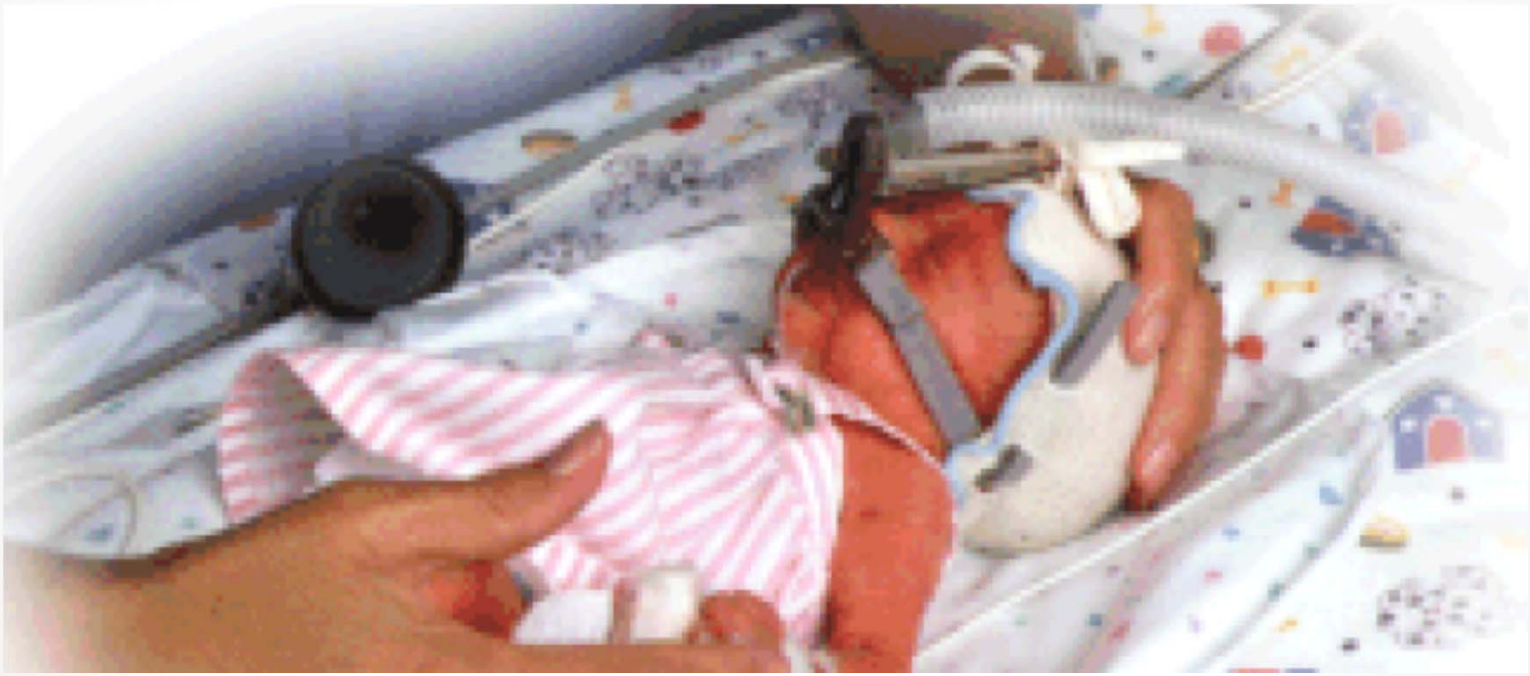
