Actualités dans les cardiopathies congénitales
PEC kiné aiguë

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Aucun lien d'intérêt potentiel à déclarer

Introduction

- Incidence : 1,5% à la naissance
- Prise en charge : majoritairement < 1 an
- Complications après chirurgie cardiaque pédiatrique (CCP)
  - Œdème laryngé post-extubation (stridor)
  - Encombrement bronchique, atélectasies, pneumonie
  - Œdème pulmonaire
  - Epanchement pleural, chylothorax
  - Paralysie diaphragmatique
- Incidence des atélectasies chez les enfants en VM invasive : 5 à 17% *(Principi, 2011)*
- Taux de ré-intubation jusque 20 % après CCP *(Fernandez Lafever, 2016)*

ELSEVIER

Physiotherapy

Physiotherapy 104 (2018) 251–263

Systematic review

Peri-operative chest physiotherapy for paediatric cardiac patients: a systematic review and meta-analysis

CrossMark

A. Beningfield*, A. Jones

Discipline of Physiotherapy, College of Healthcare Sciences, James Cook University, Townsville, Australia

Kinésithérapie respiratoire

La distinction entre 2 mondes

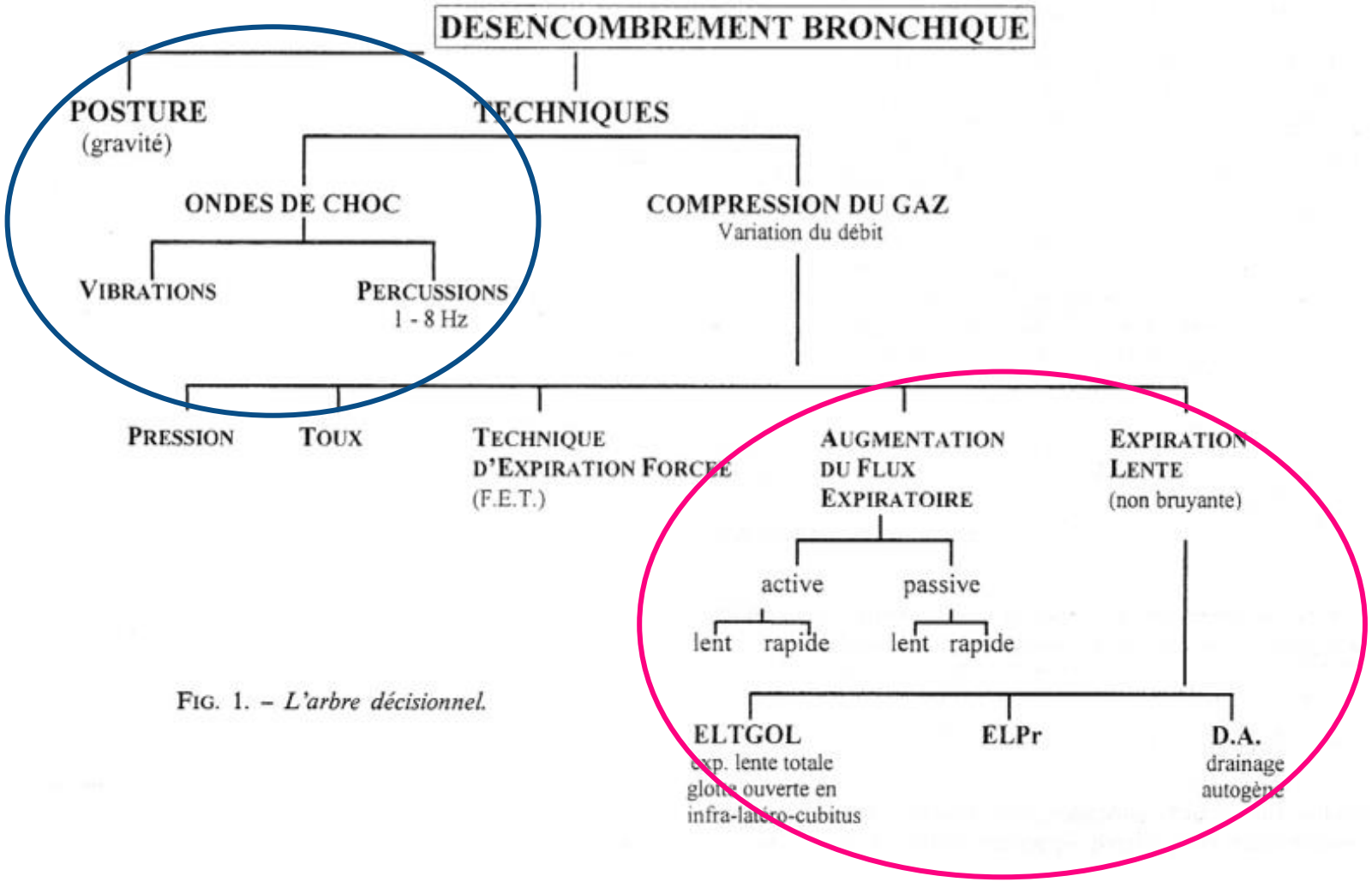
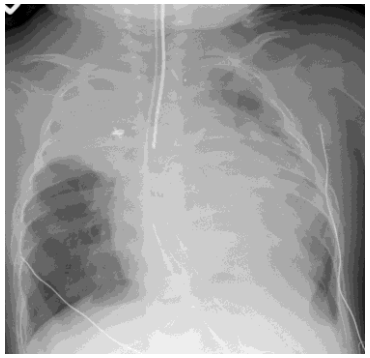


FIG. 1. – *L'arbre décisionnel.*

Chest Physiotherapy Fails to Prevent Postoperative Atelectasis in Children After Cardiac Surgery



	CPT*	NCPT†	Significance
Open heart	13	17	NS
Tetralogy of Fallot	3	3	
Transposition of great arteries	1	1	
Atrioventricular canal	2	1	
Ventricular septal defect	4	4	
Atrial septal defect	1	5	
Aortic stenosis	2	1	
Complex malformations	0	2	
Closed heart	6	8	NS
Coarctation of aorta	3	1	
Patent ductus arteriosus	2	4	
Pulmonic stenosis	1	3	

* CPT: chest physiotherapy.
† NCPT: no chest physiotherapy.

	CPT	NCPT	Significance
Age (months)	48 ± 12	46 ± 7	NS
No. patients developing atelectasis	13/19 (68.4%)	8/25 (32%)	p < 0.01
Highest postop grade	3,2 ± 0,2	2,8 ± 0,2	p < 0.01
Highest postop-preop grade	2,1 ± 0,2	1,5 ± 0,2	p < 0.01

D'après Reines et al, 1982

Chest physiotherapy following paediatric cardiac surgery: The influence of mode of treatment on oxygen saturation and haemodynamic stability

Cliniques universitaires SAINT-LUC UCLouvain BRUXELLES

Age médian : 11 mois (5 jours – 47 mois)

Operative procedures performed

Procedure	Number of children
Atrioventricular septal defect repair	15
Tetralogy of Fallot repair	14
Ventricular septal defect repair	8
Arterial switch	5
Total anomalous pulmonary venous connection repair	4
Truncus arteriosus repair	4
Mitral valve repair	4
Total cavo pulmonary connection	3
Interrupted aortic arch repair	3
Double outlet right ventricle repair	3
Others	6
Total	69

Maximum median changes in oxygen saturation (SaO_2), mean (HR) during treatment (ranges in parentheses)

	SaO_2 (%)
1. Percussion	−2.8 (0.0 to −3.0)[b]
2. Vibrations	−2.0 (0.2 to −3.6)[a]
3. Percussion and vibrations	−3.5 (0.2 to −14.0)[b]
4. Percussion, vibrations and a change in position	−5.0 (1.0 to −12.0)[c]
5. Percussion, vibrations, a change in position and an increase in ventilator O_2	−2.1 (0.2 to −5.0)[b]
6. Percussion, vibrations, a change in position and 'bag squeezing'	−1.2 (−0.6 to −13.0)[b]
7. Vibrations, a change in position and 'bag squeezing'	−1.1 (−1.0 to 4.0)[a]
8. Vibrations and 'bag squeezing'	−1.0 (−3.0 to 7.2)[a]

[a]$P<0.05$; [b]$P<0.01$; [c]$P<0.001$.

