

Ventilación No Invasiva en Pediatria

KLGO. JOSÉ LANDEROS



1

Evidencias

Falla Respiratoria Aguda Hipoxémica

Akingbola OA *Critical Care Medicine* 1994; 22:A144

Estudio retrospectivo BiPAP-S/ Máscara nasal 8m-20m

Intubados 0/9, mejoría del intercambio gaseoso a la hora

Fortenberry JD *Chest* 1995; 108:1059-1064

Estudio retrospectivo BiPAP S/Máscara nasal 4m-17a

Intubados 3/28, mejoría del intercambio gaseoso a la hora

Padman R *Critical Care Medicine*; 1998; 26:169-173

Estudio prospectivo BiPAP-ST/Máscara nasal 6m-20a

Intubados 3/34, mejoría del intercambio gaseoso, FR, FC y disnea a las 72 horas

2

Falla respiratoria hipercárbica

Padman R *Pediatric Pulmonology* 1994; 17:119-123
Estudio retrospectivo BiPAP-S Máscara nasal 4a-21a
Intubados 1/8, mejoría de FC,FR y HCO₃ a las 72 h

Padman R *Respiratory Care* 1994; 39:736-739
Estudio retrospectivo BiPAP-S Máscara nasal 7a-30a
Intubados 0/9, mejoría de FC,FR y HCO₃ a las 72 h

Niranjan V *Critical Care Medicine* 1998;26: 2061-2065
Estudio de casos control BiPAP-ST Máscara nasal 13a-21a
Intubados 0/10

Hertzog JH *Paediatric Anaesthesia* 1996;6:219-224
Estudio retrospectivo BiPAP-S Máscara nasal 4a-20a
Intubados 5/11, mejoría de intercambio gaseoso y t de estadía en UTI

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Am J Phys Med Rehabil. 1989 Dec;68(6):264-71.

Management alternatives for post-polio respiratory insufficiency. Assisted ventilation by nasal or oral-nasal interface.

Bach JR, Alba AS, Shin D.

Department of Physical Medicine and Rehabilitation, University Hospital, New Jersey Medical School, Newark.

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Noninvasive positive-pressure ventilation in children with lower airway obstruction*

Peter J. Thill, MD; John K. McGuire, MD; Harris P. Baden, MD; Thomas P. Green, MD;
Paul A. Checchia, MD, FAAP

Pediatr Crit Care Med 2004 Vol. 5, No. 4

Table 1. Clinical Asthma Score

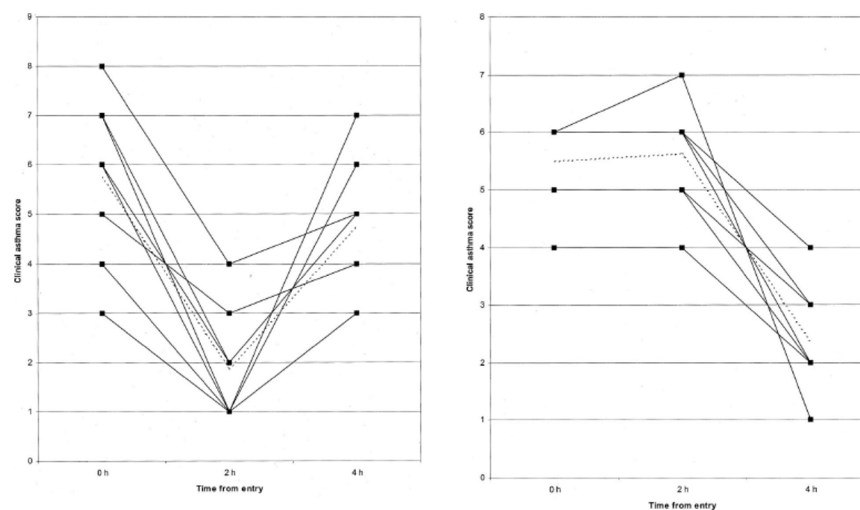
Severity	Accessory Muscle Score	Wheeze Score	Dyspnea Score
0	No retractions	No wheeze	Absent dyspnea
1	Intercostal retractions	End-expiratory wheeze	Normal activity and speech, minimal dyspnea
2	Intercostal and suprasternal retractions	Pan-expiratory $\pm$ inspiratory wheeze	Decreased activity, 5-8 word sentences, moderate dyspnea
3	Nasal flaring	Wheeze audible without stethoscope	Concentrates on breathing, <5-word sentences, severe dyspnea

Reproduced with permission from Schuh et al (14).

