Cliniques universitaires SAINT-LUC UCLouvain BRUXELLES

réanimation 2023
PARIS 14-16 JUIN

Support respiratoire dans la bronchiolite aiguë du nourrisson

Dr Laurent Houtekie

Réanimation pédiatrique

Cliniques universitaires Saint-Luc

Bruxelles

14 Juin 2023

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réanimation 2023
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Je n'ai pas de conflit d'intérêt à déclarer

Le fil rouge

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réanimation 2023
PARIS 14-16 JUIN

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GUIDELINES

Check for updates

Clinical practice guidelines: management of severe bronchiolitis in infants under 12 months old admitted to a pediatric critical care unit

Christophe Milési[1*], Florent Baudin[2], Philippe Durand[3], Guillaume Emeriaud[4], Sandrine Essouri[5], Robin Pouyau[2], Julien Baleine[1], Sophie Beldjilali[6], Alice Bordessoule[7], Sophie Breinig[8], Pierre Demaret[9], Philippe Desprez[10], Bénédicte Gaillard-Leroux[11], Julie Guichoux[12], Anne-Sophie Guilbert[13], Camille Guillot[14], Sandrine Jean[15], Michael Levy[16], Odile Noizet-Yverneau[17], Jérôme Rambaud[15], Morgan Recher[14], Stéphanie Reynaud[2], Fréderic Valla[2], Karim Radoui[18], Marie-Agnes Faure[19], Guillaume Ferraro[20] and Guillaume Mortamet[21] on behalf of the French Speaking Group for Pediatric Intensive and Emergency Care

R19
The experts suggest the use of a noninvasive ventilatory support protocol

R20
Noninvasive ventilatory support is effective to reduce the work of breathing and improve clinical respiratory parameters

R21
The experts suggest noninvasive ventilatory support as a first-line treatment rather than invasive ventilation

R22
For the most severe form, continuous positive airway pressure should probably be used as the first-line treatment rather than high-flow nasal cannula

R23
Continuous positive airway pressure should probably be initiated at a positive pressure level of 7 cmH2O

R24
The experts suggest the use of noninvasive ventilation with two pressure levels in cases of failure of continuous positive pressure and in the absence of intubation criteria

R25
The choice of interface should take into account the ventilator being used and the expertise of the medical team. The experts are not in a position to suggest a specific type of interface for patients ventilated with continuous positive airway pressure.
In cases of failure, the experts suggest the use of a face mask to improve patient-ventilator synchronization

R26
The high-flow nasal cannula should not be used prophylactically to reduce the risk of admission to the PICU

R27
A flow rate of 1.5–2 L/kg/min should probably be initiated with high-flow nasal cannula and should not exceed 2 L/kg/min

R28
The experts are not able to make a recommendation regarding the choice of invasive ventilation mode

R29
Noninvasive ventilatory support (continuous positive airway pressure or nasal high flow) should probably be used during patient transport.
If a high-flow nasal cannula is used, a humidification heating system should be used.
The experts do not recommend routine intubation for transport.

- EXPERT OPINION
- NO RECOMMENDATION
- GRADE 1-
- GRADE 1
- GRADE 1+
- GRADE 2-
- GRADE 2
- GRADE 2+
- WEAK AGREEMENT
- STRONG AGREEMENT

VENTILATORY SUPPORT

General

- Favor noninvasive support (including for transport)
- Implement local protocols with ventilatory support choice

HFNC

- Do not prevent ICU admission
- **Setting:** 1,5- 2 L/min/kg
- Humidification including during transport

CPAP

- More efficient than HFNC
- **Setting:** 7 cmH_2O
- Nasal or facial interface

NIV (2 levels)

- If CPAP failure
- Favor facial interface (synchronization)

Mechanical ventilation

According to severity

Plan

1. SpO_2 cible
2. Oxygénothérapie à haut débit
   - Vs O_2 standard
   - VS CPAP
   - Débit
3. CPAP
   - Niveau
4. VNI à deux niveaux de pression
5. Ventilation invasive

Niveau de SpO_2?

Oxygen saturation targets in infants with bronchiolitis (BIDS): a double-blind, randomised, equivalence trial

*Steve Cunningham, Aryelly Rodriguez, Tim Adams, Kathleen A Boyd, Isabella Butcher, Beth Enderby, Morag MacLean, Jonathan McCormick, James Y Paton, Fiona Wee, Huw Thomas, Kay Riding, Steve W Turner, Chris Williams, Emma McIntosh, Steff C Lewis, for the Bronchiolitis of Infancy Discharge Study (BIDS) group**

Lancet 2015; 386: 1041–48

- Prospective randomisée en double aveugle
- Groupe standard : cible SpO_2 94%
- Groupe modifié : pulse-oxymètres modifiés pour qu'une SpO_2 de 90% donne une valeur de 94%

	Standard group (n=308)	Modified group (n=307)	Median difference*	HR estimate†	p value
Time to resolution cough (days)‡	15·0 (10·0 to 42·5); n=296	15·0 (10·0 to 41·0); n=293	1·00 (−1·0 to 2·0)	–	–
Time feeding returned to ≥75% normal (h)§	24·1 (6·5 to 62·1); n=304	19·5 (6·3 to 47·2); n=296	2·7 (−0·3 to 7·3)	–	–
Time back to normal (days)¶	12·0 (7·0 to 25·0); n=296	11·0 (6·0 to 20·0); n=293	1·0 (0 to 3·0)	–	–
Time to fit to discharge (h)	44·2 (18·6 to 87·5); n=283	30·2 (15·6 to 59·7); n=276	–	1·46 (1·23 to 1·73)	<0·0001
Time to actual discharge (h)	50·9 (23·1 to 93·4); n=303	40·9 (21·8 to 67·3); n=301	–	1·28 (1·09 to 1·50)	0·003
Time to no further supplemental oxygen (h)	27·6 (0 to 68·1); n=305	5·7 (0 to 32·4); n=304	–	1·37 (1·12 to 1·68)	0·0021

Data are median (IQR); n or estimate of difference (95% CI), unless otherwise stated. *Median difference is standard–modified (+0 indicates benefit to standard practice). †HR is standard/modified (>1 indicates benefit to standard practice). ‡Equivalence defined as plus or minus 2 days. §Equivalence defined as plus or minus 4 h. ¶Equivalence defined as plus or minus 2 days.