D'après Hussey et al, 1996

Preoperative physiotherapy in prevention of pulmonary complications in pediatric cardiac surgery

G1 au moins 2 sessions de KR avant chirurgie
- Techniques de désencombrement et de ré-expansion
- Support abdominal
- Education

G1 and G2 après chirurgie
- CPT, Hyperinflation manuelle, Toux, Mobilisation, Exercices respiratoires et des membres

Table 1. Sample characteristics

	G1 n=68	G2 n=67	*P*
Age (Md; 1º e 3ºq) in months	4; 1 e 16	6; 0.7 e 28	0.867
Gender (n; %)			
Male	36 (52.9)	37 (55.2)	0.790
Female	32 (47.1)	30 (44.8)	
Diagnosis (n; %)			
Acyanotic with shunts	40 (58.8)	30 (44.8)	0.426
Acyanotic without shunts	8 (11.8)	12 (17.9)	
Cyanotic	17 (25)	21 (31.3)	
Complex	3 (4.4)	4 (6)	
Type of surgery			
Palliative	6 (8.8)	9 (13.4)	0.357
Septoplasty	26 (38.2)	20 (29.8)	
Ligature of ductus arteriosus	10 (14.7)	6 (9)	
Coartectomy	4 (5.9)	8 (11.9)	
Jatene's surgery	3 (4.4)	5 (7.5)	
Total correction of Tetralogy of Fallot	5 (7.4)	6 (9)	
Glenn surgery	0	3 (4.5)	
Fontan surgery	1 (1.5)	2 (3)	
Others	13 (19.1)	8 (11.9)	

Table 2. Pulmonary Complications

	G1 n=68	G2 n=67	*P*
Pulmonary Complication (n; %)			
Yes	17 (25)	29 (43.3)	0.025*
No	51 (75)	38 (56.7)	
	G1 n=17	G2 n=29	*P*
Pulmonary Complication (n; %)			
Pneumonia	7 (10.3)	13 (19.4)	0.150
Atelectasis	6 (8.8)	8 (11.9)	
Pneumonia + atelectasis	4 (5.9)	8 (11.9)	

**Chi-square test with Yates's correction*

D'après Felcar et al, 2008

Manual vibrocompression and nasotracheal suctioning in post-operative period of infants with heart deffects

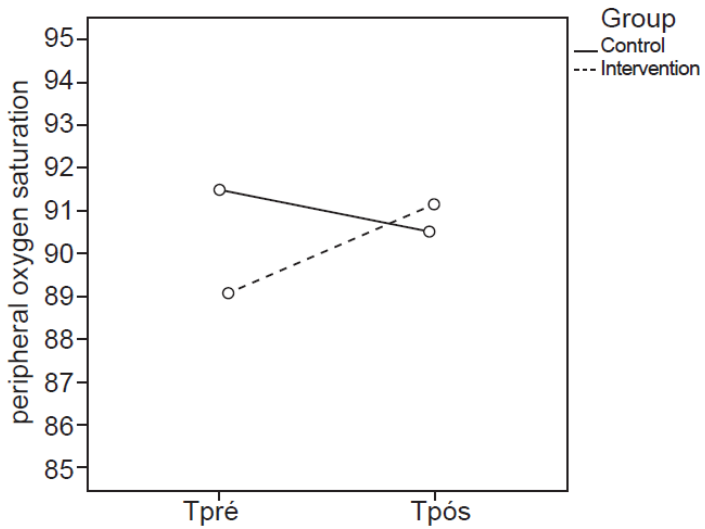
Table 1 - Demographic characteristics of the study patients

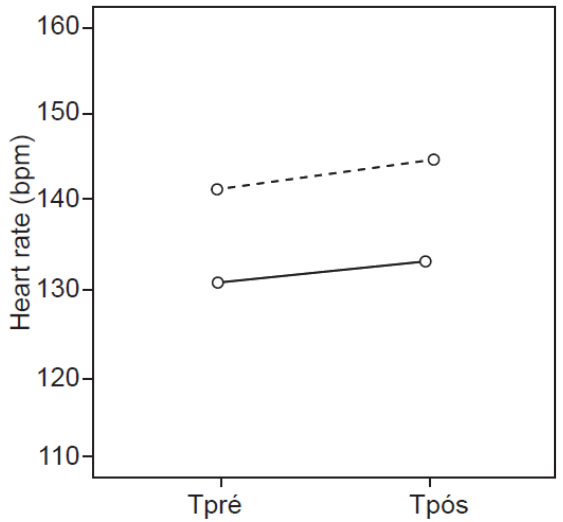
Variable	CG	IG	*p*-value
Post-extubation time (days – mean±SD)	2.10±1.60	2.40±2.50	0.967
Age (months – mean±SD)	4.60±3.72	4.90±4.28	0.790
Gender (Male/female)	5/5	6/4	0.655
Type of surgical incision (MS/LT)	8/2	8/2	1.00
Heart diseases (cyanotic/acyanotic)	3/7	3/7	1.00

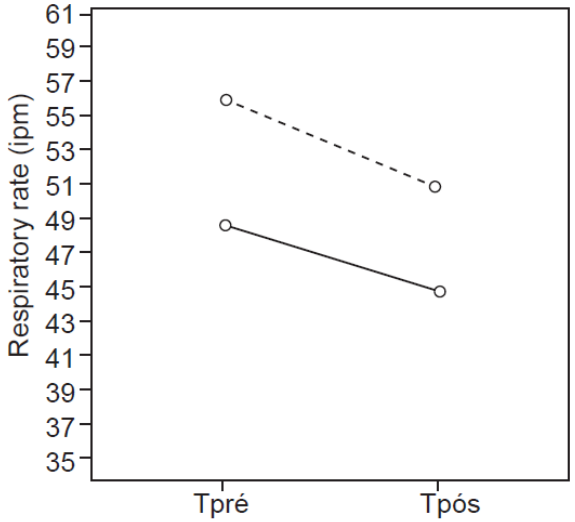
CG: Control Group; IG: Intervention Group; MS/LT: median sternotomy / lateral thoracotomy; SD: standard deviation

CG :
- 30 min de repos

IG :
- Compression et vibration (10 min)
- Aspiration endotrachéale
- Repos







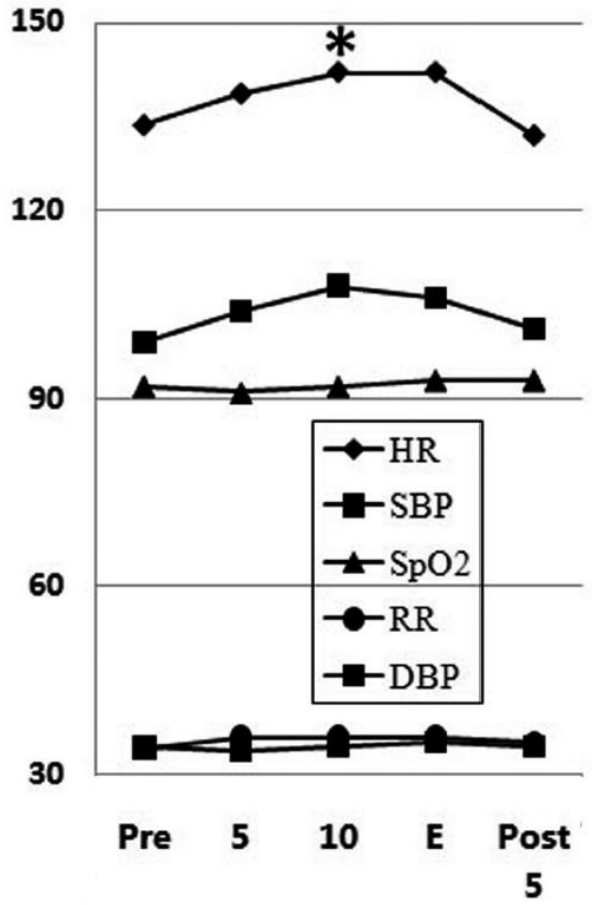
D'après de Assumpçao et al, 2013

Pain and cardiorespiratory responses of children during physiotherapy after heart surgery

