Prise en charge en réanimation pédiatrique à travers l'œil du kiné

Jusqu'à 6 ans

Damien Moerman, PT

Cliniques universitaires Saint-Luc

Unités de soins intensifs pédiatriques et Urgences

Secteur de kinésithérapie et d'ergothérapie

Cliniques universitaires SAINT-LUC UCL BRUXELLES

SOINS INTENSIFS PEDIATRIQUES

réanimation 2021
PARIS 9-11 JUIN
Palais des Congrès de Paris
Porte Maillot

ATTENTION CHANGEMENT DE DATE

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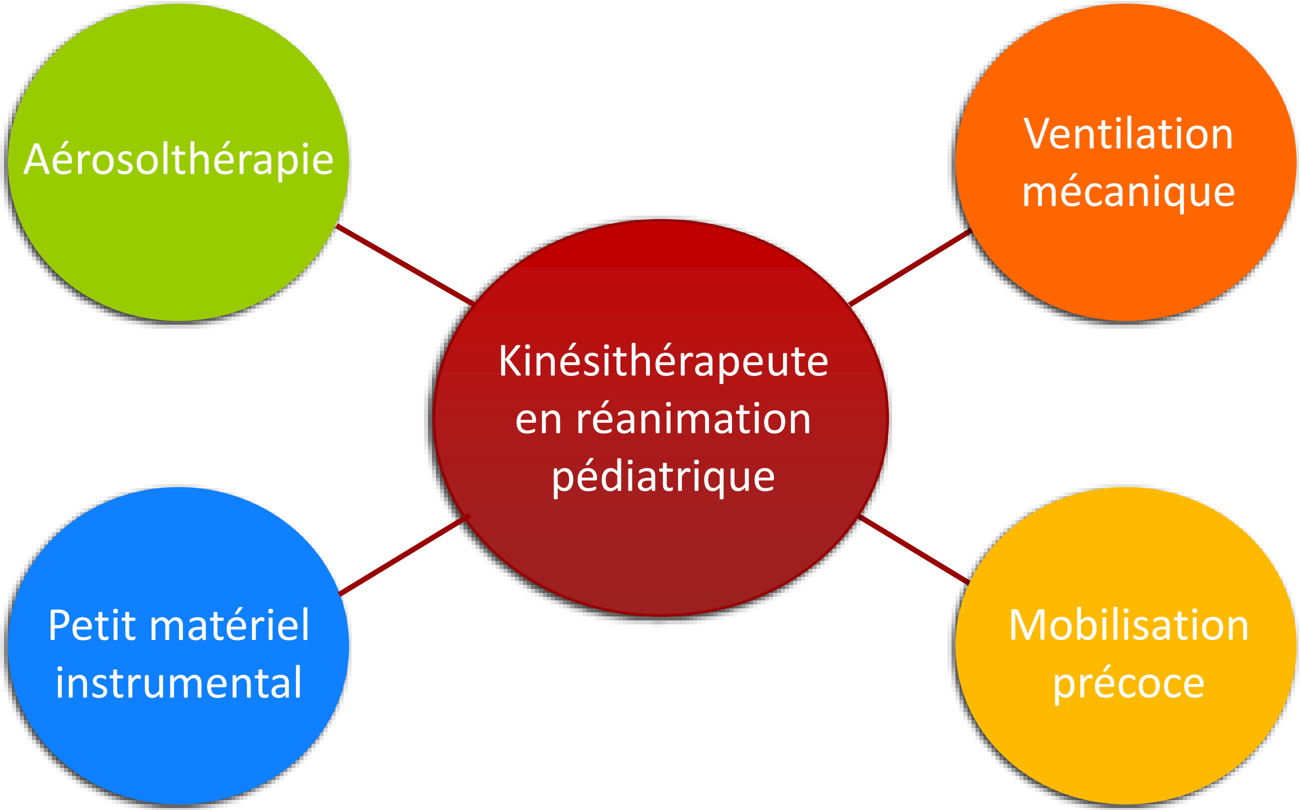
Orateur : Damien MOERMAN, Bruxelles

Aucun lien d’intérêt potentiel à déclarer

Salut l'artiste


Aérosolthérapie
Ventilation mécanique
Kinésithérapeute en réanimation pédiatrique
Petit matériel instrumental
Mobilisation précoce

L’aérosolthérapie en pédiatrie

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Aerosol Delivery to Ventilated Infant and Pediatric Patients

James B Fink MSc RRT FAARC

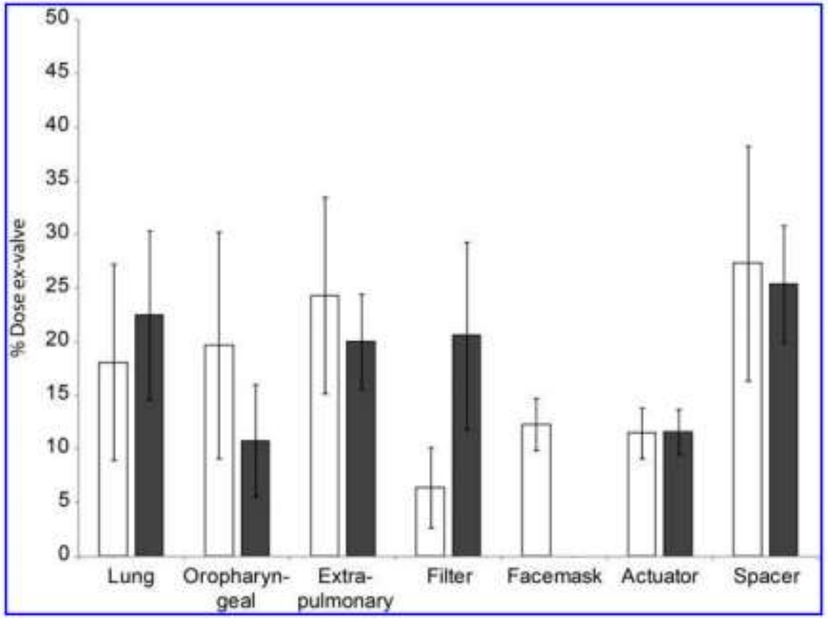
Aerosol Deposition Studies With Nonintubated Children