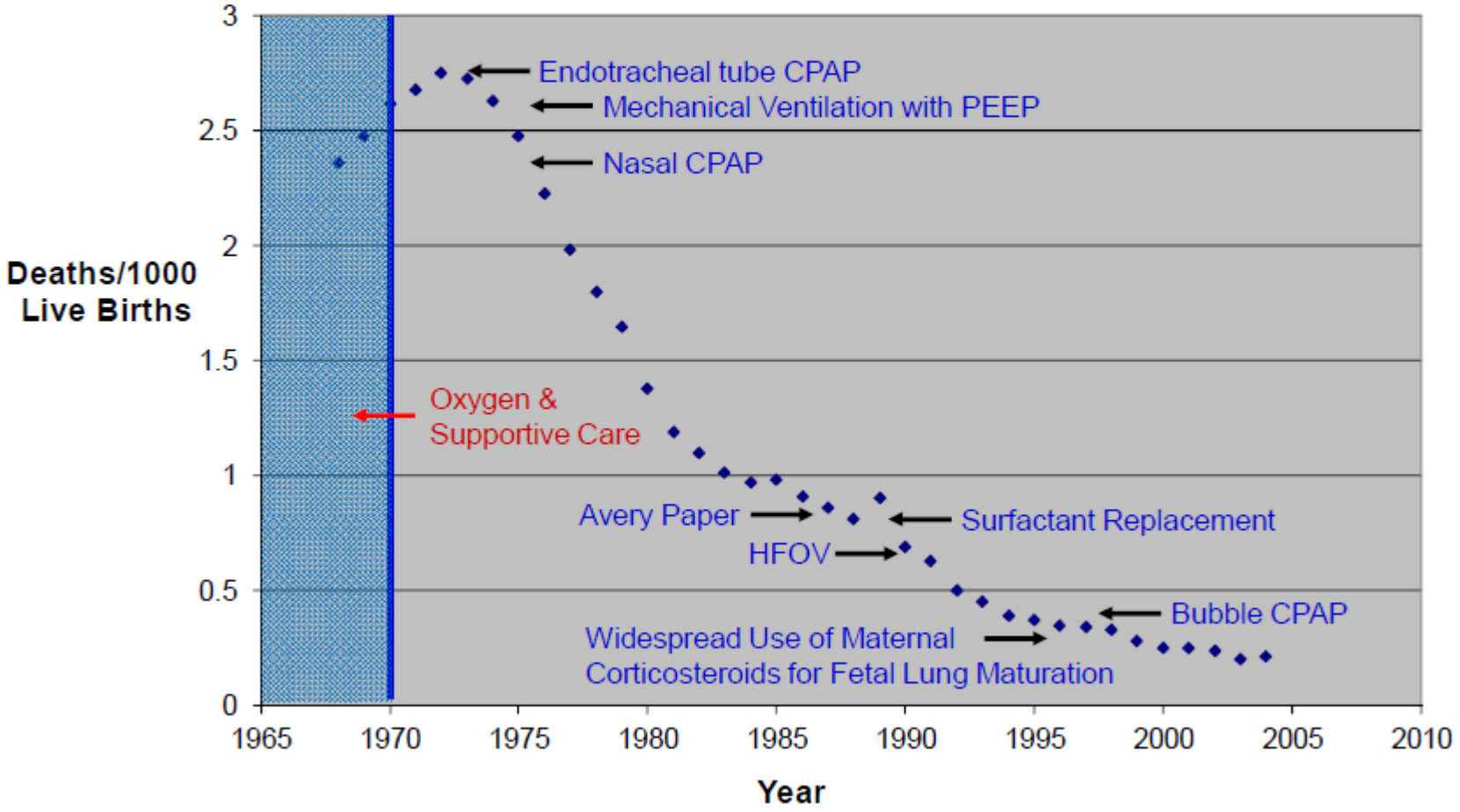
USO DE CPAP

