



# Comment je ventile de l'induction au réveil ?

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université  
de **BORDEAUX**

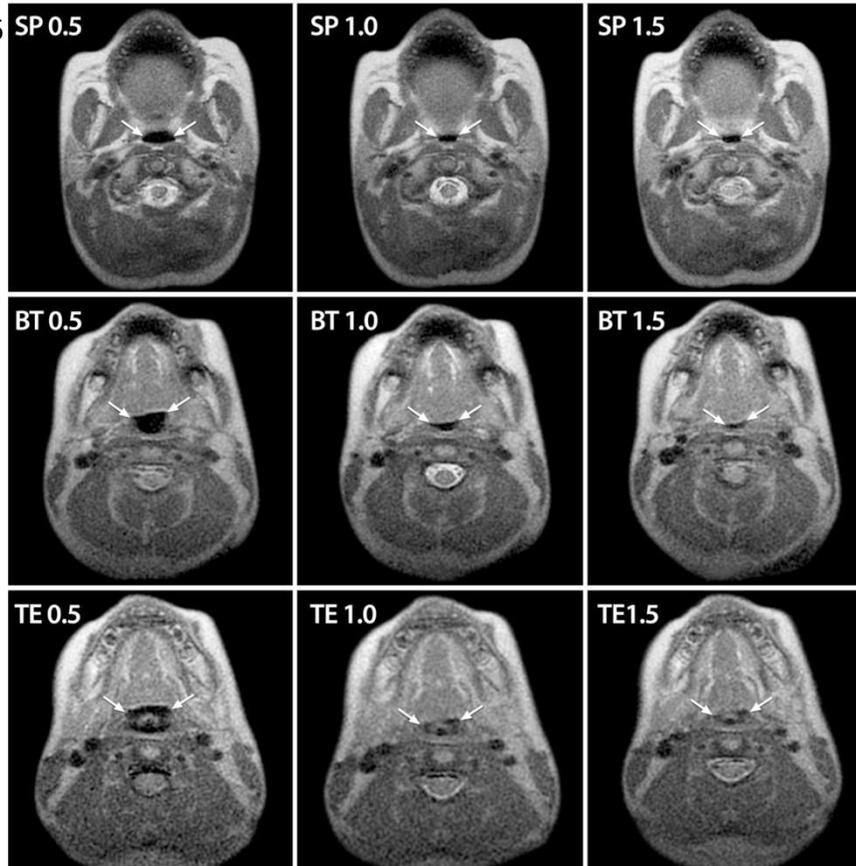
- Pas de lien d'intérêt

- La physiologie respiratoire de l'enfant
- Les stratégies de ventilation

***Extent and Localization of Changes in Upper Airway Caliber with Varying Concentrations of Sevoflurane in Children***

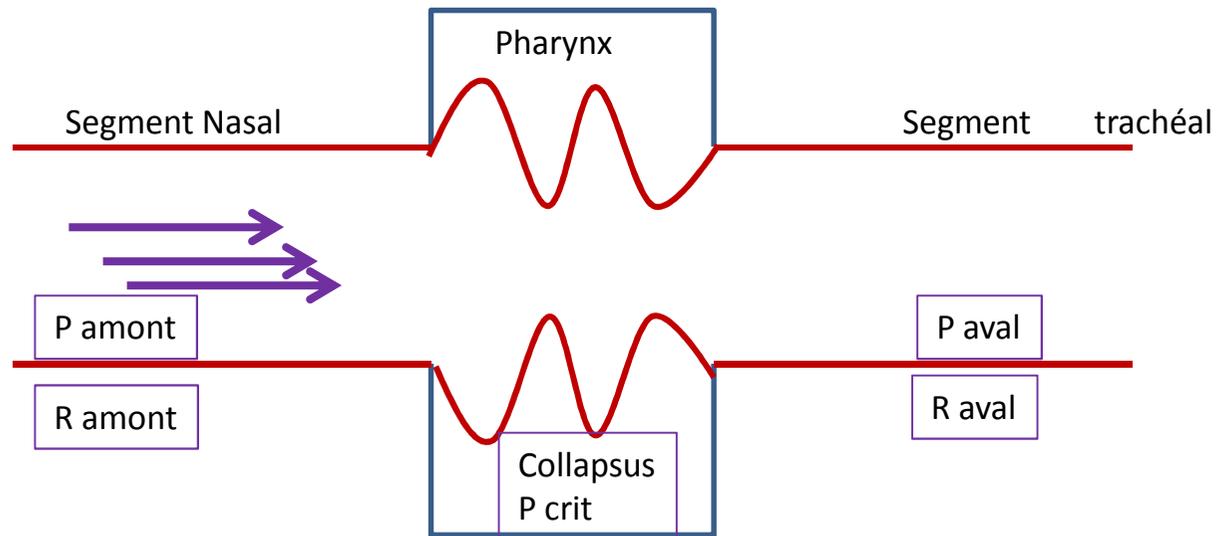
Mark W. Crawford, M.B.B.S., F.R.C.P.C.,\* Mauro Arrica, M.D.,† Christopher K. Macgowan, Ph.D.,‡  
Shi-Joon Yoo, M.D., F.R.C.P.C.§

Anesthesiology 2006



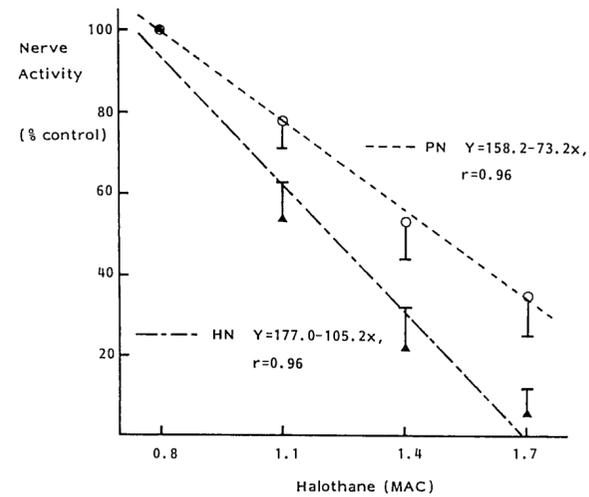
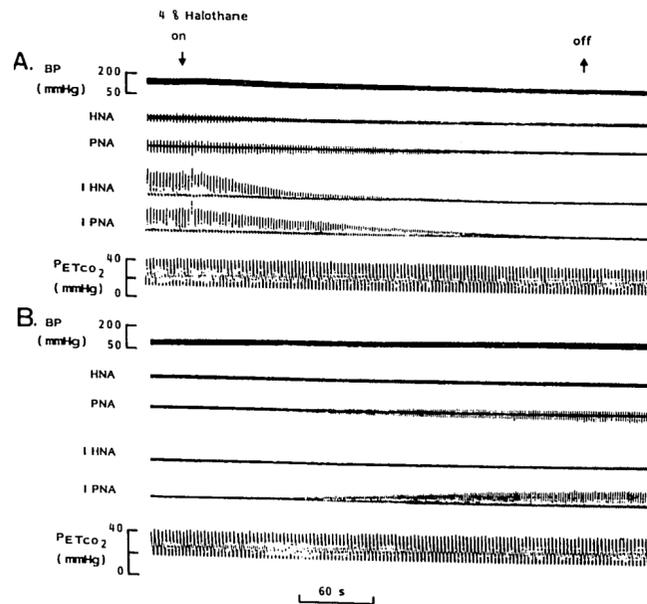
# Collapsus des VAS durant l'anesthésie

- Modèle de Starling



# Effets des Halogénés sur le nerf hypoglosse puis le nerf phrénique

*Nerf vague est sectionné*



Nishino, Anesthesiology 1984

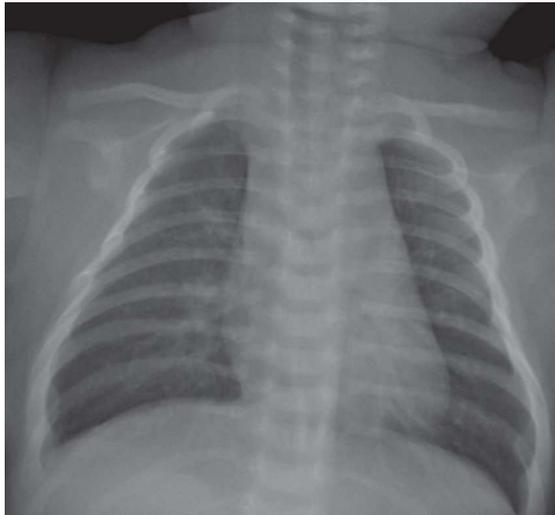
## Anesthésie et VAS en pédiatrie

- Majoration de l'Obstacle inspiratoire
- Activité nerveuse altérée
- Comparable aux obstructions lors du sommeil