Table 2: Clinical outcomes

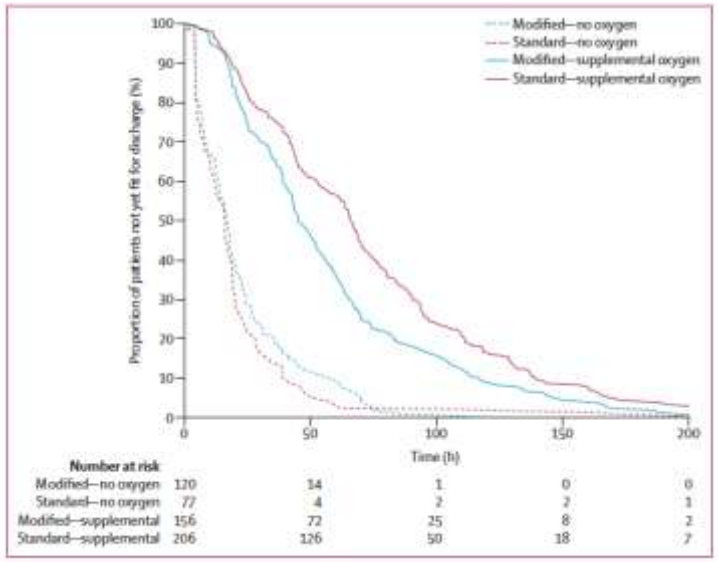


Figure 2: Time to fit to discharge by oxygen requirement and group allocation

Niveau de SpO_2?

Oxygen saturation targets in infants with bronchiolitis (BIDS): a double-blind, randomised, equivalence trial

*Steve Cunningham, Aryelly Rodriguez, Tim Adams, Kathleen A Boyd, Isabella Butcher, Beth Enderby, Morag MacLean, Jonathan McCormick, James Y Paton, Fiona Wee, Huw Thomas, Kay Riding, Steve W Turner, Chris Williams, Emma McIntosh, Steff C Lewis, for the Bronchiolitis of Infancy Discharge Study (BIDS) group**

Lancet 2015; 386: 1041–48

	Standard group (n=308)	Modified group (n=307)	Mean difference (95% CI)	Odds ratio (95% CI)	p	Reduction in events per 1000 treated
Adverse events*						
Any adverse event	75 (24%)	69 (22%)	..	..	..	..
Respiratory adverse event	49 (16%)	50 (16%)	..	..	..	..
Gastrointestinal adverse event	7 (2%)	12 (4%)	..	..	..	..
Other adverse event	27 (9%)	14 (5%)	..	..	..	..
Safety outcomes						
Deaths	2 (1%)	0	..	..	..	..
Episodes of high dependency care	8 (3%)	13 (4%)	..	..	..	..
Heart rate at discharge (bpm)	133·8 (16·2)†	135·0 (15·7)†	−1·16 (−3·70 to 1·37)	..	0·37	..
Respiratory rate at discharge (breaths per min)	38·0 (7·9)	38·0 (6·4)	0·09 (−1·05 to 1·23)	..	0·88	..
Re-admission to hospital within 7 days (episodes; infants [%])	8 (6; 2%)	5 (5; 2%)	..	..	..	..
Re-admission to hospital within 28 days (episodes; infants [%])	26 (23; 7%)	12 (12; 4%)	..	..	..	..
Re-attendance health care within 7 days	39/270 (14%)	34/267 (13%)	..	0·98 (0·65 to 1·49)	0·94	2 (−56 to 45)
Re-attendance health care within 14 days	76/267 (29%)	70/258 (27%)	..	1·07 (0·73 to 1·57)	0·73	−14 (−88 to 79)
Re-attendance health care after 28 days	127/274 (46%)	128/262 (49%)	..	0·90 (0·64 to 1·27)	0·56	26 (−99 to 104)
Antibiotics after discharge	24/305 (8%)	10/304 (3%)	..	..	..	..

Data are n (%), mean (SD), n/N (%), or difference (95% CI), unless otherwise specified. bpm=beats per min. *See appendix p 5 for more information about adverse events. †n=304.

Table 3: **Adverse events (number of patients) and safety outcomes**

Oxygénothérapie à haut débit

Recommendation

R26—The high-flow nasal cannula should not be used prophylactically to reduce the risk of admission to the PICU (**GRADE 1−, strong agreement**)

Rationale

Two large randomized control studies failed to demonstrate the benefit of prophylactic HNFC to avoid admission in PICU [124, 125]. This was confirmed by a recent meta-analysis that evaluated the impact of using HFNC to manage bronchiolitis outside of the PICU on short-term patient outcomes [116]. On the admission to PICU outcome, they reported 1127 patients in the HFNC group and 1096 patients in the standard oxygen therapy group and no significant difference in PICU admissions (OR = 1.1 [0.81–1.42]). Despite some superiority of HFNC in terms of treatment failure on the wards, most data suggest that prophylactic use of HNFC does not modify the underlying disease process in moderately severe bronchiolitis [116, 126].

Recommendation

R27—A flow rate of 1.5–2 L/kg/min should probably be initiated with high-flow nasal cannula and should not exceed 2 L/kg/min (**GRADE 2+, strong agreement**)

Rationale

Physiological studies have demonstrated that the efficiency of HNFC to improve the work of breathing increases with a flow rate close to 2 L/kg/min [105–108]. A higher flow rate (3 L/kg/min versus 2L/kg/min) failed to demonstrate better efficiency and was associated with greater discomfort [22].

OHD vs O_2 standard

High-flow warm humidified oxygen versus standard low-flow nasal cannula oxygen for moderate bronchiolitis (HFWHO RCT): an open, phase 4, randomised controlled trial

Elizabeth Kepreotes, Bruce Whitehead, John Attia, Christopher Oldmeadow, Adam Collison, Andrew Searles, Bernadette Goddard, Jodi Hilton, Mark Lee, Joerg Mattes

Lancet 2017; 369: 930–39

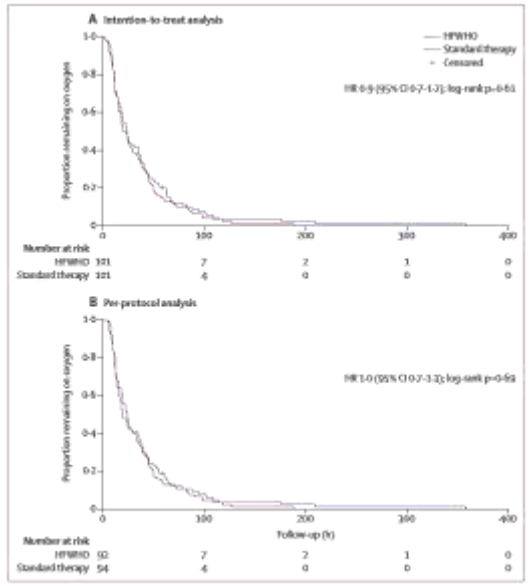


Figure 2: Comparison of time on oxygen between treatment groups using (A) intention-to-treat and (B) per-protocol analyses

- Plus d'échecs de traitement dans le groupe O_2
- Pas de différences significatives :
  - Durée de séjour
  - Durée de supplémentation en O_2
  - Admission USI
- « Crossover » à sens unique!

OHD vs O_2 standard

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

A Randomized Trial of High-Flow Oxygen Therapy in Infants with Bronchiolitis

Donna Franklin, B.N., M.B.A., Franz E. Babl, M.D., M.P.H., Luregn J. Schlapbach, M.D., Ed Oakley, M.B., B.S., Simon Craig, M.B., B.S., M.H.P.E., M.P.H., Jocelyn Neutze, M.B., Ch.B., Jeremy Furyk, M.B., B.S., M.P.H.&T.M., John F. Fraser, M.B., Ch.B., Ph.D., Mark Jones, Ph.D., Jennifer A. Whitty, B.Pharm., Grad.Dip.Clin.Pharm., Ph.D., Stuart R. Dalziel, M.B., Ch.B., Ph.D., and Andreas Schibler, M.D.