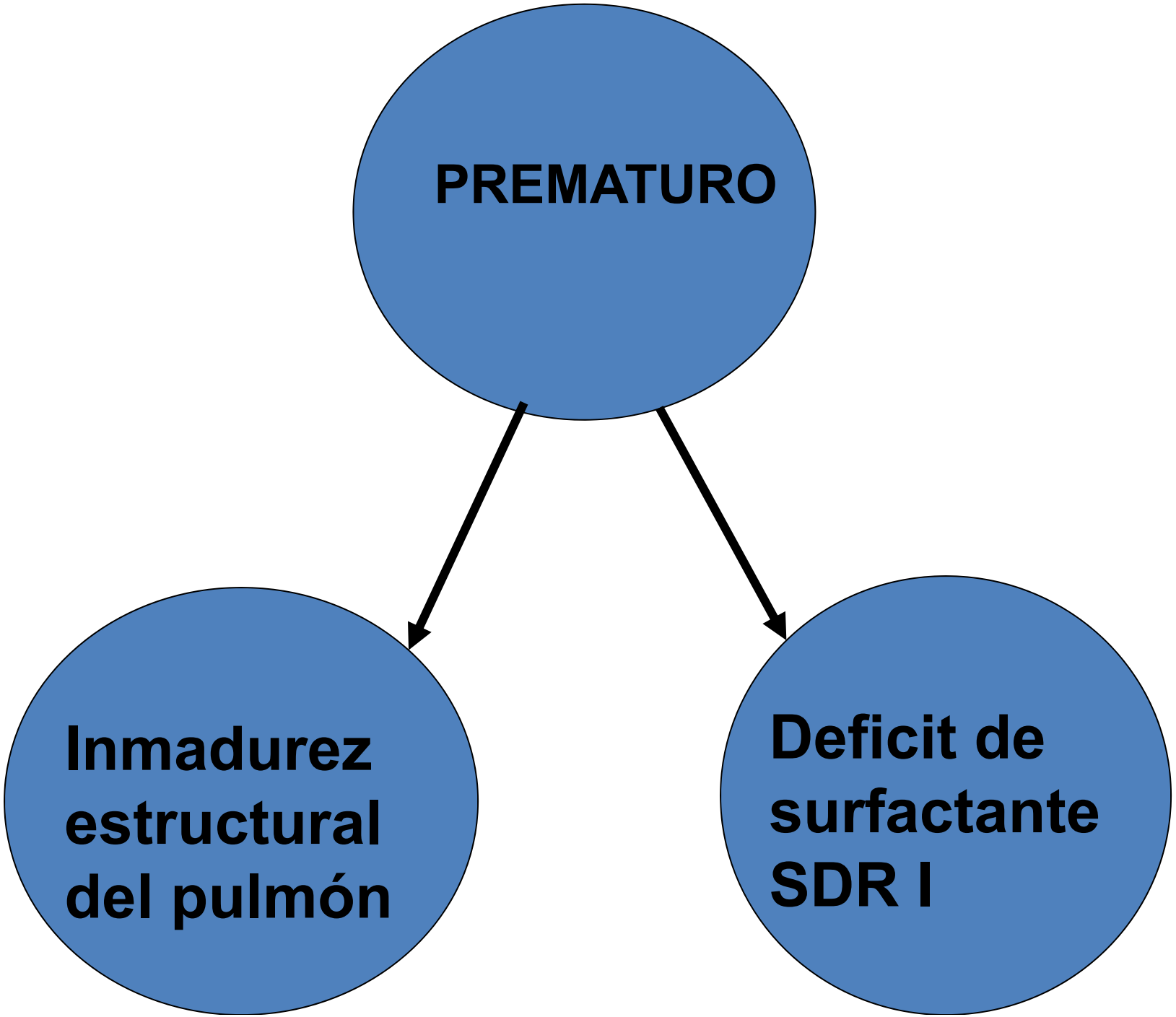
EN NEONATOLOGIA



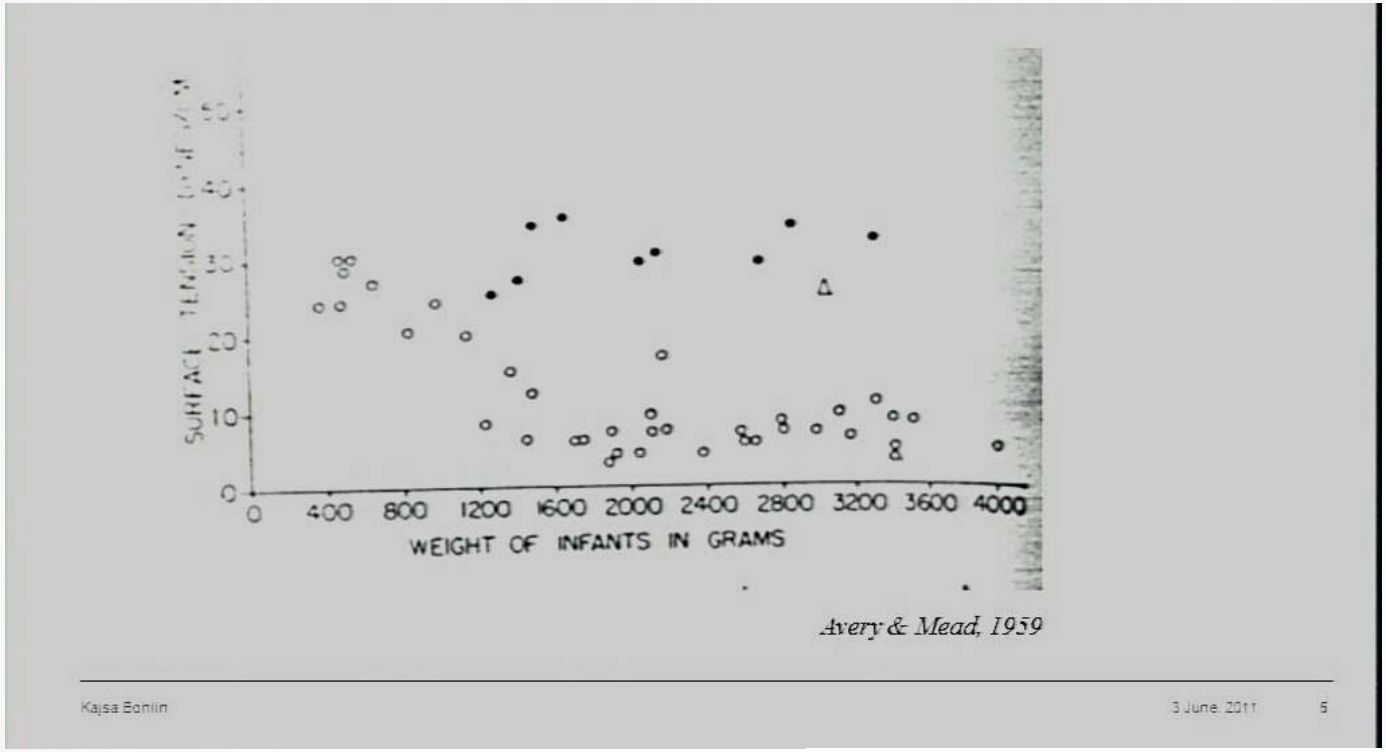
Antonio Salvadó G.-2014

Mortality of Premature Infants in the U.S. from Respiratory Distress Syndrome




PREMATURO
Inmadurez estructural del pulmón
Deficit de surfactante SDR I

Fisiopatología del SDR: déficit de surfactante es la causa principal(Avery 1959)



