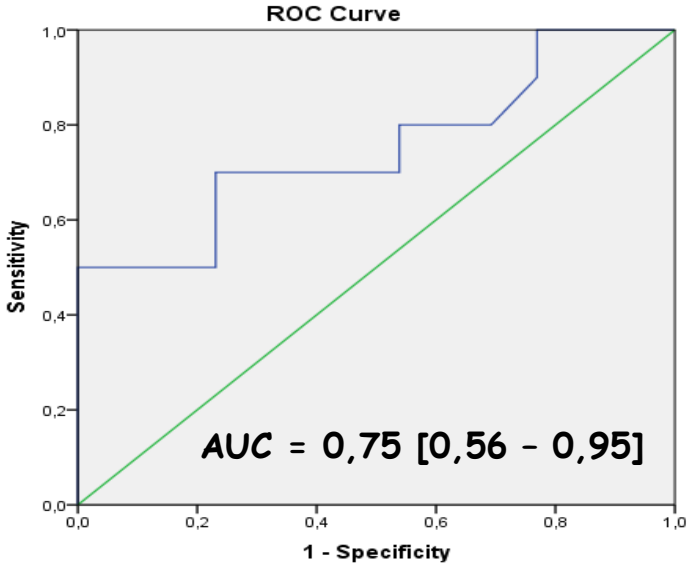
30 %

70 %





$$SvO_2 = SaO_2 - \left[\frac{VO_2}{Q \times Hb \times 1{,}34} \right]$$



Courbe ROC $StcO_2$ Avant remplissage.

29 patients < 1 an
Monitorage par NIRS
Remplissage efficace si PAM ≥ 15 %

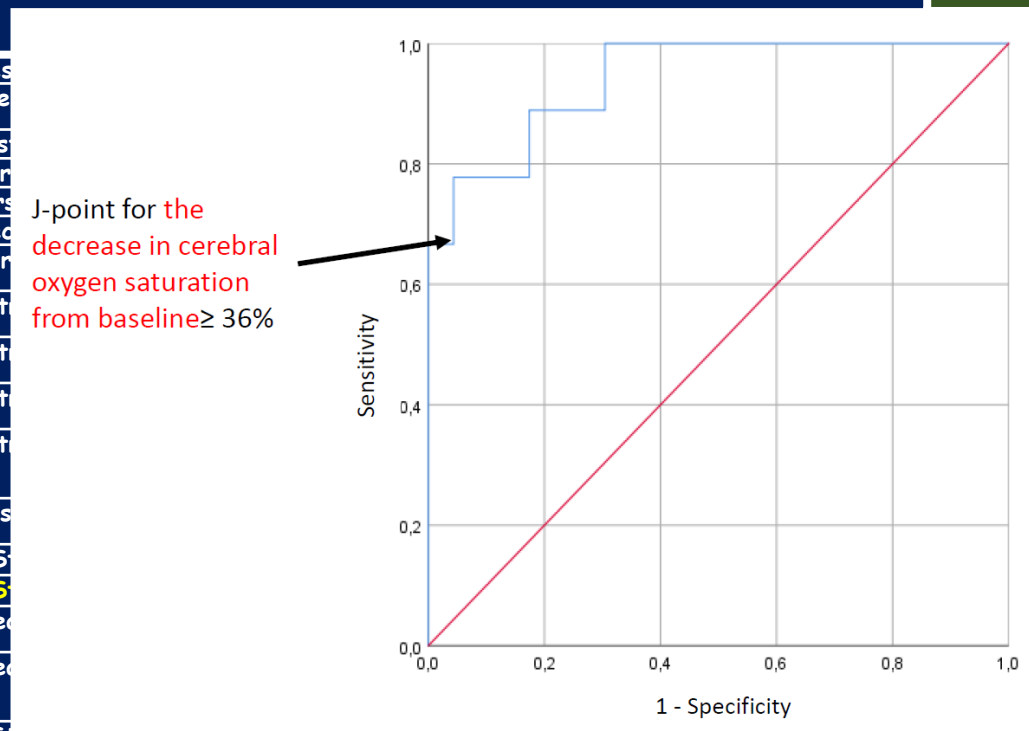
	$StcO_2$ après remplissage
Sensibilité 90 %	78
Spécificité 90 %	59
Valeur optimale	66 Se = 0,7 [0,6 – 0,79] Sp = 0,77 [0,7 – 0,83]

