Wentylacja nieinwazyjna wysokimi częstotliwościami (nHFV)

Dr hab. med. Beata Łoniewska
Klinika Patologii Noworodka PUM
Szczecin

„Nasal high frequency ventilation in neonates with moderate respiratory insufficiency"

METHOD: Twenty one preterm and term neonates were treated with nHFV for respiratory insufficiency. Criteria for starting nHFV were: deterioration on nasal CPAP expressed by a median pH of 7.24 and pCO2 of 8.3 kPa, or increasing FIO2. nHFV was delivered using the Infant Star ventilator. Ventilator setting amplitude was 35 cm H2O; mean airway pressure 7 cm H2O; and frequency 10 Hz.

RESULTS: pCO2 decreased significantly from 8.3 kPa to 7.2 kPa after nHFV was started. In five patients nHFV was discontinued after a median period of 6 1/2 hours due to CO2 retention and high oxygen need, and endotracheal mechanical ventilation was started.

CONCLUSIONS: nHFV can reduce pCO2 in neonates with moderate respiratory insufficiency and, therefore, could be used to decrease the need for endotracheal mechanical ventilation.

van der Hoeven M, Arch Dis Child Fetal Neonatal Ed. 1998 Jul;79(1):F61-3.

„Nasal high-frequency ventilation for premature infants"

STUDY DESIGN: VLBW infants, >7 days of age on nasal continuous positive airway pressure (CPAP), were placed on nasal HFV for 2 h using the Infant Star high-frequency ventilator (Mallinckrodt, Inc., St. Louis, MO, USA). Mean airway pressure was set to equal the previous level of CPAP, and amplitude was adjusted to obtain chest wall vibration. Capillary blood was sampled before starting HFV and after 2 h to determine change in pH and partial pressure of carbon dioxide (pCO(2)).

RESULTS: Fourteen subjects were studied, 10 males and 4 females. Gestational age was 26-30 weeks (median 27). Age at study was 18-147 days (median 30). Median birth weight was 955 g; median weight at study was 1605 g. Nasal CPAP pressure was 4-7 cm H(2)O (mean 5). Amplitude was 30-60 (median 50). After 2 h, PCO(2) (mean 45 torr) was significantly lower than initial PCO(2) (mean 50 torr) (p = 0.01), and pH had increased significantly (7.40 vs. 7.37, p = 0.04).

Colaizy TT, Acta Paediatr. 2008 Nov;97(11):1518-22

„Weaning of neonates from mechanical ventilation by use of nasopharyngeal high-frequency oscillatory ventilation: a preliminary study"

STUDY DESIGN: This was an observational study of 20 mechanically ventilated neonates [median (range) birth weight 635 (382-1020)g, median gestational age 25.3 (23.7-27.6) weeks] at high risk for extubation failure. Nine infants had failed at least one previous extubation. Fourteen infants were given hydrocortisone. All 20 infants were extubated into nHFOV, with a mean airway pressure of 8 cmH(2)O, an amplitude of 20 cmH(2)O, and a frequency of 10 Hz.

RESULTS: Infants remained on nHFOV for a median duration of 136.5 (7.0-456.0) h until further weaning to continuous positive airway pressure (n = 14) or reintubation (n = 6). Reintubation was performed in 1 of 11 infants who had not experienced any previous extubation, and in five of nine infants who had experienced at least one previous extubation (P < 0.05). PaCO(2) was virtually unchanged from preextubation levels 2 h after extubation, but declined significantly at 32 h from 59.8 (45.0-92.3) mmHg to 50.7 (39.8-74.4) mmHg (P < 0.01). PaCO(2) returned to preextubation levels upon discontinuation of nHFOV.

CONCLUSION: This small observational study demonstrates that nHFOV can be successfully applied to wean premature infants from ventilator support.

Czernik C; J Matern Fetal Neonatal Med. 2012 Apr;25(4):374-8.