# Configuration thoraco-abdominale

Cotes horizontales chez le nourrisson

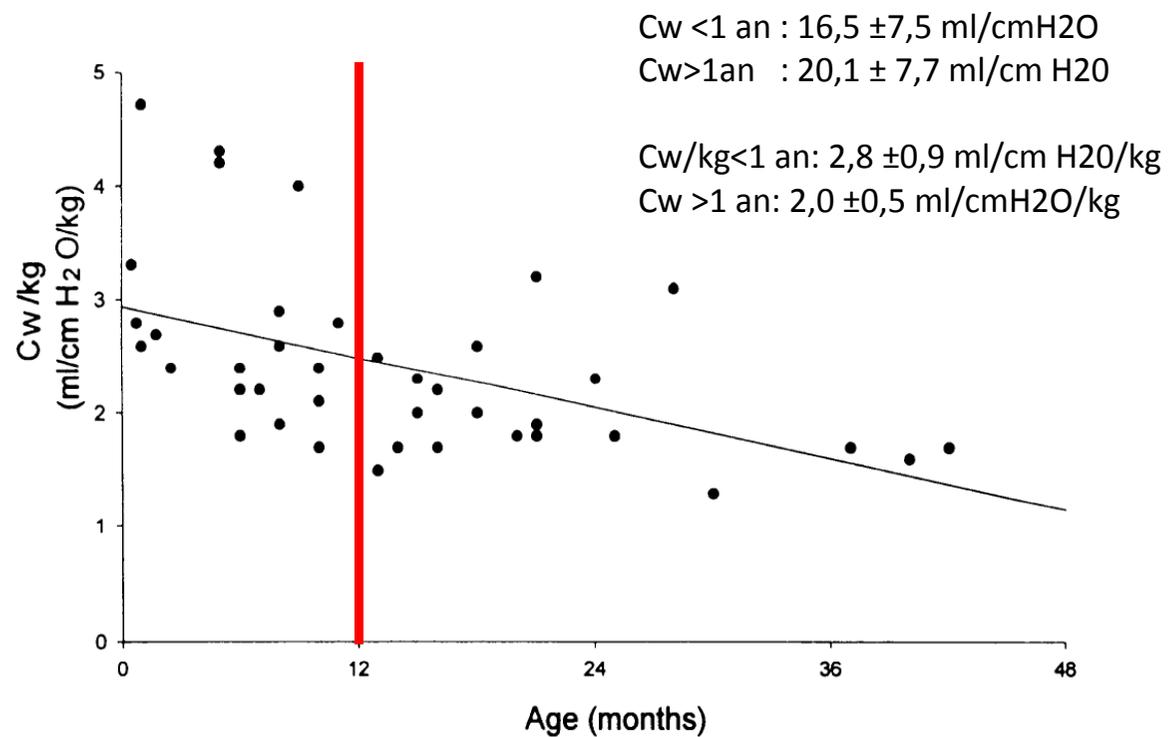
Mauvais couplage thorax poumons



Radio pulmonaire adulte

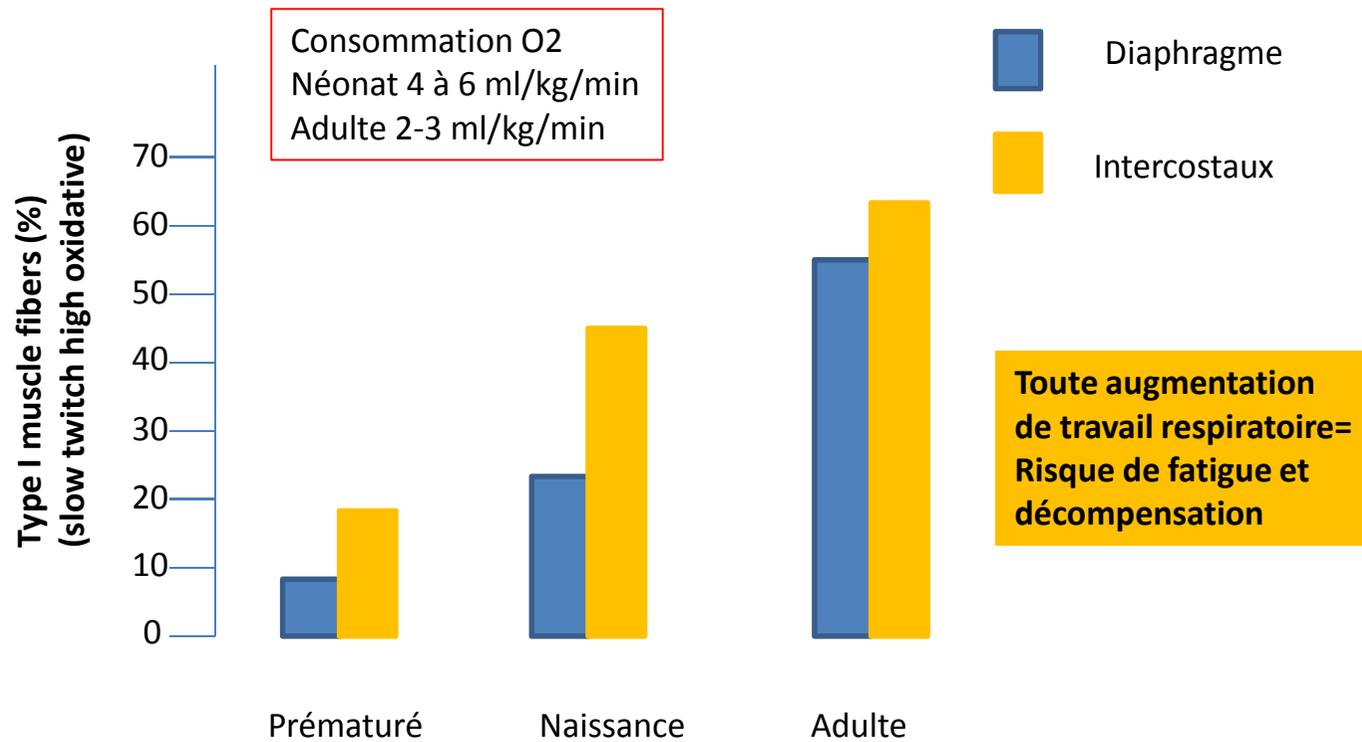


# Compliance thoracique chez le nourrisson



Papastamelos J Appl Physiol 1995: 179-84

# Histologie des muscles respiratoires



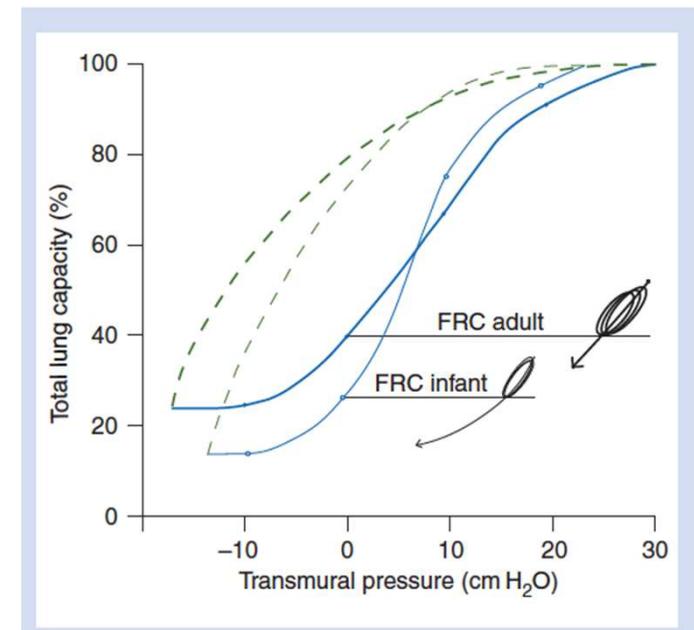
Keens. J Appl Physiol 1978: 909-913.

# La CRF

- La capacité résiduelle fonctionnelle (CRF),
  - reflet des réserves d'oxygène,
  - un des principaux marqueurs de la croissance alvéolaire
- Adulte
  - volume d'équilibre de l'ensemble thorax-poumon,
  - volume de fin d'expiration calme
- Nourrisson
  - la compliance élevée de la cage thoracique est associée à une diminution de la pression de recul élastique

Volume résiduel/  
Capacité pulmonaire totale est diminué

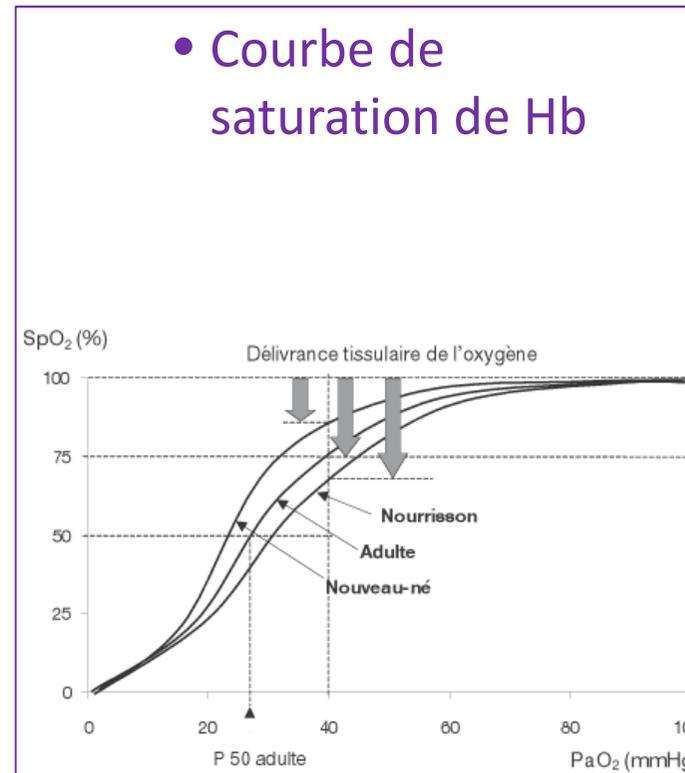
Chez le nourrisson, Nouveau né:  
VF est proche voir excède la CRF  
Risque de fermeture des petites  
voies aériennes dépourvues de cartilage



# Echanges Gazeux

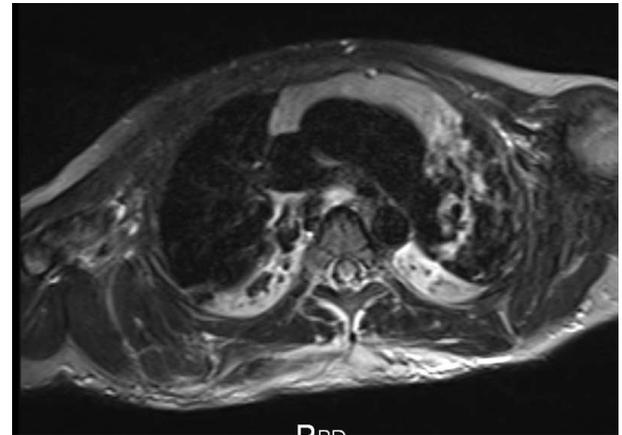
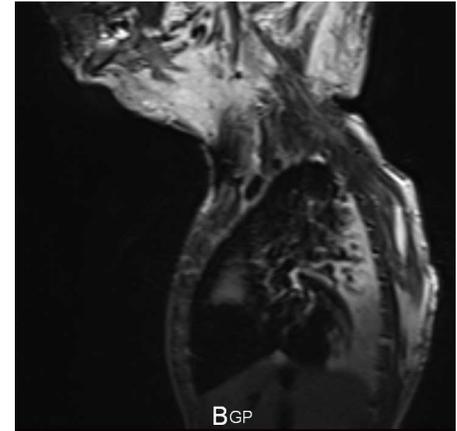
- Risque d'atélectasie
  - Fermeture des voies aériennes distales
  - Perfusion des bases > Perfusion des sommets
    - Hétérogénéité de distribution du rapport V/P
    - Atélectasies fréquentes dans les atteintes respiratoires