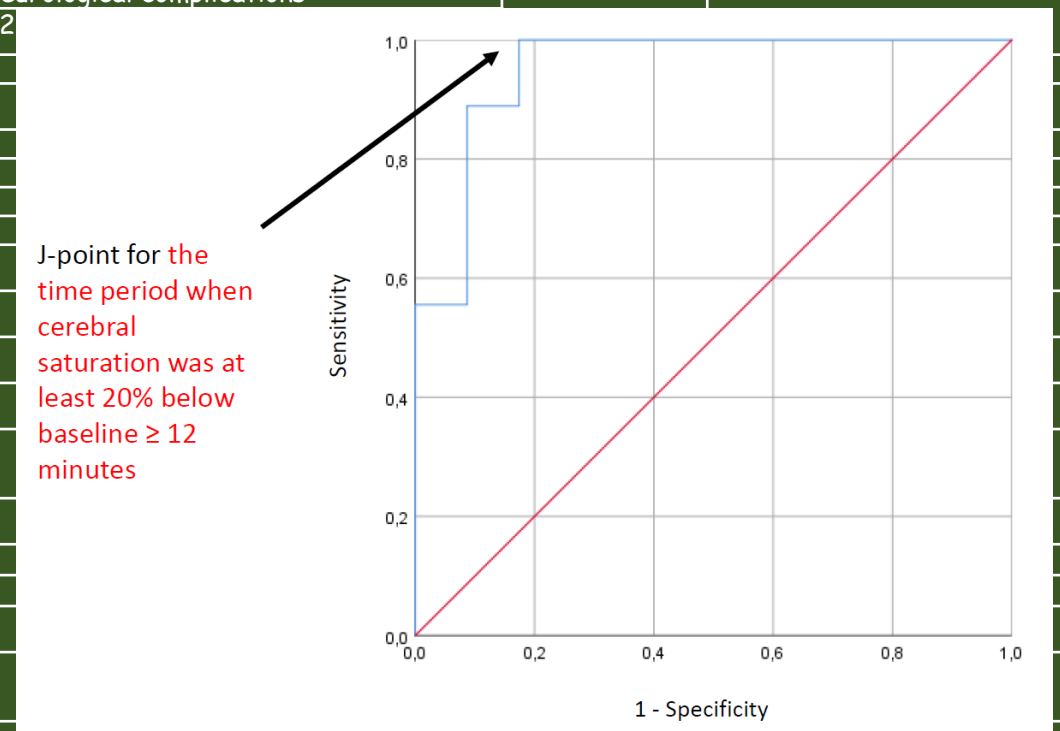
Pailleret C et al. ACCPM 2014.

Entérocolites chirurgicales : pronostic neurologique à 1 an

39e CONGRÈS ANNUEL DE L'ADARPEF
Association des Anesthésistes Réanimateurs Pédiatriques d'Expression Française
25 & 26 MARS 2022 MONTPELLIER Le Corum