„High-frequency nasal ventilation for 21 d maintains gas exchange with lower respiratory pressures and promotes alveolarization in preterm lambs"

METHODS: Preterm lambs were exposed to antenatal steroids and treated with perinatal surfactant and postnatal caffeine. Lambs were intubated and resuscitated by IMV. At ~3 h of age, half of the lambs were switched to noninvasive HFNV. Support was for 3 or 21 d. By design, Pao2 and Paco2 were not different between groups.

RESULTS: At 3 d (n = 5) and 21 d (n = 4) of HFNV, fractional inspired O2 (FiO2), peak inspiratory pressure (PIP), mean airway, intratracheal, and positive end-expiratory pressures, oxygenation index, and alveolar-arterial gradient were significantly lower than matched periods of intubation and IMV. Pao2/FiO2 ratio was significantly higher at 3 and 21 d of HFNV compared to matched intubation and IMV. HFNV led to better alveolarization at 3 and 21 d.

CONCLUSION: Long-term HFNV provides acceptable gas exchange at lower inspired O2 levels and respiratory pressures compared to intubation and IMV.

Null DM, Pediatr Res. 2014 Apr;75(4):507-16.

„Mechanism of reduced lung injury by high-frequency nasal ventilation in a preterm lamb model of neonatal chronic lung disease"

„In lambs managed by IMV, the abundance of key homeostatic alveolar epithelial-mesenchymal markers was reduced, whereas it was significantly increased in the HFNV group, providing a potential molecular mechanism by which "gentler" modes of ventilation reduce neonatal CLD."

Rehan VK, Pediatr Res. 2011 Nov;70(5):462-6

Use of Noninvasive High-Frequency Ventilation in the Neonatal Intensive Care Unit: A Retrospective Review

Study Design: Retrospective case series including all 79 instances of NIHFV use at four participating centers between July 2010 and September 2012.

Results: In 73% of cases, NIHFV was used as rescue after another noninvasive mode, and prophylactically (postextubation) in the remainder. In 58% of cases, infants transitioned to another noninvasive mode, without requiring intubation. There were significant reductions in the mean (SD) number of apneas, bradycardias, or desaturations (over 6 hours) (3.2 [0.4] vs. 1.2 [0.3]; $p < 0.001$), FiO_2 (48 [3] vs. 40 [2]%; $p < 0.001$) and CO_2 levels (74 [6] vs. 62 [4] mm Hg; $p = 0.025$] with NIHFV. No NIHFV-related complications were noted.

Conclusions: NIHFV is a promising NIV mode that may help prevent or delay intubation and deserves further clinical research.

Mukerji A, Amer J Perinatol 2015; 32(02): 171-176

„Nasal high-frequency oscillation ventilation in neonates: a survey in five European countries"

Nasal high-frequency oscillation ventilation (nHFOV) is a non-invasive ventilation mode that applies an oscillatory pressure waveform to the airways using a nasal interface. nHFOV has been shown to facilitate carbon dioxide expiration, but little is known about its use in neonates. In a questionnaire-based survey, we assessed nHFOV use in neonatal intensive care units (NICUs) in Austria, Switzerland, Germany, the Netherlands, and Sweden. Questions included indications for nHFOV, equipment used, ventilator settings, and observed side effects. Of the clinical directors of 186 NICUs contacted, 172 (92 %) participated. Among those responding, 30/172 (17 %) used nHFOV, most frequently in premature infants <1500 g (27/30) for the indication nasal continuous positive airway pressure (nCPAP) failure (27/30). Binasal prongs (22/30) were the most common interfaces. The median (range) mean airway pressure when starting nHFOV was 8 (6-12) cm H2O, and the maximum mean airway pressure was 10 (7-18) cm H2O. The nHFOV frequency was 10 (6-13) Hz. Abdominal distension (11/30), upper airway obstruction due to secretions (8/30), and highly viscous secretions (7/30) were the most common nHFOV side effects.

