

- Pourquoi ?
- Pour qui ?
- Comment ?

Université Sorbonne Paris Cité

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Hôpital Robert Debré

PROTECT
Promoting Research Oriented Toward Early CNS Therapies
DHU PROTECT

Oxymétrie cérébrale : Pourquoi , Pour qui, Comment ?

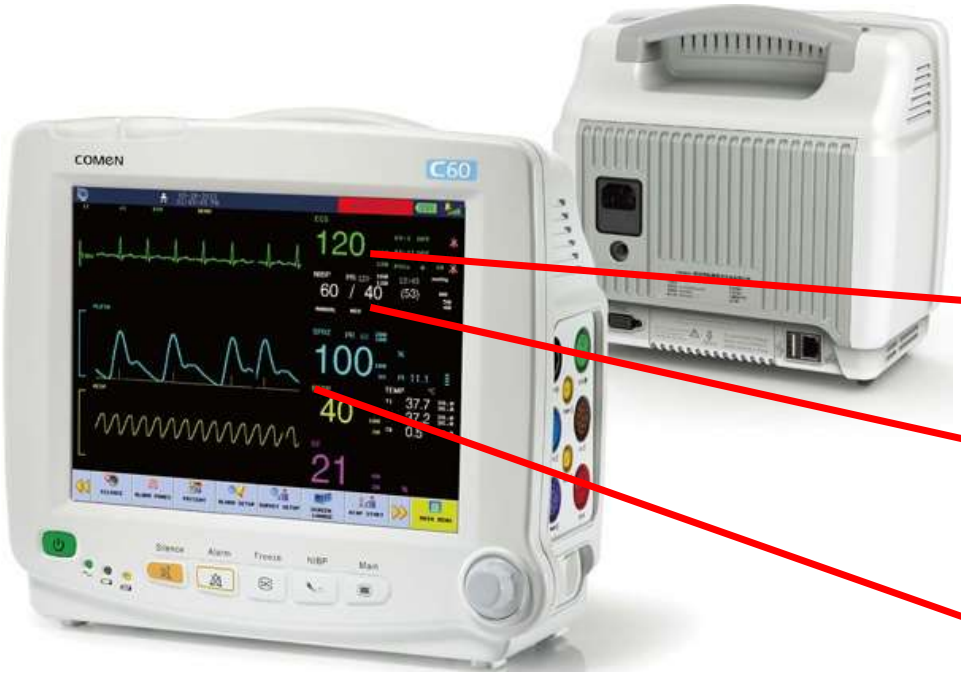
Pr Souhayl DAHMANI

DAR & DHU PROTECT. Hôpital Robert Debré. Paris



- Pourquoi ?

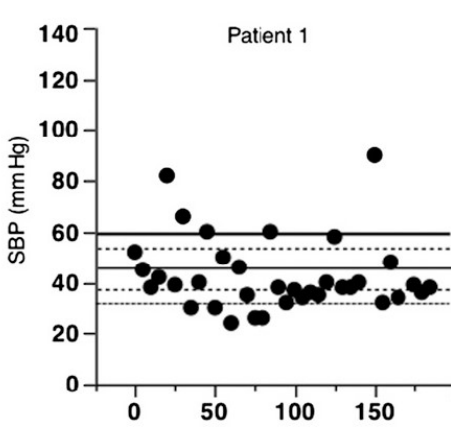
ASA I & II : 92 %

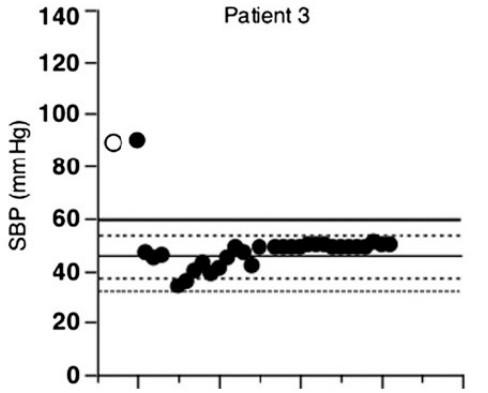


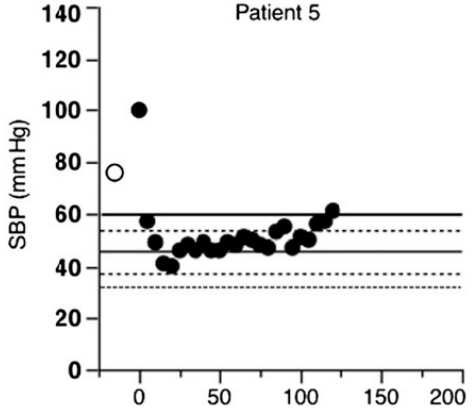
- ECG
- PA
- SpO2

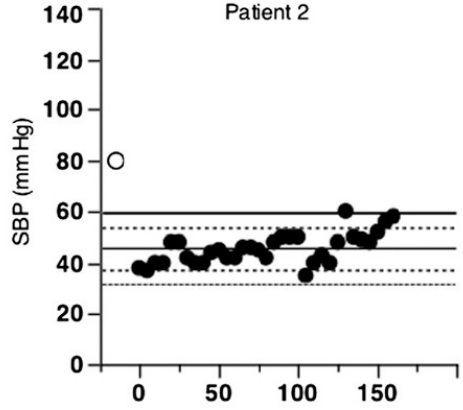


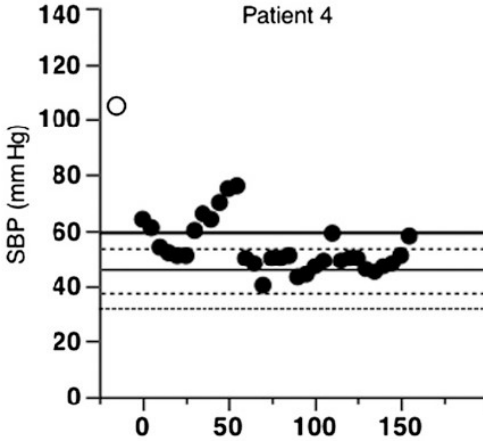
- Pourquoi ?

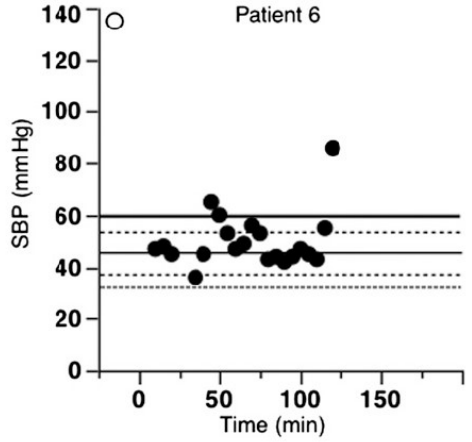










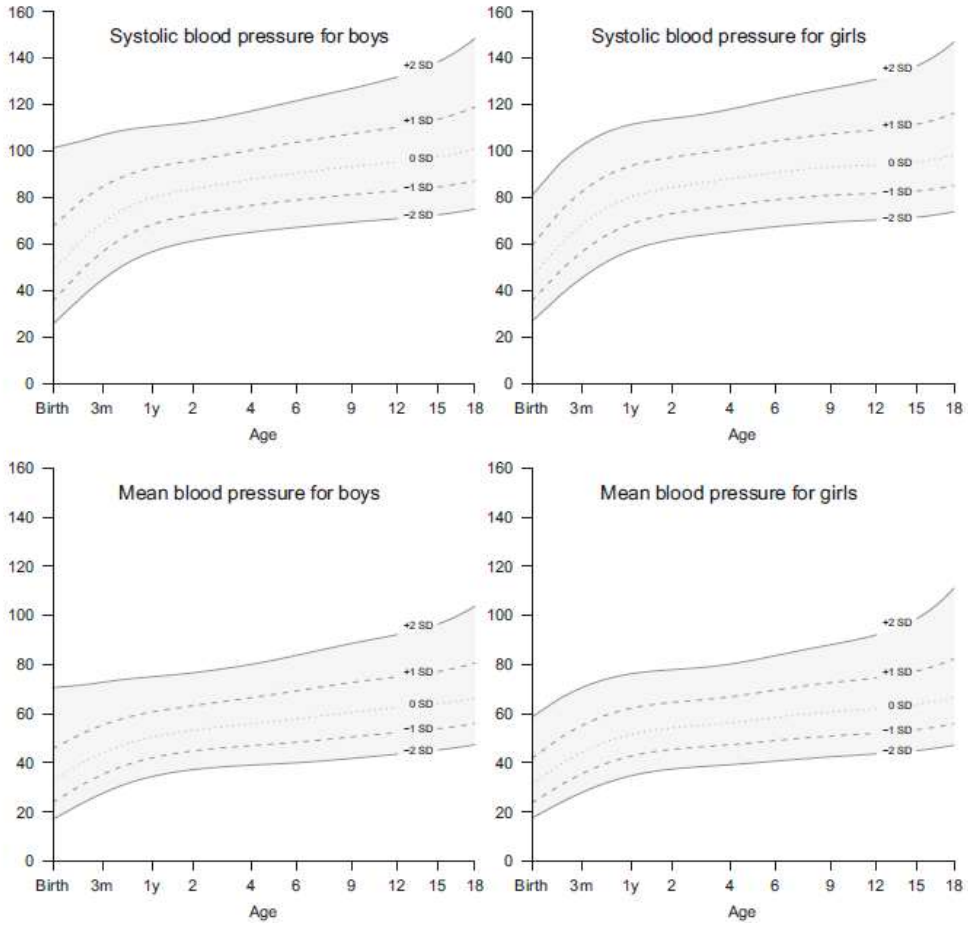


Variable	5	6
Weight, kg	3.75	4.5
Age, wk	13	13
PMA, wk	41	47
Diagnoses	naturity	Prematurity
Operation	teral IH	Bilateral IH
Duration, min	120	120
Intraoperative fluic	BS	BS + D
	75 mL	175 mL
Anesthetics		
Sevoflurane, me	± 1.14%	3.74 ± 1.55%
F_{IO_2}, mean ± SD	± 17%	64 ± 16%
Propofol (induct	40 mg	20 mg
Bupivacaine/rop	5 mg/–	–/–

McCain ME. Pediatrics 2013



- Pourquoi ?