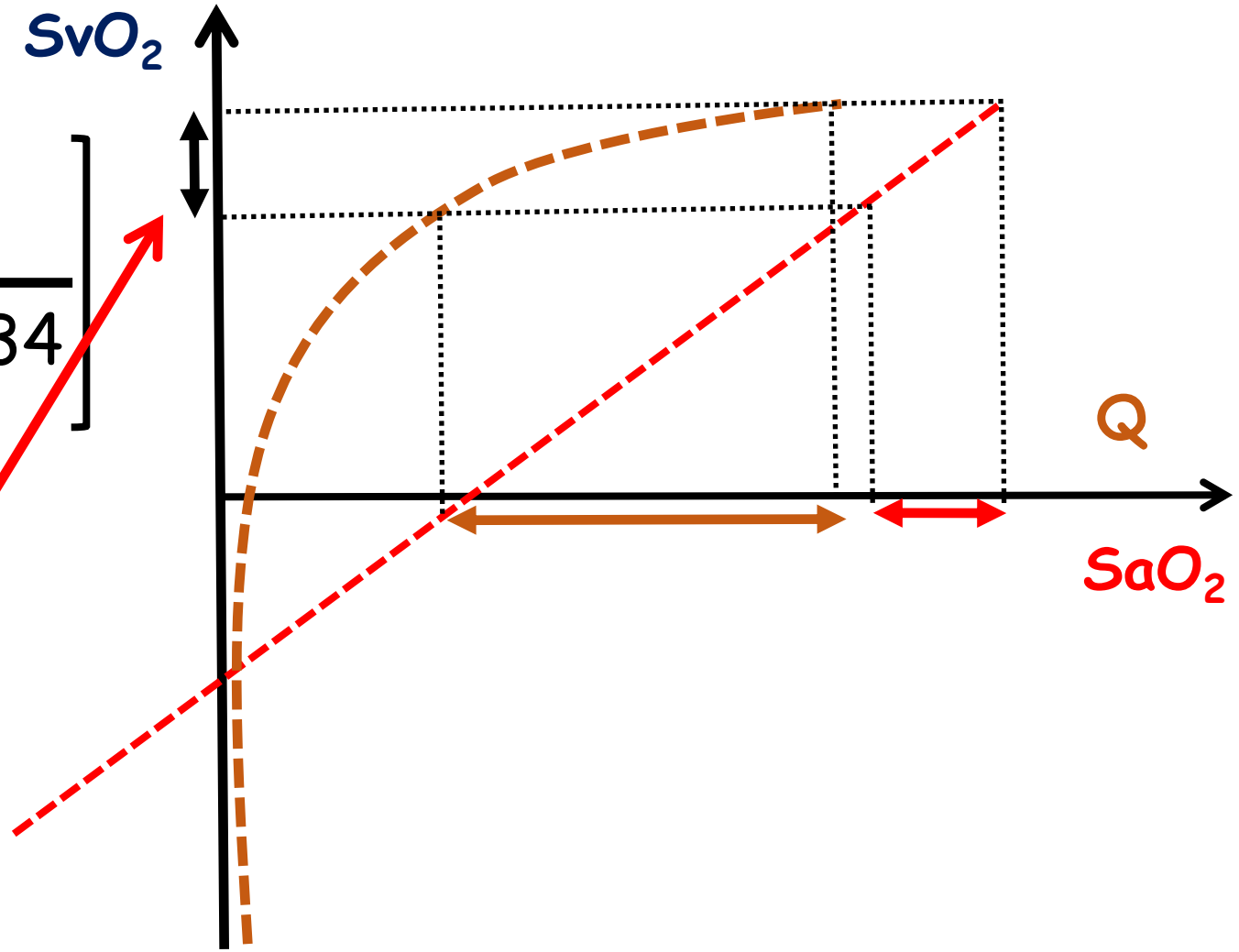
Factor	Univariable analyses			Multivariable analysis
	Neurological complications			
Ges	= 2			
We	0]			
Pos				
Car				
Firs				
Sec				
Sur				
Int				
Int				
Int				
Int				
Bas				
ΔS				
ΔS				
Me				
Me				
$TStcO_2$	5 [0 - 65]	80 [15 - 160]	< 0.001	
$TStcO_2$ ≥ 12 min	4 (17.4 %)	9 (100 %)	< 0.001	-
Duration of surgery (minutes)	80 [40 - 130]	80 [30 - 240]	0.7	