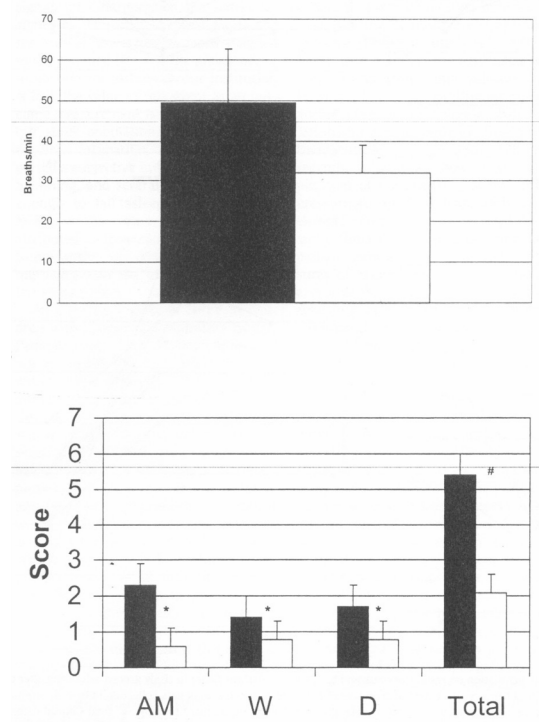
Methods: Children were randomized to receive either 2 hrs of non-invasive ventilation followed by crossover to 2 hrs of standard therapy or 2 hrs of standard therapy followed by 2 hrs of noninvasive ventilation.

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Score de Asma



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	Control group	BPAP group	P value
Resp rate(breath/min)			
Baseline	49.6 ± 12.2	49.8 ± 14.4	NS
1	45.8 ± 11.8	35.5 ± 10.9**	0.004
6	48.05 ± 11.7	37 ± 12.4	NS
12	41 ± 12.02	33.3 ± 9.6	NS
24	44.4 ± 13.6	31.3 ± 8.6	NS
48	33.6 ± 11.9	30.7 ± 8.8	NS

A prospective, randomized, controlled trial of noninvasive ventilation in pediatric acute respiratory failure[®]

Pediatr Crit Care Med 2008 Vol. 9, No. 5

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	Control group	BPAP group	P value
PaFi			
Baseline	204 ± 87.1	172.6 ± 75.8	NS
1	222.8 ± 104.3	240.5 ± 97.3***	NS
6	210.1 ± 61.1	217.9 ± 90.3	NS
12	224.9 ± 109.9	232.4 ± 81.6	NS
24	212 ± 82.5	269.6 ± 99.8	NS
48	221.6 ± 92.4	255.6 ± 108.2	NS

A prospective, randomized, controlled trial of noninvasive ventilation in pediatric acute respiratory failure*

Pediatr Crit Care Med 2008 Vol. 9, No. 5

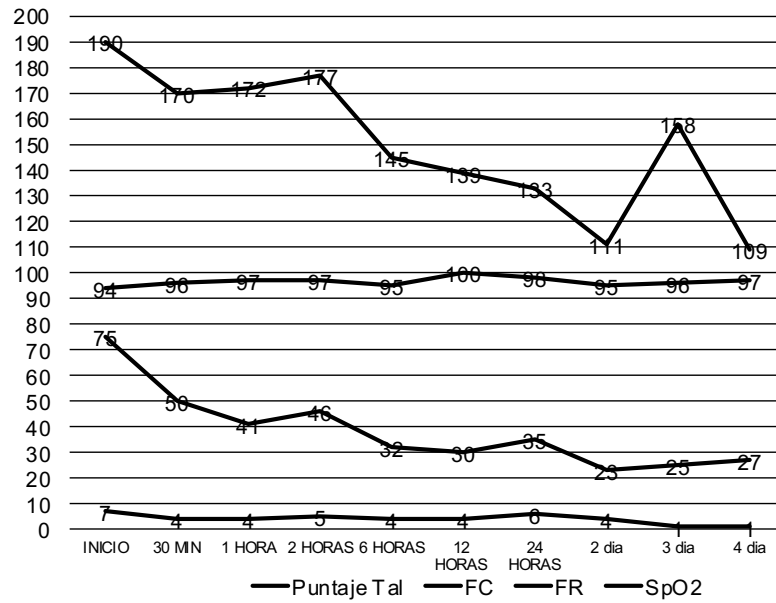
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Complicaciones