Researchers	No. of Patients	Type of Patients	Aerosol Device	Deposition (%)
Salmon et al[3]	9	Infants	Nebulizer vs MDI with spacer	0.3–1.5
Chua et al[4]	12	Infants (≤ 8 mo)	Nebulizer	0.3–1.6
Chua et al[4]	8	Children (≤ 10 y)	Nebulizer	1.6–4.4
Mallol et al[5]	20	Infants	Nebulizer	0.76–2.0
Amirov et al[6,7]	26	Infants	Nebulizer	1.5–2.6
Tal et al[8]	15	Children (≤ 21 mo)	MDI with spacer	1.97
Wildhaber et al[9]	17	Children (2–9 y)	Nebulizer vs MDI with spacer	5.4–11.1

MDI = metered-dose inhaler

Lung Deposition of ^{99m}Tc-Radiolabeled Albuterol Delivered through a Pressurized Metered Dose Inhaler and Spacer with Facemask or Mouthpiece in Children with Asthma

William Ditcham, PhD,[1] Jasminka Murdzoska, PhD,[1] Guicheng Zhang, PhD,[2] Christina Roller, PhD,[1] Dirk von Hollen, BSc,[3] Kurt Nikander, BA,[4] and Sunalene G Devadason, PhD[1]



Percent of total dose deposition; mean dose deposited throughout system. Facemask (□) and mouthpiece (■). Error bars represent standard deviation.

High-Percentage Lung Delivery in Children From Detergent-Treated Spacers

Johannes H. Wildhaber, MD,* Hettie M. Janssens, MD, Frédéric Piérart, MD, Nigel D. Dore, FRACP, Sunalene G. Devadason, PhD, and Peter N. LeSouëf, MD

	Group A	Group B	Group C
Actuator	12.3% (5.2)	12.4% (4.3)	8.5% (2.7)
Spacer	36.9% (2.6)	42.4% (10.3)	32.9% (2.7)
Filter	8.7% (3.9)	0.2% (0.1)	0.3% (0.2)
Mask	4.7% (2.8)		
Gastrointestinal deposition	20.9% (5.1)	16.8% (3.7)	16.5% (3.0)
Lung deposition	16.4% (5.5)	28.2% (6.7)	41.8% (3.8)

< 48 months | 48 - 96 months | > 96 months

Babyhaler + mask | Volumatic + embout buccal

Aerosol Deposition in Neonatal Ventilation

JEAN C. DUBUS, LAURENT VECELLIO, MICHELE DE MONTE, JAMES B. FINK, DANIEL GRIMBERT, JEROME MONTHARU, CHANTAL VALAT, NEIL BEHAN, AND PATRICE DIOT

INSERM U618 [J.C.D., L.V., M.d.M., D.G., J.M., C.V., P.D.], 37044, Tours, France; Department of Pediatrics [J.C.D.], Timone-Enfants Hospital, 13385, Marseille, France; and Aerogen, Inc. [J.B.F., N.B.], Mountain View, California 94043

Deposition of 99mTc-DTPA using APN-S, APN-C, and the MistyNeb in a macaque model of neonatal ventilation

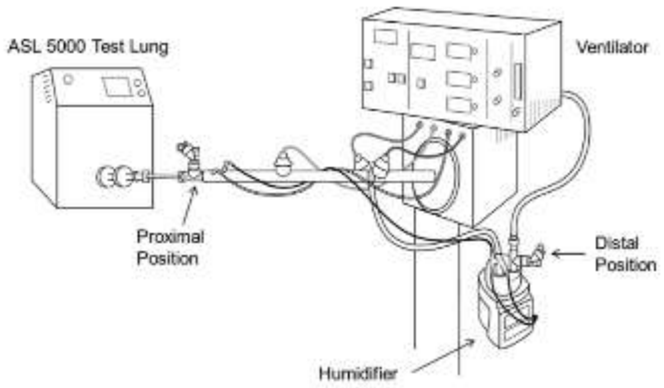
	APN-S	APN-C	MistyNeb
Nebulizer	2.7 (1.8–3.7)*	9.9 (8.7–11.3)*	22.4 (19.7–23.7)*
T-piece	0.9 (0.7–2.0)*	9.8 (2.3–15.9)*	6.5 (2.1–10.0)*
	0.9 (0.7–2.1)†	9.8 (2.6–18)†	8.4 (2.0–12.5)†
Inspiratory limb	8.2 (0.5–9.5)*	8.4 (0.7–17.3)*	7.9 (3.7–11.3)*
	8.4 (0.6–9.8)†	9.3 (0.8–19.0)†	10.2 (3.6–14.1)†
Y-piece	3.3 (1.9–5.7)*	10.5 (5.6–17.1)*	3.5 (0.0–6.9)*
	3.4 (2.0–5.9)†	11.6 (6.3–19.3)†	4.4 (0.0–6.7)†
ETT	9.0 (3.1–9.8)*	4.4 (2.1–6.8)*	1.0 (0.5–2.1)*
	9.3 (3.1–14.0)†	4.8 (2.4–7.7)†	1.3 (0.5–2.8)
Lungs	14.0 (12.2–23.7)*	12.6 (9.6–20.6)*	0.5 (0.4–1.3)*
Expiratory limb	3.0 (1.4–4.2)*	3.3 (2.7–4.8)*	1.6 (0.6–2.3)*
	3.1 (1.4–4.3)†	3.7 (3.1–5.2)†	1.9 (0.7–2.6)†
Expiratory filter	20.1 (19.0–22.3)*	9.5 (7.7–11.1)*	10.6 (8.2–12.7)*
	20.6 (19.7–22.8)†	10.5 (8.5–12.4)†	12.0 (10.2–16.4)†