Julien-Marsollier F et al. Pediatr Anesth 2022

$$SvO_2 = SaO_2 - \left[\frac{VO_2}{Q \times Hb \times 1{,}34}\right]$$



Sensibilité du moniteur

39e CONGRÈS ANNUEL DE L'ADARPEF
Association des Anesthésistes Réanimateurs Pédiatriques d'Expression Française
25 & 26 MARS 2022 MONTPELLIER Le Corum

Table 1 Demographic data of the study participants

Gestational age at birth in weeks (±SD)	27.9 (±1.7)
Birthweight in grams (±SD)	998.33 (±281.36)
Postmenstrual age in weeks at first measurement (±SD)	31.7 (±2.1)
Age in days at first measurement (±SD)	25.3 (±14.59)
Weight at first measurement, g (±SD)	1341.22 (±340.5)
Sex (female/male)	4/5
Haemoglobin level during measurements (±SD)	12.67 (±1.4)

Table 2 General information about the tested devices and the sensors

Device name	Sensor
NIRO 200	A8942 Emission Probe A8943 Detection Probe S-4B Probe Holder
INVOS 5100c	OxyAlert NIRSensor, cerebral/somatic neonatal
Fore-Sight	Fore-Sight Sensor Nonadhesive small
SenSmart X-100	SenSmart nonadhesive neonatal/paediatric sensor <40 kg

Interprétation des variations plus que la valeur absolue !!

Table 3 Tissue oxygenation values of the pairings (±SD)

Sensor pairing (device 1–device 2)	Tissue oxygenation device 1, %	Tissue oxygenation device 2, %	Minutes utilised (overall minutes)	p-value
NIRO–INVOS	64.96 (±7.44)	68.44 (±10.64)	1020 (1104)	<0.001
NIRO–Fore-Sight	63.31 (±6.81)	71.69 (±4.85)	996 (1097)	<0.001
NIRO–SenSmart	63.62 (±5.43)	76.77 (±4.62)	865 (992)	<0.001
INVOS–Fore-Sight	65.79 (±8.46)	74.23 (±4.61)	747 (924)	<0.001
INVOS–SenSmart	66.44 (±7.36)	76.22 (±3.38)	832 (1026)	<0.001
Fore-Sight–SenSmart	74.70 (±4.06)	76.86 (±3.08)	1186 (1370)	<0.001

Schneider A et al. Acta Paediatr 2013.