	Control group (n=25)	BPAP group (n=25)	P value
Intubation (N°)	15 (60%)	7 (28%)	0.045
Ventilator associated pneumonia	2/15	2/7	
Postextubation Laryngitis	1/15	1/7	
Period of MV (mean days)	3.12	2.64	
ICU stay (mean days)	5.48	6.68	NS
Hospital stay (mean days)	10.6	10.4	

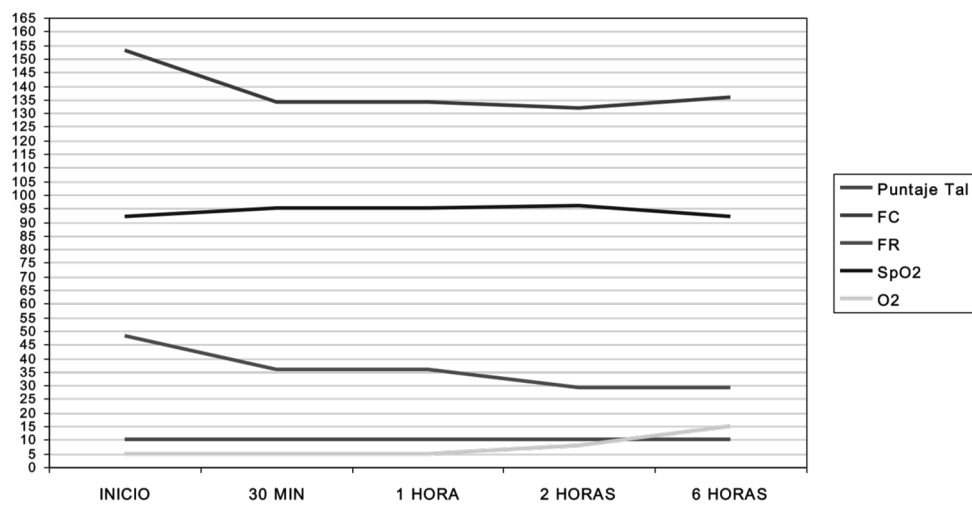
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Paciente que responde



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Paciente que no responde



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Efectos fisiológicos

- Reducción del trabajo ventilatorio inspiratorio con mejoría del patrón ventilatorio y del intercambio gaseoso.

Essouri et al, Intensive Care Med 2008

Stucky et al, Intensive Care Med 2009

- Incremento de la oxigenación y de la remoción del CO₂: Reclutamiento alveolar
- Prevención de las apneas en RNPT, por estabilización de la parrilla costal y de la vía aérea superior

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OPEN

Outcomes for Children Receiving Noninvasive Ventilation as the First-Line Mode of Mechanical Ventilation at Intensive Care Admission: A Propensity Score-Matched Cohort Study

Jenny V. Morris, MSc¹; Padmanabhan Ramnarayan, FFICM²; Roger C. Parslow, PhD¹; Sarah J. Fleming, PhD¹

Cohorte Prospectiva 2007-2014 / 31 UCIP
 Pacientes ingresados a UCIP que recibieron VM desde el primer día
 151.128 ingresos / 15.144 elegibles
 4.804 recibieron VNI inicial
 10.221 recibieron VM Invasiva inicial

Crit Care Med 2017 Jun; 45(6):1045-1053

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TABLE 2. Crude Outcomes for Patients Included in the Whole Cohort ($n = 15,025$) and Propensity Score-Matched Cohort ($n = 6,002$)

Outcome	Whole Cohort ($n = 15,025$)			Propensity Score Matching Cohort ($n = 6,002$)		
	Invasive Ventilation ($n = 10,221$)	NIV ($n = 4,804$)	p	Invasive Ventilation ($n = 3,001$)	NIV ($n = 3,001$)	p
PICU mortality (%)	9.6	4.4	< 0.001	8.5	5.9	< 0.001
Length of ventilation (d), median (IQR)	4 (2–7)	4 (2–7)	< 0.001	5 (3–9)	4 (2–7)	< 0.001
Length of stay (d), median (IQR)	5 (2–9)	5 (3–8)	< 0.001	6 (4–11)	5 (3–9)	< 0.001
VFD-28—all patients, median (IQR)	8 (0–24)	12 (0–22)	0.016	0 (0–16)	8 (0–22)	< 0.001
VFD-28—survivors only, median (IQR)	12 (0–24)	12 (0–22)	0.269	0 (0–16)	12 (0–22)	< 0.001
NIV failure rate, n (%)	NA	1,237 (25.7)	NA	NA	948 (33.3)	NA

IQR = interquartile range, NA = not applicable, NIV = noninvasive ventilation, VFD-28 = ventilation-free days at day 28.