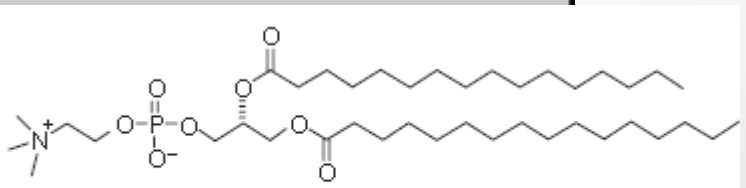
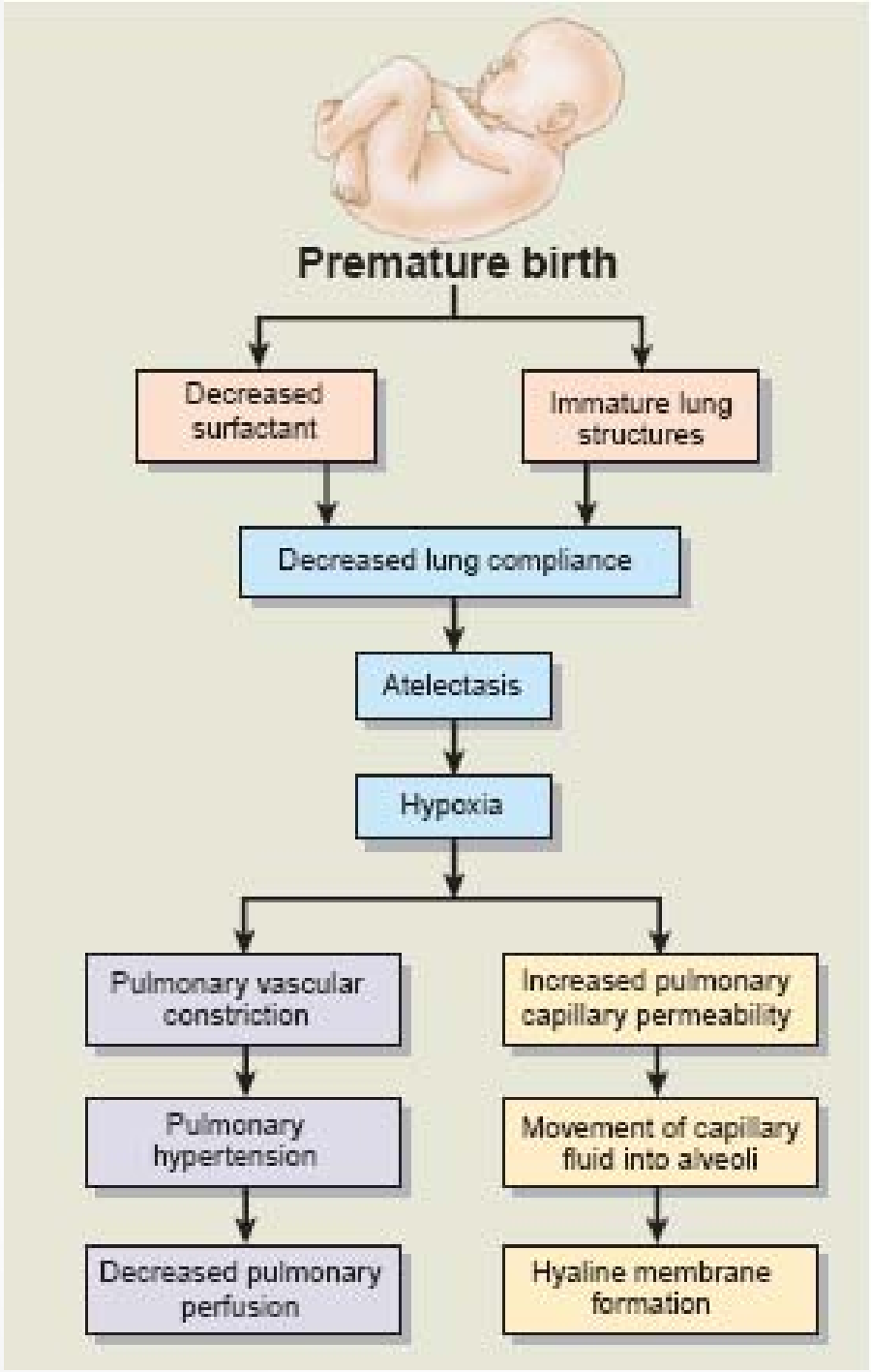


FIGURE 46-7 The main ingredient of lung surfactant, dipalmitoylphosphatidylcholine (DPPC).


Premature birth
Decreased surfactant
Immature lung structures
Decreased lung compliance
Atelectasis
Hypoxia
Pulmonary vascular constriction
Increased pulmonary capillary permeability
Pulmonary hypertension
Movement of capillary fluid into alveoli
Decreased pulmonary perfusion
Hyaline membrane formation