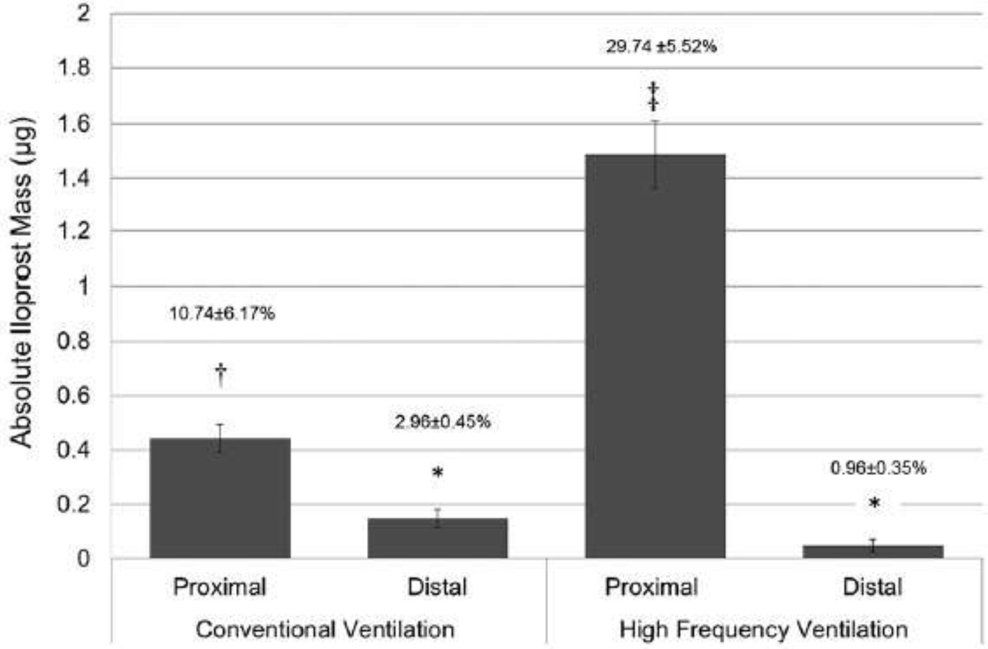
Results are expressed in percentage of the nebulizer charge (median and range)* and in percentage of the aerosol nebulized (median and range)† in the case of the circuit components.

Iloprost drug delivery during infant conventional and high-frequency oscillatory ventilation

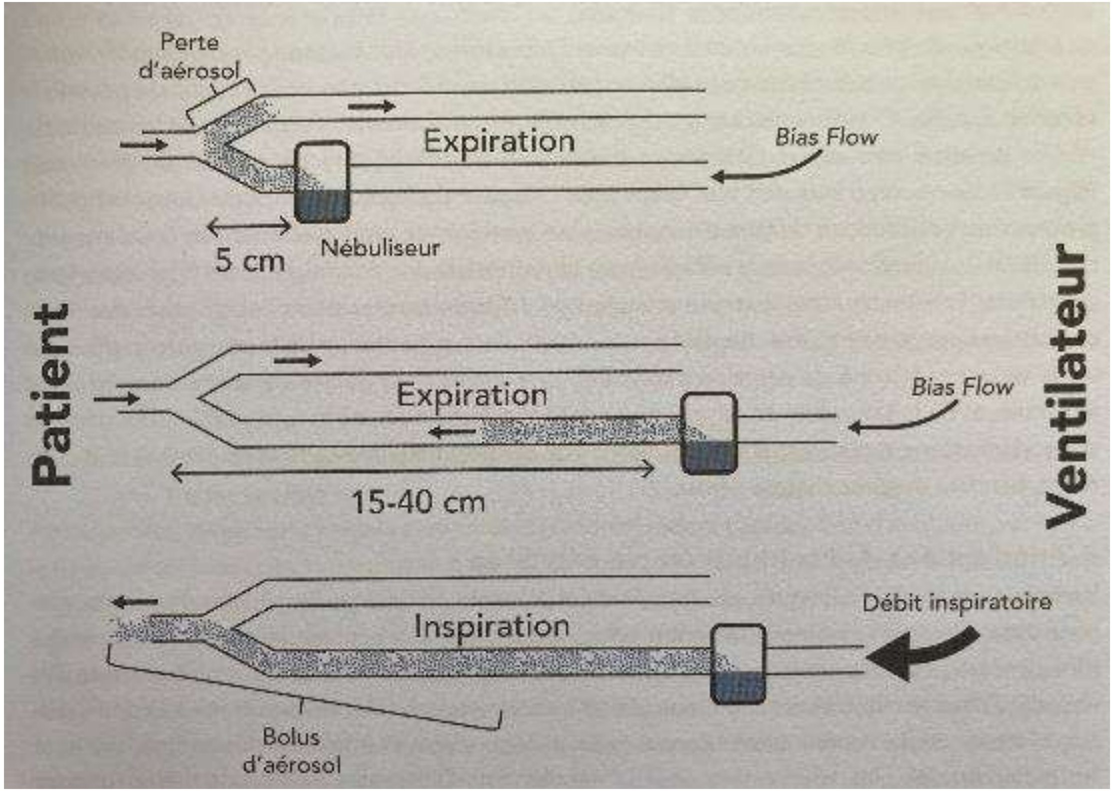
Robert M. DiBlasi,[1,2] Dave N. Crotwell,[1] Shuijie Shen,[2] Jiang Zheng,[2] James B. Fink,[3] Delphine Yung[4]