A Wilcoxon rank-sum test was used to compare all continuous variables presented as mean (interquartile range), a two sample t test was used to compare continuous variables presented as mean (sd), and chi-square test of independence compared all categorical variables presented as n (%).

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Característica

Característica	COHORTE (n=15.025)		p	Análisis de Propensión		p
	VMI (n=10.221)	VMNI (n=4.804)		VMI (n=3.001)	VM(n=3.001)	
Arterial or capillary blood gas taken, ^b n (%)						
Yes	7,588 (74.2)	2,925 (60.9)	< 0.001	2,093 (69.7)	2,133 (71.1)	0.258
Lactate, ^b median (IQR)	1.9 (1.1–3.7)	1.6 (1.1–2.6)	< 0.001	1.8 (1.0–3.5)	1.6 (1.1–2.6)	0.014
Not recorded, n (%)	6,798 (66.5)	3,347 (69.7)		64.9	65.4	
Pao ₂ /Fio ₂ ratio, ^b median (IQR)	190.6 (102.6–354.6)	129.4 (85.7–200)	< 0.001	150 (86–258)	129 (84–202)	< 0.001
Not recorded, n (%)	5,923 (57.9)	3,998 (83.2)		64.7	78.2	
Base excess, ^b median (IQR)	-3.1 (-7.0 to 0.3)	1.0 (-2.0 to 4.8)	< 0.001	-1.4 (-5.3 to 2.1)	0.9 (-2.3 to 4.9)	< 0.001
Not recorded, n (%)	3,201 (31.3)	2,186 (45.5)		1,035 (34.5)	1,080 (36.0)	
Age-standardized systolic blood pressure ^b z score, mean (sd)	-0.03 (1.18)	0.13 (0.98)	< 0.001	0.061 (1.02)	0.089 (1.02)	0.288

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Respiratory rate (breaths/minute)

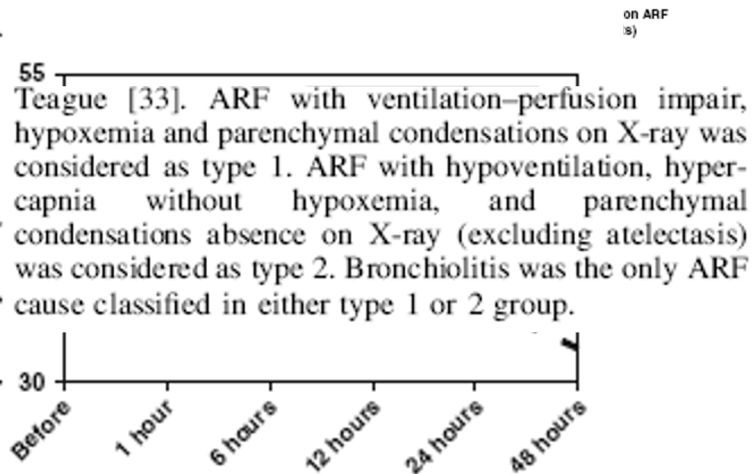


Fig. 2 Evolution of respiratory rate at the hours studied in type 1 and 2 acute respiratory failure groups. ARF acute respiratory failure

hypercapnic acute respiratory failure (ARF) due to conventional medical therapy [13]. NIV diminishes the

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Table 3 Parameters with significant differences between success and failure groups expressed in mean $\pm$ standard deviation (except for age and weight, expressed in median and range)