Fischer HS, Eur J Pediatr. 2015 Apr;174(4):465-71

„Non-invasive high-frequency ventilation versus bi-phasic continuous positive airway pressure (BP-CPAP) following CPAP failure in infants <1250 g: a pilot randomized controlled trial"

STUDY DESIGN: Infants with BW<1250 g on CPAP were randomly assigned to NIHFV or BP-CPAP if they met pre-determined criteria for CPAP failure. Infants were eligible for randomization after 72 h age and until 2000 g …

RESULTS: Thirty-nine infants were randomized to NIHFV (N=16) or BP-CPAP (N=23). There were no significant differences in mean (s.d.) postmenstrual age (28.6 (1.5) versus 29.0 (2.3) weeks, P=0.47), mean (s.d.) weight at randomization (965.0 (227.0) versus 958.1 (310.4) g, P=0.94) or other baseline demographics between the groups. Failure of assigned NRS mode was lower with NIHFV (37.5 versus 65.2%, P=0.09), although not statistically significant. There were no differences in rates of invasive MV 72 h and 7 days post-randomization or BPD.

CONCLUSION: NIHFV was not superior to BP-CPAP in this pilot study. Effectiveness of NIHFV needs to be proven in larger multi-center, appropriately powered trials before widespread implementation.

Mukerji A, J Perinatol. 2017 Jan;37(1):49-53

nHFV

- Respirator vs urządzenie do nCPAP
- Osprzęt: rurka intubacyjna vs maseczka nosowa vs kaniule donosowe (krótkie, długie, wąskie, szerokie)

Leakage in nasal high-frequency oscillatory ventilation improves carbon dioxide clearance-A bench study

RESULTS: nHFOV with moderate leakage was more effective in CO_2 elimination than without leakage ($P < 0.001$) for all tested amplitudes and frequencies. Maximum leakage resulted in highly variable, partly ineffective CO_2 elimination.

CONCLUSIONS: A moderate oral leakage rather improves than impairs gas exchange during non-invasive ventilatory support with nHFOV.

Klotz D, Pediatr Pulmonol. 2017;52:367-372

Parametry nHFV- respirator

- MAP: 4 – 7 - 8 – 10 cmH2O
  10 – 16 cmH2O w BPD
- Częstotliwość: 6 - 8 – 10 - 13 Hz
- Amplituda: 25 - 35 - 60 cmH2O
  30-50 cmH2O w BPD
- TI: 0,33-0,5 sek

Colaizy TT, Acta Paediatr. 2008, De Luca D, Pediatr Pulmonol. 2012, Fischer HS, Eur J Pediatr. 2015 , De Luca D, Arch Dis Child Fetal Neonatal, 2016

„Nasal high-frequency oscillation for lung carbon dioxide clearance in the newborn"

METHODS: A newborn mannequin with dimensions and anatomy similar to a term infant was utilized. It was connected to a commercially available neonatal mechanical ventilator using a manufacturer-provided nasal adaptor. Various modes of noninvasive ventilation were compared as CO_2 clearance was measured at the oropharynx by an end-tidal CO_2 analyzer following the addition of a known amount of CO_2 into the lung. Measurements were obtained at two different lung compliances using nHFO and compared with nCMV and nasal continuous positive airway pressure (nCPAP) as a control. Pressures near the nasal adaptor and the larynx were simultaneously measured with in-line pressure transducers.

RESULTS: Whereas no CO_2 elimination was observed under nCPAP, its clearance with nHFO was 3-fold greater as compared to NIPPV. On nHFO, CO_2 clearance was inversely proportional to frequency and maximal at 6 and 8 Hz. At a lower lung compliance, CO_2 clearance was significantly higher at 6 Hz as compared to 10 Hz. During nHFO set to deliver a MAP of 10.0, we documented pressures of 7.2 ± 0.3 at the nasal adaptor and only 2.3 ± 0.3 cm H_2O at the larynx.