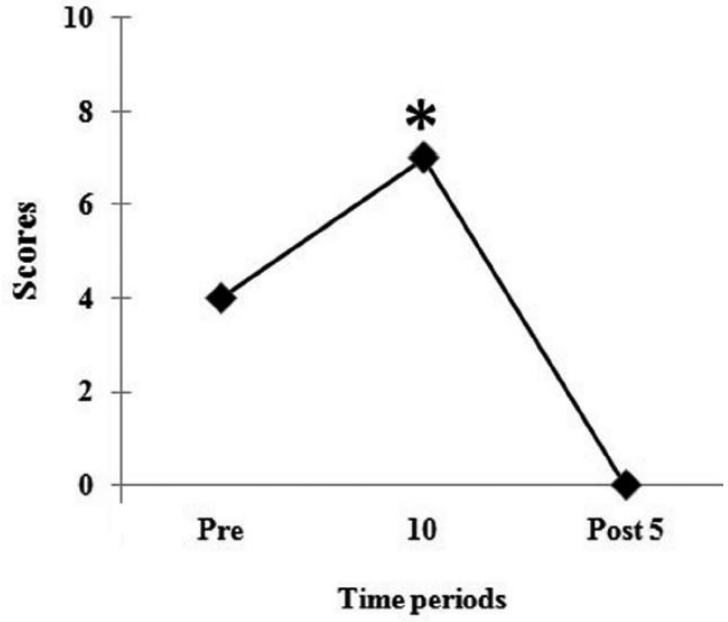
Table 1. Diagnosis of congenital heart diseases.

Diagnosis	n
Atrial septal defect (ASD)	1
Ventricular septal defect (VSD)	1
Patent ductus arteriosus (PDA)	5
ASD,VSD, PDA	1
VSD, PDA	4
Pulmonary atresia, ASD,VSD, PDA	1
Total atrioventricular canal	1
Aortic coarctation	1
Tricuspid atresia, right ventricular hypoplasia, ASD,VSD	2
Transposition of the great vessels, IAC	1
Total	18

- Vibration
- Augmentation du flux expiratoire
- Drainage autogène
- Toux dirigée
- Drainage postural

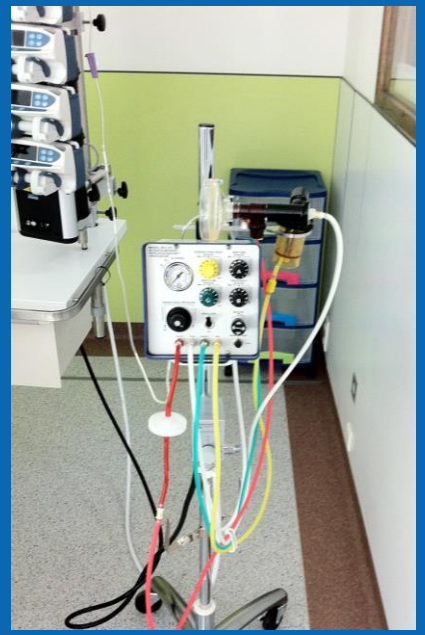


FLACC Scale



D'après Araujo et al, 2014

La ventilation à percussions intrapulmonaires



A comparison of intrapulmonary percussive ventilation and conventional chest physiotherapy for the treatment of atelectasis in the pediatric patient

Score	Description
0	Complete resolution of collapse
1	Partial collapse of 1 segment or lobe
2	Partial collapse of ≥ 2 segments or lobes
3	Complete collapse of 1 segment or lobe
4	Complete collapse of ≥ 2 segments or lobes

Patient	Atelectasis Score	
	Before*	After
CPT 1	2	2
CPT 2	2	2
CPT 3	2	2
CPT 4	1	4
CPT 5	3	3
CPT Mean	2.0	2.6
IPV 1	3	1
IPV 2	2	0
IPV 3	3	3
IPV 4	1	0
IPV 5	2	1
IPV 6	2	1
IPV 7	3	0
IPV Mean	2.3	*0.9

*p < .05

Durée de traitement : 6.2 J vs 2.1J, p < .05

D'après Deakins et al, 2002

Ventilation à percussions intrapulmonaires et ventilation non invasive : rapport de cas d'une enfant de 15 mois atteinte d'une cardiopathie congénitale hypoxémiante et présentant une atélectasie postopératoire

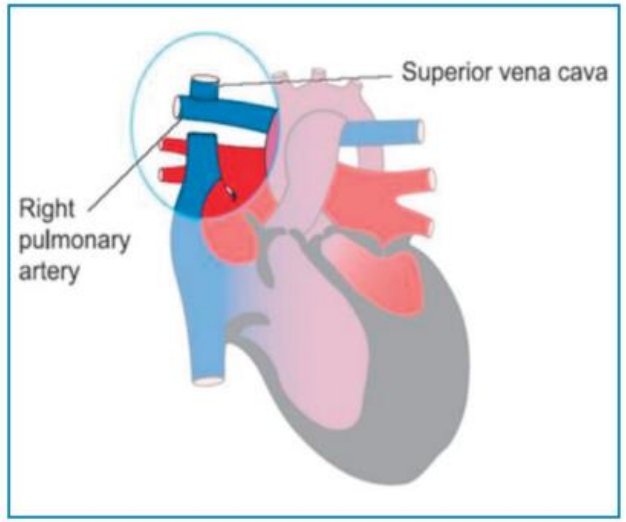
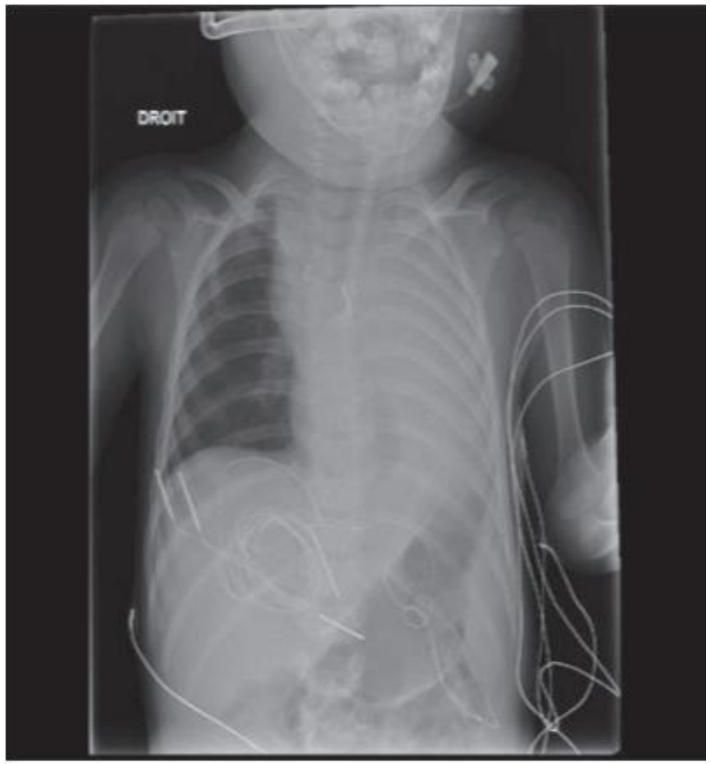
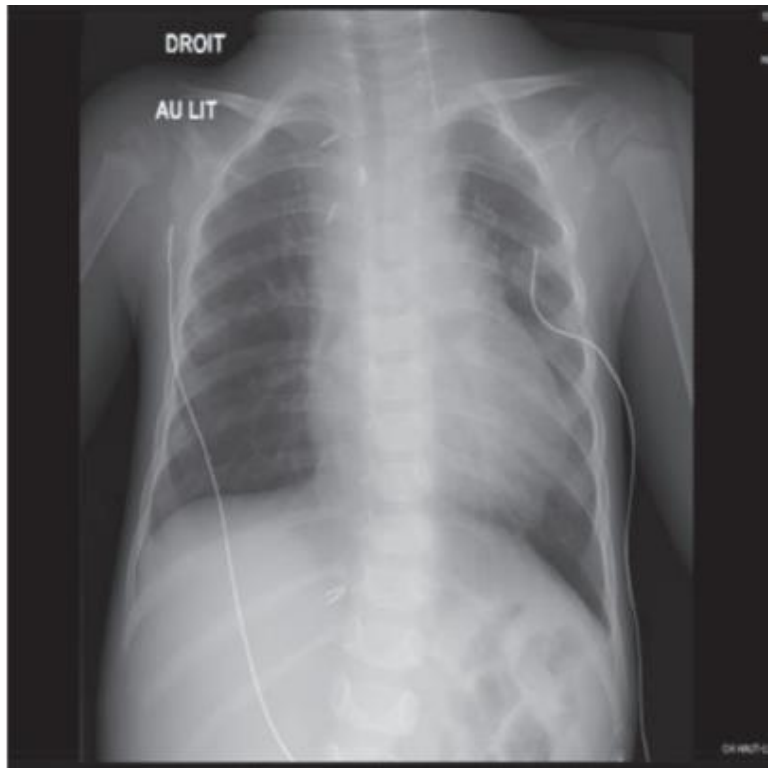