N ENGL J MED 378;12 NEJM.ORG MARCH 22, 2018

- Plus grande série (700 patients/groupe)
- Plus d'échecs de traitement dans le groupe O_2
- Pas de différences significatives :
  - Durée de séjour
  - Durée de supplémentation en O_2
  - Admission USI
- « Crossover » à sens unique!

Table 2. Primary Outcome in the Trial Cohort and Outcomes in Subgroups of Infants Who Received Escalation of Care.*

Outcome	Standard-Therapy Group (N=733)	High-Flow Group (N=739)	Relative Risk or Mean Difference (95% CI)†	Risk Difference (95% CI)	P Value
				percentage points	
Escalation of care in overall trial cohort					
Treatment failure — no. (%)	167 (23)	87 (12)	0.52 (0.40 to 0.66)	−11 (−15 to −7)	<0.001
Interval between enrollment and escalation — days	0.67±0.83	0.72±0.82	0.05 (−0.17 to 0.26)	—	0.67
Treatment failure according to age — no./total no. (%)					0.60‡
≤3 mo	55/186 (30)	34/211 (16)	0.55 (0.36 to 0.81)	−13 (−22 to −5)	
>3 to 6 mo	34/170 (20)	22/187 (12)	0.59 (0.35 to 0.99)	−8 (−16 to −1)	
>6 mo	78/377 (21)	31/341 (9)	0.44 (0.29 to 0.66)	−12 (−17 to −7)	
Treatment failure according to on-site ICU status — no./total no. (%)					<0.001‡
No	69/247 (28)	20/270 (7)	0.27 (0.16 to 0.43)	−21 (−27 to −14)	
Yes	98/486 (20)	67/469 (14)	0.71 (0.53 to 0.95)	−6 (−11 to −1)	
Treatment failure accord					
Yes					19‡
No					
Treatment failure accord					67‡
Respiratory syncytial					
Other					
Not tested					
Escalation of care in infa					
Treatment failure — no.					001
Interval between enrollm					43
Treatment failure accord					85‡
≤3 mo					
>3 to 6 mo					
>6 mo	51/377 (14)	19/341 (6)	0.41 (0.24 to 0.70)	−8 (−12 to −4)	
Treatment failure according to on-site ICU status — no./total no. (%)					<0.001‡
No	51/247 (21)	12/270 (4)	0.22 (0.11 to 0.40)	−16 (−22 to −11)	
Yes	64/486 (13)	41/469 (9)	0.66 (0.45 to 0.98)	−4 (−8 to −1)	
Treatment failure according to premature birth status — no./total no. (%)					0.85‡
Yes	27/128 (21)	19/137 (14)	0.66 (0.37 to 1.16)	−7 (−16 to 2)	
No	88/605 (15)	34/601 (6)	0.39 (0.26 to 0.58)	−9 (−12 to −6)	

formed only in ICUs. Clinicians escalated care in 34% of the infants who did not meet at least three of the four prespecified clinical criteria, according to the independent chart review we conducted. This relatively high percentage indi-

* Plus–minus values are means ±SD. Escalation of care occurred if infants met three of four prespecified clinical criteria. ICU denotes intensive care unit.
† The difference between rates is expressed as a relative risk, and the difference between outcomes that were assessed in days are shown in days.
‡ The P values for all the subgroup analyses represent the test of homogeneity across the odds ratios that were compared among subgroups.

OHD vs O_2 standard

A randomised trial of high-flow nasal cannula in infants with moderate bronchiolitis

Philippe Durand[1], Tamazoust Guiddir[1], Christèle Kyheng[1], Florence Blanc[2], Olivier Vignaud[3], Ralph Epaud[4], Frédéric Dugelay[4], Isabelle Breant[5], Isabelle Badier[6], Vanessa Degas-Bussière[7], Florence Phan[8], Valérie Soussan-Banini[9], Agnès Lehnert[10], Célestin Mbamba[11], Catherine Barrey[12], Cédric Tahiri[13], Marion Decobert[14], Marie Saunier-Pernaudet[15], Irina Craiu[1], Mélanie Taveira[16] and Vincent Gajdos[16,17] for the Bronchopti study group[18]

Eur Respir J 2020; 56: 1901926

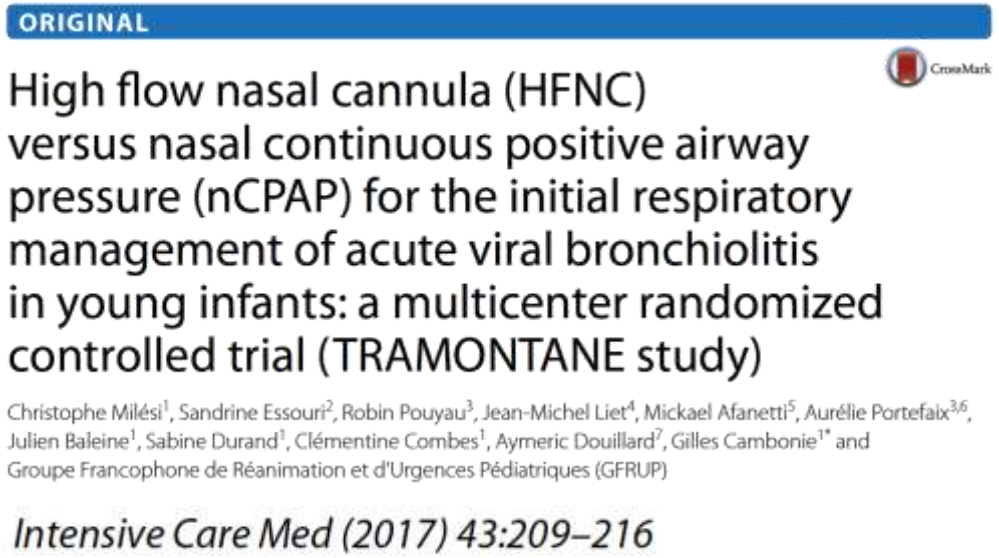
TABLE 2 Primary and secondary outcomes according to group

	HFNC	Control	OR (95% CI)	Mean difference (95% CI)
Patients n	133	135		
Primary outcome (escalating within 7 days)#	19 (14)	27 (20)	0.66 (0.35–1.26)	
Secondary outcome				
Failure requiring ICU transfer within 7 days (ICU on-site or tertiary care)	21 (15)§	26 (19)f	0.78 (0.41–1.41)	
Length of nutritional support days¶	2.9±2.1	2.4±2.2		0.50 (−0.04–1.04)
Length of oxygen support days+	1.7±1.7	2.5±2		−0.80 (−1.2–−0.3)
Length of stay on general ward unit days¶	4.4±2.4	3.8±2.7		0.6 (−0.04–1.2)

Data are presented as n (%) or mean±SD of patients, unless otherwise stated. HFNC: high-flow nasal cannula; ICU: intensive care unit. #: noninvasive ventilation (NIV) or HFNC support in control group and NIV support in HFNC group in case of failure; ¶: until discharge at home or ICU-level admission; +: inspiratory oxygen fraction >21% (HFNC group) or nasal oxygen requirement (control group) until discharge at home or ICU-level admission; §: two additional patients in study group who failed were kept on HFNC during their paediatric ICU stay; f: one patient in control group who failed and escalated on HFNC was kept on the paediatric general ward.