FISIOPATOLOGIA

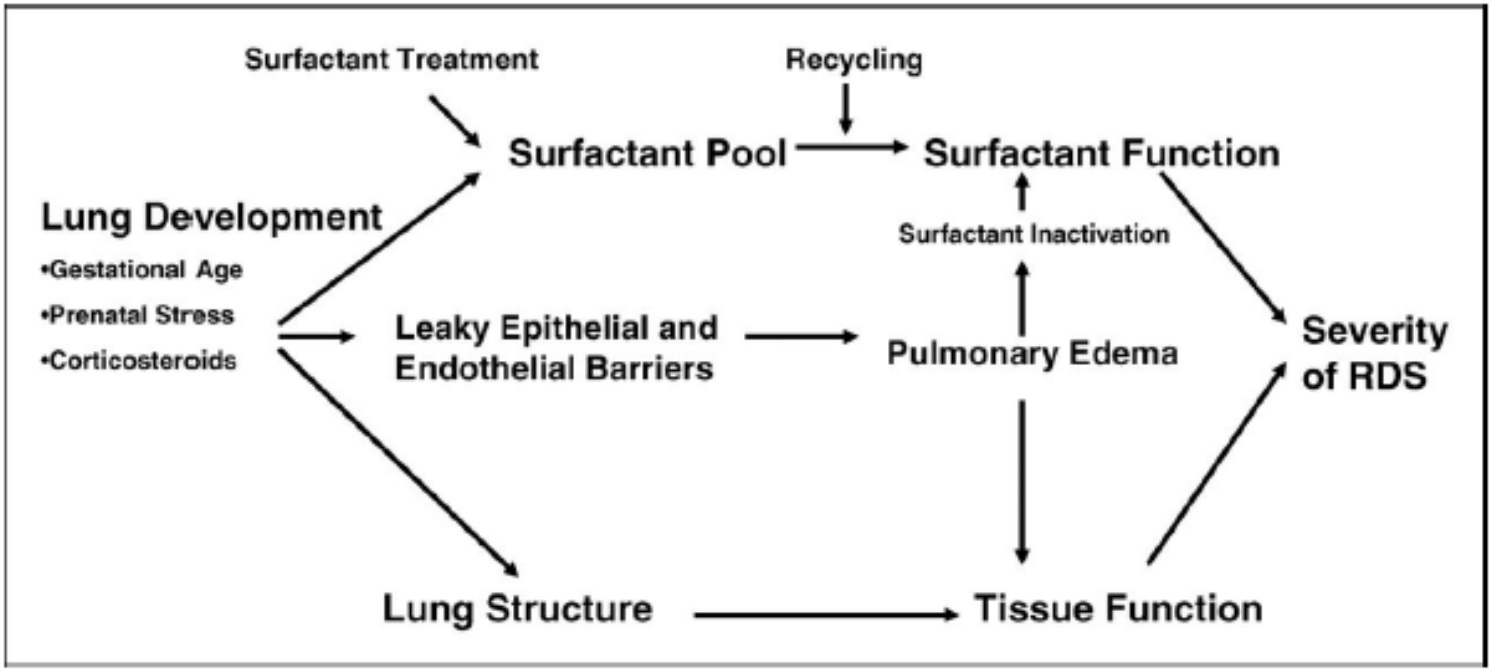


Figure 1. Pathophysiology of respiratory distress syndrome (RDS) circa 1985. RDS has been understood as respiratory failure resulting from the interaction between surfactant deficiency and a structurally immature lung that is easily injured, resulting in pulmonary edema and surfactant inactivation.