Figure 1. Dérivation cavo-pulmonaire partielle.

J 4



J 7



D'après Mouret et al, 2019

Support respiratoire

SYSTEMATIC REVIEW

Pediatric Anesthesia WILEY

Noninvasive respiratory support preventing reintubation after pediatric cardiac surgery—A systematic review

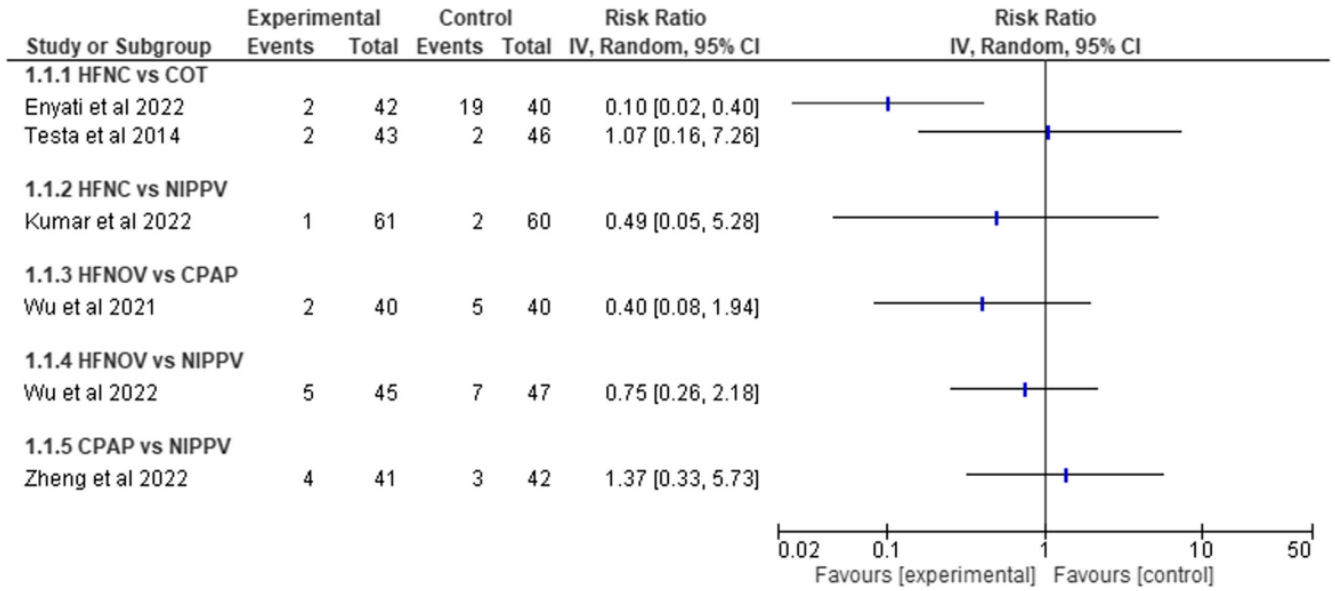


FIGURE 3 Reintubation rate compared between different noninvasive ventilation strategies.

Conclusion: We did not find clear evidence of a difference in reintubation rates and other clinical outcomes between different noninvasive ventilation strategies. Evidence certainty was assessed to be very low due to the risk of bias, the small number of included studies, and high imprecision. Future quality studies are needed to determine the optimal postextubation support in pediatric cardiac surgery patients.

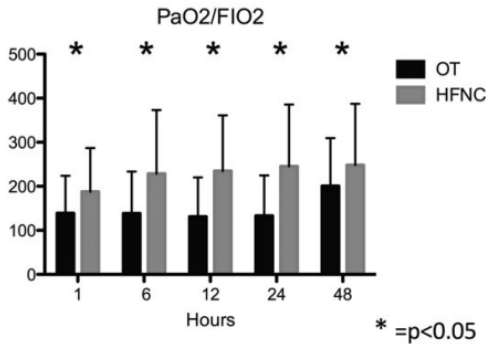
D'après Kuitunen et al, 2023

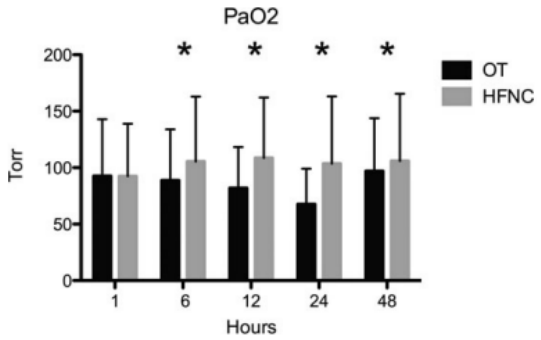
Comparative evaluation of high-flow nasal cannula and conventional oxygen therapy in paediatric cardiac surgical patients: a randomized controlled trial

2 l/kg/min

2 l/min max

SpO_2 > 90% non-cyanogène
SpO_2 > 75% cyanogène





D'après Testa et al, 2014

Comparison of High-Flow Nasal Cannula and Conventional Oxygen Therapy Following Extubation After Pediatric Cardiac Surgery: A Retrospective Study

1 à 2 l/kg/min

5 à 6 l/min max

SpO_2 cible

Table 4. PaO_2/FiO_2 ratio at different time points

Time point (hr)	Group I	Group II	p
1	280.75 ± 178.5	194.65 ± 121.6	**0.01**
6	233.65 ± 112.8	188.68 ± 111.9	**0.01**
12	242.52 ± 123.5	192.81 ± 101.7	**0.01**
24	240.2 ± 134.6	190.23 ± 113.5	**0.01**
48	245.5 ± 126.2	181.32 ± 107.6	**0.01**

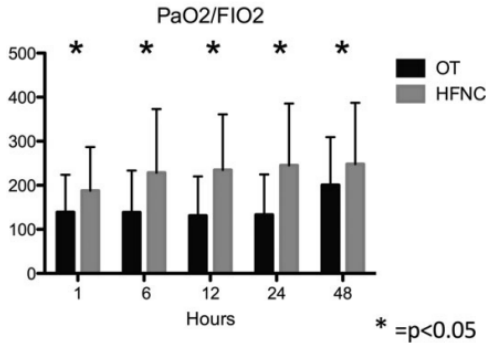
D'après Savluk et al, 2021

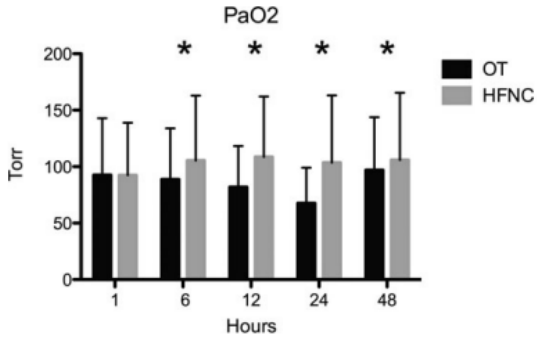
Comparative evaluation of high-flow nasal cannula and conventional oxygen therapy in paediatric cardiac surgical patients: a randomized controlled trial