- Pas de différences significatives :
  - Echec de traitement
  - Durée de séjour en pédiatrie
  - Admission USI
  - Durée du support nutritionnel
  - Durée de supplémentation en O_2
- Pas de crossover!

OHD vs CPAP



ORIGINAL

High flow nasal cannula (HFNC) versus nasal continuous positive airway pressure (nCPAP) for the initial respiratory management of acute viral bronchiolitis in young infants: a multicenter randomized controlled trial (TRAMONTANE study)

Christophe Milési[1], Sandrine Essouri[2], Robin Pouyau[3], Jean-Michel Liet[4], Mickael Afanetti[5], Aurélie Portefaix[3,6], Julien Baleine[1], Sabine Durand[1], Clémentine Combes[1], Aymeric Douillard[7], Gilles Cambonie[1*] and Groupe Francophone de Réanimation et d'Urgences Pédiatriques (GFRUP)

Intensive Care Med (2017) 43:209–216

- 5 USIS françaises
- 142 patients randomisés (71/groupe) :
  - nCPAP +7 cmH_2O, FiO_2 pour SpO_2 94-97%
  - OHD 2L/Kg/min, FiO_2 pour SpO_2 94-97%
- Si échec → switch vers l'autre groupe (un vrai crossover)
- Outcome : échec de traitement à 24h (↗ mWCAS, ↗RR > 10 bpm et > 60 bpm, ↗ EDIN, > 2 apnées)
-

OHD vs CPAP

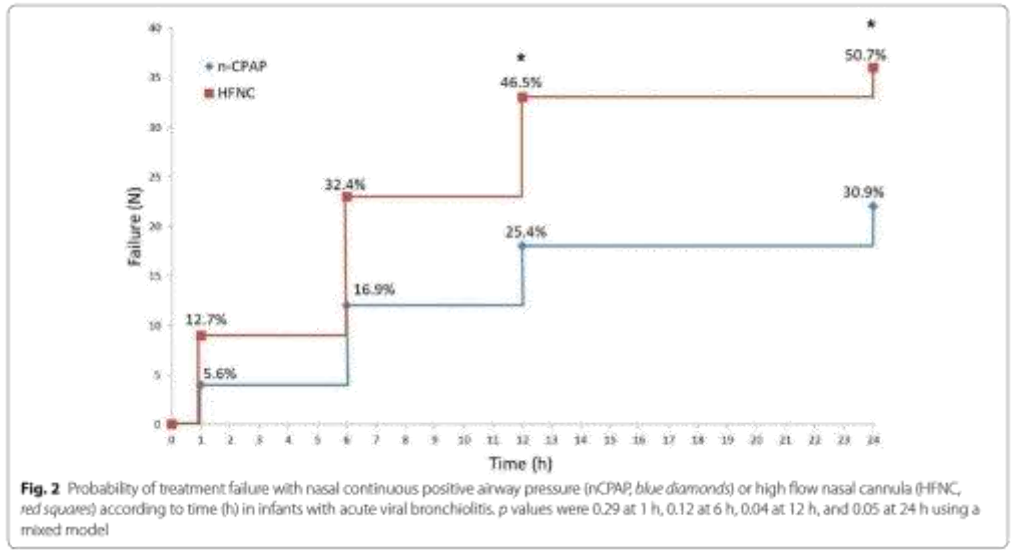


Fig. 2 Probability of treatment failure with nasal continuous positive airway pressure (nCPAP, *blue diamonds*) or high flow nasal cannula (HFNC, *red squares*) according to time (h) in infants with acute viral bronchiolitis. *p* values were 0.29 at 1 h, 0.12 at 6 h, 0.04 at 12 h, and 0.05 at 24 h using a mixed model

Primary endpoint

Failure occurred in 22 of 71 infants (31.0%) in the nCPAP group and 36 of 71 infants (50.7%) in the HFNC group.

Noninferiority analysis

With a risk-difference of −19% (95% CI −35 to −3%), the prespecified noninferiority margin of −15% was included in the confidence limit, not allowing the conclusion of noninferiority ($p = 0.707$). Hence, the result allowed us to test the superiority of nCPAP compared with HFNC.

Superiority analysis

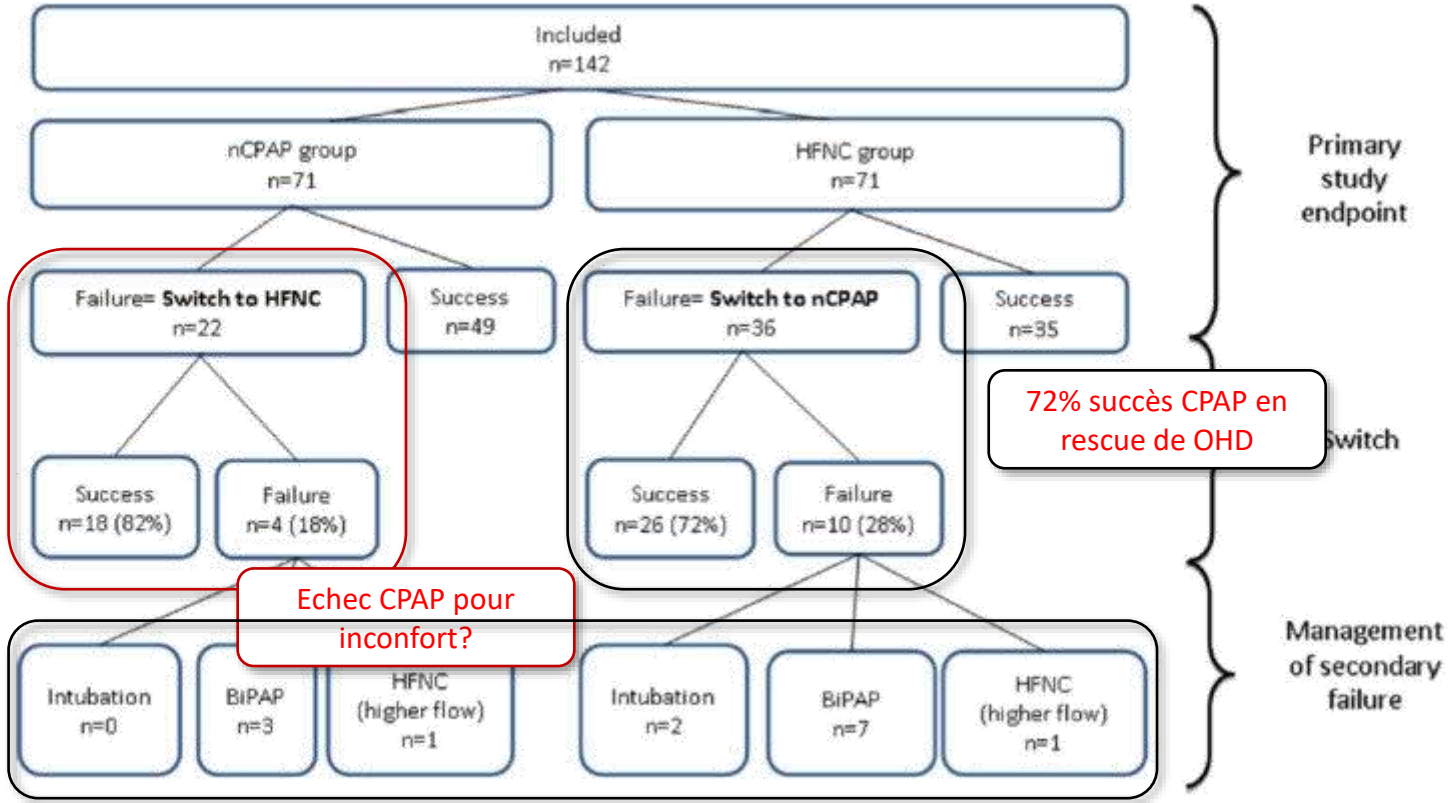
The intention-to-treat population was used to test the superiority of nCPAP compared with HFNC. With a difference of 20% (95% CI 4–36%), success was higher in the nCPAP group ($p = 0.001$), suggesting the superiority of nCPAP and a relative risk of success 1.63 (95% CI 1.02–2.63) higher with nCPAP compared with HFNC.