CONCLUSIONS: Nasal HFO is effective and superior to NIPPV at lung CO_2 elimination in a newborn mannequin model. The use of nHFO as the preferred mode of noninvasive ventilation warrants further clinical studies.

Mukerji A, Neonatology. 2013;103(3):161-5

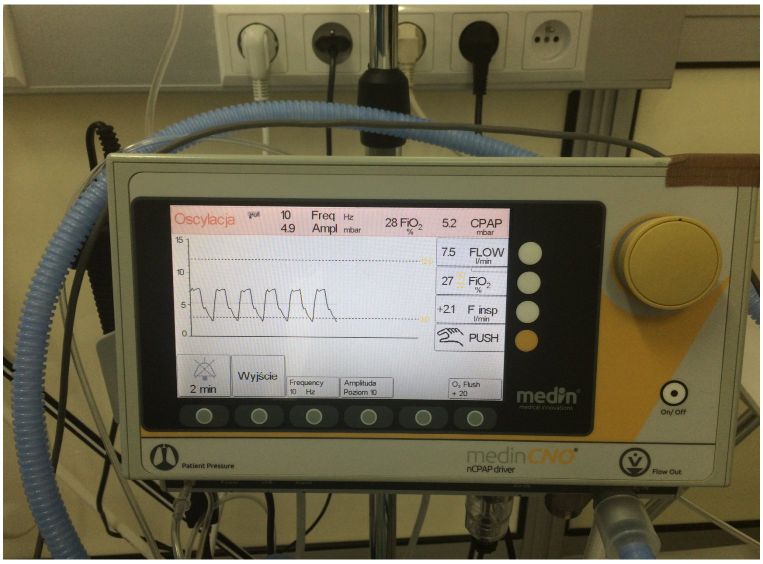
Effect of amplitude and inspiratory time in a bench model of non-invasive HFOV through nasal prongs

METHODS: In vitro mechanical study on a previously described bench model of nHFOV. The model was built connecting SM3100A tubings to a neonatal lung model, via two differently sized binasal prongs. A circuit with no nasal prongs was used as control. Tidal volume (T(v)), oscillatory pressure ratio (ΔP(dist) /ΔP(prox)), and ventilation (DCO(2)) were measured across a range of amplitudes and inspiratory times (I(T)). Measurements were performed with a low-dead space hot wire anemometer coupled with a pressure transducer.

RESULTS: …No differences were noticed between small and large prongs. T(v) and ΔP(prox) were linked by a quadratic relationship. T(v) plateaus for amplitude values >65 cmH(2)O. ΔP(dist) /ΔP(prox) shows same tendency. Same results were obtained with both types of prongs and with increasing I(T) . On the whole, mean T(v) was higher with I(T) at 50% than at 33% (2.4 ml vs. 1.4 ml; $P < 0.001$).

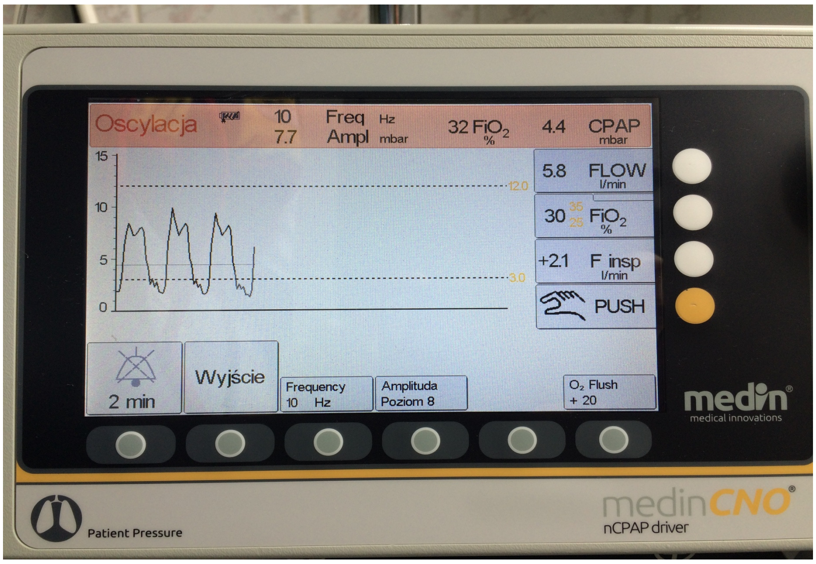
CONCLUSIONS: Changing oscillation amplitude and I(T) has a significant effect on ventilation. Varying these two parameters provides a theoretical T(v) within the ideal values for HFOV also using the smallest nasal prongs.