2 l/kg/min

2 l/min max

SpO_2 > 90% non-cyanogène
SpO_2 > 75% cyanogène





D'après Testa et al, 2014

Comparison of High-Flow Nasal Cannula and Conventional Oxygen Therapy Following Extubation After Pediatric Cardiac Surgery: A Retrospective Study

1 à 2 l/kg/min

5 à 6 l/min max

SpO_2 cible

Table 2. Arterial oxygen tension (PaO_2) at different time points

Time point (hr)	Group I	Group II	p
1	143.25 ± 98.8	118.72 ± 77.3	**0.02**
6	135.43 ± 88.7	101.53 ± 68.4	**0.01**
12	138.67 ± 69.5	98.83 ± 57.6	**0.01**
24	131.53 ± 58.9	92.75 ± 62.1	**0.01**
48	132.46 ± 61.3	87.52 ± 57.3	**0.01**

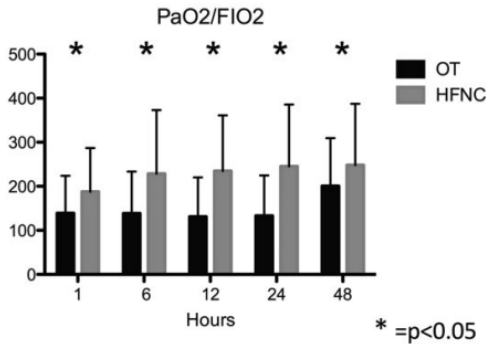
D'après Savluk et al, 2021

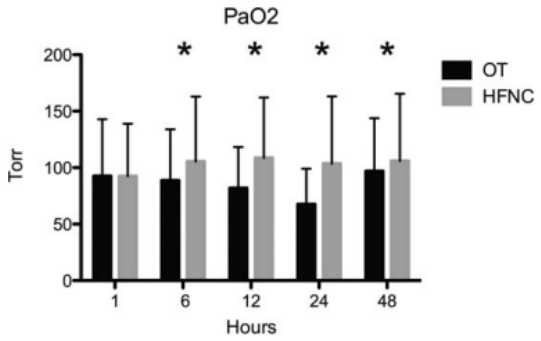
Comparative evaluation of high-flow nasal cannula and conventional oxygen therapy in paediatric cardiac surgical patients: a randomized controlled trial