Table 2 Primary outcome

	nCPAP ($n = 71$)	HFNC ($n = 71$)	*p*
Patients with at least one failure, *n* (%)	22 (31.0)	36 (50.7)	0.001
Rise in mWCAS, *n* (%)	10 (14.1)	21 (29.6)	0.04
mWCAS score before switch	4 (1)	4 (1)	0.90
Rise in RR, *n* (%)	8 (11.3)	19 (26.8)	0.03
RR value before switch	46 (11)	58 (21)	0.04
Rise in EDIN score, *n* (%)	13 (18.3)	6 (8.5)	0.14
EDIN score before switch	6 (4)	3 (3)	0.02
Apnea, *n* (%)	2 (2.8)	5 (7.0)	0.698

Intensive Care Med (2017) 43:209–216

OHD vs CPAP



72% succès CPAP en rescue de OHD

Echec CPAP pour inconfort?

Table 2 Primary outcome

	nCPAP ($n=71$)	HFNC ($n=71$)	p
Patients with at least one failure, n (%)	22 (31.0)	36 (50.7)	0.001
Rise in mWCAS, n (%)	10 (14.1)	21 (29.6)	0.04
mWCAS score before switch	4 (1)	4 (1)	0.90
Rise in RR, n (%)	8 (11.3)	19 (26.8)	0.03
RR value before switch	46 (11)	58 (21)	0.04
Rise in EDIN score, n (%)	13 (18.3)	6 (8.5)	0.14
EDIN score before switch	6 (4)	3 (3)	0.02
Apnea, n (%)	2 (2.8)	5 (7.0)	0.698

Fig. 3 Patient outcome after crossover. *nCPAP* nasal continuous positive airway pressure, *HFNC* high flow nasal cannula, *BiPAP* bilevel positive airway pressure

Intensive Care Med (2017) 43:209–216

Intensive Care Med (2017) 43:209–216

Débit OHD

Intensive Care Med (2013) 39:1088–1094
DOI 10.1007/s00134-013-2879-y

PEDIATRIC ORIGINAL

Christophe Milési
Julien Baleine
Stefan Matecki
Sabine Durand
Clémentine Combes
Aline Rideau Batista Novais
Gilles Combonie

Is treatment with a high flow nasal cannula effective in acute viral bronchiolitis? A physiologic study

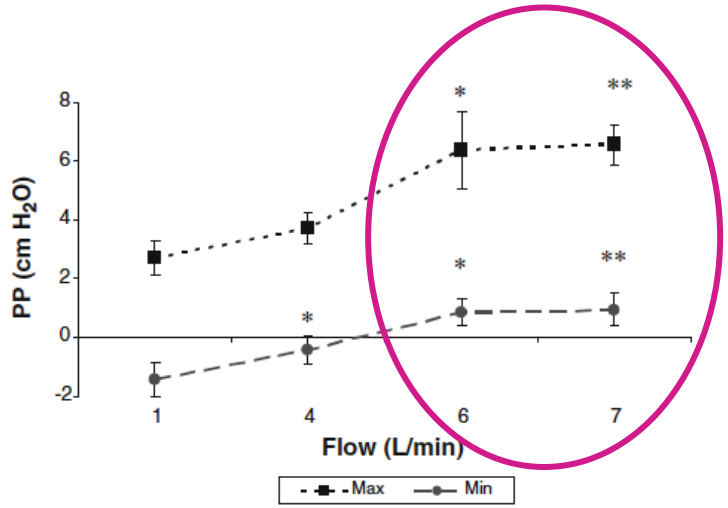


Fig. 2 Maximum (Max) and minimum (Min) pharyngeal pressure (PP) amplitude generated by the high flow nasal cannula (HFNC), using flows ranging from 1 to 7 L/min. *$p < 0.05$, **$p < 0.01$ vs 1 L/min

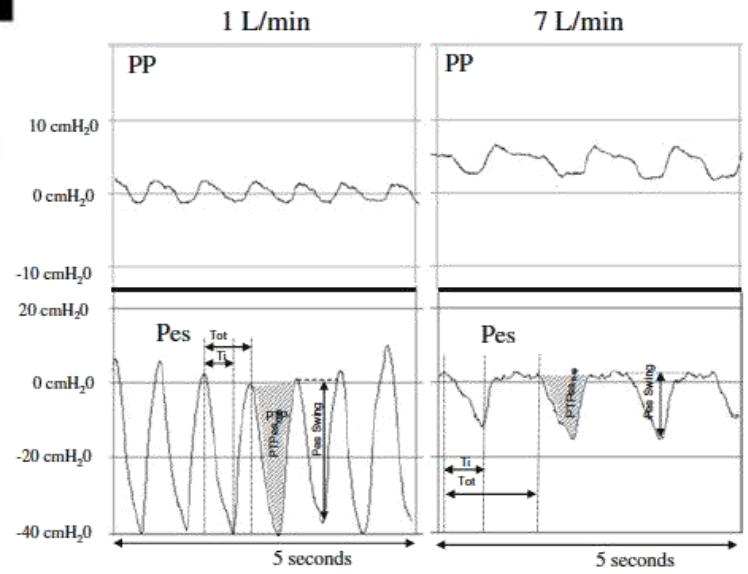


Fig. 1 Simultaneous recording of the pharyngeal pressure (PP) and the esophageal pressure (Pes) at 1 and 7 L/min in an infant. From the Pes trace, Pes swing was measured as the maximal variation in esophageal pressure generated by an inspiration, and pressure–time product ($PTPes_{insp}$) as the area under the pressure–time curve during inspiratory effort. Inspiratory (T_i), expiratory times and the ratio of the inspiratory time to the total time of the breathing cycle (T_i/T_{tot}) were also determined from the Pes traces (see "Methods" for details). The maximal flow, delivered by the nasal cannula, resulted in positive PP values during both inspiration and expiration and a dramatic decrease in Pes swings

Conclusion

HFNC with a flow rate equal to or above 2 L/kg/min generated a clinically relevant PP, i.e., a mean PP $\geq$ 4 cmH_2O, with improved breathing pattern and rapid unloading of respiratory muscle in young infants with acute RSV bronchiolitis.