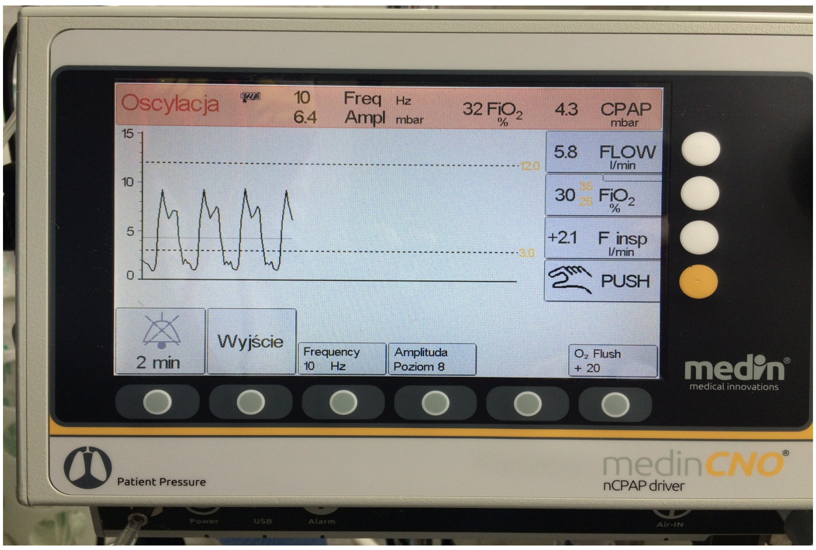
De Luca D, Pediatr Pulmonol. 2012 Oct;47(10):1012-8



Parametry nHFV- MedinCNO

- CPAP: 4-5 cmH2O
- Częstotliwość: 8 – 12 -15 Hz
- Amplituda: 7 - 10


Oscylacja
10 Freq Hz
7.7 Ampl mbar
32 FiO2 %
4.4 CPAP mbar
5.8 FLOW l/min
30 FiO2 %
+2.1 F insp l/min
PUSH
2 min
Wyjście
Frequency 10 Hz
Amplituda Poziom 8
O2 Flush + 20
medin
medical innovations
Patient Pressure
medinCNO
nCPAP driver


Oscylacja
10 Freq Hz
6.4 Ampl mbar
32 FiO2 %
4.3 CPAP mbar
5.8 FLOW l/min
30 FiO2 %
+2.1 F insp l/min
PUSH
2 min
Wyjście
Frequency 10 Hz
Amplituda Poziom 8
O2 Flush + 20
medin
medical innovations
Patient Pressure
medinCNO
nCPAP driver

nHFV po nCPAP

Nazwisko	Hbd	MC (g)	Włączenie NHFV	Czas stosowania NHFV
KS	35	2610	5 hż	7h
PS	36	2980	5 hż	44h
SS	37	3230	15 hż	5h
DC	29	1350	4 dż	3 dni
NS	38	3180	2 hż	16h
GFS	37	2025	28 hż	8,5h
GC	30	1470	I/ 30 hż; II/ 78hż	I/ 24h; II/ 5,5 dni
KC	36	2410	12 hż	11h
MC	36	2700	16 hż	20h
KS	32	1540	56 hż - 2,5 dż	36h
BC	26	820	14 dż	36h
HS	24	600	74 dż	5,5 dni
WS	32	800	21dż	2 dni
TS	30	1620	19 hż	35h
PC	32	1240	5,5 hż	36h