[1]Respiratory Therapy Department, Seattle Children's Hospital, Seattle, Washington, USA; [2]Seattle Children's Hospital Research Institute, Seattle, Washington, USA; [3]James B. Fink, LLC, San Mateo, California, USA; [4]Department of Cardiology, Seattle Children's Hospital, Seattle, Washington, USA





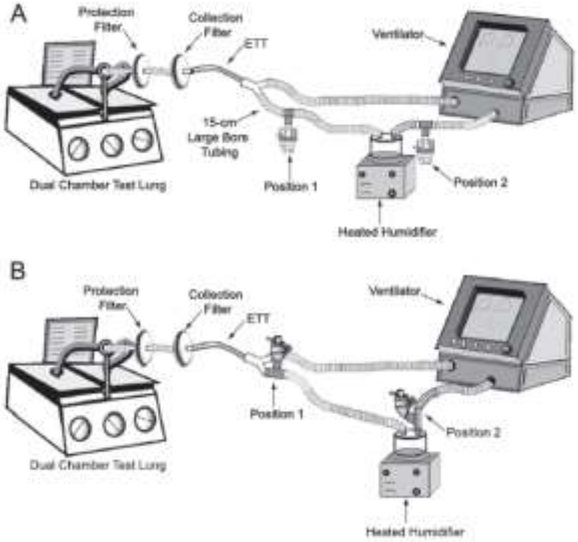
Ventilation mécanique invasive : *Position proximale du nébuliseur*



D'après GAT de la SPLF, 2019

Influence of Nebulizer Type, Position, and Bias Flow on Aerosol Drug Delivery in Simulated Pediatric and Adult Lung Models During Mechanical Ventilation

Arzu Ari PhD RRT PT CPFT, Orcin Telli Atalay PhD PT, Robert Harwood MSA RRT, Meryl M Sheard MSc RRT, Essam A Aljamhan MSc RRT, and James B Fink PhD RRT FAARC



Albuterol Sulfate Deposited Distal to the Endotracheal Tube

	Percent of Nominal or Emitted Dose (mean ± SD %)							
	Adult Lung Model				Pediatric Lung Model			
	Position 1		Position 2		Position 1		Position 2	
	Bias flow 2 L/min	Bias flow 5 L/min	Bias flow 2 L/min	Bias flow 5 L/min	Bias flow 2 L/min	Bias flow 5 L/min	Bias flow 2 L/min	Bias flow 5 L/min
Jet nebulizer	4.7 ± 0.1*	4.0 ± 0.1*	5.2 ± 0.2*	4.7 ± 0.4*	4.2 ± 0.2*	3.8 ± 0.3*	5.2 ± 0.3*	4.1 ± 0.4*
Vibrating-mesh nebulizer	13.4 ± 1.1	9.7 ± 0.6	23.8 ± 1.0	21.4 ± 0.4	11.4 ± 0.7	8.4 ± 0.2	13.6 ± 1.3	10.6 ± 0.3

* Significant difference between jet nebulizer and vibrating-mesh nebulizer (p < .05).

La ventilation mécanique en pédiatrie

D. Moerman – Réanimation 2021

Intensive Care Med (2017) 43:1764–1780
DOI 10.1007/s00134-017-4920-z

espnic
European Society of Paediatric and Neonatal Intensive Care

CONFERENCE REPORTS AND EXPERT PANEL

CrossMark

Recommendations for mechanical ventilation of critically ill children from the Paediatric Mechanical Ventilation Consensus Conference (PEMVECC)

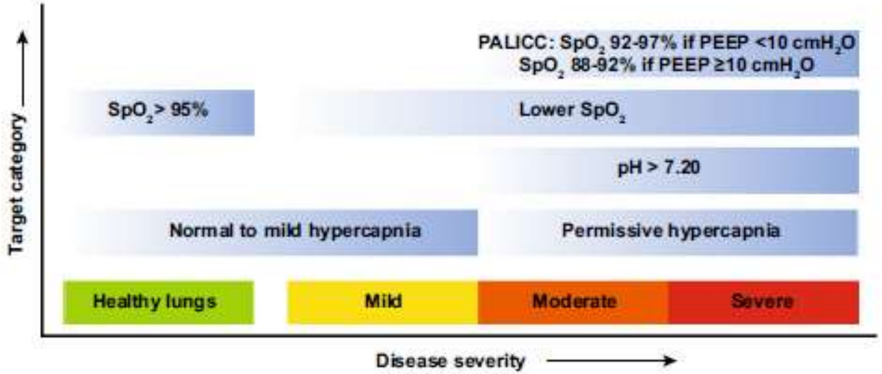
Martin C. J. Kneyber[1,2*], Daniele de Luca[3,4], Edoardo Calderini[5], Pierre-Henri Jarreau[6], Etienne Javouhey[7,8], Jesus Lopez-Herce[9,10], Jürg Hammer[11], Duncan Macrae[12], Dick G. Markhorst[13], Alberto Medina[14], Marti Pons-Odena[15,16], Fabrizio Racca[17], Gerhard Wolf[18], Paolo Biban[19], Joe Brierley[20], Peter C. Rimensberger[21] and on behalf of the section Respiratory Failure of the European Society for Paediatric and Neonatal Intensive Care