	Success group (N = 98)	Failure group (N = 18)	P value
Age (months)	11.6 (0.6–169.7) (N = 98)	6.1 (0.8–115.9) (N = 18)	0.028
Weight (kg)	9.6 (2.8–58.0) (N = 98)	6.3 (2.8–39.0) (N = 18)	0.016
PRISM score	7.4 $\pm$ 4.4 (N = 98)	11.7 $\pm$ 7.6 (N = 18)	0.026
HR at 24 h (beats/min)	129.7 $\pm$ 22.2 (N = 83)	149.6 $\pm$ 20.9 (N = 8)	0.033
RR at 24 h (breaths/min)	35.7 $\pm$ 8.3 (N = 83)	48.9 $\pm$ 11.6 (N = 8)	0.001
EPAP at 24 h (cmH ₂ O)	6.4 $\pm$ 1.3 (N = 83)	7.9 $\pm$ 1.0 (N = 8)	0.001
EPAP at 48 h (cmH ₂ O)	6.5 $\pm$ 1.5 (N = 52)	9 $\pm$ 2.6 (N = 4)	0.040
RR decrease in the first hour (breaths/min)	12.2 $\pm$ 12.9 (N = 98)	4.9 $\pm$ 11.9 (N = 18)	0.032
RR decrease at 24 h (breaths/min)	17.8 $\pm$ 16.4 (N = 83)	3.1 $\pm$ 18.2 (N = 8)	0.015
FiO ₂ at 1 h (%)	43.3 $\pm$ 18.9 (N = 98)	50.5 $\pm$ 19.0 (N = 18)	0.040
FiO ₂ at 6 h (%)	37.9 $\pm$ 14.6 (N = 98)	46.5 $\pm$ 14.7 (N = 13)	0.025
FiO ₂ at 24 h (%)	32.8 $\pm$ 9.4 (N = 83)	45.0 $\pm$ 14.9 (N = 8)	0.015
FiO ₂ at 48 h (%)	31.6 $\pm$ 8.9 (N = 52)	50.0 $\pm$ 14.1 (N = 4)	0.006
Venous PCO ₂ at 6 h (mmHg)	46.5 $\pm$ 9.9 (N = 19)	65.9 $\pm$ 10.7 (N = 3)	0.021
Venous PCO ₂ at 24 h (mmHg)	46.5 $\pm$ 7.6 (N = 19)	78.1 $\pm$ 36.8 (N = 3)	0.030

Number of episodes analyzed in each item is specified beside

HR heart rate, RR respiratory rate, EPAP expiratory pressure, PRISM paediatric risk of mortality

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Factores de Riesgo de Fracaso de NIV

	Success group (N = 98)	Failure group (N = 18)	P value
Variable			
Age (months)	11.6 (0.6–169.7)	6.1 (0.8–115.9)	0.028
Males	62.2%	77.8%	0.205
Weight (kg)	9.6 (2.8–58.0)	6.3 (2.8–39.0)	0.016
PRISM score	7.4 $\pm$ 4.4	11.7 $\pm$ 7.6	0.026
HR (beats/min)	162.4 $\pm$ 30.2	165.1 $\pm$ 22.4	0.972
RR (breaths/min)	53.5 $\pm$ 18.2	47.5 $\pm$ 14.5	0.231
FiO ₂ (%)	43.6 $\pm$ 23.5	40.8 $\pm$ 24.9	0.293
Venous PCO ₂ (mmHg)	48.6 $\pm$ 14.9	57.8 $\pm$ 14.3	0.062

- Falla aguda Tipo 1 (condensación)
- PRISM > 10
- Baja disminución de la FR la primera hora

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CHEST

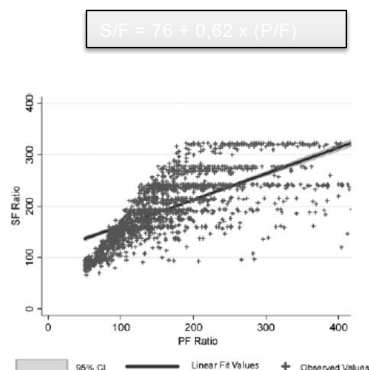
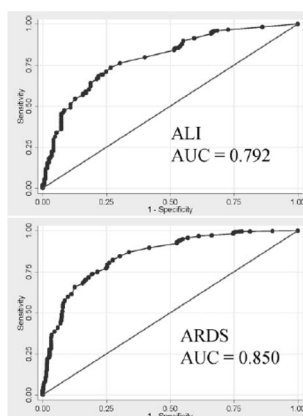
Original Research

CRITICAL CARE MEDICINE

Comparison of the Pulse Oximetric Saturation/Fraction of Inspired Oxygen Ratio and the Pao₂/Fraction of Inspired Oxygen Ratio in Children*

Robinder G. Khemani, MD, MSCI; Neal R. Patel, MD, MPH; Robert D. Bart, III, MD; and Christopher J. L. Neuch, MD