nHFV po MW

Nazwisko	Hbd	MC (g)	Włączenie NHFV	Czas stosowania NHFV
DC	30	1600	I/ 4hż; II/ 16 dż	I/ 27h; II/ 3 dni
FC	29	1220	11 dż	3dni
JC	31	1560	4,5 dż	2dni
SC	26	860	12 dż	11dni
BS	26	870	35 dż	4 dni
ĆC	29	860	9 dż	2 dni
BC	29	1550	7,5 hż	40h
WC	24	622	102 dż	11dni
RJC	25	830	45 dż	6 dni

Nieefektywne nHFV

Nazwisko	Hbd	MC (g)	Włączenie NHFV	Czas stosowania NHFV
BS	38	2530	2 hż	18h
PS	31	1640	6,5 hż	30h
Łc	33	1890	20 hż	23h
LS	30	1330	23 hż	9h
LC	30	1540	36 hż	9h
KBC	29	870	44 hż	4h

Parametry nHFV

Nazwisko	Amp/Częstotliwość	Nazwisko	Amp/Częstotliwość	Nazwisko	Amp/Częstotliwość
KS	7 / 10Hz	DC	I: 10 / 10-12Hz	BS	10 /10Hz
PS	10 /10Hz		II: 7 / 10Hz	PS	10 / 10Hz
SS	10 / 15Hz	FC	10 / 10Hz	ŁC	7-10 / 10Hz
DC	10 / 10Hz	JC	10 / 10Hz	LS	10 / 10Hz
NS	7 / 10Hz	SC	10 / 10Hz	LC	10 / 10Hz
GFS	10 / 10Hz	BS	8 / 12Hz	KBC	10 / 10Hz
GC	10 / 10Hz	ĆC	10 / 10Hz		
KC	10 / 10Hz	BC	10 / 10Hz		
MC	10 / 10Hz	WC	10 / 10Hz		
KS	10 / 10Hz	RJC	8 / 10Hz		
BC	10-7 / 10-8 Hz				
HS	7 / 10Hz				
WS	7 / 10Hz				
TS	10 / 10Hz				
PC	7 / 10Hz				