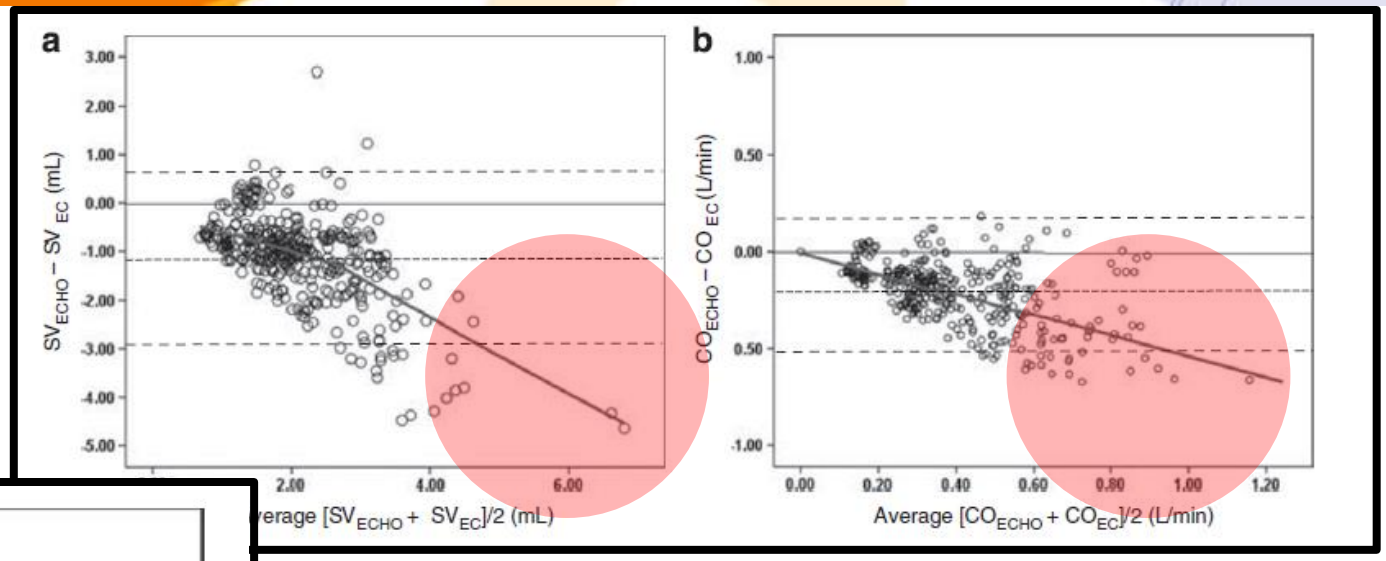
Bioimpédance & Velocimétrie

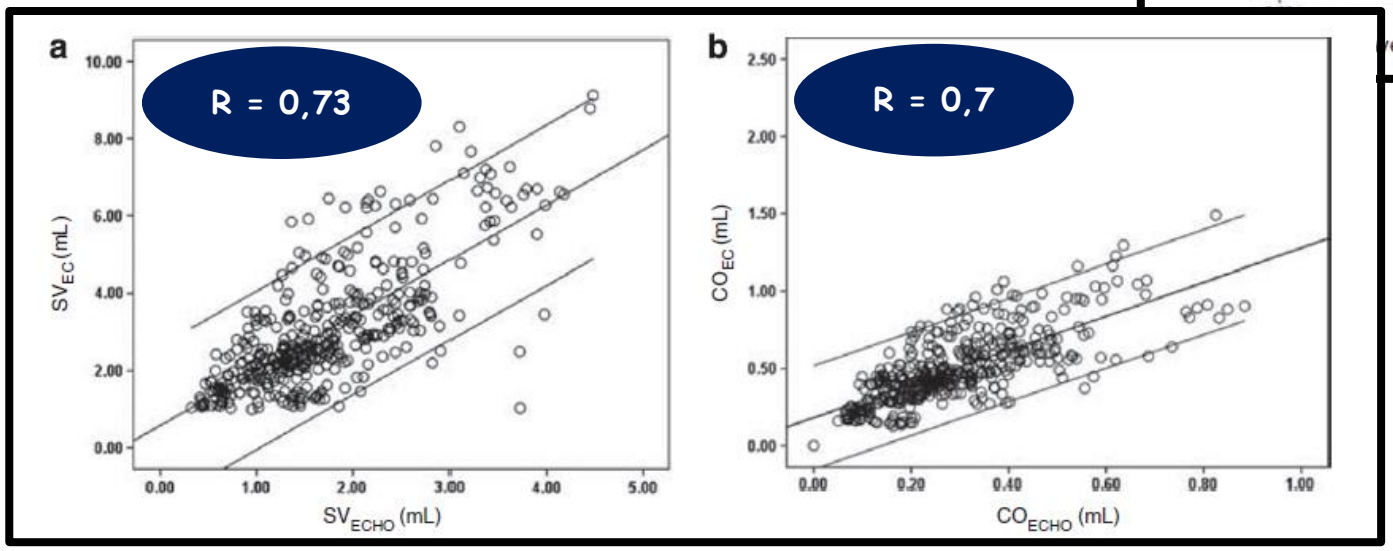
39e CONGRÈS ANNUEL DE L'ADARPEF
Association des Anesthésistes Réanimateurs Pédiatriques d'Expression Française
25 & 26 MARS 2022 MONTPELLIER Le Corum