Invasive ventilation	
Mode	No recommendation
High-frequency oscillatory ventilation	Consider when conventional ventilation fails May be used in cardiac patients
High-frequency jet/percussive ventilation	No recommendation Do not use high-frequency jet ventilation in obstructive airway disease
Liquid ventilation	Do not use
Extra-corporeal life support	Consider in reversible disease if conventional ventilation and/or HFOV fails
Triggering	Target patient-ventilator synchrony
Inspiratory time/I:E ratio	Set inspiratory time by respiratory system mechanics and underlying disease (use time constant and observe flow-time scalar). Use higher rates in restrictive disease
Maintaining spontaneous breathing	No recommendation
Plateau pressure	Keep ≤28 or ≤29–32 cmH_2O with increased chest wall elastance, ≤30 cmH_2O in obstructive airway disease
Delta pressure	Keep ≤10 cmH_2O for healthy lungs, unknown for any disease condition
Tidal volume	Keep ≤10 mL/kg ideal bodyweight, maybe lower in lung hypoplasia syndromes
PEEP	5–8 cmH_2O, higher PEEP necessary dictated by underlying disease severity (also in cardiac patients) Use PEEP titration, consider lung recruitment (also in cardiac patients) Add PEEP in obstructive airway disease when there is air-trapping and to facilitate triggering Use PEEP to stent upper airways in case of malacia

PEMVECC, 2017

Monitoring	
Ventilation	Measure PCO_2 in arterial or capillary blood samples Consider transcutaneous CO_2 monitoring Measure end-tidal CO_2 in all ventilated children
Oxygenation	Measure SpO_2 in all ventilated children Measure arterial PO_2 in moderate-to-severe disease Measure pH, lactate and central venous saturation in moderate-to-severe disease Measure central venous saturation as marker for cardiac output
Tidal volume	Measure near Y-piece of patient circuit in children <10 kg
Lung mechanics	Measure peak inspiratory pressure and/or plateau pressure, mean airway pressure, positive end-expiratory pressure. Consider measuring transpulmonary pressure, (dynamic) compliance, intrinsic PEEP Monitor pressure–time and flow-time scalar
Lung ultrasound	Consider in appropriately trained hands
Targets	
Oxygenation	$SpO_2 \geq 95\%$ when breathing room air for healthy lungs No threshold for any disease condition or cardiac patients, but keep $SpO_2 \leq 97\%$ For PARDS: SpO_2 92–97% when PEEP < 10cmH_2O and 88–92% when PEEP ≥10 cmH_2O
Ventilation	PCO_2 35–45 mmHg for healthy lungs Higher PCO_2 accepted for acute (non-)pulmonary patients unless specific diseases dictate otherwise Target pH >7.20 Target normal pH for patients with pulmonary hypertension
Weaning and extubation readiness	
Weaning	Start weaning as soon as possible Perform daily extubation readiness testing
Non-invasive ventilation after extubation	Consider non-invasive ventilation in neuromuscular patients
Corticosteroids	Use in patients at increased risk for post-extubation stridor

PEMVECC, 2017



Graphical simplification of the recommendations on "targets of oxygenation and ventilation" in the context of healthy lungs, obstructive airway, restrictive and mixed disease. It is also applicable for cardiac patients, patients with congenital of chronic disease and patients with lung hypoplasia syndromes. The *colour gradient* denotes increasing applicability of a specific consideration with increasing disease severity. *Absence of the colour gradient* indicates that there is no relationship with disease severity. The *question mark* associated with specific interventions highlights the uncertainties because of the lack of paediatric data. PALICC pediatric acute lung injury consensus conference

PEMVECC, 2017

Supportive measures	
Humidification	Use humidification
Endotracheal suctioning	Do not perform routinely, only on indication. No routine instillation of isotonic saline prior to suctioning
Chest physiotherapy	Do not use routinely Consider using cough-assist devices in neuromuscular patients
Positioning	Maintain head of bed elevated 30–45°
Endotracheal tube and patient circuit	Use cuffed endotracheal tube, keep cuff pressure ≤20 cmH_2O Minimise dead space by added components Use double-limb circuits for invasive ventilation Do not use home ventilators during the acute phase in the intensive care unit
Miscellanenous	
Hand-ventilation	Avoid hand ventilation unless specific conditions dictate otherwise

PEMVECC, 2017

Petit matériel instrumental

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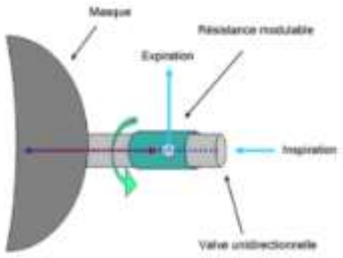
PEP masque