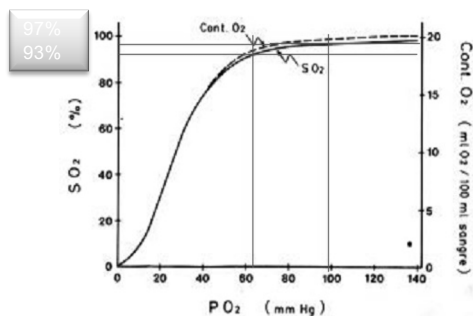
CHEST / 135 / 3 / MARCH, 2009



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	Rice Chest 2007	Khemani Chest 2009	Thomas PCCM 2010	Khemani PCCM 2012	Lobete JCC 2013
P/F					
300	315	263	253	264	296
200	235	201	242	224	236
100				148	146

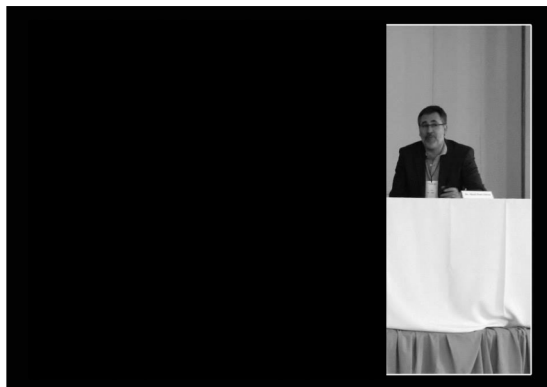
>270
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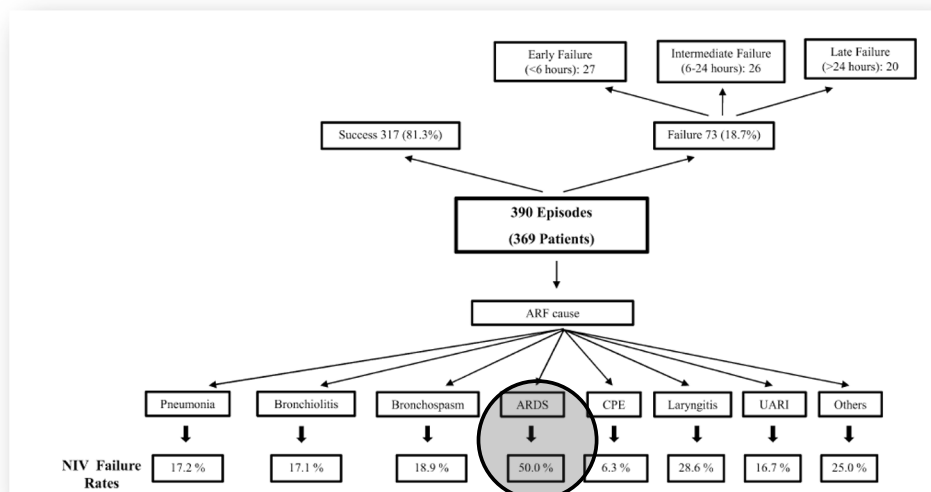
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Juan Mayordomo-Colunga
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Mirella Gáboli
Milagros García-López
Maria González-Sánchez
Paula Madurga-Revilla
Amelia González-Calvar
Eider Oñate

Predicting non-invasive ventilation failure in children from the $\text{SpO}_2/\text{FiO}_2$ (SF) ratio



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Table 2 Demographic and baseline characteristics of the successful and failed episodes

Patients' characteristics	Success group (N = 317)	Failure group (N = 73)	P value
Age (months)	6.6 (1.6–30)	5.8 (1.4–14.7)	0.015
Males (%)	89.1	86.3	0.613
Weight (kg)	7 (4.4–13)	6 (3.5–10)	0.036
Deaths	6 (1.9 %)	9 (12.3 %)	<0.001
PRISM III-24 score	3 (0–4)	5.5 (1–9)	<0.001
HR (beats/min)	161 (140–180)	155 (143–172)	0.471
RR (breaths/min)	49 (37–62)	43 (30.2–55)	0.071
FiO ₂ (%)	40 (28–75)	50 (30–72)	0.304
SpO ₂	96 (93–99)	97 (93–99)	0.965
Venous Pco ₂ (mmHg)	53.9 (44.4–64.2)	59.5 (49.2–74)	0.040
SF ratio	270 (153.7–372.8)	208.5 (162.3–329.1)	0.170
Venous pH	7.31 (7.25–7.37)	7.3 (7.25–7.34)	0.926
Venous lactate	1.7 (1.2–2.4)	1.4 (1.1–3.1)	0.756
NIV duration (hours)	60 (33–91)	13 (4–32.5)	<0.001