Reference Values for Noninvasive Blood Pressure in Children during Anesthesia

A Multicentered Retrospective Observational Cohort Study

Jurgen C. de Graaff, M.D., Ph.D., Wietze Pasma, D.V.M., Stef van Buuren, Ph.D., Jesse J. Duijghuisen, M.D., Olubukola O. Nafiu, M.D., Sachin Kheterpal, M.D., Wilton A. van Klei, M.D., Ph.D.

Référence par rapport à quel paramètre ?

Intraoperative blood pressure levels in young and anaesthetised children: are we getting any closer to the truth?

De Graaf JC. Anesthesiology 2016
De Graaf JC. Curr Opin Anaesthsiol 2018



- Pourquoi ?

Machine-learning Algorithm to Predict Hypotension Based on High-fidelity Arterial Pressure Waveform Analysis

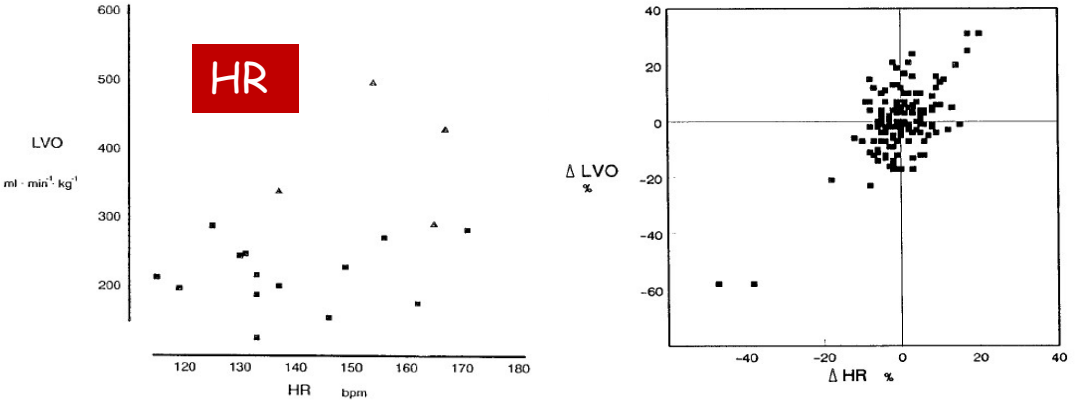
Feras Hatib, Ph.D., Zhongping Jian, Ph.D., Sai Buddi, Ph.D., Christine Lee, M.S., Jos Settels, M.S., Karen Sibert, M.D., F.A.S.A., Joseph Rinehart, M.D., Maxime Cannesson, M.D., Ph.D.

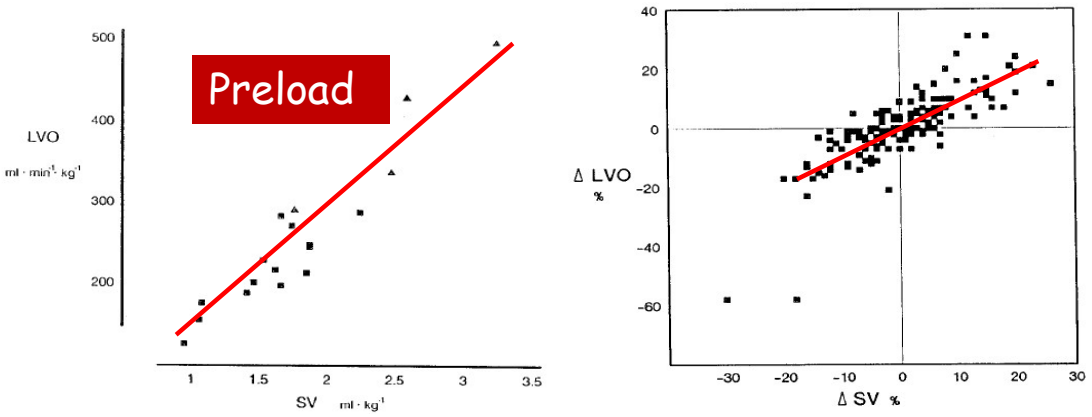
Ability of an Arterial Waveform Analysis–Derived Hypotension Prediction Index to Predict Future Hypotensive Events in Surgical Patients

Simon James Davies, MD, PhD,* Simon Tilma Vistisen, PhD,† Zhongping Jian, PhD,‡ Feras Hatib, PhD,‡ and Thomas W. L. Scheeren, PhD§



- Pourquoi ?



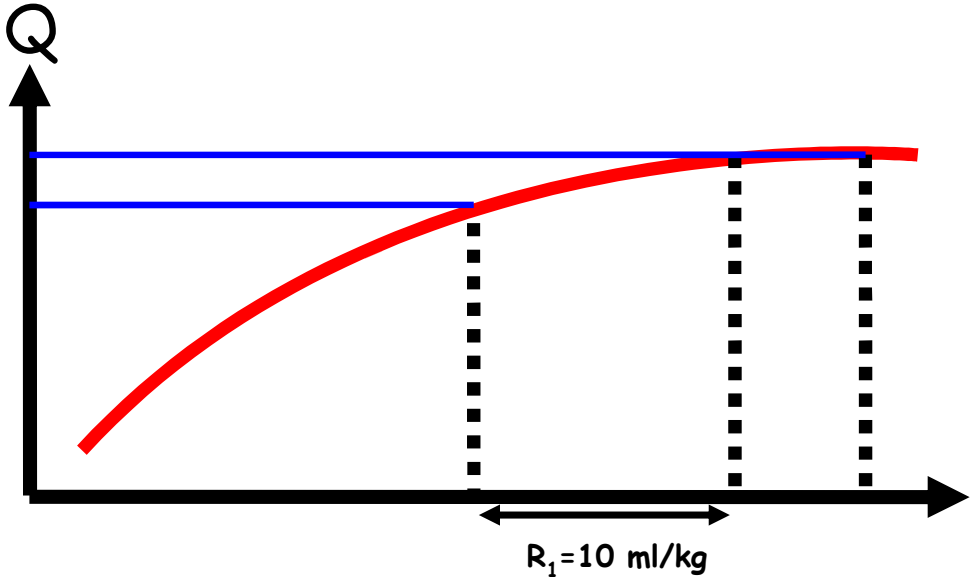


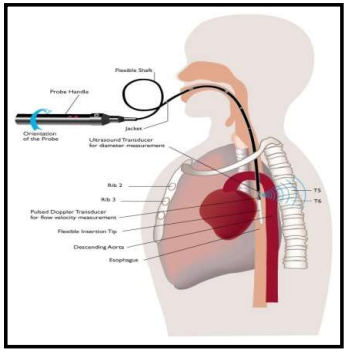
Nourrissons de 29 SA
Age 10 JPN

Winberg P et al. Pediat Resear 1992.



- Pourquoi ?