Table 1. Basic population details

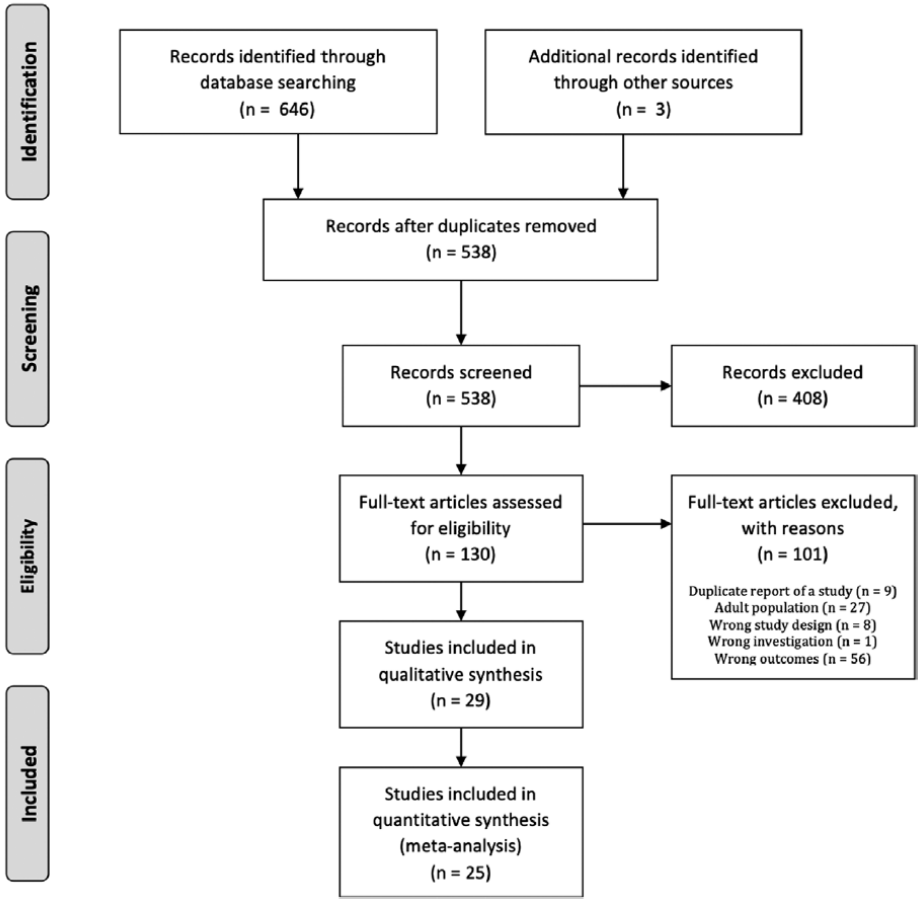
Neonates	*79*
Males	50 (63%)
Gestational age (weeks)	31 ± 3.2
Gestational age (min–max weeks)	26–36
Birth weight (g)	1440 ± 533
SGA babies	13 (16.4%)
C-section	36 (45%)
5-min Apgar	8.2 ± 1.9
CRIB-II	8.6 ± 4

Abbreviations: CRIB-II, critical risk index for babies-II; SGA, small for gestational age. Data are expressed as mean ± s.d., number (%) or min–max value.