- Courbe de saturation de Hb



## Physiologie respiratoire et pédiatrie

- Obstruction inspiratoire des VAS
- Besoin accru d'oxygène
- Risque de fatigue musculaire à l'effort
- Compliance augmentée: risque d'asynchronisme
- CRF proche du volume de fermeture
  - Risque d'atélectasies
- **Risque de désaturation rapide et hypoxémie**



## Risque de collapsus des petites voies aériennes distales

- En ventilation spontanée, éveillé
  - Frein laryngé
    - Activité Exp des M adducteurs du larynx
  - Frein diaphragmatique
    - Activité tonique post inspiratoires du diaphragme
  - Fréquence respiratoire élevée
  - Maintient d'une hyperinflation pulmonaire en VS,
- En anesthésie
  - Objectif: rétablir une relation normale entre VF et CRF

- La physiologie respiratoire de l'enfant
- Les stratégies de ventilation
  - Pré oxygénation
  - PEP
  - Manœuvres de recrutement
  - Ventilation : VC/PC

## Importance de la pré-oxygénation en pédiatrie

27 % des ACR  
per-anesthésique  
d'origine respiratoire

Table 2. Causes of Cardiac Arrest 1998-2004

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 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	3 (3)
Medication	35 (18)
Halothane-induced CV depression	9 (5)
Sevoflurane-induced CV depression	6 (3)
Other single medication <sup>a</sup>	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)

# Age et durée de l'apnée pour sat<90% après FIO2 100

TABLE Relationship between age and apnoea time (n = 50)

Group*	Age	T 90% (sec) Mean ± SD	T 90% (sec) Range
I	2 d-6 mo	96.5 ± 12.7	77 - 118
II	7 mo-23 mo	118.5 ± 9.0	79 - 163
III	2-5 yr	160.4 ± 30.7	114 - 205
IV	6-10 yr	214.9 ± 34.9	165 - 274
V	11-18 yr	382.4 ± 79.9	185 - 490

\*10 pts in each group.

Patel CJA 1994

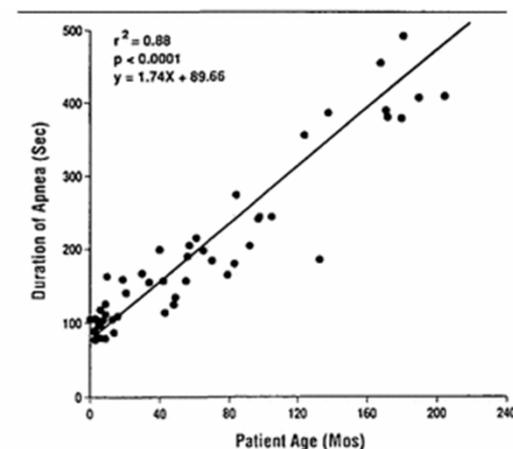


FIGURE 1 Relationship between duration of apnoea and patient age.

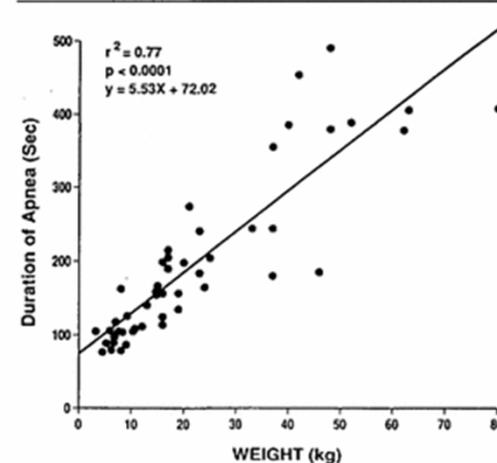
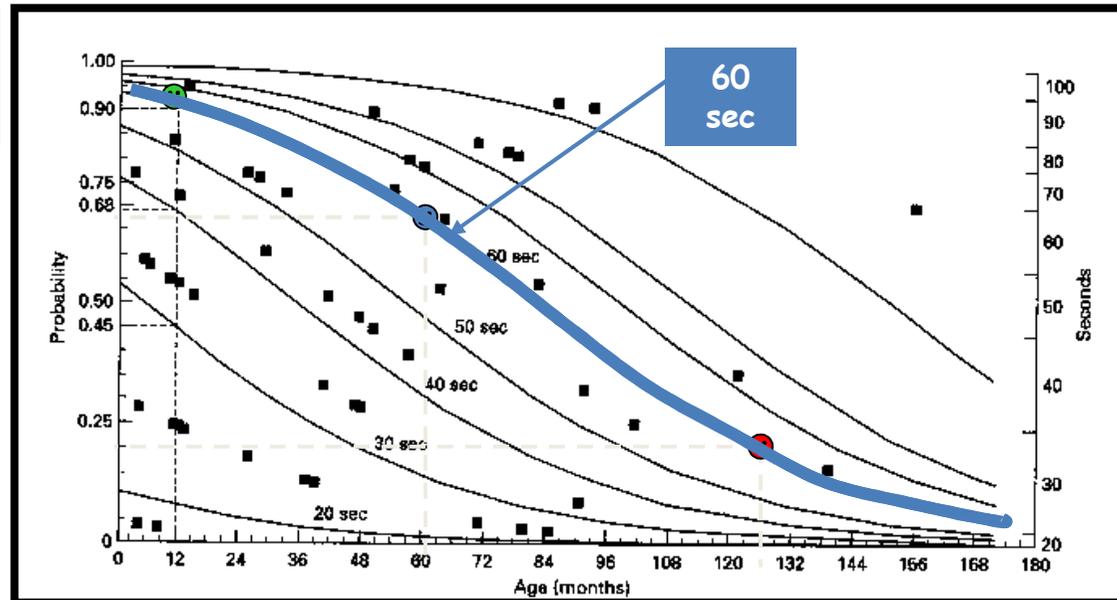


FIGURE 2 Relationship between duration of apnoea and patient weight.

# Pré oxygénation : combien de temps ?

Probabilité

FeO<sub>2</sub> =  
0,9



*Morrisson Paed Anaesth 1998;8:293-8*

< 1 an = 60 sec

> 2 ans : pré O<sub>2</sub> de 2 min = 2 min d'apnée sans désaturation

*Xue J Clin Anesth 1995; 7:93-6*

Pré oxygénation ?

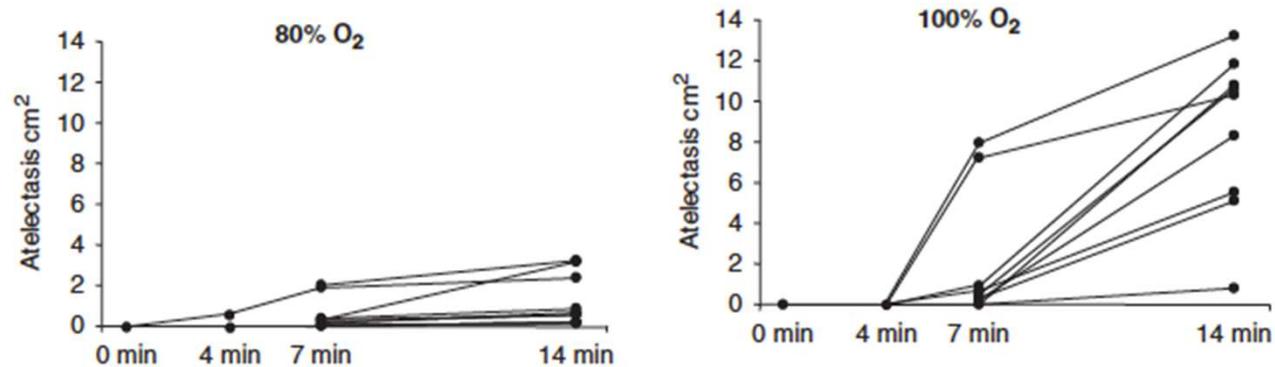
## Ami ou ennemi: O<sub>2</sub> et atélectasies

### Oxygen concentration and characteristics of progressive atelectasis formation during anaesthesia

Acta Anaesthesiol Scand 2011; 55: 75–81

L. EDMARK<sup>1</sup>, U. AUNER<sup>2</sup>, M. ENLUND<sup>1</sup>, E. ÖSTBERG<sup>1</sup> and G. HEDENSTIERNA<sup>3</sup>

Departments of <sup>1</sup>Anaesthesiology and Intensive Care, <sup>2</sup>Radiology, Central Hospital, Västerås, Sweden and <sup>3</sup>Department of Medical Sciences, Clinical Physiology, University Hospital, Uppsala, Sweden