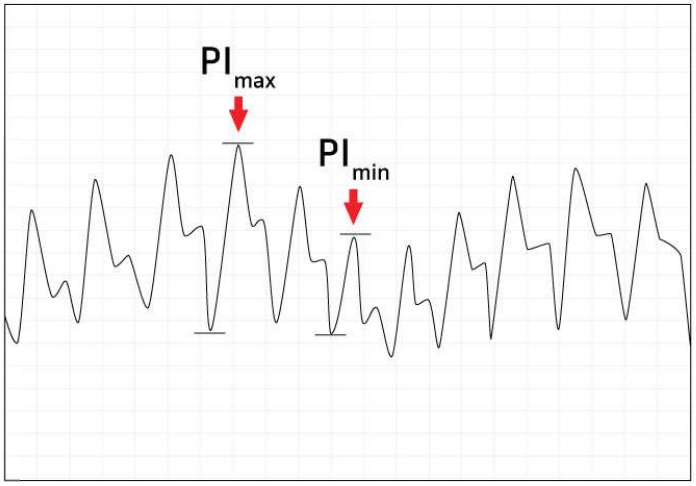




Doppler Esophagien

PVI

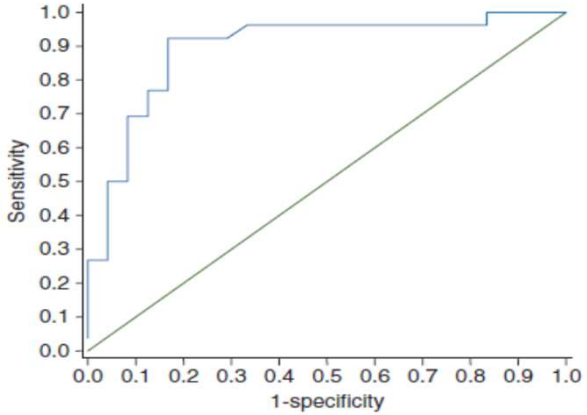


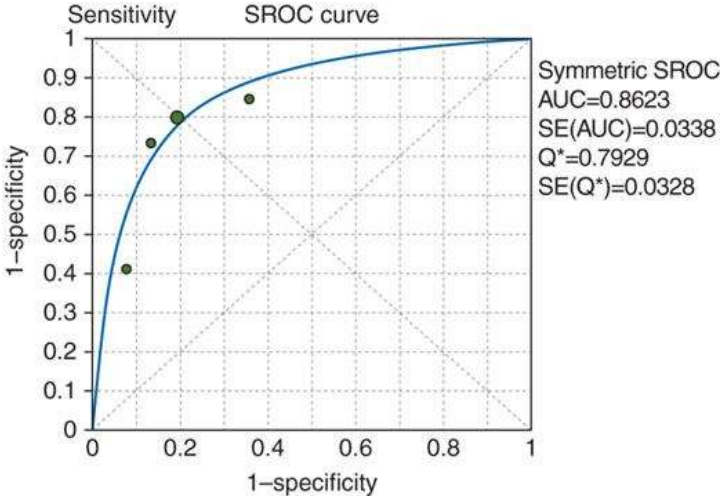




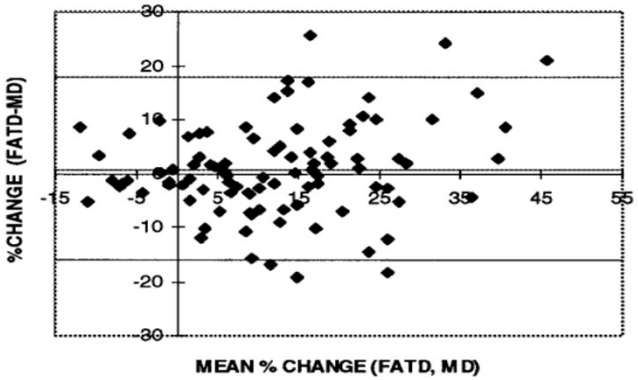
- Pourquoi ?

Age < 42 s APC
25 mlxKg^{-1}m^{-2}, iVES prédit une réponse au remplissage avec Se of 92% et Sp of 83%.





Age de 4 à 8 ans.
Comparaison ~~VARIATIONS DU Q~~ avec DO vs Thermodillution fémorale



Se = 72% (95% CI 62–81),
Sp = ~~81% (95% CI 71–88)~~
Patients > 2 ans

Tibby SM et al. Crit Care Med 2000.
Raux O et al. Br J Anesth 2012.
Desgranges FP et al, BJA 2017.



- Pourquoi ?

Technology	Measurements derived	Sample manufacturer(s) or brand(s)
Transpulmonary indicator dilution	Cardiac output	LiDCO and PiCCO©
Arterial waveform-derived	Stroke volume variation and cardiac output	FloTrac™, LiDCO and PiCCO©
Oesophageal Doppler	Flow corrected time and stroke volume	CardioQ™
Echocardiography	Cardiac output, stroke volume and contractility assessment	Philips© and Sonosite™
Partial CO_2 rebreathing	Cardiac output	NICO©
Bioreactance	Cardiac output	NICOM©

	Illustrative comparative risks (95% CI)				
Outcomes	Assumed risk (standard care group)	Corresponding risk reduction in GDT group (95% CI)	Relative effect (95% CI)	Number of subjects (number of studies)	Quality of the evidence (GRADE)
Mortality	52 per 1000 patients	18 (7 to 26) events avoided per 1000 patients	0.66 (0.50 to 0.87)	5550 (52)	⊕⊕ low[a]
Arrhythmia	109 per 1000 patients	30 (10 to 47) events avoided per 1000 patients	0.70 (0.55 to 0.91)	3269 (33)	⊕⊕ low[a]
CHF	28 per 1000 patients	Not significantly different	0.61 (0.33 to 1.12)	2125 (17)	⊕⊕ low[a]
Pneumonia	93 per 1000 patients	27 (7 to 43) events avoided per 1000 patients	0.69 (0.52 to 0.92)	2776 (29)	⊕⊕ low[a]
Wound infection	111 per 1000 patients	55 (39 to 67) events avoided per 1000 patients	0.48 (0.37 to 0.63)	3593 (32)	⊕⊕ low[a]
AKI	141 per 1000 patients	35 (11 to 55) events avoided per 1000 patients	0.73 (0.58 to 0.92)	4310 (37)	⊕⊕ low[a]
Hospital LoS	The mean hospital LoS ranged across control groups from 1.2 to 29 days	The mean hospital LoS was 0.90 (0.48 to 1.32) days shorter in the GDT group		8797 (62)	⊕ very low[a,b]

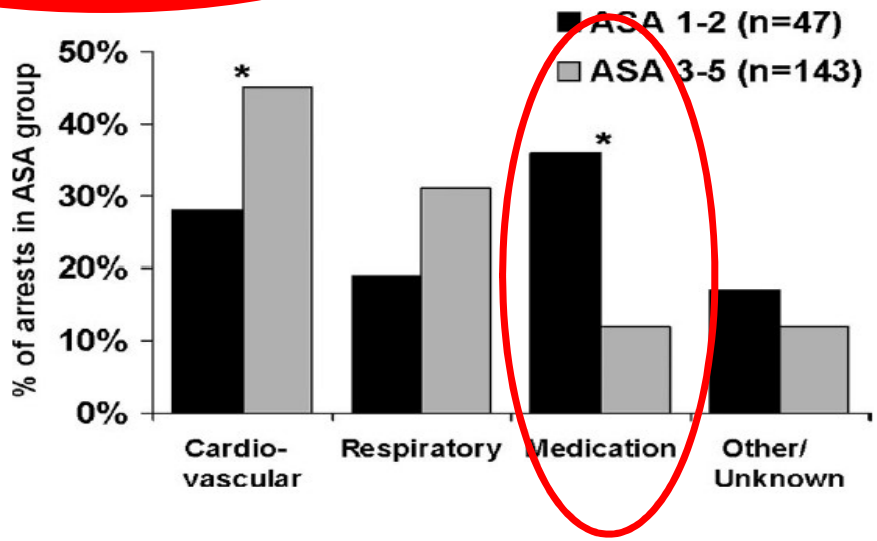
Chong MA et al, Eur J Ananesthsiol 2018.



- Pourquoi ?

Cause	n = 193 No. (% of 193)
Cardiovascular	79 (41)
Hypovolemia associated with blood loss	23 (12)
Electrolyte imbalance	10 (5)
Hypovolemia (nonhemorrhage)	5 (3)
Air embolism	4 (2)
Other CV	11 (6)
Presumed CV unclear mechanism	26 (13)
Respiratory	53 (27)
Airway obstruction—laryngospasm	11 (6)
Airway obstruction—other	5 (3)
Inadequate ventilation or oxygenation	9 (5)
Inadvertent or premature extubation	7 (4)
Difficult intubation	4 (1)
Esophageal or endobronchial intubation	3 (2)
Bronchospasm	4 (2)
Pneumothorax	2 (1)
Aspiration	2 (1)
Other	1 (1)
Presumed respiratory, unclear mechanism	5 (3)
Medication	35 (18)
Halothane-induced CV depression	9 (5)
Sevoflurane-induced CV depression	6 (3)
Other single medication[a]	9 (5)
Medication combination	7 (3)
Allergic reaction	2 (1)
Intravascular injection of local	2 (1)
Equipment	9 (5)
Central catheter	5 (3)
Kinked or plugged ET tube	2 (1)
Peripheral IV catheter	1 (1)
Breathing circuit	1 (1)
Multiple events	3 (2)
Miscellaneous	2 (1)
Unknown	12 (6)