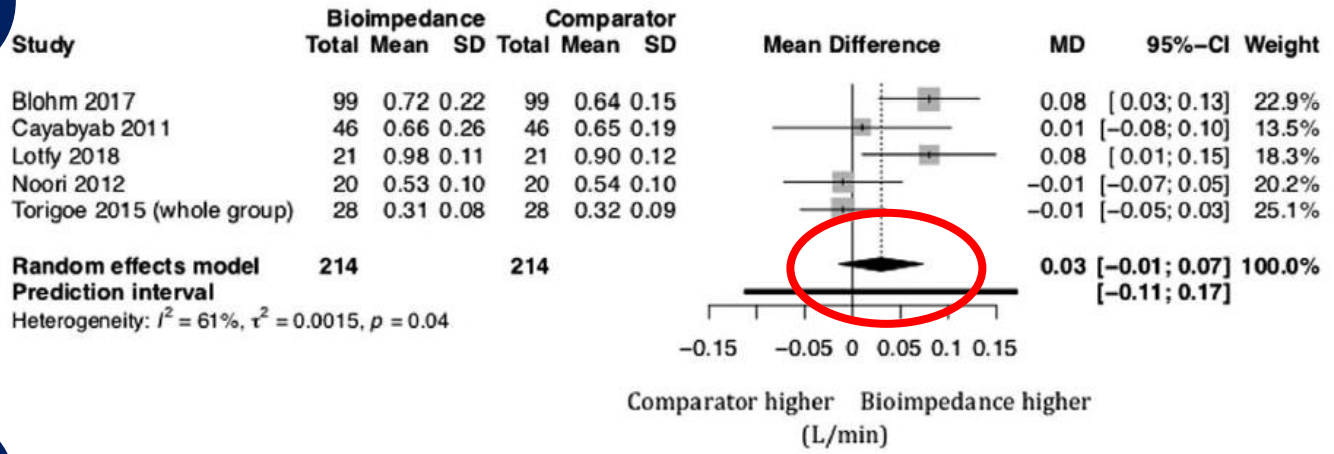




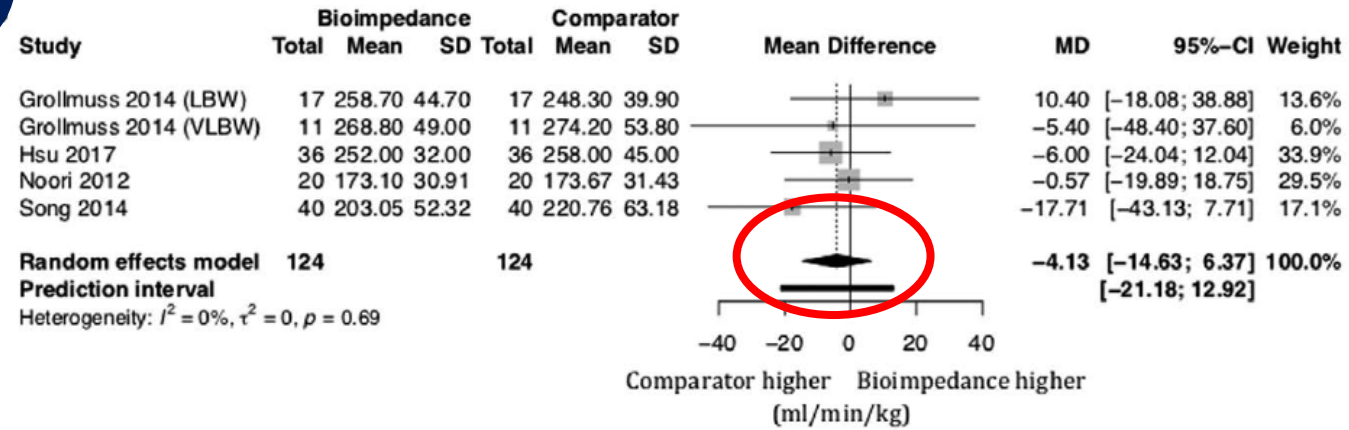
Boet A et al. J Perinatol 2015



IC



VES



Rushni C et al. CCMjournal 2022

Conclusions



- Connaissance de chaque paramètre et des facteurs susceptibles de le moduler
- Travailler à l'innovation et/ou la validation de nouveaux paramètres.
- Congruence dans l'interprétation des valeurs