2 l/kg/min

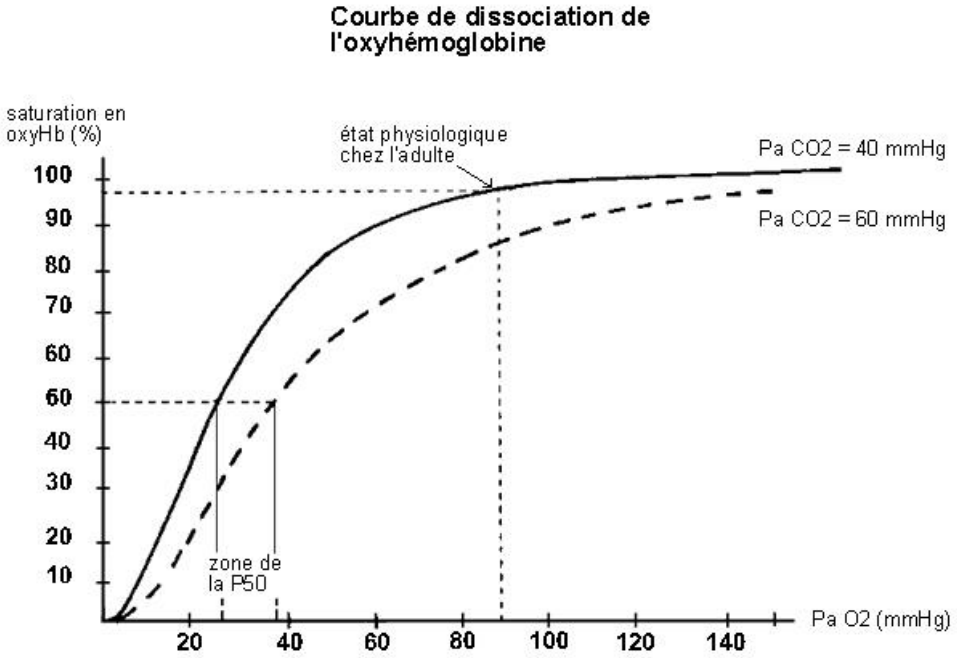
2 l/min max

SpO_2 > 90% non-cyanogène
SpO_2 > 75% cyanogène



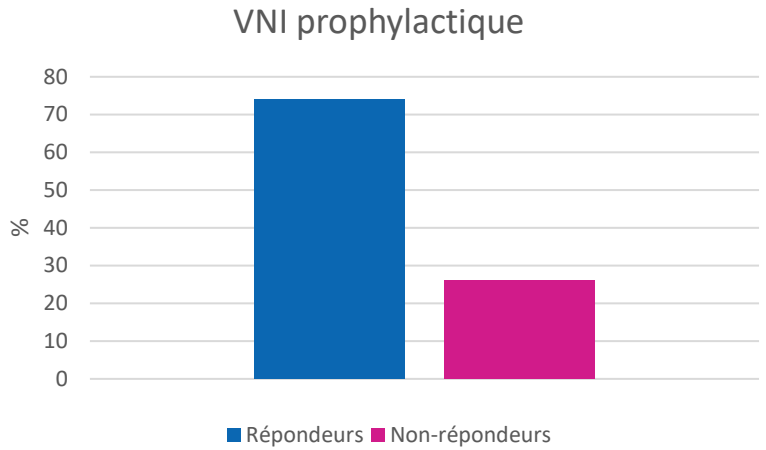


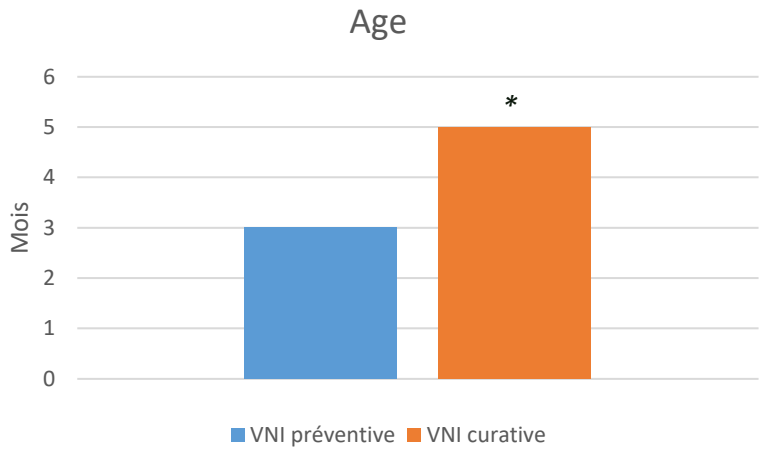
D'après Testa et al, 2014

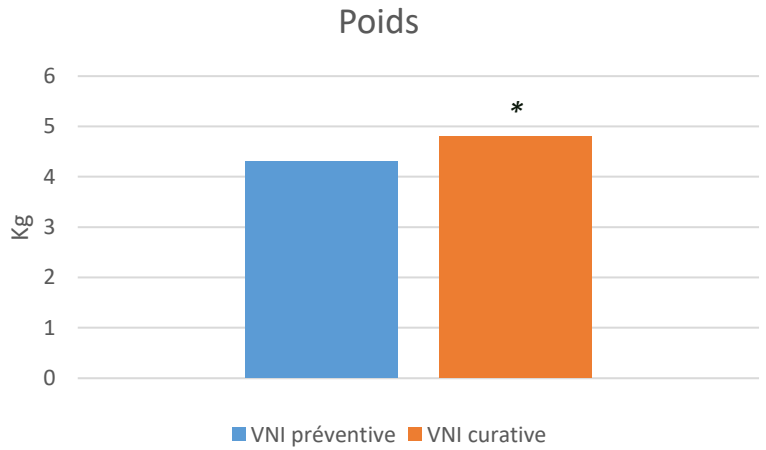


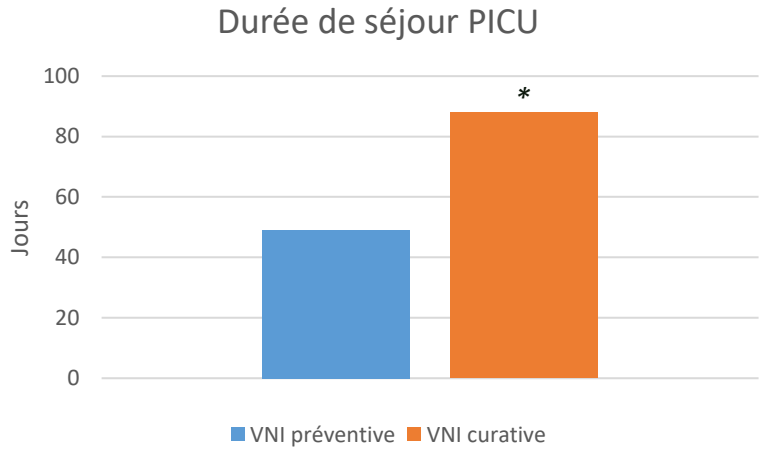
! Limites alarmes SpO_2 sup et inf !

Efficacy and Predictors of Success of Noninvasive Ventilation for Prevention of Extubation Failure in Critically Ill Children With Heart Disease









p < .05

D'après Gupta et al, 2013

Use of Noninvasive Ventilation in Respiratory Failure After Extubation During Postoperative Care in Pediatrics

Table 2 Demographic, surgical, and ventilation-related characteristics of patients according to outcome (success and failure groups)

Variable	Outcome of NIV		*p*
	Success ($n=105$)	Failure ($n=65$)	
Sex			0.013
Male	61	25	
Female	44	40	
Age (Months)	2 (0; 108)[a]	1 (0; 36)[a]	0.098**
Interface			0.714
Face mask	45	26	
Nasal cannula	60	39	
Sedation			0.084
Yes	75 (71.4%)	54 (83%)	
Genetic syndrome			0.342
Yes	18 (17.1%)	15 (23%)	
Pulmonary hypertension			0.254
Yes	18 (17.1%)	7 (10.7%)	
ECC (min)	86.1 (64.7)[b]	85.1 (58.8)[b]	0.669*
IMV duration (days)	3 (0; 211)[a]	5 (0; 139)[a]	0.186*
NIV duration (h)	46 (3; 402)[a]	48 (1; 286)[a]	0.804**
RACHS-1 (N)			0.097*
1	3 (2.8%)	0 (0)	
2	20 (19%)	20 (30.7%)	
3	24 (22.8%)	18 (27.7%)	
4	34 (32.4%)	17 (26.1%)	
5	3 (2.8%)	1 (1.5%)	
6	21 (20%)	9 (13.8%)	

ECC extracorporeal circulation, *IMV* invasive mechanical ventilation, *NIV* noninvasive mechanical ventilation, *RACHS-1* risk-adjusted classification for congenital heart surgery score

Succès = pas de ré-intubation dans les 48h après l'arrêt de la VNI-2P

Réussite 2/3 des cas

Variable	NIV success		OR (adjusted)	CI (95%)		*p*[a]
	Yes (n = 105)	No (n = 65)		Inferior	Superior	
Minimum pressure gradient	11.8 (1.8)[b]	13.9 (2.1)[b]	1.45	1.11	1.91	0.007
Maximum SpO_2	96.8 (4.2)[b]	92.5 (5.5)[b]	0.88	0.80	0.97	0.011
Maximum FiO_2	37.4 (7.6)[b]	59.2 (14.5)[b]	1.16	1.10	1.23	<0.001

SpO_2 blood-oxygen saturation level, *FiO_2* fraction of inspired oxygen, *min* minimum, *max* maximum

[a]Chi-square test

[b]Mean (SD)

D'après Rolim et al, 2020

Neurally Adjusted Ventilatory Assist After Pediatric Cardiac Surgery: Clinical Experience and Impact on Ventilation Pressures

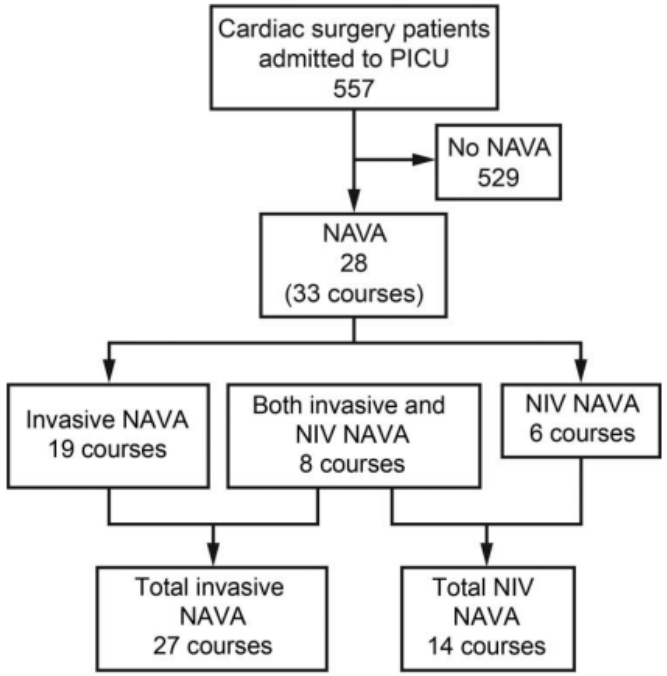
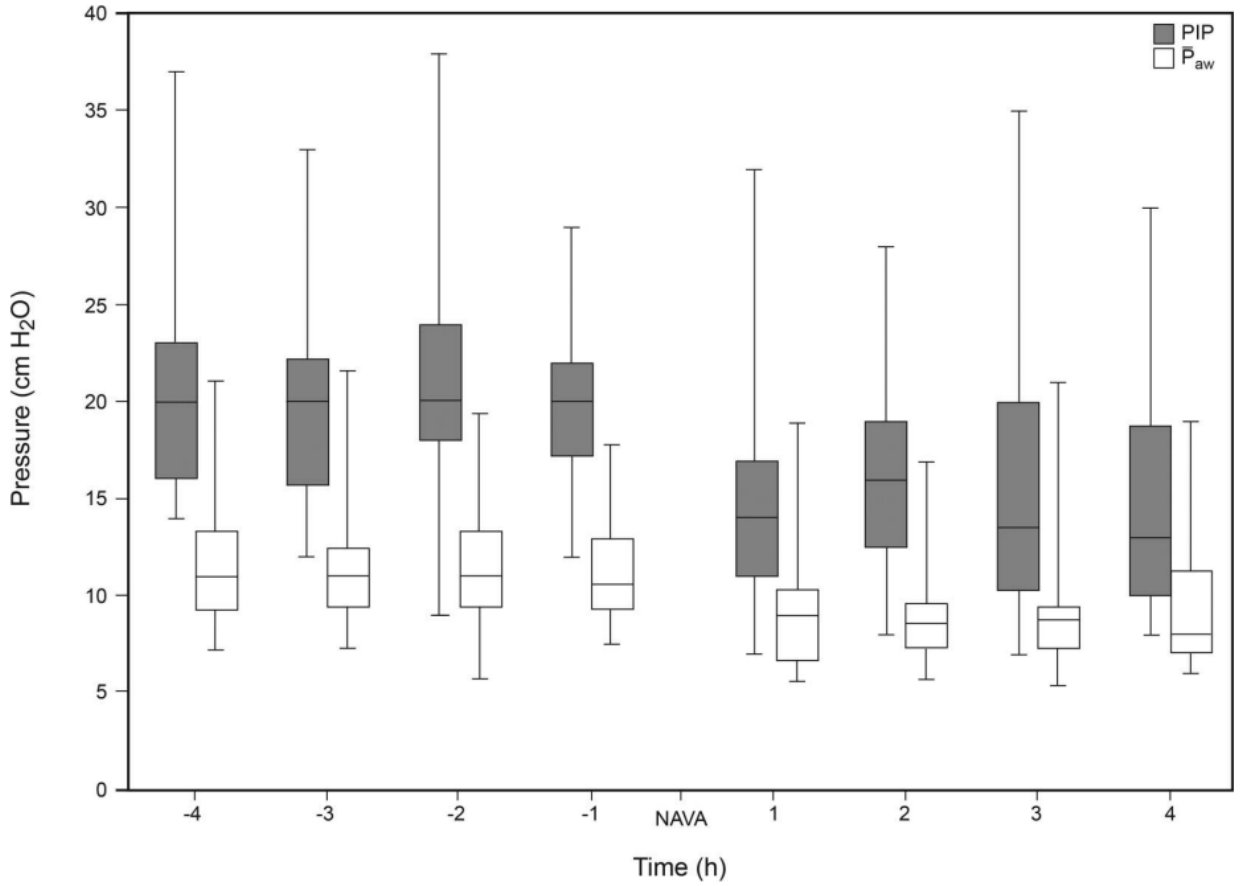
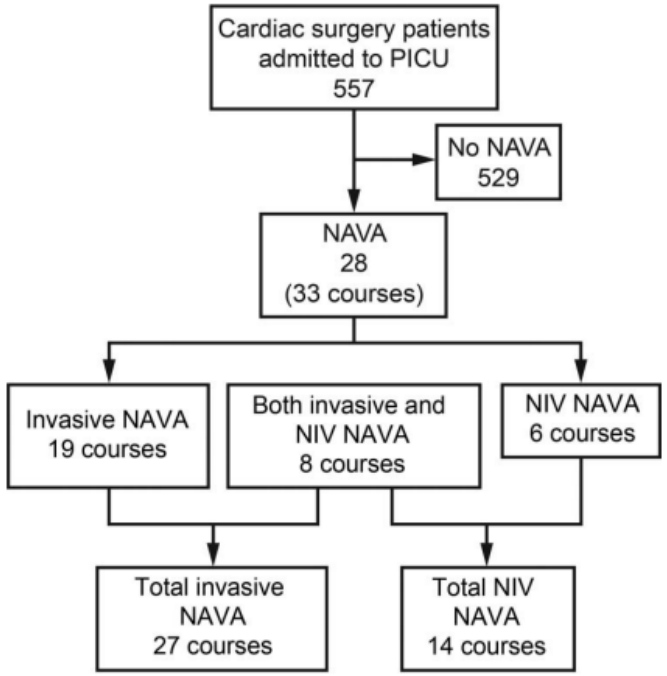