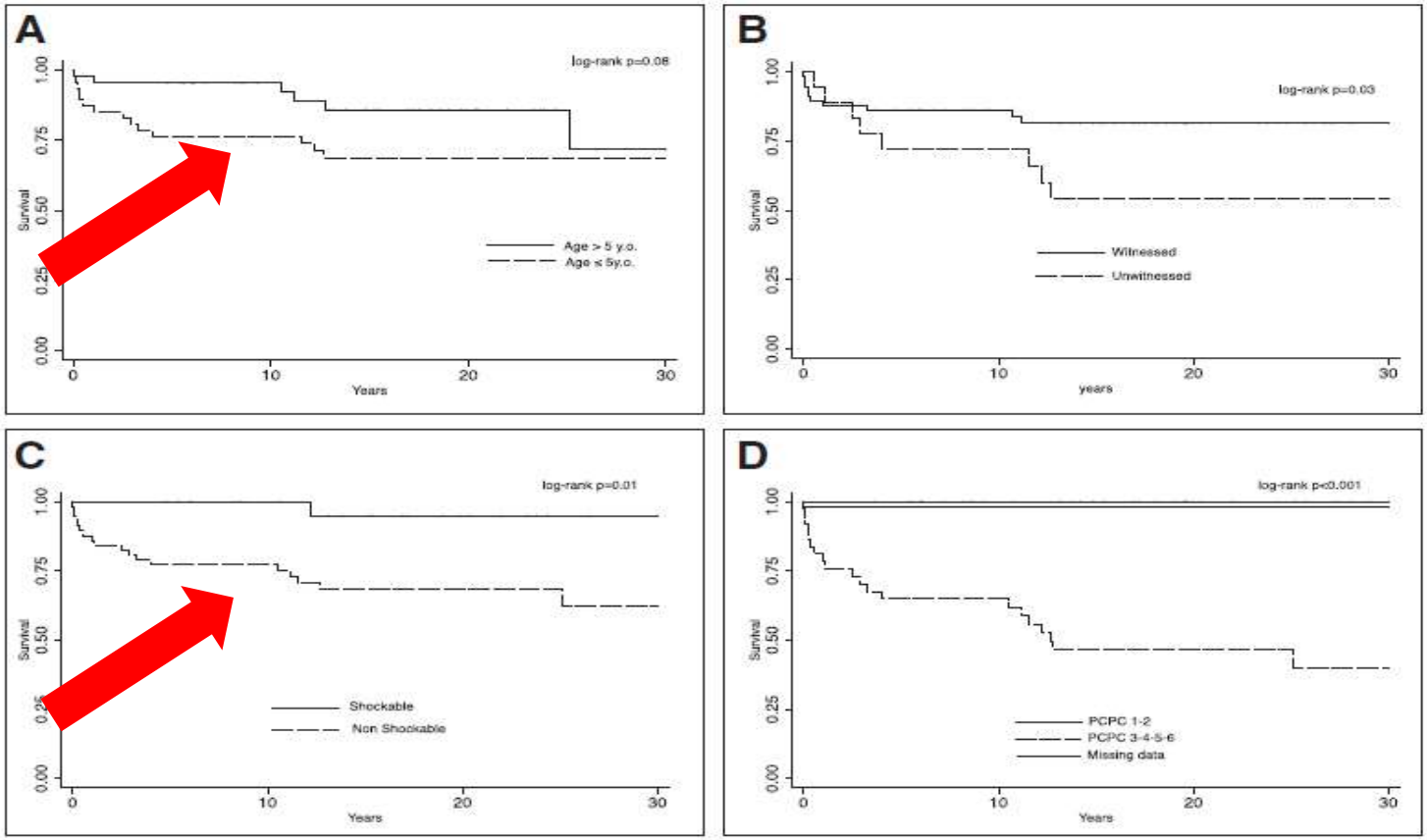
Incidence : 3 à 20 /10 000 anesthésies



Bhananker SJ. Anesth & Analg 2007



- Pourquoi ?



Michiels EA et al. Pediat Int Care Med 2013.



- Pourquoi ?

	Age	ASA category	Procedure	Timing	Clinical signs	Perioperative severe adverse event	Plausible cause	Treatment	Outcome	Status at 30 days
Children with perioperative cardiac arrest (n=9)										
Case 1	8m	II	Trauma	Maintenance	..	Hypotension, hypoxaemia	Displacement endotracheal tube during endoscopic thoracic surgery, severe hypoxaemia, and hypotension	CCM, atropine, ephedrine, re-intubation	Uneventful	Discharged home
Case 2	4y 6m	II	ENT	PACU	..	Hypoxaemia	Pneumothorax under tension (closure tracheostomy)	CCM, epinephrine	Uneventful	Still in hospital
Case 3a	4y 3m	IV	Cardiac catheterism (eg, DORV, VSD, ASD, pulmonary stenosis)	Induction (ketamine)	..	Arrhythmia, hypotension	Low cardiac output at induction	CCM, epinephrine	Recovered; admitted to ICU for 24 hours	Death from cardiopathy
Case 3b	4y 3m	V	Cardiac surgery	Induction (etomidate and ketamine)	..	Arrhythmia, hypotension	Low cardiac output at induction from complex cardiopathy	CCM, OCM, defibrillation, epinephrine, calcium, bicarbonate	Bypass in urgent situation; admitted to ICU (for 19 days)	Death from cardiopathy
Case 4	14y 8m	II	Trauma	Maintenance	..	Hypoxaemia, haemodynamic instability, bradycardia	Trachea blocked by endobronchial blocker	CCM, atropine	Uneventful	Discharged home
Case 5	1m	II	Gastrointestinal surgery	Induction	..	Severe hypoxaemia (SpO_2<85% for >2 min), bradycardia, asystole	Difficult ventilation; no intubation	CCM, epinephrine	Haemodynamic instability; neurological controls normal	Discharged home
Case 6	5d	IV	Cardiac surgery	Maintenance	..	Haemodynamic instability	Norwood operation	CCM, defibrillation, extracorporeal membrane oxygenation	Multiple organ failure and death	Death
Case 7	10y 10m	V	Gastrointestinal surgery	Induction (rapid sequence induction with propofol-atracurium)	..	Bleeding, hypotension, transfusion	..	CCM, epinephrine, phenylephrine	Death from sepsis	Death
Case 8	2m	III	Gastroenterology endoscopy	Induction	..	Hypotension, severe hypoxaemia (SpO_2 about 60%)	Cardiac dysfunction in a complex patient; low cardiac output	CCM, epinephrine, phenylephrine	Uneventful	Still in hospital
Case 9	29d; born at 36 weeks	IV	Thoracic	Maintenance	..	Hypotension, bradycardia	Under ACE inhibitors for coarctation	CCM, atropine	Uneventful	Discharged to acute centre

(Table 5 continues on next page)

Incidence 3 / 10 000

↓

Mortalité 1,3 / 10 000

Habre W. Lancet 2017



- Pourquoi ?

- **Pourquoi ? : parce qu'on en a besoin !**



- Pour qui ?

Dépistage des facteurs de risques de complications CV

- Facteurs liées au terrain : âge < 1 an
- Facteur lié aux comorbidités : ASA 3 à 5,
- Facteurs liées à la chirurgie : voies aériennes, cardiaque ou chirurgie à potentiel hémorragique.
- Facteurs liées aux conditions de réalisation : chirurgie urgente, réalisation sur des périodes de garde.



- Pour qui ?



ECG

PA

SpO2



- Pour qui ?

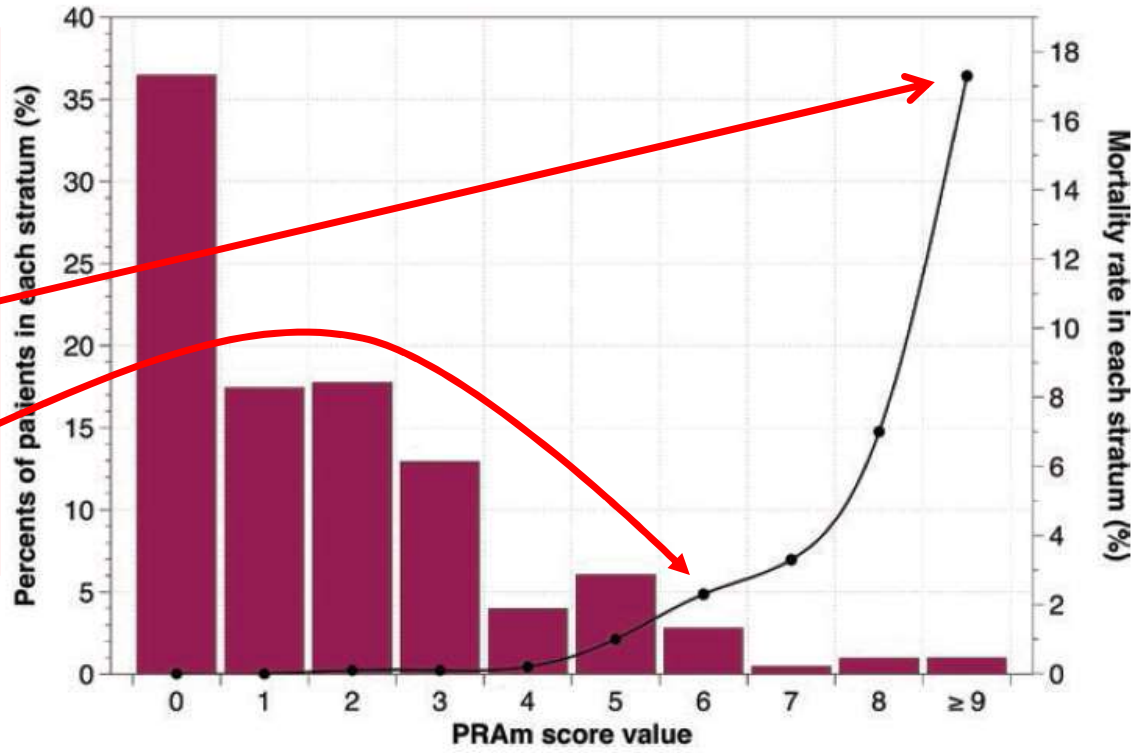
Variable	Deaths/Total	Crude Rate per 100,000 Cases	Unadjusted OR (95% CI), n = 2,866,141	Adjusted OR* (95% CI), n = 2,104,998
Patient age group (yr)				
<1	42/47,388	89	5.08 (3.62–7.12)	4.09 (2.38–7.05)
1–18	34/244,609	14	0.80 (0.55–1.15)	0.89 (0.48–1.68)
19–49	169/968,502	17	Ref	Ref
50–64	233/768,154	30	1.74 (1.43–2.12)	1.25 (0.94–1.65)
65–79	296/613,728	48	2.76 (2.29–3.34)	1.84 (1.40–2.43)
≥80	144/191,347	75	4.32 (3.45–5.39)	2.23 (1.62–3.08)
Patient sex				
Female	418/1,643,054	25	Ref	Ref
Male	526/1,196,414	44	1.73 (1.52–1.97)	0.93 (0.78–1.12)
ASA physical status				
1 or 2	116/1,740,144	7	Ref	Ref
3	150/799,232	19	2.82 (2.21–3.59)	2.15 (1.61–2.87)
4	367/181,182	203	30.4 (24.7–37.5)	14.2 (10.7–18.9)
5	271/4,646	5,833	929 (743–1160)	204 (144–289)
Procedure urgency				
Nonemergent	737/2,647,035	28	Ref	Ref
Emergent	177/82,234	215	7.74 (6.56–9.12)	2.70 (2.07–3.52)
Case start time				
7:00 AM–3:59 PM	364/2,075,621	18	Ref	Ref
4:00 PM–5:59 PM	59/117,055	50	2.88 (2.18–3.79)	1.64 (1.22–2.21)
6:00 PM–10:59 PM	74/85,989	86	4.91 (3.82–6.31)	1.69 (1.26–2.28)
11:00 PM–6:59 AM	62/70,606	88	5.01 (3.82–6.56)	1.97 (1.43–2.70)
Surgery type				
Extremity	102/552,902	18	Ref	Ref
Head/spine	62/329,116	19	1.02 (0.74–1.40)	0.79 (0.5–1.18)
Thorax/neck	201/373,438	54	2.92 (2.30–3.70)	1.29 (0.96–1.74)
Abdomen/pelvis	382/966,942	40	2.14 (1.72–2.66)	1.58 (1.20–2.08)
Obstetric	6/162,443	4	0.20 (0.09–0.46)	0.51 (0.20–1.32)
Radiological	38/74,520	51	2.77 (1.90–4.01)	0.99 (0.62–1.58)
Eye	3/118,921	3	0.14 (0.04–0.43)	0.22 (0.07–0.72)

Whithlock EL. Anesthesiology 2015



- Pour qui ?