nHFV po nCPAP

Nazwisko	Gazometria przed NHFO	Gazometria po ok.1h NHFO	FiO2 przed - po
KS	pH 7,20; pCO2 62; BE(-3,8); HCO3 24,2	pH 7,24; pCO2 55; BE(-3,8); HCO3 23,6	0,25 - 0,25
PS	pH 7,18; pCO2 69; BE(-2,6); HCO3 25,8	pH 7,25; pCO2 59; BE(-1,3); HCO3 25,9	0,25 - 0,25
SS	pH 7,19; pCO2 76; BE(0,8); HCO3 29,0	pH 7,28; pCO2 58; BE(0,6); HCO3 27,3	0,25 - 0,25
DC	pH 7,28, pCO2 50; BE (-3,2); HCO3 23,5	pH 7,22; pCO2 54; BE (-5,6); HCO3 22,1	0,5 - 0,4
NS	pH 7,21; pCO2 64; BE (-2,3); HCO3 25,6,	pH 7,29; pCO2 51; BE (-2,1); HCO3 24,5	0,3 - 0,21
GFS	pH 7,26; pCO2 70; BE (4,3); HCO3 31,4	pH 7,37; pCO2 46; BE (1,3); HCO3 26,7	0,21 - 0,21
GC	I/ pH 7,29; pCO2 59; BE (1,8); HCO3 28,4+ B	I/ pH 7,29, pCO2 54; HCO3 26,0; BE (-0,6)	I/ 0,6 - 0,7
	II/ pH 7,24; pCO2 70; HCO3 30,0; BE 2,6	II/ pH 7,26; pCO2 71; HCO3 31,9; BE 4,8	II/ 0,35 - 0, 3
KC	pH 7,17; pCO2 76; BE (-0,8); HCO3 27,7	pH 7,21; pCO2 65; BE (-1,9); HCO3 26,0	0,25 - 0,21
MC	pH 7,19; pCO2 74; BE(0,1); HCO3 28,3	pH 7,31; pCO2 40; BE (-6,2), HCO3 20,1	0,21 - 0,21
KS	pH 7,24, pCO2 63; BE (-0,4); HCO3 27,0	pH 7,33; pCO2 49; BE (-0,1); HCO3 25,8	0,4 - 0,21
BC	pH 7,25; pCO2 71; BE 3,9, HCO3 31,1	pH 7,28; pCO2 66; BE 5,7; HCO3 32,4	0,45 - 0,35
HS	pH 7,19; pCO2 91; BE 6,6, HCO3 34,8	pH 7,25; pCO2 77; BE 6,6; HCO3 33,8	0,4 - 0,3
WS	pH 7,32; pCO2 74; BE 12, HCO3 38,1	pH 7,36; pCO2 62; BE 9,6; HCO3 35	0,28 - 0,25
TS	pH 7,22; pCO2 59; BE -3,6 HCO3 24	pH 7,28; pCO2 51; BE -2,7; HCO3 24	0,5 - 0,4
PC	pH 7,23; pCO2 54; BE -5; HCO3 22,8+ B	pH 7,3; pCO2 50; BE(-1,8); HCO3 24,8	0, 25- 0,21

nHFV po MW

Nazwisko	Wspomaganie oddechu przed NHFV
DC	nCPAP+PA 4h - nHFO 27h - SNIPPV 3 dni -SIMV 5 dni - SNIPPV 6 dni - nHFO
FC	AC+VG/ AC 8 dni - SNIPPV 3 dni
JC	nCPAP+PA 2,5 dni - AC+VG 2 dni - SNIIPPV 30min
SC	AC+VG 6h - nCPAP+PA
BS	SIMV 6,5 dni - SNIPPV+BU
ĆC	SIMV 40h - nCPAP+PA
BC	AC+VG 5h - SNIPPV+BU
WC	SIMV/AC+VG 102 dni
RJC	AC+VG/SIMV 45 dni

nHFV po MW

Nazwisko	Gazometria przed NHFV	Gazometria po ok. 1h NHFV	FiO2 przed-po
DC	I/ pH 7,16, pCO2 74; BE (-2,3); HCO3 26,4	I/ pH 7,17; pCO2 70; BE (-0,7); HCO3 28,2	I/ 0,45 - 0,3
	II/ pH 7,29; pCO2 89; BE (16.2); HCO3 42,8	II/ pH 7,35; pCO2 74; BE 15,3; HCO3 40,9	II/ 0,25 - 0,25
FC	pH 7,24, pCO2 70; BE (2,6); HCO3 30,0	pH 7,32; pCO2 57; BE (3,3); HCO3 29,4	0,4 - 0,4
JC	pH 7,38; pCO2 35; BE (-4,4); HCO3 20,7+ B	pH 7,30; pCO2 39; BE (-7,2); HCO3 19,2	0,25 - 0,21
SC	pH 7,31; pCO2 59; BE 3,4; HCO3 29,7+ B	pH 7,26, pCO2 56, BE (-2,0), HCO3 25,1	0,27- 0,25
BS	pH 7,30, pCO2 82; BE 13,9, HCO3 40,3+ B	pH 7,31; pCO2 78; BE 13,0; HCO3 39,3	0,35 - 0,25
ĆC	pH 7,23; pCO2 68; BE (-0,8); HCO3 23,4	pH 7,30; pCO2 54; BE (0,2); HCO3 26,6	0,25 - 0,21
BC	pH 7,22; pCO2 59; BE (-3,6), HCO3 24,1	pH 7,30; pCO2 51; BE (-1,3); HCO3 25,1	0,35 - 0,35
WC	pH 7,36; pCO2 57; BE 6,8; HCO3 32,2	pH 7,28; pCO2 71; BE(6,7); HCO3 33,4	0,4 - 0,4 - 0,27
RJC	pH 7,36; pCO2 50; BE 2,8; HCO3 28,2	pH 7,30; pCO2 63; BE (4,6);HCO3 30,0	0,57 - 0,4