Fig. 1. Flow chart. PICU = pediatric intensive care unit, NAVA = neurally adjusted ventilatory assist, NIV = noninvasive ventilation.



D'après Crulli et al, 2018

Neurally Adjusted Ventilatory Assist After Pediatric Cardiac Surgery: Clinical Experience and Impact on Ventilation Pressures



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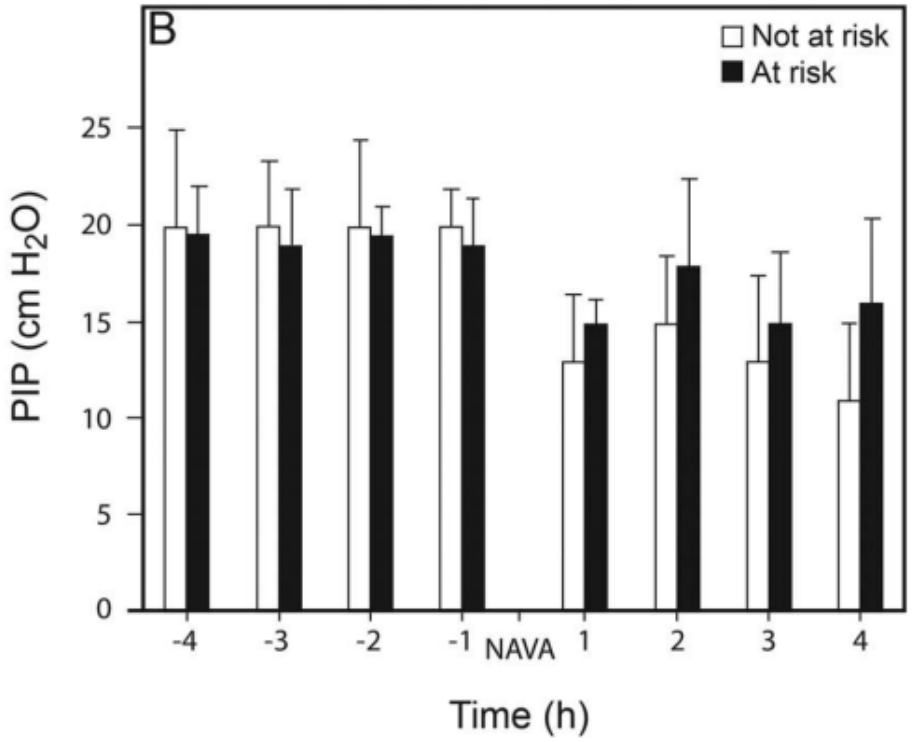


D'après Crulli et al, 2018

La mobilisation précoce

Early mobilization is defined as nonmobility interventions (passive range of motion) to prevent muscle atrophy and maintain range of motion (ROM) and mobility interventions (active ROM, in bed cycling, transfers) to enhance endurance, strength, and balance.

D'après Choong et al, 2014

La mobilisation précoce

Early mobilization should be started within 48 hours of PICU admission.

D'après Choong et al, 2018

An inpatient rehabilitation program utilizing standardized care pathways after paracorporeal ventricular assist device placement in children

< 1 an

Table 1 Standardized Care Pathway for Rehabilitation of Infants After Paracorporeal VAD Implantation

Age-appropriate goals:
1. Positioning and range of motion
2. Tolerance to therapeutic handling and interaction
3. Tolerance to upright position in McLaren reclining bouncy chair
4. Parent holding
5. Appropriate developmental play/program (to be determined by PT/OT)
6. Participation in morning, afternoon and bedtime routine
7. Wagon rides, outings to pre-school if appropriate
8. Floor-time play activities

PT/OT, physical therapy/occupational therapy; VAD, ventricular assist device.

Faisabilité :
- 5/8 patients : tous les items
- 7/8 patients : 7 items
- 6/7 patients : position ventrale

Sécurité :
- Aucun évènement indésirable

> 1 an

Table 2 Standardized Care Pathway for Rehabilitation of Children > 1 Year of Age After Paracorporeal VAD Implantation

Age-appropriate goals:
1. Establish daily schedule
2. If intubated and alert, work on tolerance to upright position (bed in chair position)
3. Therapeutic exercise program
4. Edge of bed sitting
5. Out of bed to chair
6. Toilet/commode transfers
7. Wearing regular clothes (out of hospital gown)
8. Participation in ADLs (e.g., grooming, brushing teeth, personal hygiene)
9. Ambulation
10. Outings to school, PT/OT gym, playroom

ADLs, activities of daily living; PT/OT, physical therapy/occupational therapy; VAD, ventricular assist device.

Faisabilité :
- 6/6 patients : tous les items
- 5/6 patients : école à l'hôpital

Sécurité :
- Aucun évènement indésirable

D'après Hollander et al, 2014

Feasibility and safety of early mobilization in critically ill children: A prospective experimental study

Matériel et méthode :

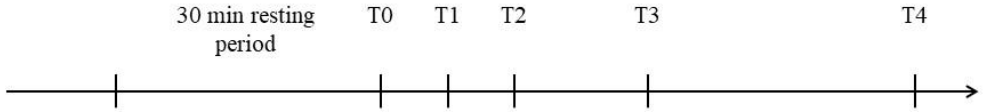
- Enfant < 2 ans
- Admission au PICU entre 24h et 48h

Faisabilité :

- Capacité à réaliser une mobilisation complète MS et MI
- EDIN score et COMFORT score

Sécurité :

- Stabilité des paramètres (FC, FR, TAS, TAD et SpO_2)
- Présence d'évènements indésirables



T0, before the mobilization; T1, at the end of the mobilization; T2, 10 min after; T3, 30 min after and T4, 1 hour after the end of the mobilization

D'après Moerman et al, 2024

Feasibility and safety of early mobilization in critically ill children: A prospective experimental study

Table 1: Clinical characteristics of the patients at baseline.