Variables	Definition	Value
Urgent	Urgent surgical procedure	+1
Comorbidity	The presence of at least 1 comorbidity among the following: respiratory disease, congenital heart disease, preoperative acute or chronic kidney disease, neurologic disease, hematologic disease	+2
Critically ill	The presence of at least 1 of the following characteristics of critical illness: preoperative mechanical ventilation, inotropic support, preoperative cardiopulmonary resuscitation	+3
Age <12 mo	Age at the time of the surgical procedure <12 mo	+3
Neoplasm	Surgical procedure in a patient with a neoplasm with or without preoperative chemotherapy	+4



Nasr VG t al. Anesth Analg 2017.



- Pour qui ?

Complications postopératoires patients < 6 mois

168 patients < 6 mois

Facteur	B	P	OR	IC 95 %
Age corrigé < 40 semaines	1.5	0.013	4.5	[1.4 - 14,6]
Malformations cardiaques et/ou séquelles de prématurité	1.3	0.040	3.5	[1.1 – 11.7]
Réanimation préopératoire	2.6	0.000	12.8	[3.6 – 46.1]
Remplissage intraopératoire	1.5	0.013	4.4	[1.4 -14.1]

20 % De complications non-chirurgicales
- MODS
- Choc séptiques
- Hypotension artérielles…

Michelet D et al. ACCPM 2016.



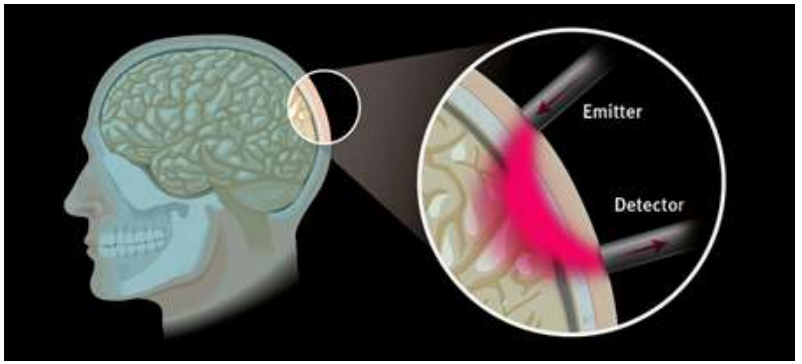
- Pour qui ?

- Pourquoi ? : parce qu'on en a besoin !
- Pour qui ? : patients < 1an surtout si comorbidités

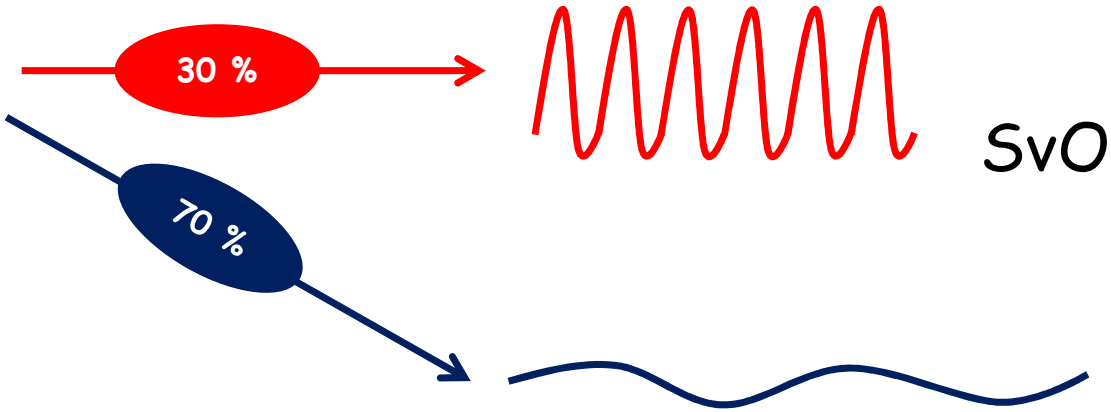


- Comment ?

Spectroscopie Proche de l'infra-rouge (NIRS)