# Enquête ADARPEF 2010-2011

232 QUESTIONNAIRES (46%)

**Table 2** Preoxygenation before induction and before intubation

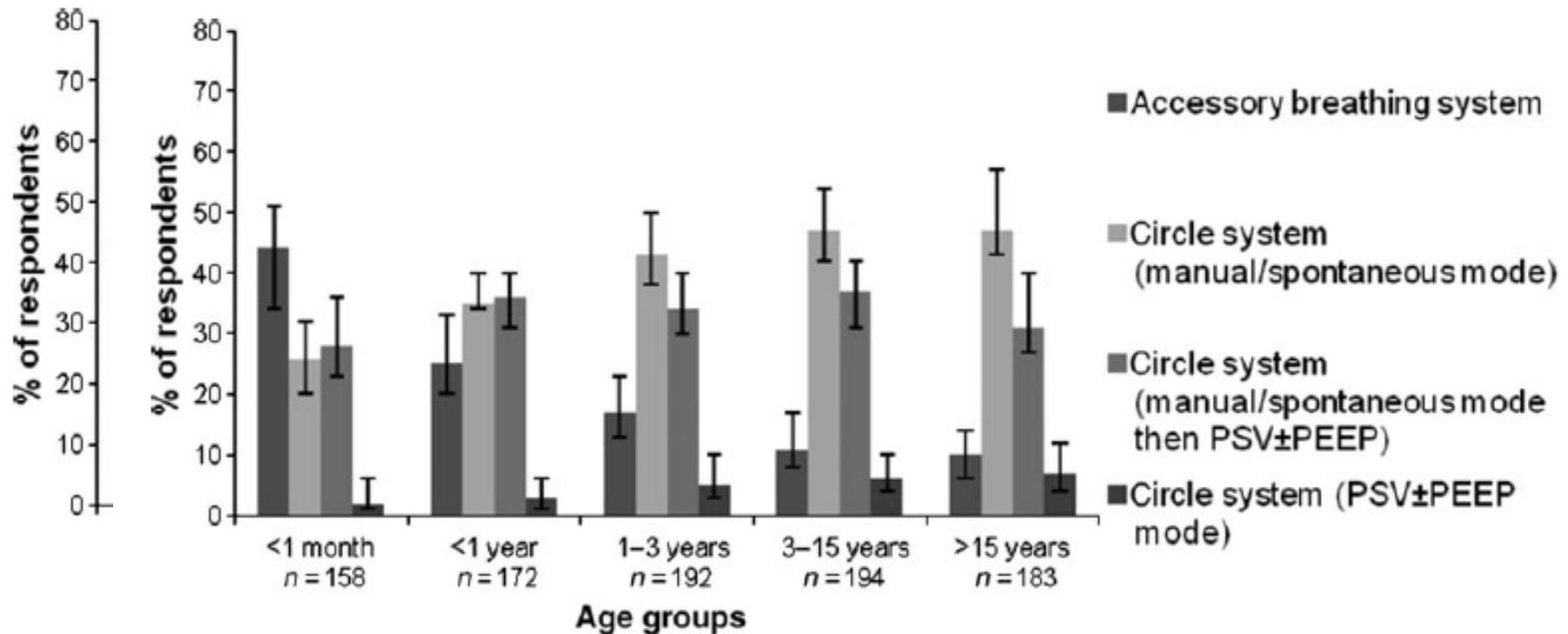
	Preoxygenation = yes	Before induction FiO <sub>2</sub> 80–100%	FiO <sub>2</sub> = 100%	Before intubation FiO <sub>2</sub> = 100%
< 1 month	80% [74–86], <i>n</i> = 161	68% [61–75], <i>n</i> = 161	53% [45–61], <i>n</i> = 161	77% [71–84], <i>n</i> = 161*
1 month–1 year	72% [65–79], <i>n</i> = 176	65% [58–72], <i>n</i> = 182	56% [49–63], <i>n</i> = 182	77% [71–83], <i>n</i> = 178*
1–3 years	70% [64–76], <i>n</i> = 196	62% [55–69], <i>n</i> = 197	53% [46–60], <i>n</i> = 197	73% [67–79], <i>n</i> = 195*
3–15 years	76% [70–82], <i>n</i> = 197	65% [58–72], <i>n</i> = 200	59% [52–66], <i>n</i> = 200	69% [63–75], <i>n</i> = 198*
>15 years	83% [78–88], <i>n</i> = 198	77% [71–83], <i>n</i> = 193	73% [67–79], <i>n</i> = 193	71% [65–78], <i>n</i> = 190
Obese	95% [92–98], <i>n</i> = 198	92% [87–95], <i>n</i> = 200	87% [82–92], <i>n</i> = 200	–
Full stomach	96% [93–99], <i>n</i> = 200	95% [90–97], <i>n</i> = 200	92% [87–95], <i>n</i> = 200	–
Difficult Intubation	98% [96–100], <i>n</i> = 191	95% [91–98], <i>n</i> = 192	92% [88–96], <i>n</i> = 192	–

Preoxygenation and FiO<sub>2</sub> chosen before induction and before intubation. Results expressed as percentage of *n* total of respondents [ $\pm$ 95 CI] for each item.

\**P* < 0.05 between FiO<sub>2</sub> 100% before intubation vs FiO<sub>2</sub> 100% before induction.

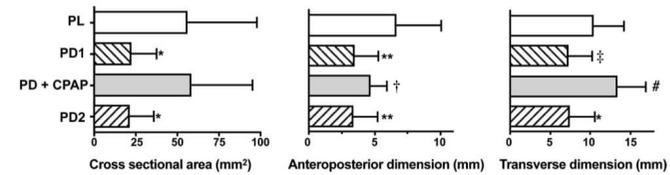
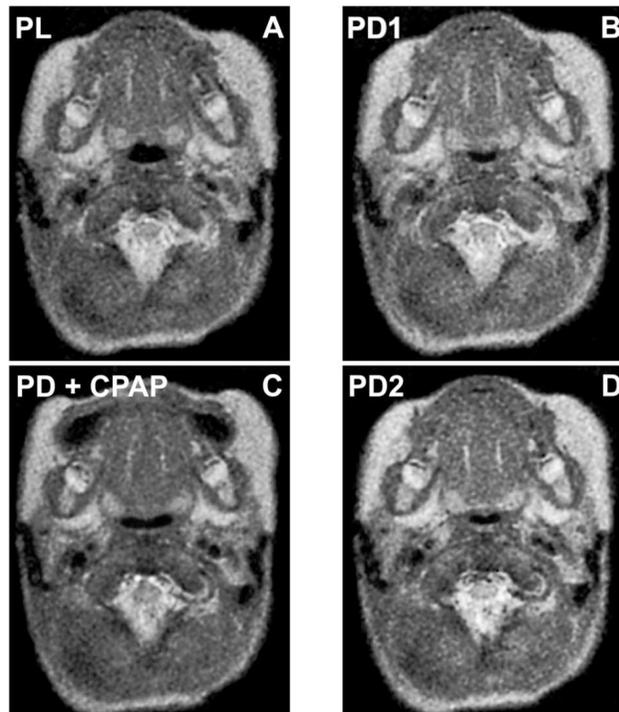
*n*: number of respondents for each question.

# Enquête ADARPEF 2010-2011



## ***Effect of Propofol Anesthesia and Continuous Positive Airway Pressure on Upper Airway Size and Configuration in Infants***

Mark W. Crawford, M.B.B.S., F.R.C.P.C.,\* Denise Rohan, M.B.B.Ch., F.F.A.R.C.S.I.,† Christopher K. Macgowan, Ph.D.,‡  
Shi-Joon Yoo, M.D., F.R.C.P.C.,§ Bruce A. Macpherson, M.D., F.R.C.P.||



PL 80µg/kg/min de propofol

PD1: 2mg/kg de propofol et 240µg/kg/min

CPAP à 10 cmH<sub>2</sub>O

**Prévention de l'obstruction  
par la CPAP**

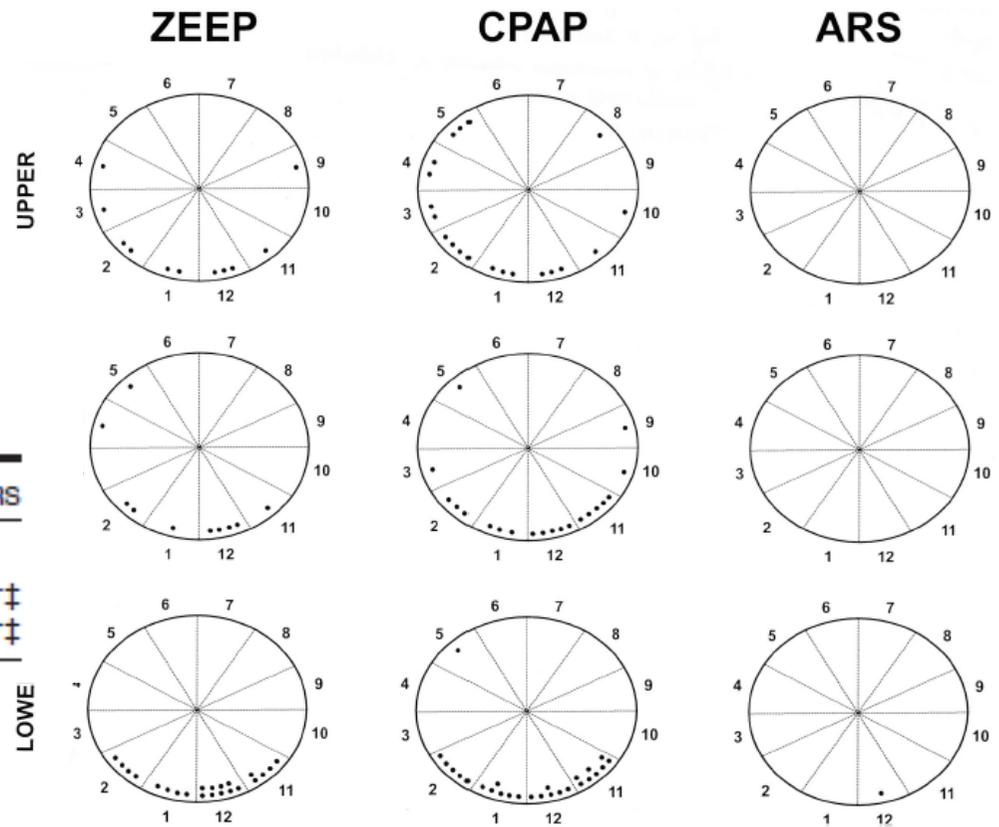
## Effects of Recruitment Maneuver on Atelectasis in Anesthetized Children

Gerardo Tusman, M.D.,\* Stephan H. Böhm, M.D.,† Alejandro Tempa, M.D.,‡ Fernando Melkun, M.D.,\*  
Eduardo García, M.D.,‡ Elsie Turchetto, M.D.,§ Paul G. H. Mulder, M.S., Ph.D.,|| Burkhard Lachmann, M.D., Ph.D.#