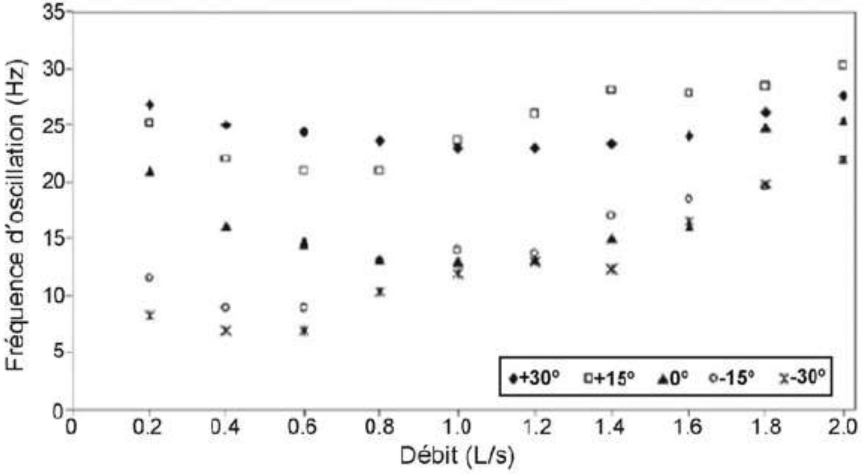


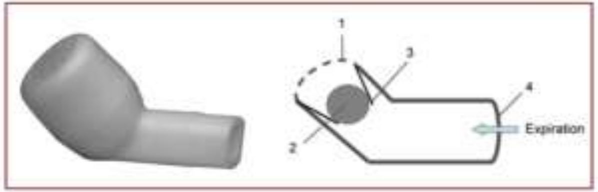
D'après Reychler, 2012

- Buts :
  - Diminution de la compression dynamique des VA
  - Amélioration de la ventilation collatérale
- Efficacité similaire entre PEP masque vs CPT en termes de mucus expectoré, maintien de la fonction pulmonaire et confort chez les patients CF *(McIlwaine et al., 2015)*
- Préférence des PEP systèmes par les patients CF *(McIlwaine et al., 2015)*
- Effet bénéfice d'un PEP masque sur la fonction pulmonaire en comparaison au DP – Vibrations chez l'enfant *(McIlwaine et al., 1997)*

Flutter

- Buts :
  - Amélioration des propriétés rhéologiques des sécrétions

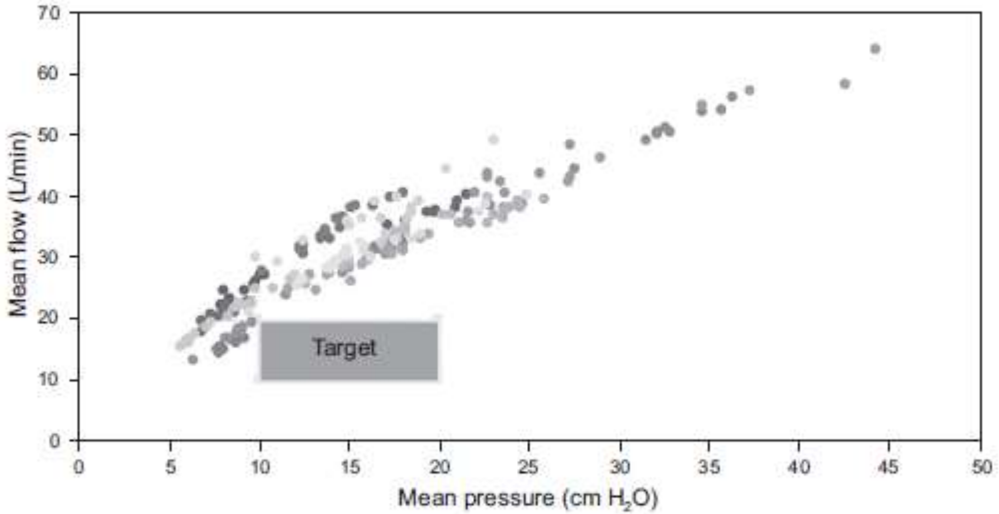




D'après Reychler, 2012

Oscillating Positive Expiratory Pressure Therapy May Be Performed Poorly by Children With Cystic Fibrosis

Kevin J O'Sullivan, Louise Collins, Deirdre McGrath, Barry Linnane, Leonard O'Sullivan, and Colum P Dunne



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Diminution du nbre oscillations entre expirations courtes vs longues

Pediatric Cystic Fibrosis Cohort

Participant no.	Age at Test (y)	Sex	FEV_1 Predicted (%)	Peak Pressure (cm H_2O)	Mean Pressure (cm H_2O)	Peak Flow (L/min)	Mean Flow (L/min)	Mean Breath Length (s)	Mean Oscillations (Hz)	Mean Inter-Breath Delay (s)	Mean I:E	Total Oscillation During Therapy	Total Expiratory Time (s)
1	8	F	83	21.74	8.96	61.17	24.54	2.65	9.8	2.17	1:1.23	261	26.54
2	11	M	96	45.49	19.63	97.86	37.07	1.86	18.0	1.49	1:1.25	335	18.62
3	11	F	75	20.90	7.82	59.15	20.55	3.68	10.4	3.12	1:1.18	383	36.82
4	8	M	47	69.40	14.88	142.58	35.03	2.00	13.8	0.83	1:2.42	275	20.02
5	16	M	110	26.73	13.54	74.72	34.19	4.97	14.2	2.90	1:1.71	704	49.70
6	14	F	60	20.25	8.35	47.22	15.67	5.78	13.1	2.52	1:2.30	679	52.00
7	17	M	46	28.28	17.25	70.30	31.43	2.25	18.4	1.32	1:1.71	414	22.51
8	13	M	89	68.29	31.88	129.71	49.58	1.69	21.1	1.66	1:1.02	356	16.90
9	6	M	99	21.74	8.88	56.68	18.07	4.82	13.1	7.89	1:0.61	562	43.35
10	6	F	83	67.50	21.31	131.63	38.63	1.11	15.1	2.00	1:0.56	164	11.12
11	5	M	94	77.23*	31.08	168.96	47.35	0.91	18.6	2.18	1:0.41	159	9.05
12	8	M	71	62.19	15.97	125.30	29.87	1.63	14.9	1.46	1:1.11	240	16.30
13	6	M	78	54.32	17.68	101.67	31.12	0.95	16.3	0.83	1:1.15	154	9.51
14	9	M	85	77.14*	24.02	142.00	37.35	2.20	17.7	1.21	1:1.82	389	21.97
15	7	F	100	68.02	17.75	129.52	33.32	1.49	15.6	1.39	1:1.07	230	14.85
16	10	M	94	22.76	9.45	62.23	22.77	4.17	12.4	2.91	1:1.43	516	41.66
17	11	F	92	18.09	6.53	47.13	17.25	2.58	10.4	1.78	1:1.44	265	25.76
18	7	F	83	77.25*	17.09	154.37	34.29	3.19	13.8	8.76	1:0.36	437	31.90
19	8	F	117	77.21*	15.71	169.73	37.07	1.70	14.6	1.64	1:1.04	242	17.01
20	8	F	99	60.60	18.14	118.57	32.77	1.62	15.7	1.61	1:1.00	252	16.16
21	9	F	60	60.15	14.12	119.34	28.99	1.97	12.8	1.75	1:1.13	252	19.73