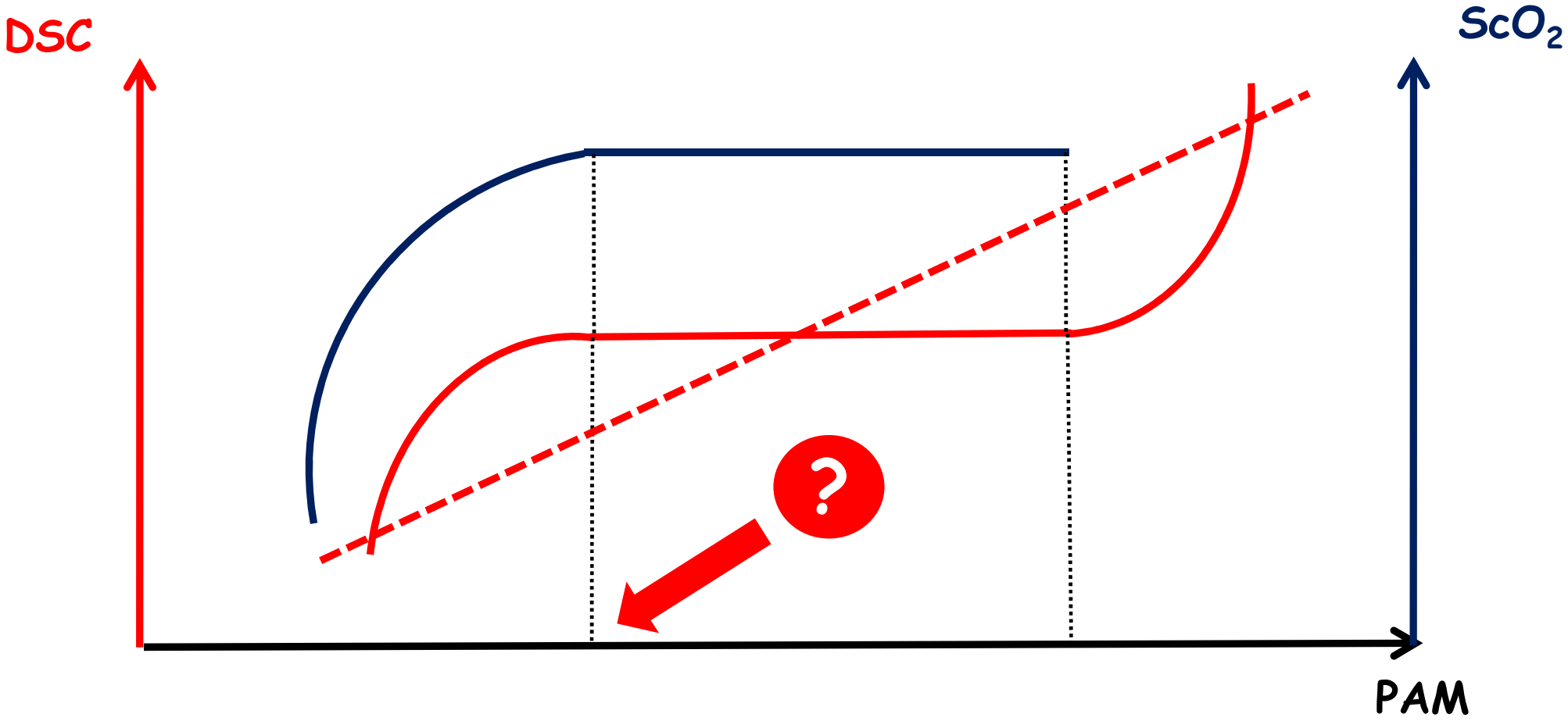
ScO2



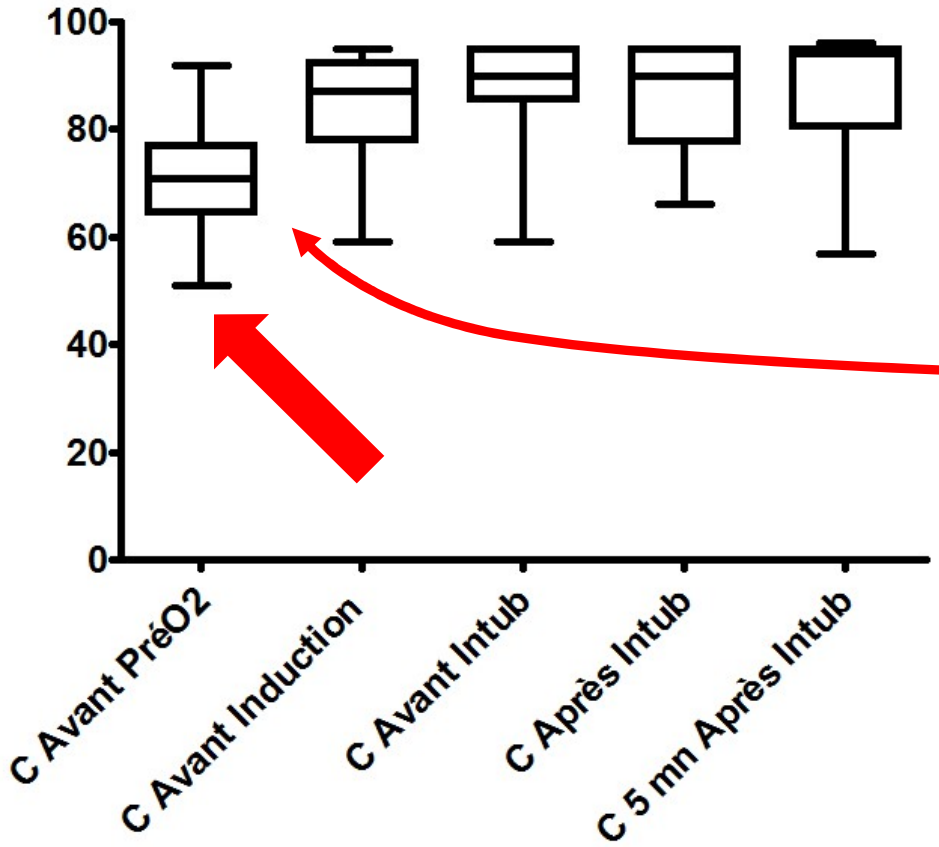
$$SvO_2 = SaO_2 - \left[\frac{VO_2}{Q \times Hb \times 1{,}34}\right]$$


38e CONGRÈS ANNUEL DE L'ADARPEF
Association des Anesthésistes Réanimateurs Pédiatriques d'Expression Française
29 & 30 MARS 2019 NANTES
www.e-adarpef.fr

- Comment ?


DSC
ScO2
?
PAM





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

Découplage CrO2 par anesthésiques

Pailleret C et al. ACCPM 2014.



- Comment ?

	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

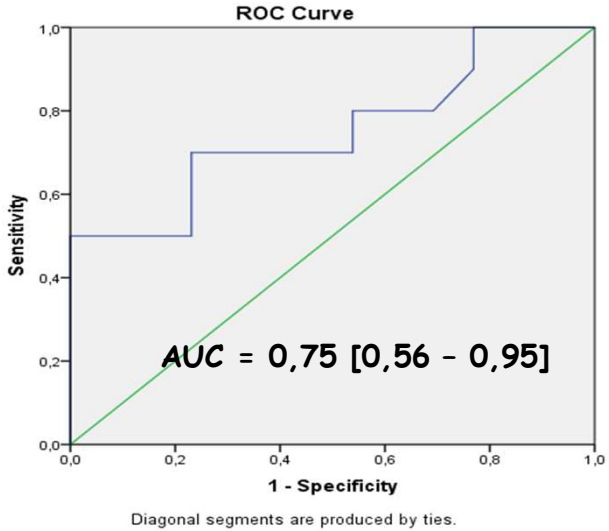
SBP	AUC	J point	Se J	Sp J	Gray zone
All patients	0.79 [0.74 - 0.84]	28.5 %	0.7 [0.6 - 0.8]	0.75 [0.72 - 0.77]	20.5 % - 37.5 %
Preterm	0.84 [0.77-0.88]	31.5 %	0.74 [0.6 - 0.8]	0.74 [0.7 - 0.78]	32.5 % - 39.5 %
Term	0.76 [0.7 - 0.83]	28.5 %	0.63 [0.57 - 0.80]	0.7 [0.77 - 0.8]	20.5 % - 36.5 %

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. Pediatr Anesth 2016.



- Comment ?



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.



- Comment ?

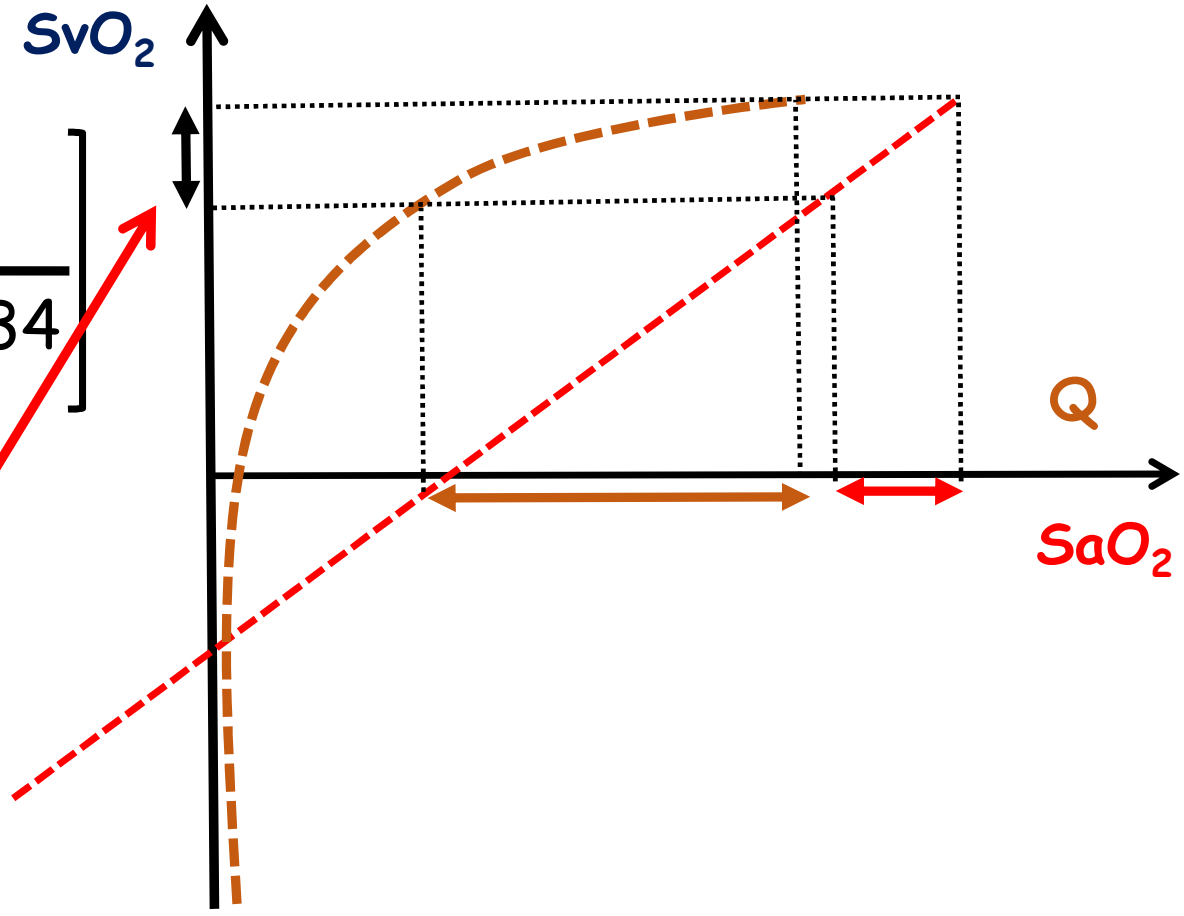
	Incidence (%) (95% CI)	Frequency of Events per Patient, Median (Range)	Percentage of Anesthesia Time of Each Event, Median (Range)	Percentage of Anesthesia Time at Low Saturation or Hypotension, Median (Range)
11–20% Decline of $rSco_2$ from baseline	27 (22–31) n = 106	0 (0–9)	0 (0–9)	0 (0–85)
21–30% Decline of $rSco_2$ from baseline	6(4–8) n = 24	0 (0–8)	0 (0–19)	0 (0–50)
> 30% Decline of $rSco_2$ from baseline	1 (0–2) n = 4	0 (0–7)	0 (0–9)	0 (0–31)
Absolute $rSco_2$ 60–69%	43 (39–48) n = 196	0 (0–14)	0 (0–55)	0 (0–85)
Absolute $rSco_2$ 50–59%	11 (8–14) n = 51	0 (0–10)	0 (0–17)	0 (0–47)
Absolute $rSco_2$ < 50%	2 (0–3) n = 7	0 (0–4)	0 (0–6)	0 (0–24)

	RCH (N = 84)	WZH (N = 29)	Total Values (N = 453)
	38 ± 3	38 ± 3	38 ± 5
	50 ± 9	53 ± 8	51 ± 9

	Mild Cerebral Desaturation		Moderate Cerebral Desaturation	
	10–20% Decline of $rSco_2$ from Baseline, OR (95% CI)	Absolute $rSco_2$ 60–70%, OR (95% CI)	20–30% Decline of $rScO_2$ from Baseline, OR (95% CI)	Absolute $rScO_2$ 50–60%, OR (95% CI)
Mild low arterial pressure	2.6 (1.5–4.3)*	1.4 (1.0–2.1)	2.3 (0.8–6.2)	3.2 (1.5–6.8)*
Moderate low arterial pressure	2.1 (1.4–3.4)*	1.3 (0.9–1.9)	1.6 (0.7–3.6)	1.9 (1.0–3.4)†
Severe low arterial pressure	2.5 (1.4–4.6)*	1.4 (0.8–2.5)	1.3 (0.4–4.1)	2.1 (1.0–4.4)†
Mild low Spo_2	3.9 (2.2–6.9)‡	3.1 (1.8–5.4)‡	5.5 (2.3–13)*	2.9 (1.5–5.6)*
Moderate low Spo_2	5.0 (1.8–14)*	1.9 (0.7–4.7)	6.0 (1.8–20)*	4.0 (1.5–11)*
Severe low Spo_2	14.4 (1.7–124)†	3.3 (0.6–17)	8.4 (1.5–48)†	21.7 (4.1–115)*

Olbrecht VA et al. Anesthesiology 2018.