24 enfants 6 mois – 6 ans ASA I-II  
AG IOT => ventilation spontanée  
ZEEP  
CPAP + 5 CM H2O  
ARS = Recrutement 10 cycles / PEEP=5/ PIP = 40

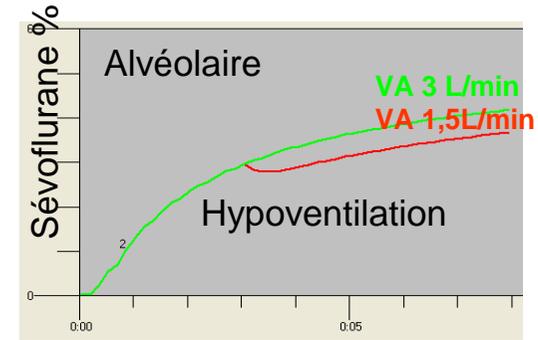
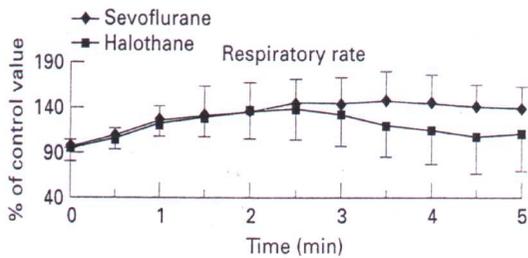
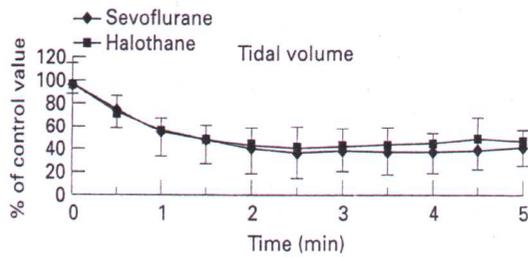
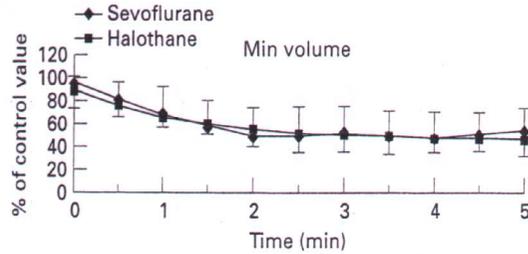
**Table 2. Atelectatic Volumes**

	ZEEP	CPAP	ARS
Atelectasis volume (cm <sup>3</sup> )			
Right	1.25 (0.75–4.56)*	9.5 (3.1–23.7)	0†‡
Left	4.25 (3.2–13.9)	8.8 (5.3–28.5)	0†‡

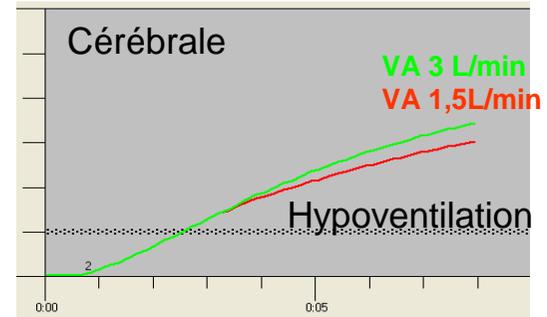


# Mode ventilatoire?

20 enfants 1-5 ans, VS + ALR  
 Baseline Halo 0.75%, Sevo 2%,  
 Puis augmentation Halo 5%, Sevo 8%



Simulation GASMAN



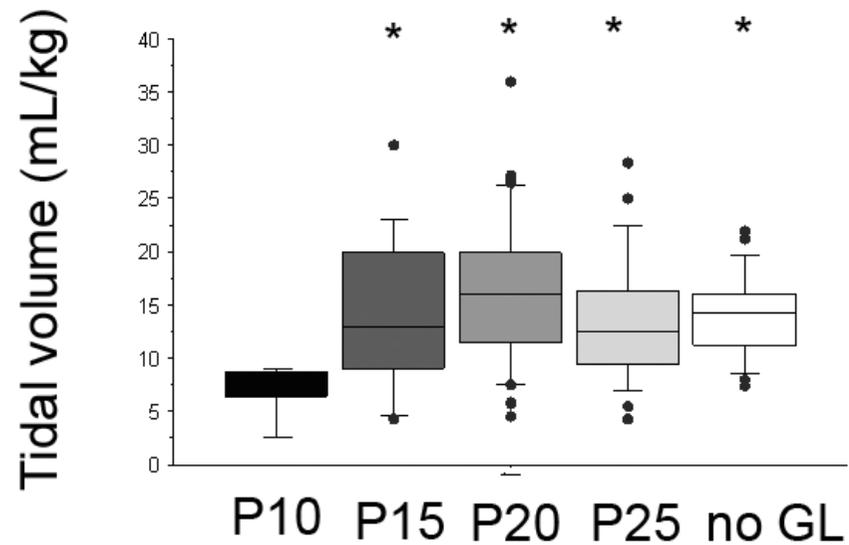
# Aide inspiratoire à l'induction

- Augmentation du niveau d'aide
  - Obtenir le volume courant désiré
  - Diminution proportionnelle du travail
  - Diminution proportionnelle de l'effort
- Etroitement liée à la FR et au volume courant
  - FR: minimum doit être réglé
  - Permet la ventilation en apnée de sécurité

## Facemask Pressure-Controlled Ventilation in Children: What Is the Pressure Limit?

Sylvaine Lagarde, MD,\* François Semjen, MD,\* Karine Nouette-Gaulain, MD, PhD,\*†  
Françoise Masson, MD,‡ Maryline Bordes, MD,\* Yves Meymat, MD,\* and Anne-Marie Cros, MD\*

Au-delà de P15, pas d'augmentation du VT

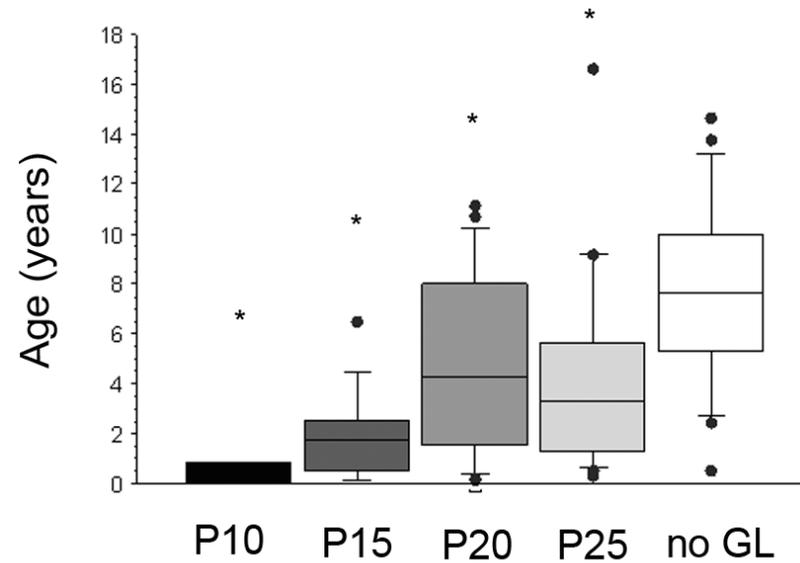


Anesth Analg 2010;110:1676–9)

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**La présence des fuites gastriques à l'induction est liée à l'âge de l'enfant**



Anesth Analg 2010;110:1676–9)

# Quel niveau d'aide inspiratoire?

- Eviter les niveau d'aide trop élevé
  - Fuite gastrique +++
  - Risque de décollage patient respirateur avec asynchronie, apnée, effort inefficace

*L'insufflation se prolonge passivement après la fin de la fin de l'effort inspiratoire (pendant l'expiration neurale)*
- Eviter niveau d'aide trop bas
  - Clinique: mise en jeu des sternocleidomastoidiens = travail excessif

**Pressure Support Ventilation Versus Continuous Positive Airway Pressure Ventilation with the ProSeal™ Laryngeal Mask Airway: A Randomized Crossover Study of Anesthetized Pediatric Patients**

(Anesth Analg 2005;100:357-60)

A. von Goedecke, MD\*, J. Brimacombe, MB, ChB, FRCA, MD†, C. Hörmann, MD\*, H.-C. Jeske, MD\*, A. Kleinsasser, MD\*, and C. Keller, MD\*

\*Department of Anaesthesia and Intensive Care Medicine, Leopold-Franzens University, Innsbruck, Austria; and †James Cook University, Cairns Base Hospital, Australia

**20 enfants 1 à 7 ans**  
**AG pour Ventilation spontanée sur masque laryngé**  
**N=10 CPAP puis VSAI puis CPAP**  
**N=10 VSAI puis CPAP puis VSAI**

**VSAI P=10 + PEEP=3**  
**CPAP =3**

**VS AI PEP > CPAP**

**Table 2.** Hemodynamic and Respiratory Characteristics During Pressure Support Ventilation (PSV) and Continuous Positive Airway Pressure (CPAP)

	PSV	CPAP	P value
Heart rate (min <sup>-1</sup> )	117 ± 19	117 ± 21	NS
Mean arterial blood pressure (mm Hg)	64 ± 9	64 ± 9	NS
End-tidal sevoflurane (%)	2 ± 0.2	2 ± 0.2	NS
Fraction of inspired oxygen (%)	0.36 ± 0.04	0.36 ± 0.05	NS
Axillary skin temperature (°C)	36.4 ± 0.3	36.5 ± 0.4	NS
Oxygen saturation (%)	98.9 ± 0.6	98.8 ± 0.9	NS
End-tidal carbon dioxide (mm Hg)	46 ± 6	52 ± 7	<0.001
Respiratory rate (min <sup>-1</sup> )	24 ± 6	30 ± 6	<0.001
Expired tidal volume (mL)	179 ± 50	129 ± 44	<0.001
Peak airway pressure (cm H <sub>2</sub> O)	12.4 ± 0.9	5.2 ± 0.7	<0.001
Work of breathing patient (J L <sup>-1</sup> )	0.54 ± 0.54	0.95 ± 0.72	<0.04
Pressure time product (cm H <sub>2</sub> O s <sup>-1</sup> m <sup>-1</sup> )	94 ± 88	150 ± 90	<0.001
δ Pressure esophagus (cm H <sub>2</sub> O)	10.6 ± 7.4	14.1 ± 8.9	<0.04
Inspiratory time fraction (%)	29 ± 3	34 ± 5	<0.001
Respiratory drive (cm H <sub>2</sub> O)	4.1 ± 3.6	5.1 ± 4.5	NS

Data are mean ± sd or numbers.  
 NS = not significant.