Mean values are averages across each participant's total number of expirations.
* Denotes that the generated pressure exceeded the pressure sensor limit.
I:E = inspiration-expiration ratio

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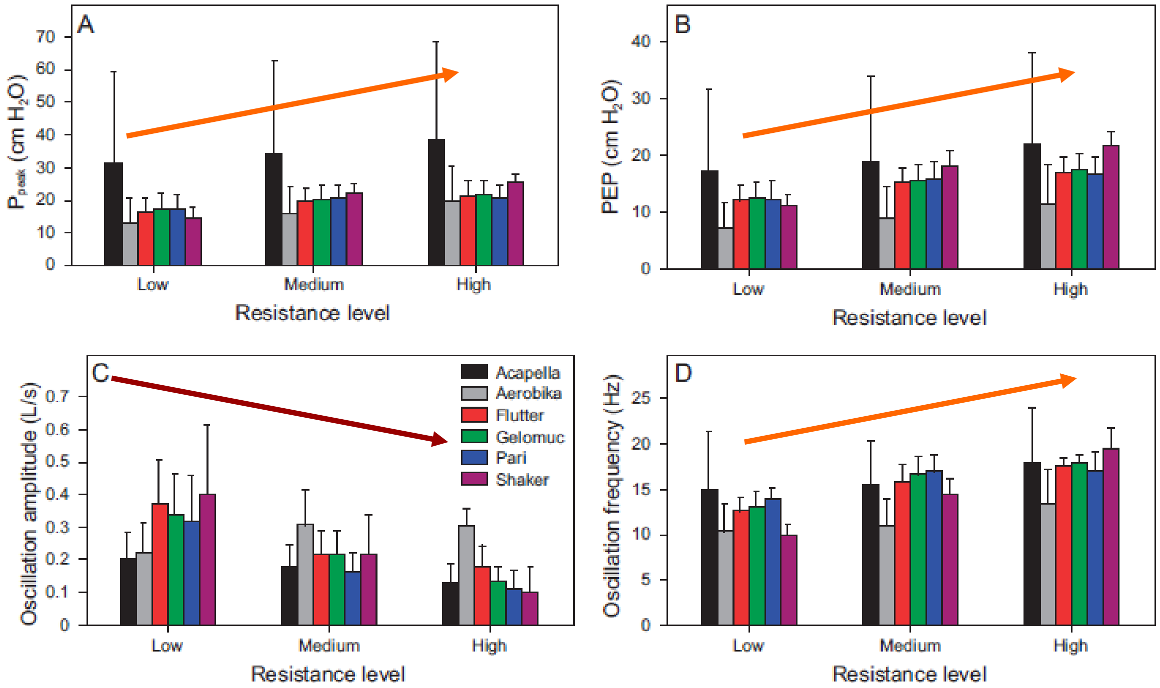
Comparison of 6 Oscillatory Positive Expiratory Pressure Devices During Active Expiratory Flow

William Poncin, Grégory Reychler, Massimo Liistro, and Giuseppe Liistro



PEP
10 – 20 cmH_2O

Fr Oscillation
> 12 Hz

Durée
4 s
1:3/1:4

Répétition
10 à 20 fois

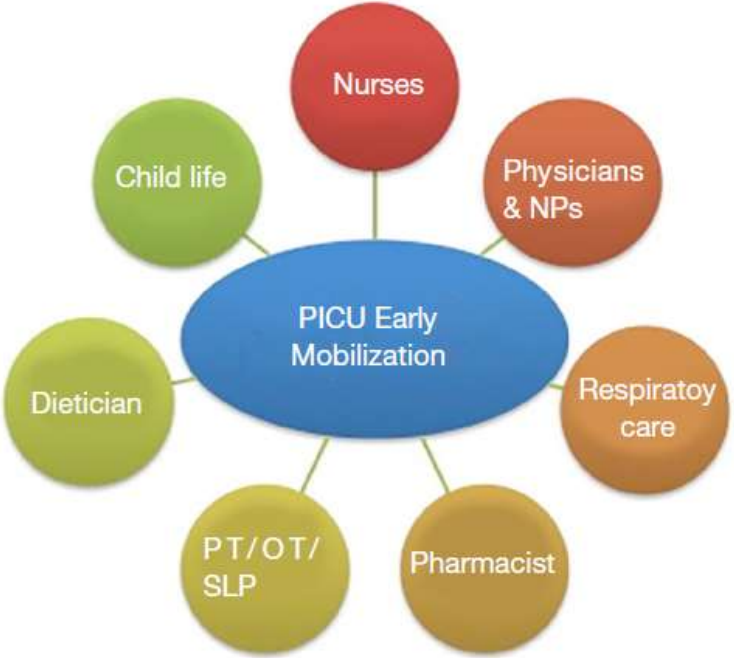
Prix onéreux !!!!