Data are expressed as median (interquartile range), or percentage. *P* values refer to the differences between NIV success and failure groups. PRISM III-24 was calculated within the first day of PICU admission

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Table 3 Predictive models of NIV outcomes. No predictive model could be calculated for episodes failing after 24 h upon NIV initiation

	AUC (CI 95 %)	Cutoff value (<i>Sn</i> – <i>Sp</i>)	PPV (CI 95 %)	NPV (CI 95 %)
Whole sample –0.059 × SF ratio at 1 h (10 units) – 0.030 × age (months) + 0.208 × PRISM III-24	0.755 (0.661–0.849)	–1.310 (86.2–57.8)	26.9 % (17.3–36.4)	95.9 % (89.8–98.9)
Episodes failing before 6 h SF ratio at 1 h	0.748 (0.588–0.908)	193 (77.8–70)	10.9 % (2.5–19.4)	98.5 % (94.6–99.8)
Episodes failing between 6 and 24 h 0.202 × PRISM III-24 – 0.074 × RR decrease at 6 h – 0.008 × SF ratio at 6 h (10 units)	0.895 (0.800–0.990)	–0.8 (87.5–83)	31.8 % (16.9–46.7)	98.5 % (94.9–99.8)

AUC area under the curve, *CI* confidence interval, *Sn* sensitivity (in %), *Sp* specificity (in %), *PPV* positive predictive value, *NPV* negative predictive value, *PRISM* pediatric risk of mortality

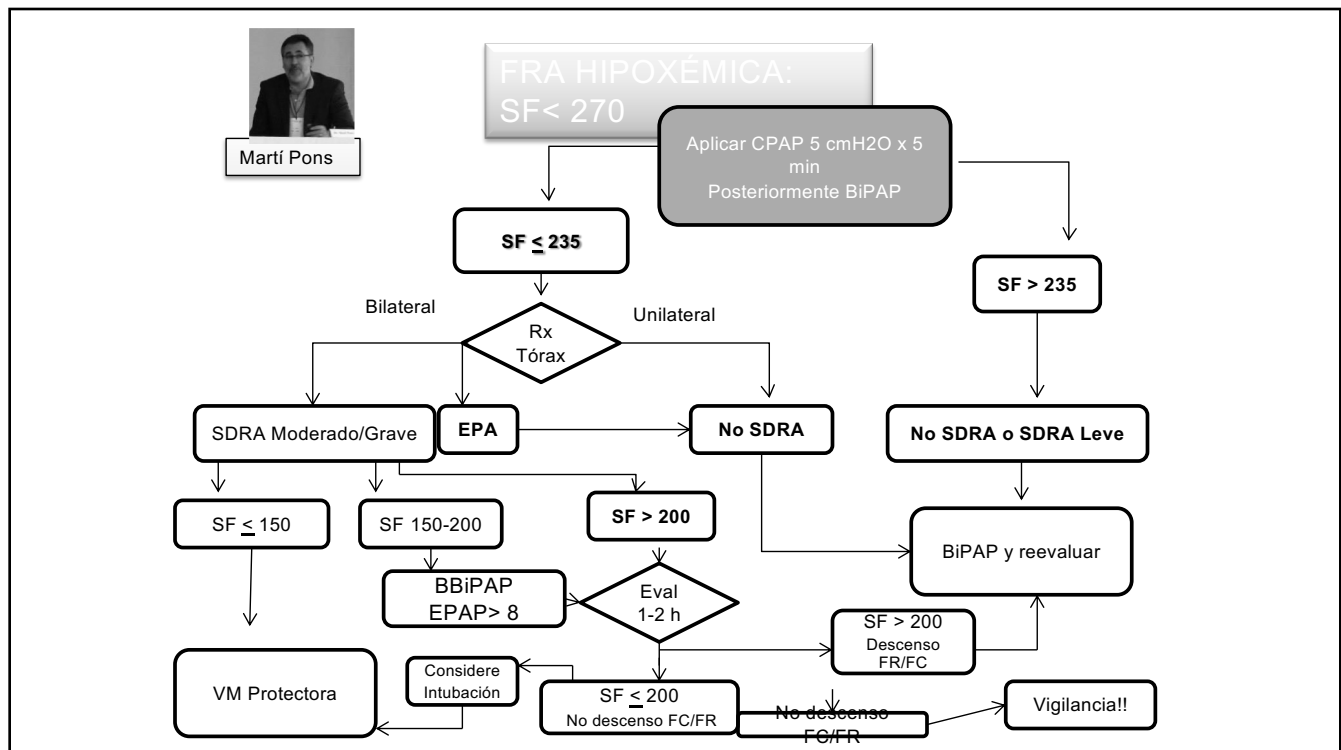
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Pacientes con mayor riesgo de fracaso de la VNI inicial