# Pressure-controlled ventilation is superior to volume-controlled ventilation with a laryngeal mask airway in children

M. BORDES<sup>1</sup>, F. SEMJEN<sup>1</sup>, C. DEGRYSE<sup>1</sup>, J. L. BOURGAIN<sup>2</sup> and A. M. CROS<sup>1</sup>

<sup>1</sup>Pellegrin Children's Hospital, Bordeaux 2 University, Bordeaux and <sup>2</sup>Department of Anesthesia, Institut Gustave Roussy, Villejuif, France

PC: P<sub>insp</sub> > P<sub>leak</sub>  
n=1/40  
VC: P<sub>insp</sub> > P<sub>leak</sub>  
n=9/40

RESULTS

Comparison of respiratory parameters after 5 min and at the end of the procedure with the same mode and comparison of respiratory parameters between the two modes at the end of procedure (mean ± SD).

	PCV		VCV	
	5 min n = 20	End of surgery n = 23	5 min n = 20	End of surgery n = 17
P <sub>insp</sub> (cm H <sub>2</sub> O)	12.4 ± 2.6	12.4 ± 2.2 NS*	14.2 ± 2.8	14.7 ± 2.9 NS
VT <sub>exp</sub> (ml)	204 ± 65	206 ± 62 NS*	196 ± 61	197 ± 60 NS
P <sub>ET</sub> CO <sub>2</sub> (mm Hg)	38.7 ± 3.2	38.9 ± 3.3 NS*	39.7 ± 4.1	39.9 ± 4.0 NS

NS, no significant difference in respiratory parameters at 5 min and at the end of the procedure between PCV and VCV.

\*Comparison between the two modes at the end of surgery, P < 0.03.

<b>âge</b>	<b>fréquence respiratoire (c.min<sup>-1</sup>)</b>
<b>prématuré 750 g</b>	40 - 60
<b>prématuré 1000 g</b>	40 - 60
<b>nouveau-né à terme</b>	30 - 50
<b>6 mois</b>	26 - 30
<b>1 an</b>	22 - 26
<b>3 ans</b>	20 - 24
<b>5 ans</b>	18 - 22
<b>8 ans</b>	16 - 20
<b>12 ans</b>	14 - 18
<b>15 ans</b>	12 - 16
<b>21 ans</b>	12 - 14

## Pression contrôlée, Débit décélérant

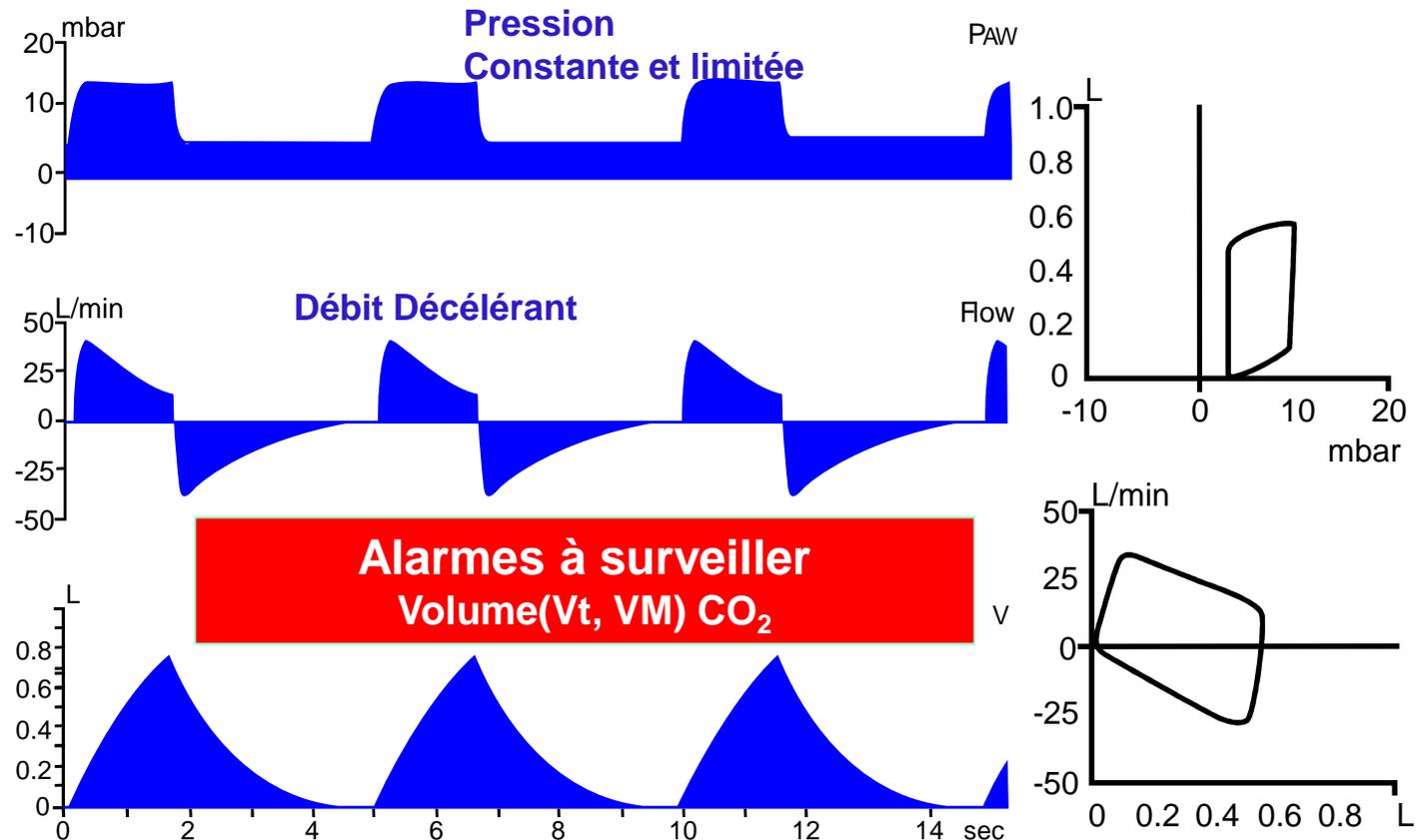
**Fréquence** 10 à 60 /min  
ajustée selon

$\text{FeCO}_2$

**Pression inspiratoire**  
pour avoir  
un  $V_t$  compris  
entre 6-9 ml/kg

**Rapport I/E ou  $T_i/T_{tot}$**   
-1/2 ou 33%  
augmentée selon  
clinique

**PEP**  
-selon clinique,  
avec des niveaux de 5 à 6

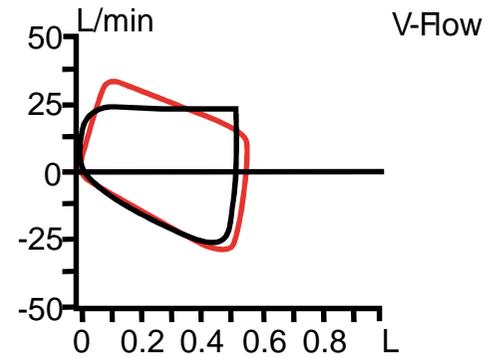
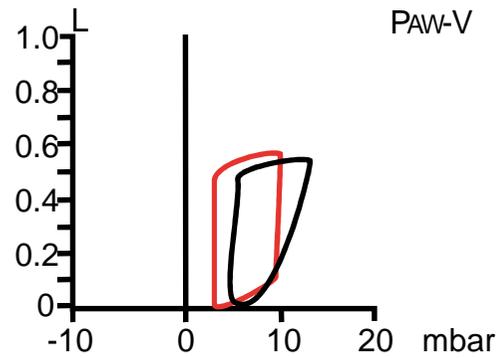