MADURACION PULMONAR

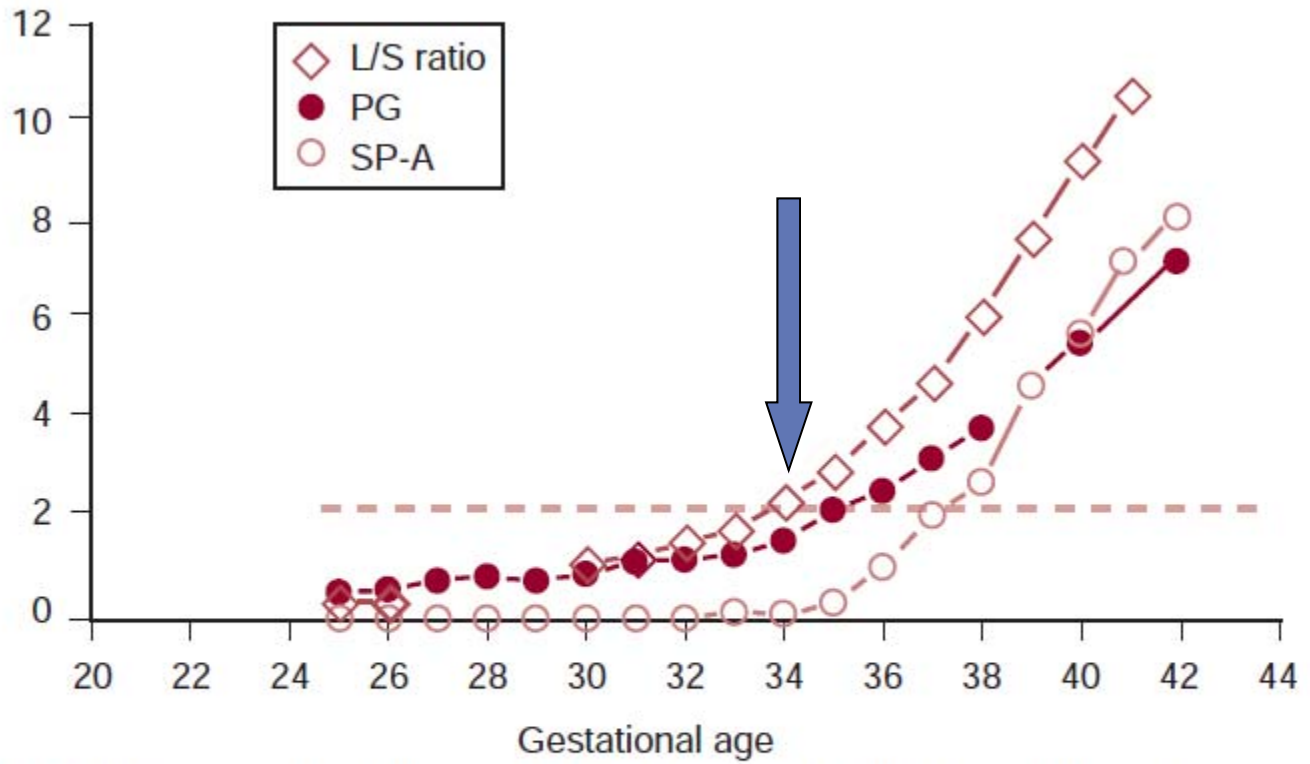


Figure 4-1 Measurements of lung maturity using amniotic fluid. The values are expressed as a ratio of lecithin to sphingomyelin (the L/S ratio), as% phosphatidylglycerol (PG) relative to other phospholipids, and as µg/ml SP-A in amniotic fluid. An L/S ratio of 2.0 indicates lung maturation, which normally occurs at about 35 weeks gestation when PG appears. Data from Gluck et al. (10), Kulovich et al. (8) and Pryhuber et al. (9).

COMPLIANCE PULMONAR

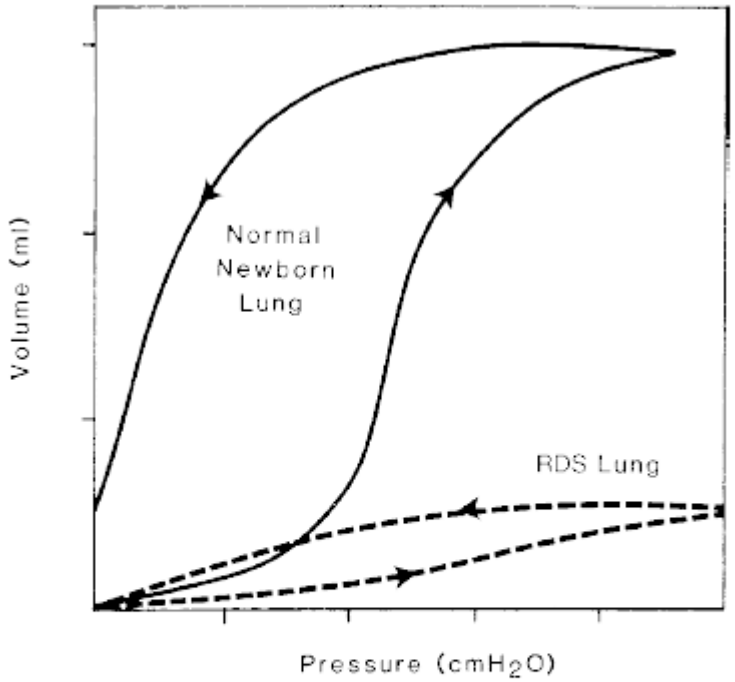


Figure 2-4 □ Comparison of the pressure-volume curve of a normal infant (*solid line*) with that of a newborn with respiratory distress syn drome (*dotted line*). Note that very little hysteresis (i.e., the difference between the inspiratory and expiratory limbs) is observed in the respira tory distress syndrome curve because of the lack of surfactant for stabilization of the alveoli after inflation. The wide hysteresis of the normal infant's lung curve reflects changes (reduction) in surface tension once the alveoli are opened and stabilized. *RDS*, Respiratory distress syndrome.