La mobilisation précoce

D. Moerman – Réanimation 2021

A	**Assess, Prevent and Manage Pain** Understand pain and find tools for its assessment, treatment, and prevention
B	**Both SAT & SBT** Using both spontaneous awakening trials and spontaneous breathing trials can lead to earlier extubation.
C	**Choice of Analgesia & Sedation** Understand the importance of defining the depth of sedation and choosing the right medication.
D	**Delirium: Assess, prevent, manage** Understand delirium risk factors and find tools for its assessment, treatment, and prevention.
E	**Early Mobility & Exercise** ICU early mobility involves more than changing the patient's position.
F	**Family Engagement & Empowerment** Involving the family in patient care can help recovery.

ICU Liberation Bundle, PADIS Guideline, d'après Society of Critical Care Medicine, 2018



D'après Walker, 2018

La mobilisation précoce en réanimation pédiatrique

Early Mobilization in the Pediatric Intensive Care Unit

D. Moerman · L. Houtekie

Indications

Mobilisation du nourrisson

- Différente de celle de l'adulte
  - Pédalage des MI
  - Flexion dorsale des chevilles (genou fléchi)
  - Mouvements de circumduction des épaules
- Traitement du torticolis postural
- Postures
  - MS dans la ligne médiane
  - Pieds en position neutre (*taping* ou chaussures)
- Relax ou siège moulé
- Travail de l'équilibre assis et/ou debout dès acquisition
- Travail de la marche dès acquisition
- Table de verticalisation (rare)

Mobilisation de l'enfant

- Semblable à celle de l'adulte
- Postures des pieds en position neutre (coussins de positionnement ou chaussures)
- Cycloergomètre
- Utilisation de la Wii
- Fauteuil ou siège moulé
- Travail de l'équilibre assis et/ou debout
- Travail de la marche
- Table de verticalisation

Contre-indication

- Pas d'électrostimulation chez le nourrisson (fragilité cutanée)

PICU Up!: Impact of a Quality Improvement Intervention to Promote Early Mobilization in Critically Ill Children

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Hallie Lenker, PT, DPT, STAR/C; Caroline Potter, MS, CCLS, CIMI; Nehal J. Shata, MBBS;
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Early Mobilization Activities: First 3 Days of PICU Admission

Activity (No. of Children Participating in That Activity)	Preimplementation $n = 100$	Postimplementation $n = 100$	p[a]
In-bed activities, *n*			
Passive range of motion	13	17	0.43
Passive bed positioning	41	47	0.39
Splinting	3	9	0.08
Active range of motion	2 (2)	2 (1)	0.99
Active bed positioning	26	57	< 0.001[b]
At least one bed activity	70	98	< 0.001[b]
Mobility activities, *n*			
Sit edge of bed	6	11	0.20
Sit to stand	24	30	0.34
Transfer	48	46	0.77
Ambulate	15	27	0.04[b]
Play	6	3	0.78
Other	5	3	0.31
At least one mobility activity	63	76	0.05[b]

[a]Descriptive, Fisher exact, and chi-square tests used for analysis, as appropriate.
[b]Statistically significant.







D. Moerman – Réanimation 2021

Benefits of Early Mobilization After Pediatric Liver Transplantation

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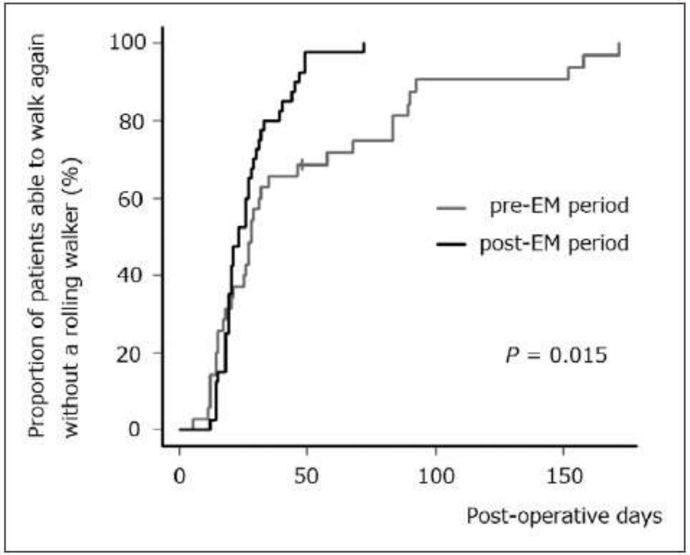
Satoshi Nakagawa, MD[1]; Mureo Kasahara, MD, PhD[2]; Takeshi Kamikubo, MD, PhD[3]

- Marche 50 m sans walker
  (28 j vs 23 j post-op ; p = .015)
- Diminution de la durée d'hospitalisation
  (55 j vs 40 j post-op ; p = .012)



Cumulative frequency of patients regaining the ability to walk again without a rolling walker. EM = early mobilization.

Take home messages

- Nébuliseur à tamis > nébuliseur pneumatique
  - A 10 – 15 cm de la pièce en Y
  - Sur la pièce en Y avec HFVO
  - A l'entrée de l'humidificateur si Vt > 100 mL ?
- Recommandations VM en pédiatrie selon PEMVECC (ESPNIC)
- OPEP therapy
  - Acapella, Aerobika
  - PEP entre 10-20 cmH_20, durée 4 s, répétition 10 à 20 fois
- Faisabilité et sécurité d'une MP chez l'enfant de 6 ans
  - Bénéfices restent à déterminer