# Comparaison VC-PC Courbes

A VENIR  
PEDIAVENT  
2018

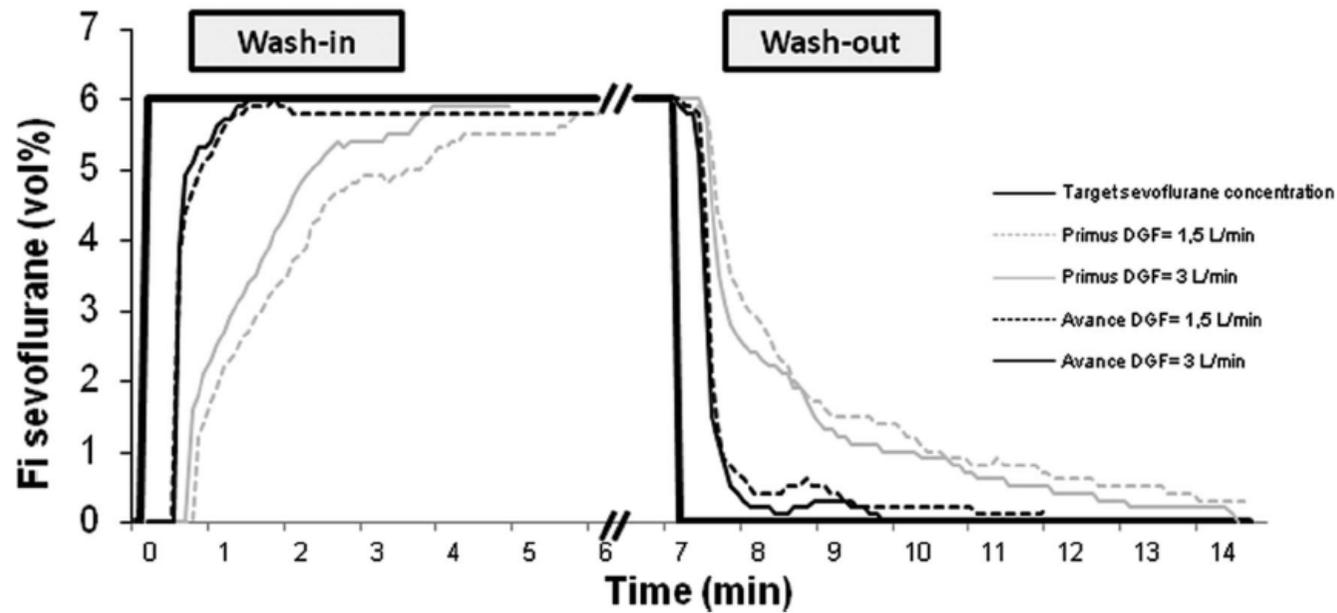
Courbe Pression Volume

Courbe Débit volume



# Caractéristiques des ventilateurs

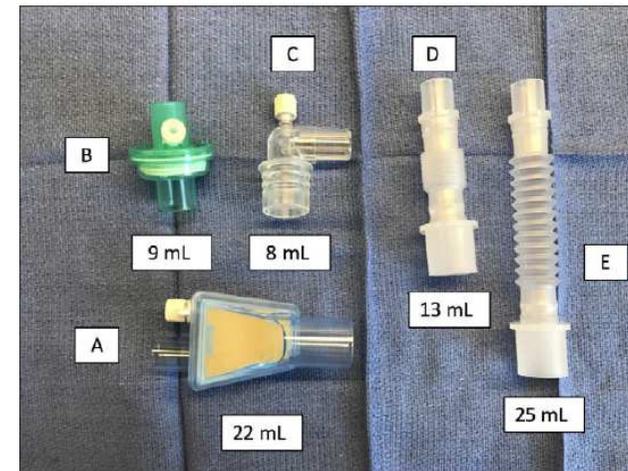
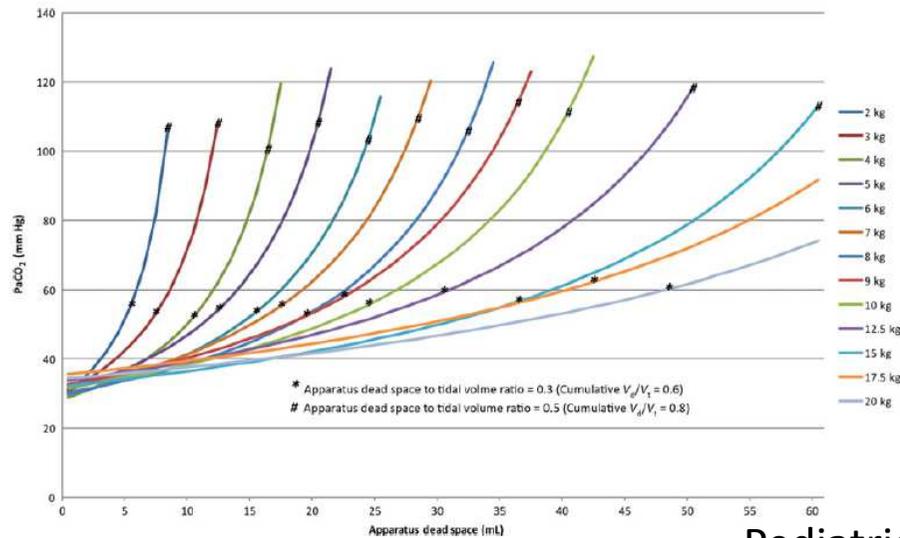
Sevoflurane Wash-in and Wash-out during newborn ventilation



Anesth Analg 2012;115:310-4)

# Optimisation de l'espace mort

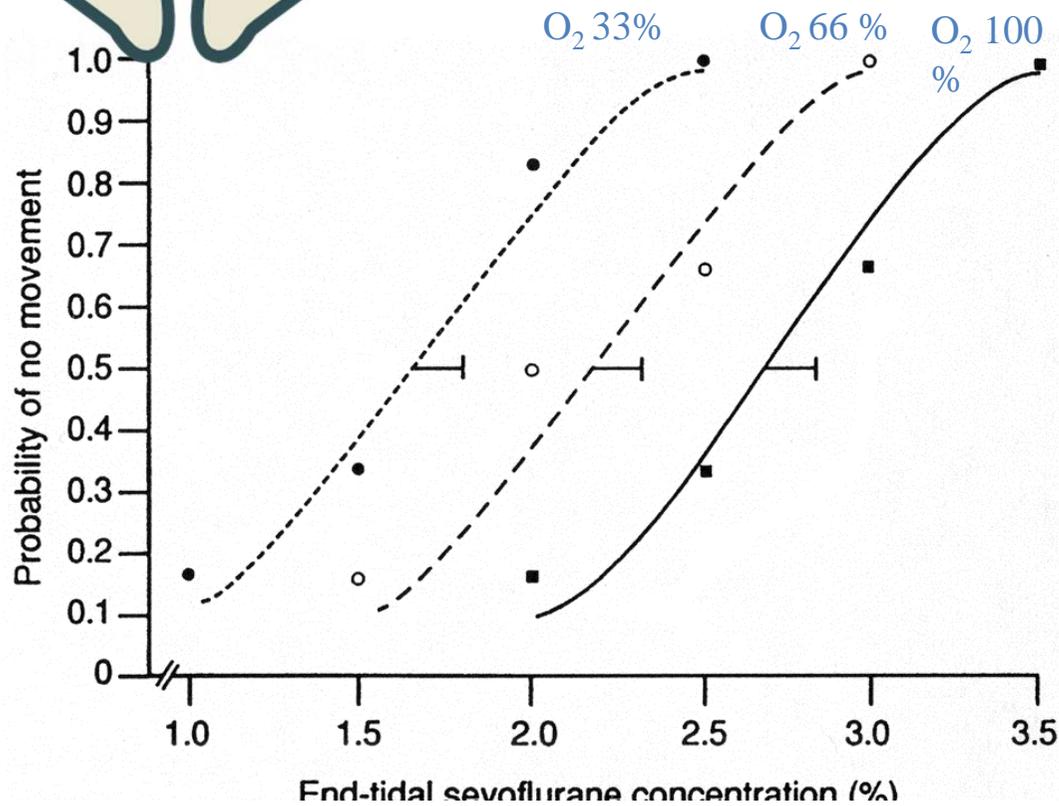
<5 kg      Vt 3-30 ml  
 5-15 kg    Vt 30-90 ml  
 >15kg     Vt 90 ml



Pediatric Anesthesia. 2017;27:1185–1192.

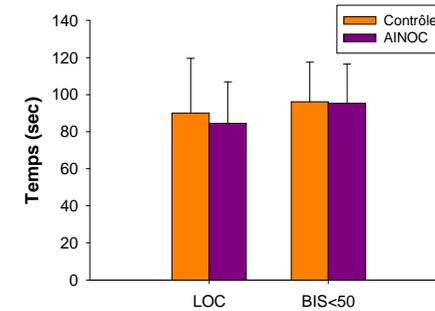


# • Green Anaesthesia



*Target-controlled inhalation induction with sevoflurane in children: a prospective pilot study*

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Diminution des consommations  
 Diminution de la pollution

# MRA après intubation et à la fin de l'intervention chirurgicale

Enfant 2mois à 1 an

Durée anesthésie 30-230 min

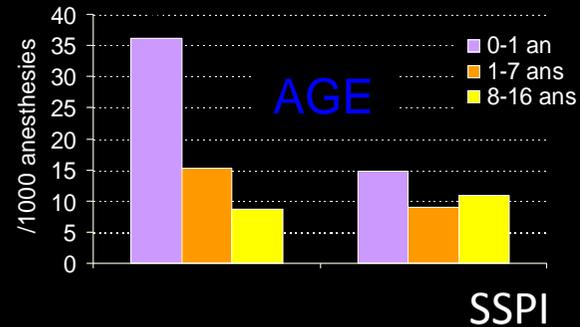
Incidence des atélectasies  
80% groupe contrôle  
25% MRA

	Recruitment Manoeuvre group n = 20	p value*	Control group n = 20	p value†	p value‡
First ultrasound examination					
<b>Consolidation score</b>	<b>11.0 (8.0–15.0 [3.0–21.0])</b>		<b>10.0 (8.0–12.3 [3.0–20.0])</b>		0.412
In the anterior regions	2.5 (1.8–3.0 [0.0–4.0])		3.0 (2.0–4.0 [0.0–4.0])		0.265
In the lateral regions	3.0 (2.0–4.0 [0.0–6.0])		3.5 (2.0–4.0 [0.0–6.0])		0.571
In the posterior regions	5.0 (4.0–9.0 [0.0–12.0])		4.0 (3.0–6.0 [1.0–12.0])		0.073
<b>B-lines score</b>	<b>12.0 (8.0–16.0 [4.0–29.0])</b>		<b>11.5 (8.0–13.5 [1.0–20.0])</b>		0.571
In the anterior regions	2.5 (1.0–4.0 [1.0–8.0])		3.0 (2.0–4.0 [0.0–5.0])		0.549
In the lateral regions	3.5 (1.8–4.0 [0.0–10.0])		3.0 (2.8–4.0 [0.0–6.0])		0.975
In the posterior regions	6.5 (4.0–8.3 [1.0–12.0])		5.0 (3.8–7.0 [0.0–11.0])		0.128
Second ultrasound examination					
<b>Consolidation score</b>	<b>6.0 (3.0–9.3 [0.0–14.0])</b>	<b>&lt; 0.001</b>	<b>13.5 (11.0–16.5 [8.0–23.0])</b>	<b>&lt; 0.001</b>	<b>&lt; 0.001</b>
In the anterior regions	1.0 (0.0–3.3 [0.0–4.0])	0.004	4.0 (2.8–4.0 [2.0–4.0])	0.027	< 0.001
In the lateral regions	1.5 (1.0–3.0 [0.0–4.0])	< 0.001	4.0 (4.0–4.3 [2.0–7.0])	0.005	< 0.001
In the posterior regions	3.0 (2.0–4.3 [0.0–6.0])	< 0.001	6.0 (4.0–9.3 [3.0–12.0])	< 0.001	< 0.001
<b>B-lines score</b>	<b>6.5 (3.0–12.0 [0.0–28.0])</b>	<b>&lt; 0.001</b>	<b>15.0 (10.8–20.5 [7.0–28.0])</b>	<b>&lt; 0.001</b>	<b>&lt; 0.001</b>
In the anterior regions	1.0 (1.0–3.3 [0.0–8.0])	0.007	4.0 (2.8–5.0 [2.0–7.0])	0.001	< 0.001
In the lateral regions	2.0 (0.8–3.0 [0.0–9.0])	< 0.001	4.0 (3.0–5.3 [1.0–9.0])	0.002	< 0.001
In the posterior regions	3.0 (2.0–6.0 [0.0–11.0])	< 0.001	6.5 (4.8–11.0 [2.0–12.0])	< 0.001	< 0.001