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



Sensibilité du moniteur



- Comment ?

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.



- Comment ?

	Incidence (%) (95% CI)	Frequency of Events per Patient, Median (Range)	Percentage of Anesthesia Time of Each Event, Median (Range)	Percentage of Anesthesia Time at Low Saturation or Hypotension, Median (Range)
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Absolute $rSco_2$ 60–69%	43 (39–48) n = 196	0 (0–14)	0 (0–55)	0 (0–85)
Absolute rSc				
Absolute rSc	n = 7			

	RCH (N = 84)	WZH (N = 29)	Total Values (N = 453)
	38 ± 3	38 ± 3	38 ± 5
	50 ± 9	53 ± 8	51 ± 9

Utilisation du moniteur le plus « optimiste » dans l'étude

	Mild Cerebral Desaturation		Moderate Cerebral Desaturation	
	10–20% Decline of $rSco_2$ from Baseline, OR (95% CI)	Absolute $rSco_2$ 60–70%, OR (95% CI)	20–30% Decline of $rScO_2$ from Baseline, OR (95% CI)	Absolute $rScO_2$ 50–60%, OR (95% CI)
Mild low arterial pressure	2.6 (1.5–4.3)*	1.4 (1.0–2.1)	2.3 (0.8–6.2)	3.2 (1.5–6.8)*
Moderate low arterial pressure	2.1 (1.4–3.4)*	1.3 (0.9–1.9)	1.6 (0.7–3.6)	1.9 (1.0–3.4)†
Severe low arterial pressure	2.5 (1.4–4.6)*	1.4 (0.8–2.5)	1.3 (0.4–4.1)	2.1 (1.0–4.4)†
Mild low Spo_2	3.9 (2.2–6.9)‡	3.1 (1.8–5.4)‡	5.5 (2.3–13)*	2.9 (1.5–5.6)*
Moderate low Spo_2	5.0 (1.8–14)*	1.9 (0.7–4.7)	6.0 (1.8–20)*	4.0 (1.5–11)*
Severe low Spo_2	14.4 (1.7–124)†	3.3 (0.6–17)	8.4 (1.5–48)†	21.7 (4.1–115)*

Olbrecht VA et al. Anesthesiology 2018.



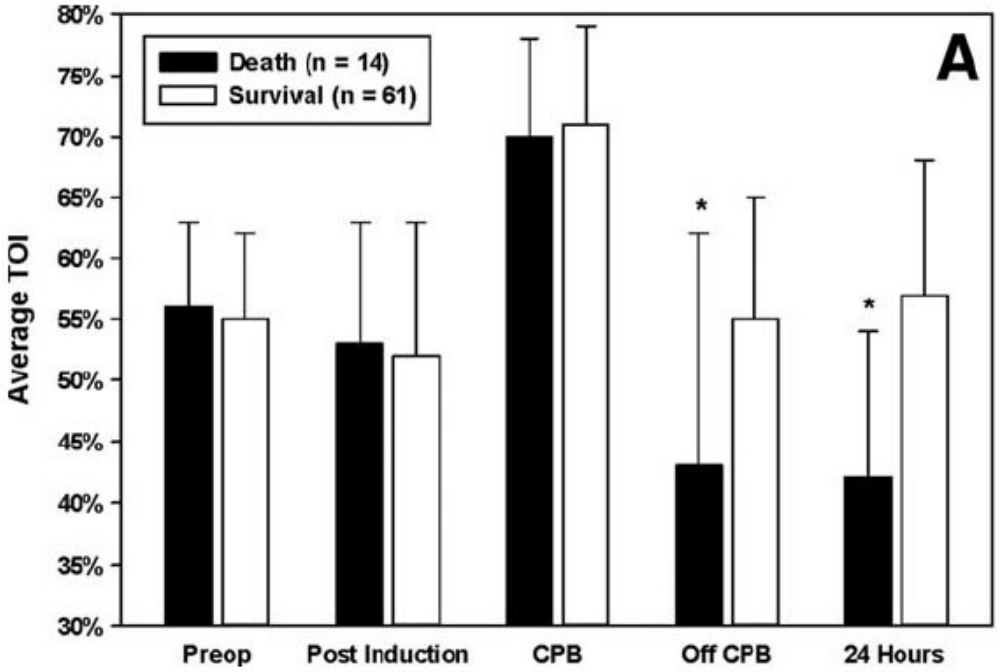
- Pour qui ?

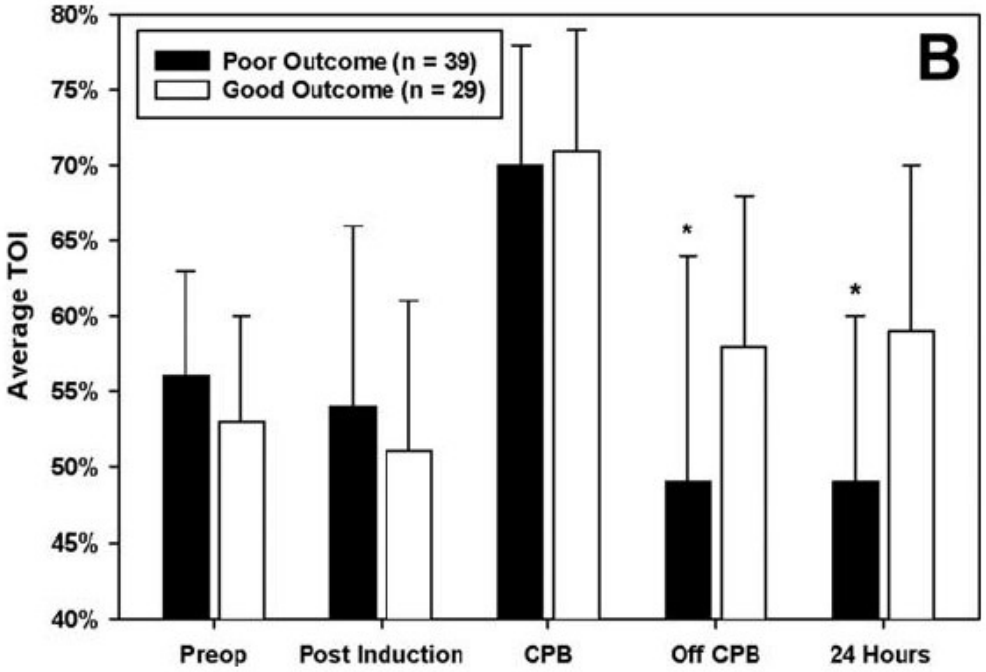
- Pourquoi ? : parce qu'on en a besoin !
- Pour qui ? : patients < 1an surtout si comorbidités
- Comment ? : moniteur « sensible » et en tenant compte des variations



- Comment ?

Variable	All patients	Single ventricle patients	Two ventricle patients	*P* value
Number of patients	75	40	35	
Weight (kg)	3.5 (3.0-3.8)	3.2 (2.8-3.6)	3.5 (3.1-4.0)	.01
Patient age (days)	5 (4-8)	5 (3-7)	6 (4-8)	.03
CPB time (min)	118 (101-125)	117 (107-124)	118 (82-126)	.59

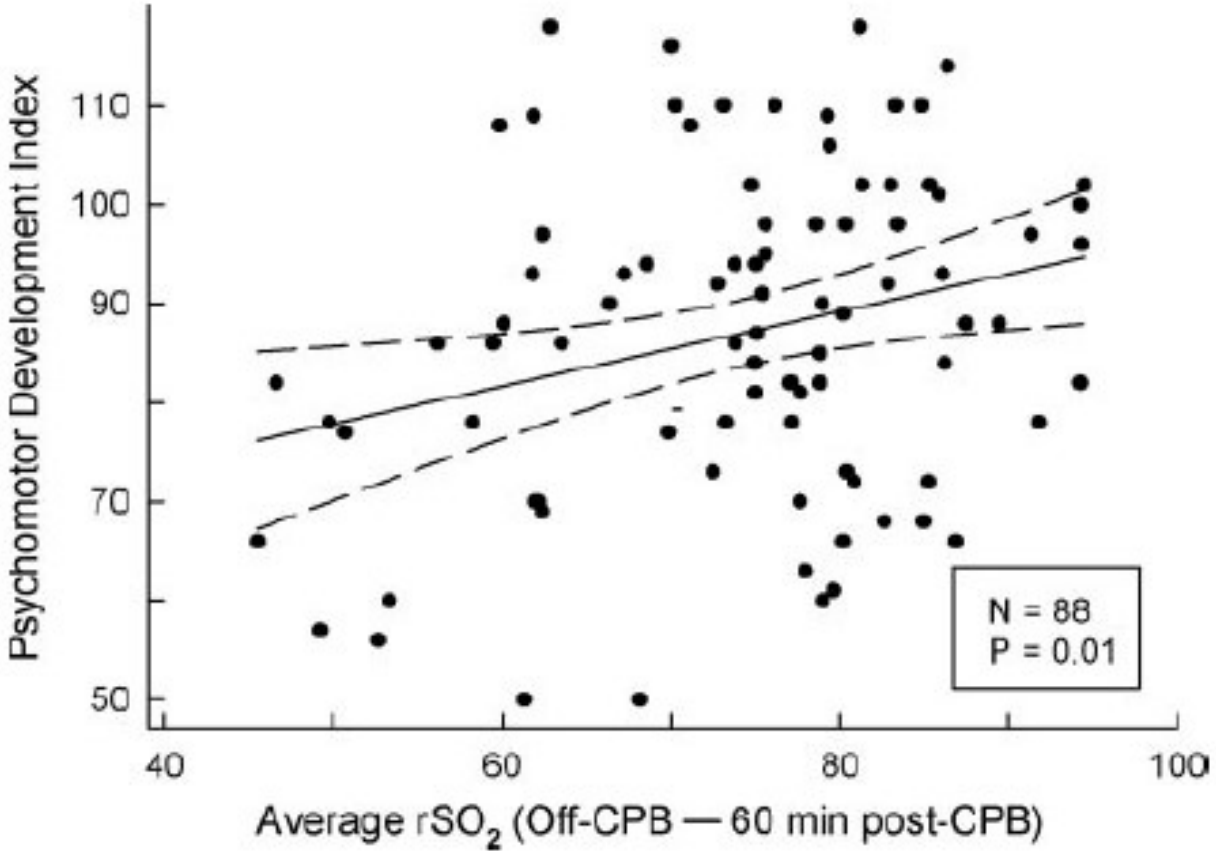




Aly SA et al. Cong Heart Des 2016.