Débit OHD

SEVEN-DAY PROFILE PUBLICATION

A multicenter randomized controlled trial of a 3-L/kg/min versus 2-L/kg/min high-flow nasal cannula flow rate in young infants with severe viral bronchiolitis (TRAMONTANE 2)

Christophe Milési[1], Anne-Florence Pierre[2], Anna Deho[3], Robin Pouyau[4], Jean-Michel Liet[5], Camille Guillot[6], Anne-Sophie Guilbert[7], Jérôme Rambaud[8], Astrid Millet[9], Mickael Afanetti[10], Julie Guichoux[11], Mathieu Genuini[12], Thierry Mansir[13], Jean Bergounioux[14], Fabrice Michel[15], Marie-Odile Marcoux[16], Julien Baleine[1], Sabine Durand[1], Philippe Durand[2], Stéphane Dauger[3], Etienne Javouhey[4], Stéphane Leteurtre[6], Olivier Brissaud[11], Sylvain Renolleau[12], Aurélie Portefaix[17], Aymeric Douillard[18], Gilles Cambonie[1*] and for the GFRUP Respiratory Study Group

Intensive Care Med (2018) 44:1870–1878
https://doi.org/10.1007/s00134-018-5343-1

Débit OHD

Results

From 1 November 2016 to 1 March 2017, 998 infants ≤6 months were admitted to the 16 PICUs for AVB. Of the 742 eligible patients, 286 (39%) underwent randomization (Fig. 1). The baseline demographic and clinical characteristics were comparable in the 142 patients allocated to receive HFNC with a flow rate of 2 L/kg/min and the 144 allocated to receive 3 L/kg/min (Table 1). Respiratory syncytial virus (RSV) was positive for 241 infants (84%).

Primary endpoint

Intention-to-treat analysis found no difference in treatment failure, occurring in 55/142 (38.7%) infants in the 2-L/kg/min group and 56/144 (38.9%) infants in the 3-L/kg/min group ($p = 0.98$).

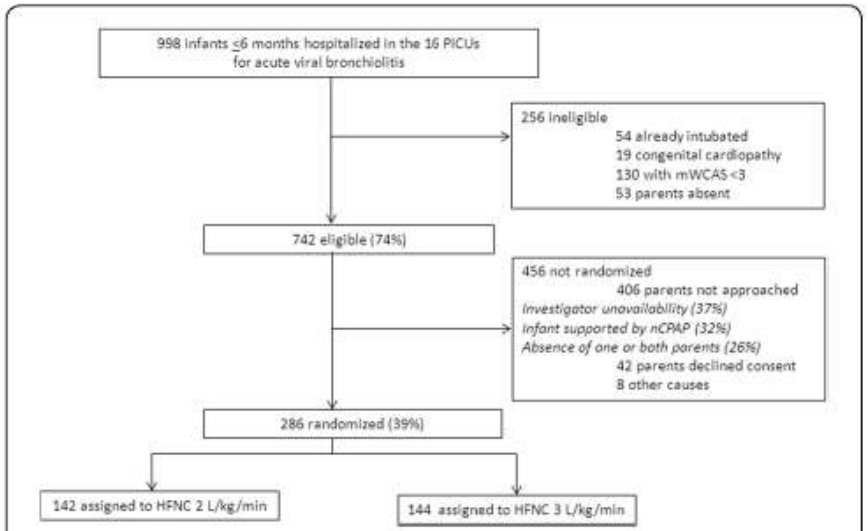


Fig. 1 Flowchart of the study population. *PICUs* pediatric intensive care units, *mWCAS* modified Wood's clinical asthma score, *HFNC* high-flow nasal cannula

Intensive Care Med (2018) 44:1870–1878
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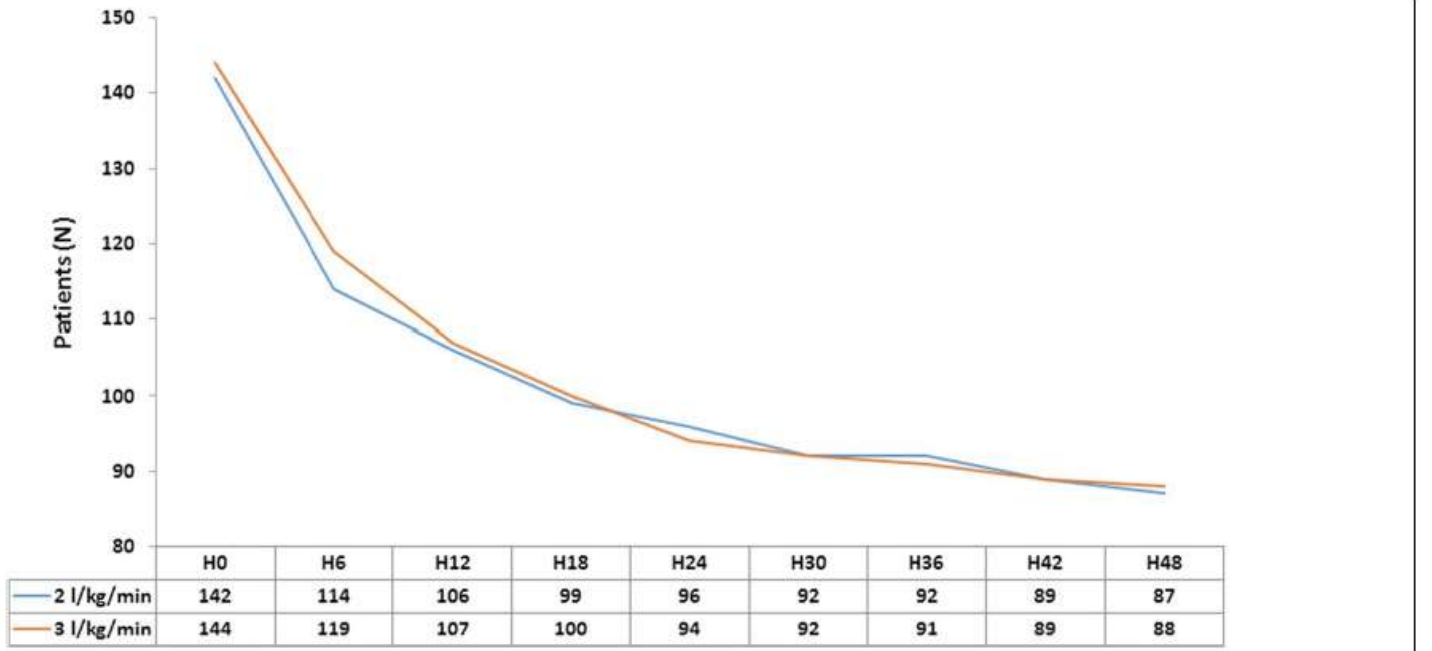