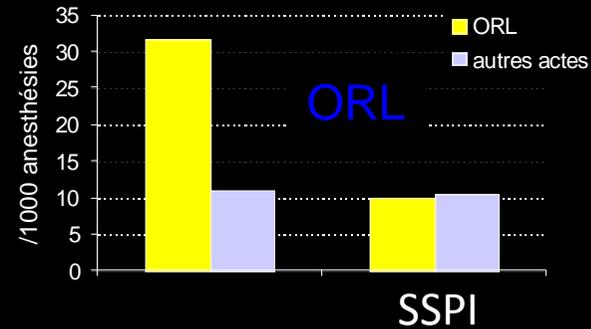


# Facteurs de risque de complications respiratoires

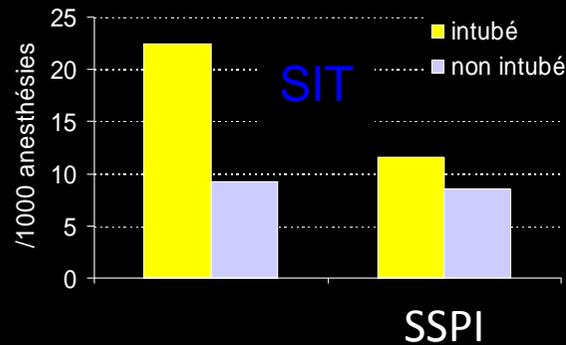
Incidents critiques respiratoires  
Effets de l'âge



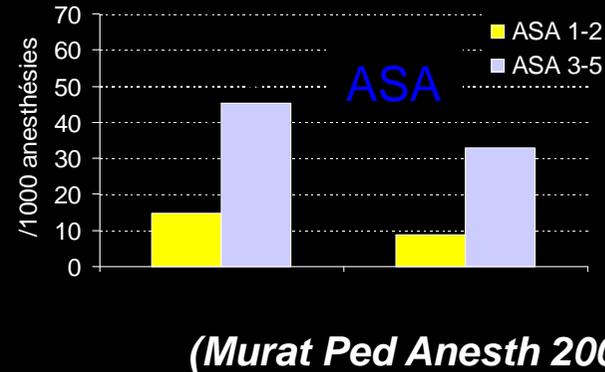
Incidents critiques respiratoires :  
ORL (n=6138)  
versus autres actes (n=16905)



Incidents critiques respiratoires:  
intubé (n=13126)  
versus non-intubé (n=11039)



Incidents critiques respiratoires :  
ASA 1-2 (n=20424)  
versus ASA 3-5 (n=1522)



(Murat Ped Anesth 2004)

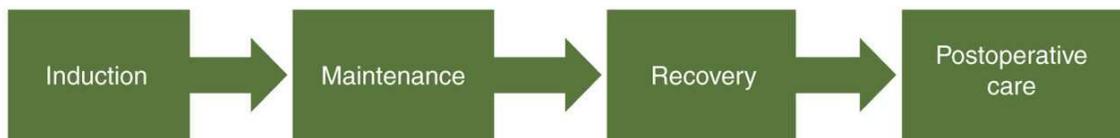
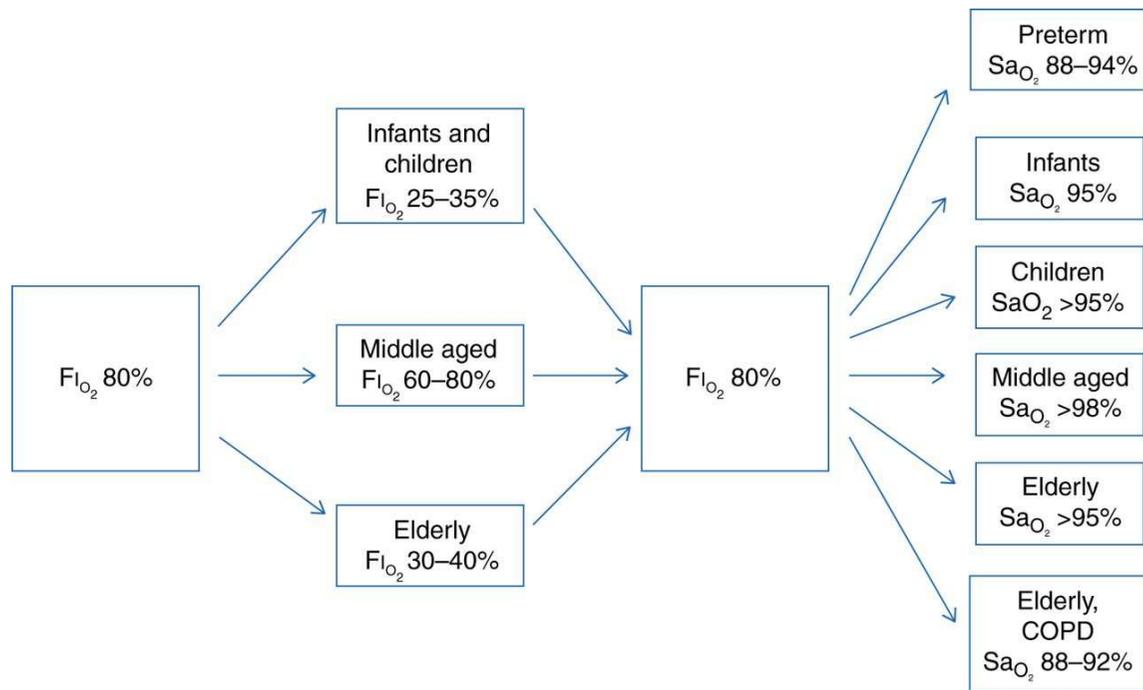
Le jeune garçon de 4 ans, 20kg, amygdalectomie,  
pour syndrome d'apnée obstructive du sommeil

- **Préoxygénation d'au moins deux minutes**
- **Induction en AI + PEP (inh ET/OU IV) avec voie veineuse précoce**
  - FI02 80-100%
  - CIRCUIT MACHINE
- **Intubation puis MRA**

Le jeune garçon de 4 ans, 20kg, amygdalectomie, pour syndrome d'apnée obstructive du sommeil

- **Ventilation peropératoire PC ou VC**
  - VT 6 et 9 ml/kg
  - PEP >5
  - FIO<sub>2</sub> qsp sat >95%
  - Monitoring courbe pression volume
- **Mode AINOC sévoflurane sans protoxyde d'azote**
- **MRA à la fin de l'intervention**
- **Réveil en salle en mode AI PEP avant extubation bien éveillé**

## Suggested perioperative concentrations of inspired oxygen (FIO<sub>2</sub>) for different age groups under normal physiological conditions.



Quels Enfants?  
Quelles difficultés d'intubation?  
Quelle préoxygénation?

## Effect of continuous Positive airway pressure on the measurement of thoracoabdominal asynchrony and minute ventilation in children anesthezed with sevoflurane and nitrous oxyde

**90 enfants de 2 à 9 ans, sévo 3% O<sub>2</sub>/N<sub>2</sub>O 50/50**  
**Respiration spontanée sur masque facial**  
**PEEP = 0 vs 5 vs 10 cm d'H<sub>2</sub>O**  
**Paramètres d'asynchronie thoraco abdominale**

**Table 1—Effect of CPAP on TAA and  $\dot{V}_E$  (All Patients)\***

Variables	Patients, No.	CPAP Level		
		0 cm H <sub>2</sub> O	5 cm H <sub>2</sub> O	10 cm H <sub>2</sub> O
PA, °	63	122 (99–138)	120 (56–135)†	116 (49–134)†
PhRIB, %	81	67.4 (38.1–76.4)	54.2 (25.9–77.3)†	50.4 (28.0–75.6)†
PhREB, %	81	28.6 (18.5–36.6)	25.8 (19.6–32.7)	25.9 (15.4–38.8)
PhRTB, %	81	43.6 (29.3–52.8)	40.1 (26.1–48.1)†	37.3 (22.9–49.0)†
Ti/Trot	81	0.42 (0.39–0.44)	0.39 (0.35–0.42)†	0.39 (0.36–0.42)†
Respiratory frequency, breaths/min	81	36 (31–40)	36 (32–41)	39 (35–44)†‡
V <sub>T</sub> , mL/kg	81	3.2 (2.5–4.6)	3.4 (2.3–4.1)	2.5 (1.8–3.4)†‡
V <sub>E</sub> , mL/kg/min	81	119 (93–155)	115 (95–140)	101 (77–127)†‡

\*Because PA data were skewed, all data are presented uniformly as median and 25 to 75% interquartile range. For PA presentation, only children with acceptable Lissajous figures for PA determination were included.

†Significantly different from no CPAP (0 cm H<sub>2</sub>O).

‡Significantly different from CPAP of 5 cm H<sub>2</sub>O.

**L'application d'une PEEP à 5 cm d'H<sub>2</sub>O diminue l'asynchronisme thoraco abdominal par action supra glottique probable**

## Work of Breathing During Spontaneous Ventilation in Anesthetized Children: A Comparative Study Among the Face Mask, Laryngeal Mask Airway and Endotracheal Tube

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