Chirurgie cardiaque < 1 an
ScO2 limite 45 %
Score de Développement cognitif à 1 an

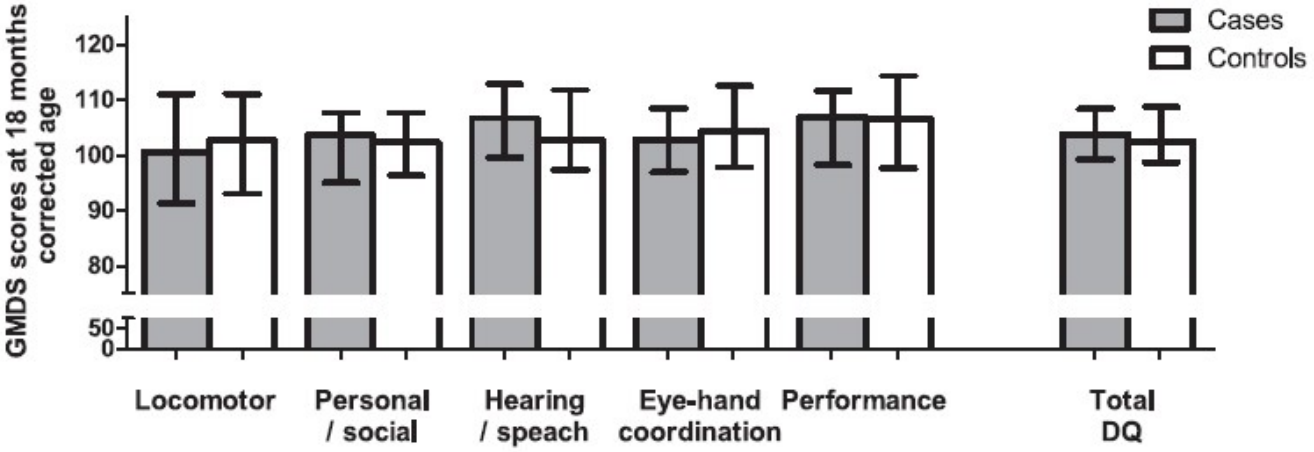


Kusmann BD et al. Circulation 2010.



- Comment ?

66 prématurés (<32 SA) : hypoTA traitée vs contrôle



Fonctions supérieures à 18 mois

Les patients avec une rScO2 <50% >10% du temps avaient des fonctions supérieures altérées (P = 0.02) en comparaison avec les autres patients

Aderliesten T et al. Journal of Pediat 2014.



Table 1 Baseline characteristics, burden of cerebral hypoxia and hyperoxia and neonatal complications in the intervention and control group

	Intervention (n = 65)	Control (n = 50)	p value
Baseline characteristics			
Gestational age (w)	26.6 ± 1.1	26.7 ± 1.2	
Birthweight (g)	868 ± 208	901 ± 204	
Male sex	54	38	
Twins	24	22	
Prenatal steroids	72	81	
Prolonged rupture of membranes	26	40	
Maternal clinical chorioamnionitis	6	6	
Apgar score <5 at five minutes	18	16	
Burden of cerebral hypoxia and hyperoxia			
Burden of cerebral hypoxia (%h)*	16 (4–63)	50 (16–122)	<0.01
Burden of cerebral hyperoxia (%h)*	1 (0.2–10)	0.7 (0.1–14)	0.83
Total burden of cerebral hypoxia and hyperoxia (%h)*	32 (9–78)	68 (38–143)	<0.01
Neonatal complications			
Severe brain injury on cUS**	11	16	0.58
Necrotising enterocolitis	11	10	>0.99
Bronchopulmonary dysplasia	57	48	0.35
Retinopathy of prematurity	18	10	0.29

2-year follow-up (n = 64)
- Bayley-II (n = 14)
- Bayley-III (n = 30)
- ASQ (n = 48)
- Parental information or medical record (n = 8)

2-year follow-up (n = 48)
- Bayley-II (n = 16)
- Bayley-III (n = 23)
- ASQ (n = 42)
- Parental information or medical record (n = 2)

Table 3 Follow-up at two years of corrected age using Bayley-II, Bayley-III and ASQ

	Intervention	Control	p value
Bayley-II (n)	14	16	
Age at Bayley-II (months)	25.0 (1.4)	24.8 (1.1)	0.65
Mental Developmental Index	96.9 (13.9)	86.4 (13.8)	0.05
Psychomotor Developmental Index	83.9 (14.3)	87.4 (16.0)	0.54
Bayley-III (n)	30	23	
Age at Bayley-III (months)	24.3 (3.6)	25.2 (2.9)	0.34
Cognitive index	95.8 (19.9)	97.6 (10.2)	0.69
Language index	94.4 (18.8)	95.6 (13.4)	0.81
Motor index	91.8 (15.6)	99.1 (9.2)	0.07
Predicted Mental Developmental Index*	85.6 (21.1)	90.0 (15.4)	0.43
Ages and Stages Questionnaire (n)	48	42	
Age at ASQ (months)	25.7 (3.3)	25.6 (3.4)	0.88
Gross motor score	39.7 (15.9)	44.5 (14.6)	0.14
Fine motor score	42.7 (14.9)	44.3 (10.9)	0.57
Communication score	46.1 (14.4)	40.6 (15.7)	0.08
Personal social score	43.4 (14.1)	41.4 (13.2)	0.48
Problem solving score	43.3 (12.3)	42.6 (13.8)	0.80
Total ASQ score	215.3 (58.0)	213.4 (58.4)	0.88
Medical examination (n)	45	37	
Age (months)	24.6 (3.1)	24.8 (2.3)	0.69
Head circumference (centimetres)	48.0 (1.8)	48.1 (1.6)	0.75
Weight (kilograms)	11.2 (1.7)	11.0 (1.4)	0.85
Height (centimetres)	85.4 (4.6)	85.0 (4.8)	0.67
Cerebral palsy (number)	3	2	>0.99
GMFCS for patients with CP**	1, 2, 2	1, 4	–
Hearing impairment (number)	0	0	–
Moderate vision impairment† (number)	2	2	>0.99
Severe vision impairment†† (number)	0	0	–
Combined outcome (n)	45	38	
Moderate neurodevelopmental impairment§ (number)	8	3	0.21
Severe neurodevelopmental impairment§§ (number)	2	3	>0.99

Plomgaard AM et al. Acta Paediatr 2018.

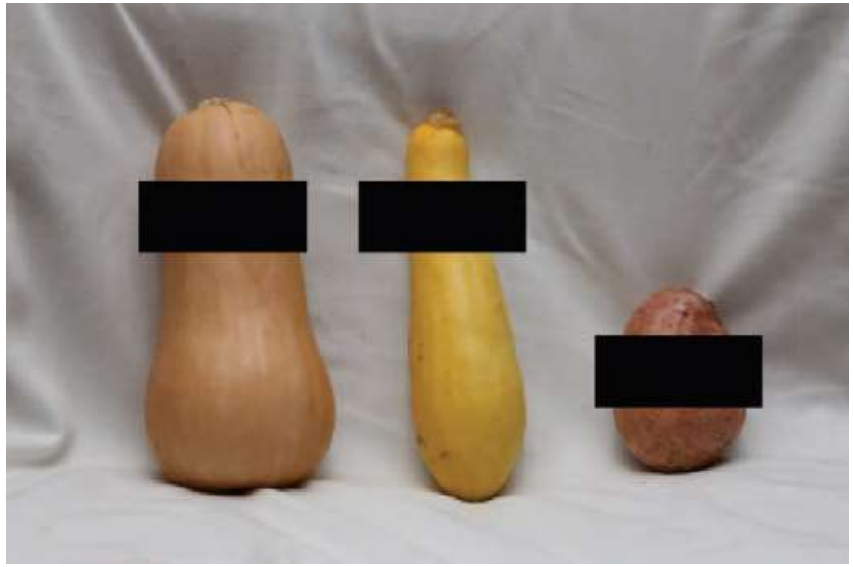


Les messages clés

- Indication privilégiée : âge < 1 an surtout en situation de comorbidités associées (réanimation, malformation congénitale…)
- Peu importe le moniteur privilégier les variations de la ScO2 : le seuil communément admis de variation est de 20 %... mais si vous avez le choix du moniteur optez pour le plus sensible
- En cas de doute, privilégier un « test thérapeutique ».
- Comme tout moniteur il doit s'interpréter dans un contexte et être confronté aux autres données disponibles.







	Oximetry (%)
Control	71 (68 to 74)[a]
Butternut squash	63 (62 to 64)
Yam	64 (63 to 65)
Yellow zucchini	75 (74 to 76)[a]

Kahn AM et al. Eur J Anaesthsiol 2018.