	H0	H6	H12	H18	H24	H30	H36	H42	H48
2 l/kg/min	142	114	106	99	96	92	92	89	87
3 l/kg/min	144	119	107	100	94	92	91	89	88

Fig. 2 Primary endpoint: successful management with flow rates of 2 L/kg/min (blue line) or 3 L/kg/min (red line) according to time (H, hours) in infants with acute viral bronchiolitis

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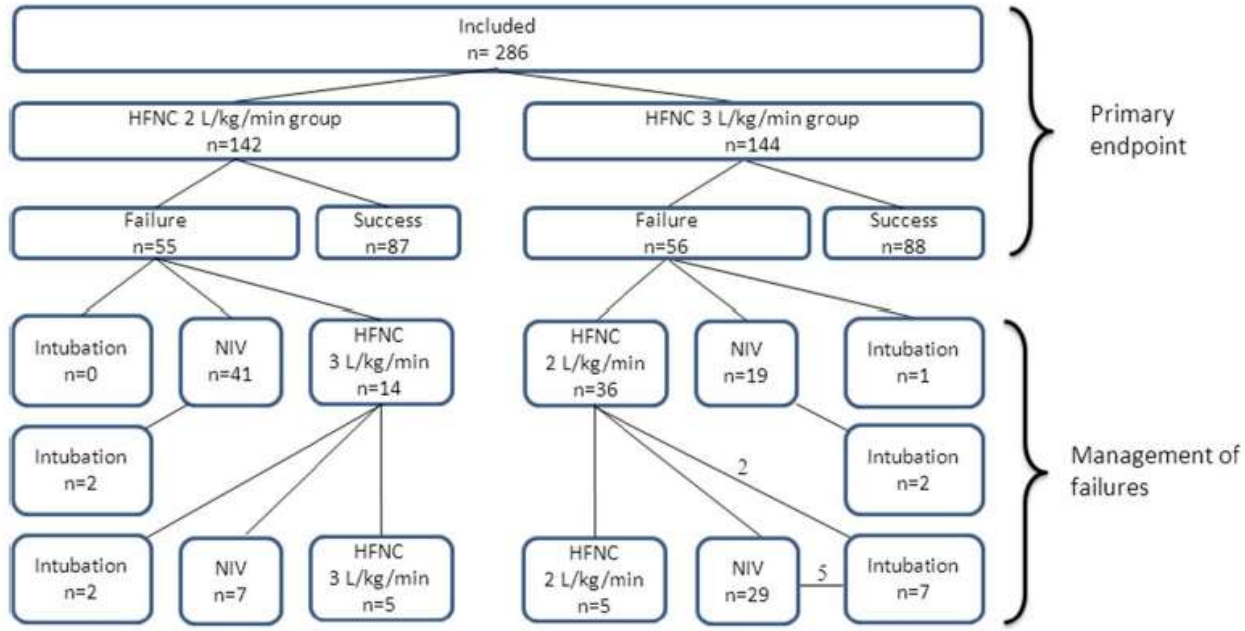

Fig. 3 Management of failures in the study groups. *HFNC* high-flow nasal cannula; *NIV* noninvasive ventilation, including nasal continuous positive airway pressure (nCPAP) and bilevel positive airway pressure (BiPAP)

Conclusion

This study found that of a flow rate of 3 L/kg/min was not superior to 2 L/kg/min when HFNC was used for the primary management of moderate to severe AVB in young infants. 2 L/kg/min was better tolerated by the patients and should be favored for clinical practice.

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VNI - CPAP

Noninvasive ventilation

Recommendation

R20—Noninvasive ventilatory support is effective to reduce the work of breathing and improve clinical respiratory parameters (**GRADE 1+, strong agreement**)

Rationale

Data from eight studies (four on continuous positive airway pressure, CPAP [19, 21, 25, 104] and four on high-flow nasal cannula, HFNC [105–108]) are convergent and show a significant and lasting reduction in the markers of respiratory failure (respiratory frequency, pCO_2) and work of breathing (esophageal pressure–time product) with noninvasive ventilatory support.

A physiological study [25] evaluated different levels of positive airway pressure and showed greater effectiveness in terms of reduction in the work of breathing with a CPAP setting of 7 cmH_2O. With regard to HFNC, the work by Milési et al. and Weiler et al. showed that the physiological impact was greater when the flow was close to 2 L/kg/min [105, 108].

Recommendation

R22—For the most severe form, continuous positive airway pressure should probably be used as the first-line treatment rather than high-flow nasal cannula (**GRADE 2+, strong agreement**)

Rationale

Four randomized controlled trials in the literature compared the efficacy and safety of HFNC versus CPAP. In the largest one, Milési et al. found a higher failure rate of HFNC (51 versus 31%) in a multicenter study [20]. In this work, it is important to note that a large majority of the CPAP failures was explained by poor tolerance of the device, whereas in the HFNC group, support failure was mainly due to respiratory deterioration.

The other three studies, of small size and with variable criteria of judgment, did not confirm these results [71, 114, 115], which explains the conclusions of a recent meta-analysis on this question [116].

Recommendation

R23—Continuous positive airway pressure should probably be initiated at a positive pressure level of 7 cmH_2O (**GRADE 2+, strong agreement**)

Rationale

Only one physiological study evaluating different levels of positive pressure demonstrated greater efficacy for a CPAP setting of 7 cmH_2O [25]. But most data on bronchiolitis in the PICU were based on levels of pressure support close to 7 cmH_2O, with significant efficiency and a low adverse effect rate.