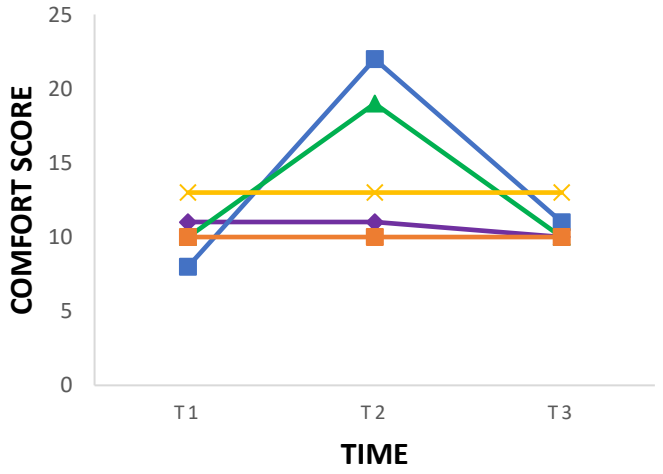
Variables	Total (n = 20)
Age (days)	162 [1; 434]
Weight (kg)	6 [3; 10]
Female gender	12 (60)
Reasons for admission	
Congenital heart disease	14 (70)
Neurologic disease	3 (15)
Lung disease	2 (10)
Digestive disease	1 (5)
Ventilation	
Spontaneous breathing without NIV	15 (75)
Invasive ventilation	5 (25)

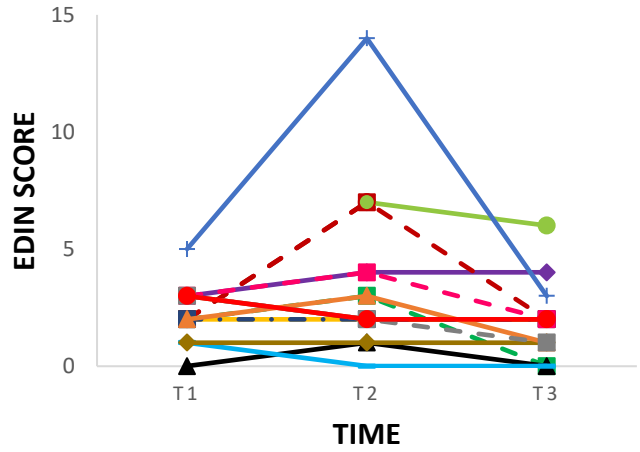
NIV, non-invasive ventilation.

Values are expressed as median with min-max values in square brackets, or numbers with percentage in round brackets.

Faisabilité :

- 16 sessions de MP complètes
- 4 sessions arrêtées
  - ✓ Agitation
  - ✓ 3 chirurgies cardiaques
  - ✓ 1 trauma crânien





D'après Moerman et al, 2024

Feasibility and safety of early mobilization in critically ill children: A prospective experimental study

Table 2: Change in parameters at different times.

	T0	T1	T2	T3	T4	p-value
HR (bpm)	133 ± 15	138 ± 20	129 ± 15	128 ± 14	131 ± 14	.03 [a,*]
RR (cycles/min)	31 ± 13	33 ± 12	32 ± 12	30 ± 10	32 ± 13	.64 [a]
SBP (mmHg)	94 ± 12	101 ± 18	96 ± 14	93 ± 13	93 ± 13	.02 [a,*]
DBP (mmHg)	49 ± 7.0	54 ± 11	49 ± 8.0	48 ± 8.0	49 ± 7.0	.04 [a,*]
SpO_2 (%)	99 [87; 100]	98 [81; 100]	98 [88; 100]	99 [89; 100]	98 [89; 100]	.44 [b]
EDIN scale (point)	2 [0.0; 5.0]	2 [0.0; 14.0]	2 [0.0; 6.0]			.02 [b,*]

HR, heart rate; RR, respiratory rate; SBP, systolic blood pressure; DBP, diastolic blood pressure; SpO_2, peripheral oxygen saturation.

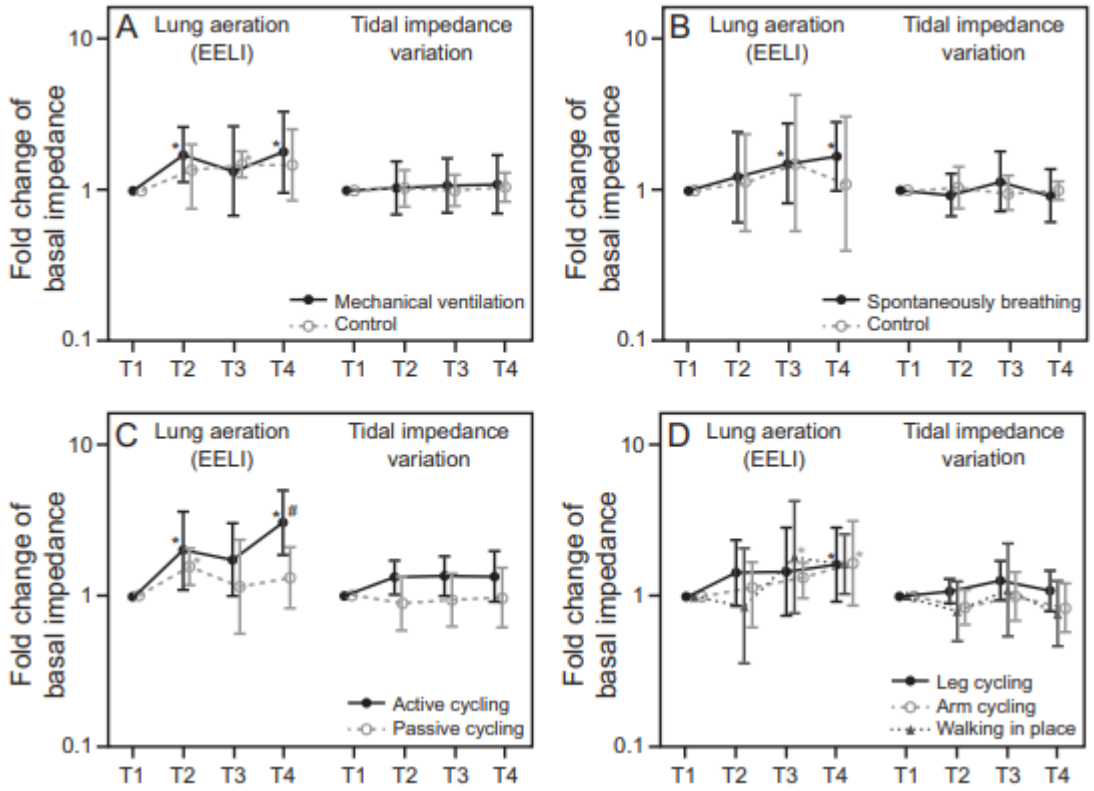
T0, before the mobilization; T1, at the end of the mobilization; T2, 10 min after; T3, 30 min after and T4, 1 hour after the end of the mobilization.

Values expressed as mean ± *SD* or median with min–max values in square brackets.

[a] *p*-value (Within Subjects – Factor = Time); [b] *p*-value (Friedman test); * $p < .05$.

D'après Moerman et al, 2024

Acute Effects of Sitting Out of Bed and Exercise on Lung Aeration and Oxygenation in Critically Ill Subjects



D'après Hickmann et al, 2021

Take home messages

Positionnement

Paramètres cibles

- SpO_2 : valeurs cibles de l'enfant
- ! Limites alarmes SpO_2 inf et sup !

Douleur et inconfort

ECMO

- Canules
- Risque hémorragique

Thorax ouvert

- C/I relative

Drains, cathéters

Sternotomie/thoracotomie