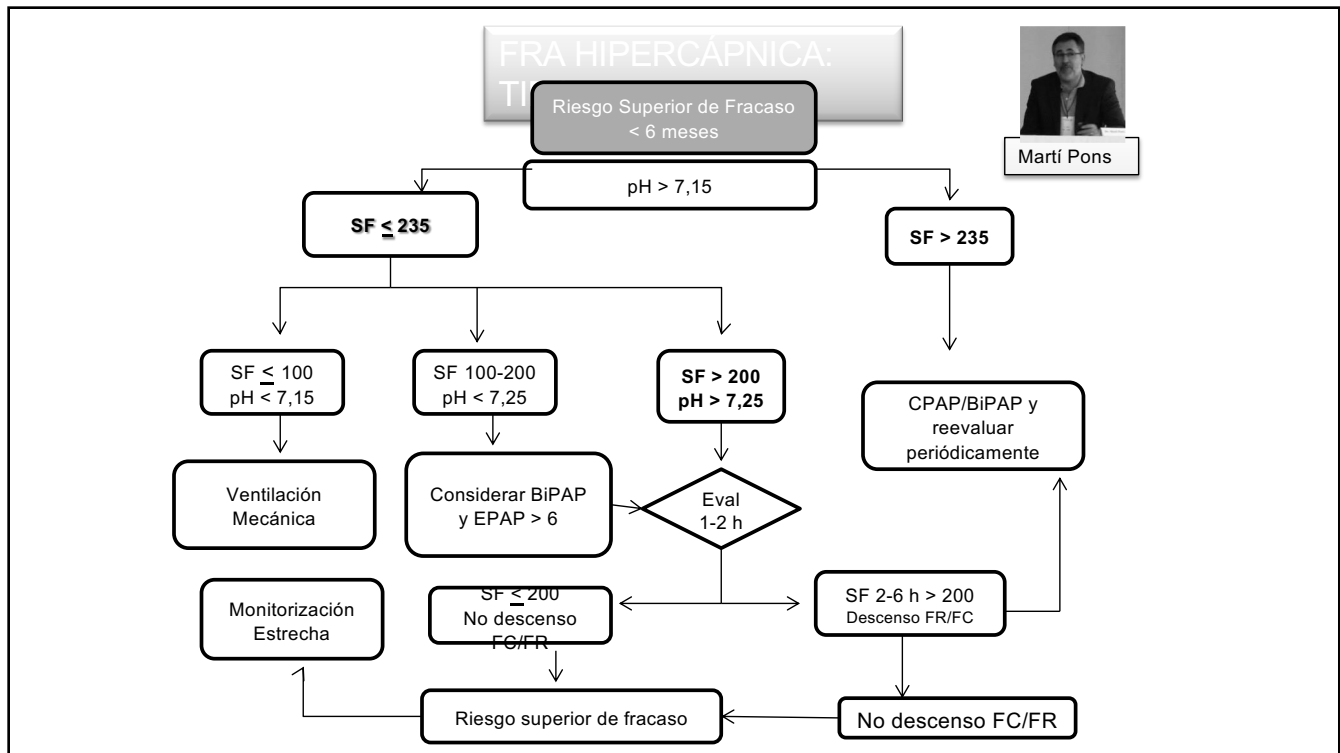
- **Hipoxemia (FRA Tipo I)**
- **Cociente SF < 200 1-2-6 horas**
- SDRA
- **Edad**
- Lactantes < 6 meses
- **NO MEJORA TRABAJO VENTILATORIO**
- No descenso de FR y FC a 2 horas
- Mayor IPAP a 2 horas; MAP > 11,5
- **pH < 7,25**
- **PRISM o PELOD elevado**

Martí Pons

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Factores de riesgo de fracaso de VNI

- Menores de 6 meses
- FRA Tipo 1 (Hipoxemia)
- Baja disminución de la FR y FC a la hora 1 (< 10 puntos para ambas)
- Baja disminución de la PaCO₂ a la hora 2 (<12 mmHg)
- Baja Sa/Fi a la hora 1-2 (< 200)
- Factor de riesgo cultural



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Aplíquela ANTES que el paciente esté agotado

SIRVE PARA TODAS
LAS TERAPIAS...

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