Niveau CPAP

Intensive Care Med (2011) 37:2002–2007
DOI 10.1007/s00134-011-2372-4

PEDIATRIC ORIGINAL

Sandrine Essouri
Philippe Durand
Laurent Chevret
Laurent Balu
Denis Devictor
Brigitte Fauroux
Pierre Tissières

Optimal level of nasal continuous positive airway pressure in severe viral bronchiolitis

- 10 patients.
- Monitoring paramètres respiratoires : RR, RC, SpO_2, $P_{tc}CO2$,
- Cathéter de mesure de pression (Poeso, Pgas)à inséré par voie orale
- Mesure de la PEEPi et du PTPoeso et PTPdia

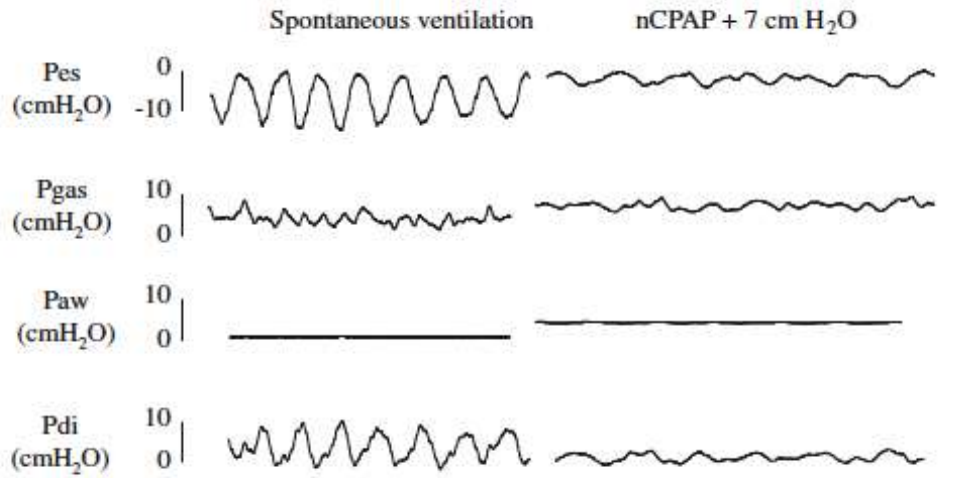

Fig. 1 Inspiratory pressure effort during spontaneous breathing and with nCPAP support. Traces from an infant during spontaneous breathing (SB) (*left panel*) and with nasal continuous pressure support (nCPAP) with a pressure level of 7 cmH_2O (*right panel*). Parameters of respiratory muscle load measured are shown: P_{es}, oesophageal pressure; P_{gas}, gastric pressure; P_{di}, transdiaphragmatic pressure; P_{aw}, airway pressure

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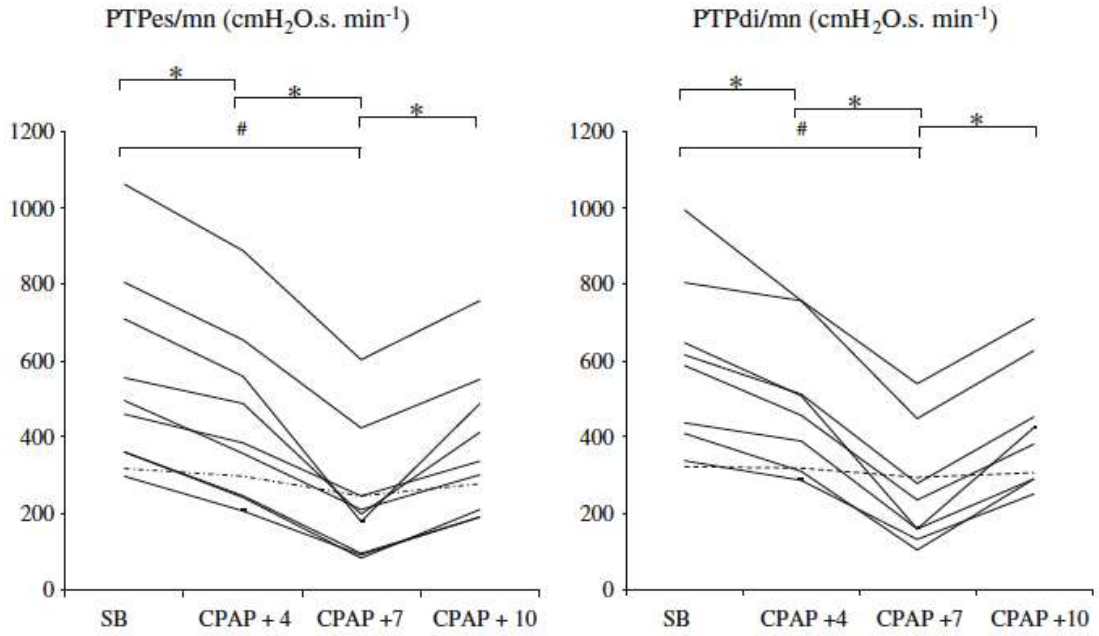
Fig. 2 Variations of oesophageal and diaphragmatic load in infants with severe viral bronchiolitis during spontaneous breathing and nCPAP at different pressure levels. Oesophageal pressure–time product per minute (PTP_{es}/min) and diaphragmatic pressure–time product per minute (PTP_{di}/min) of the 10 infants with severe bronchiolitis during spontaneous breathing (SB), and the three consecutive nCPAP levels (+4 cmH_2O, +7 cmH_2O, +10 cmH_2O). Each pressure level was compared to the previous level, $*p < 0.05$. The optimal level (7 cmH_2O) was compared to SB, $^{\#}p < 0.05$



VNI à deux niveaux de pression

Recommendation

R24—The experts suggest the use of noninvasive ventilation with two pressure levels in cases of failure of continuous positive pressure and in the absence of intubation criteria (**Expert opinion, strong agreement**)

Rationale

There are no studies in the literature that randomly compare two levels of pressure in NIV to another noninvasive ventilation modality. The data are limited to three retrospective studies evaluating the risk factors for failure using this mode [27, 117, 118]. These studies highlight that this technique can be used as initial support or as rescue, with greater efficiency in terms of the reduction in oxygen requirements compared to CPAP [117]. However, we cannot specifically recommend two pressure levels of ventilation. Delacroix et al. suggested that the use of NIV at two pressure levels could be associated with unfavorable outcomes, but the retrospective design of the study makes the interpretation of these results difficult [27].

Ventilation invasive

- Peu d'études sur meilleure stratégie
- Grande hétérogénéité des pratiques
- Comorbidités fréquentes
- → pas de recommandations, si ce n'est de monter des études fiables pour proposer des « bundles » de traitement

Invasive ventilation

Recommendation
R28—The experts are not able to make a recommendation regarding the choice of invasive ventilation mode (**No recommendation, strong agreement**)

CONCLUSION

- SpO2
  - Viser plus bas?
- Oxygénothérapie à haut débit
  - Pas en prophylaxie de l'admission en réanimation
  - Inférieure à la CPAP en réanimation
  - Avantages en termes de confort?
  - Si on en fait → 2L/Kg/min
- CPAP
  - Gold standard
  - PEEP idéale +7 cmH2O
- VNI à deux niveaux de pression
  - Recommandée, mais comment?
- Ventilation invasive
  - Pas de recommandations

Merci pour votre attention

Si vous avez des questions, n'hésitez pas à les poser

CONCLUSION

- SpO2
  - Viser plus bas?
- Oxygénothérapie à haut débit
  - Pas en prophylaxie de l'admission en réanimation
  - Inférieure à la CPAP en réa
  - Avantages en termes de confort?
  - Si on en fait → 2L/Kg/min
- CPAP
  - Gold standard
  - PEEP idéale +7 cmH2O
- VNI à deux niveaux de pression
  - Recommandée, mais comment?
- Ventilation invasive
  - Pas de recommandations