Nieefektywne nHFV

Nazwisko	Wspomaganie oddechu przed NHFV
BS	nCPAP+PA 2h - nHFV 18h - AC+VG/SIMV 11 dni - SNIPPV – przekazanie na OITDz SPSK1 w 12 dniu
PS	nCPAP 6,5h - nHFV29h - AC 4,5 dni - SNIPPV 1,5 dnia
ŁC	nCPAP+PA 20h - nHFV 23h - AC/SIMV 5 dni - NIPPV 24h
LS	nCPAP+PA 23h - nHFV 9h - SIMV 5 dni - SNIPPV 4 dni
LC	SNIPPV+BU 36h - nHFV 9h - SIMV 4 dni - NIPPV 8 dni
KBC	nCPAP+PA 44h - nHFV 5h - SIMV 41h - SNIPPV 4 dni

Nieefektywne nHFV

Nazwisko	Rozpoznania	Czas wentylacji
BS	zakażenie wrodzone, nawracająca odma opłucnowa lewostronna, krwawienie z płuc, nadciśnienie płucne	12 dni- OITDz
PS	hsPDA, hiperbilirubinemia, konflikt ABO, ZUM	7,5 dnia
ŁC	zakażenie wrodzone, hsPDA	8 dni
LS	zakażenie wrodzone, drgawki	11 dni
LC	RDSII, odma opłucnowa lewostronna, zakażenie wrodzone, śródmiąższowe zapalenie płuc	15 dni
KBC	zakażenie wrodzone, hsPDA, NEC, BPD	21 dni

Nieefektywne nHFV

Nazwisko	Gazometria przed NHFO	Gazometria po ok.1h NHFO	FiO2 przed-po
BS	pH 7,16; pCO2 77; BE (-1,3), HCO3 27,4	pH 7,14; pCO2 79; BE (-2,1); HCO3 26,9	0,25 - 0,25
		po 2h: pH 7,26; pCO2 53; BE (-3,3); HCO3 23,8	
PS	pH 7,12; pCO2 70; BE (-6,5); HCO3 22,8	pH 7,17; pCO2 67; BE (-4,1); HCO3 24,4	0,3 - 0,6
		po 6h: pH 7,32; pCO2 46; BE (-2,4); HCO3 23,7	
ŁC	pH 7.24, pCO2 61; BE (-1,3), HCO3 26.1	pH 7.25, pCO2 59, BE (-1,3), HCO3 25.9	0,45 - 0,8
LS	pH 7,19; pCO2 56; BE (-6,8); HCO3 21,4	pH 7,18; pCO2 60; BE (-6,0); HCO3 22,4	0,75 - 0,6
		po 3h: pH 7,21; pCO2 55, BE (-5,9); HCO3 22,0,	
LC	pH 7,15; pCO2 65; BE (-6,3); HCO3 22,6	pH 7,21; pCO2 60; BE (-3,9); HCO3 24,0	0,8 - 0,75
KBC	pH 7,22; pCO2 58; BE (-4), HCO3 23,7	pH 7,19; pCO2 66; BE (-3); HCO3 25,2;	0,6 - 0,8