METABOLISMO DEL SURFACTANTE

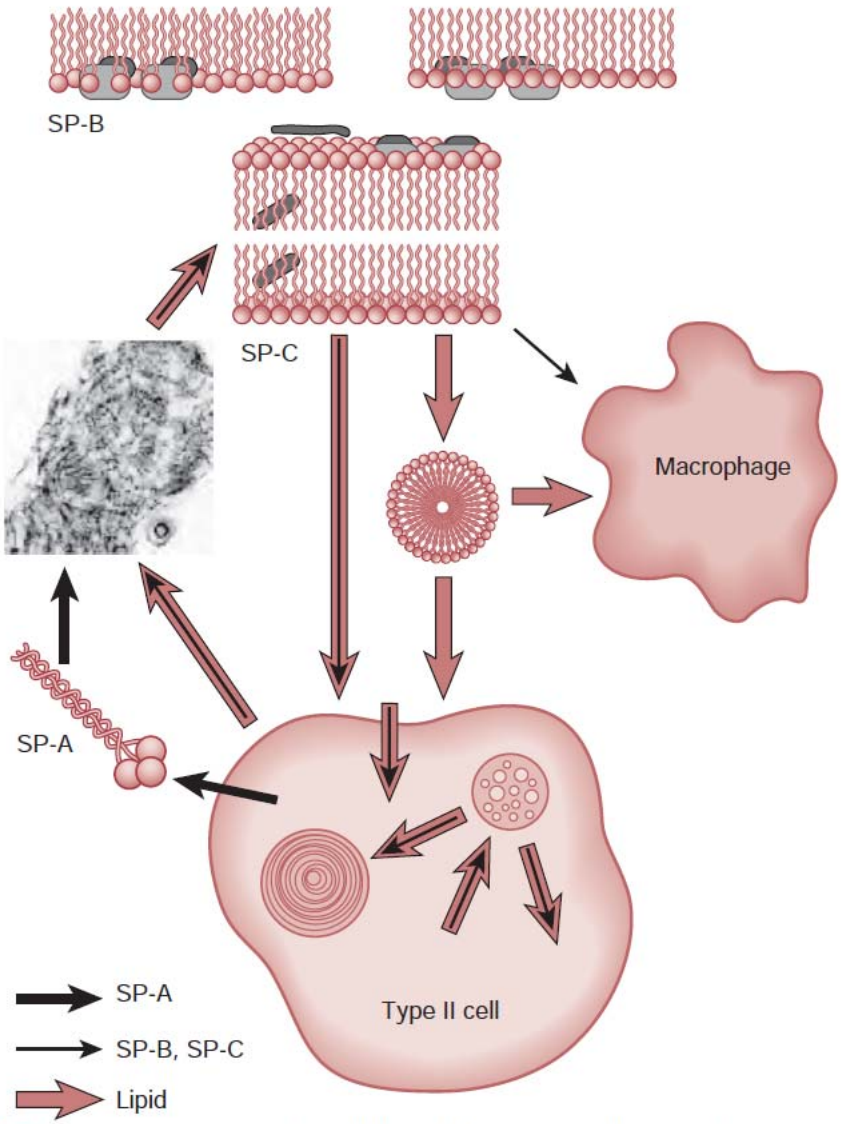


Figure 4-2 Pathways for surfactant metabolism. Surfactant is synthesized in type II cells, stored in lamellar bodies and secreted into the alveoli where it forms a surface film. It is cleared from the airspaces by macrophages for catabolism or is taken back into type II cells where it is reprocessed and resecreted – a recycling pathway. The pathways for the lipids and proteins are qualitatively similar.

METABOLISMO DEL SURFACTANTE

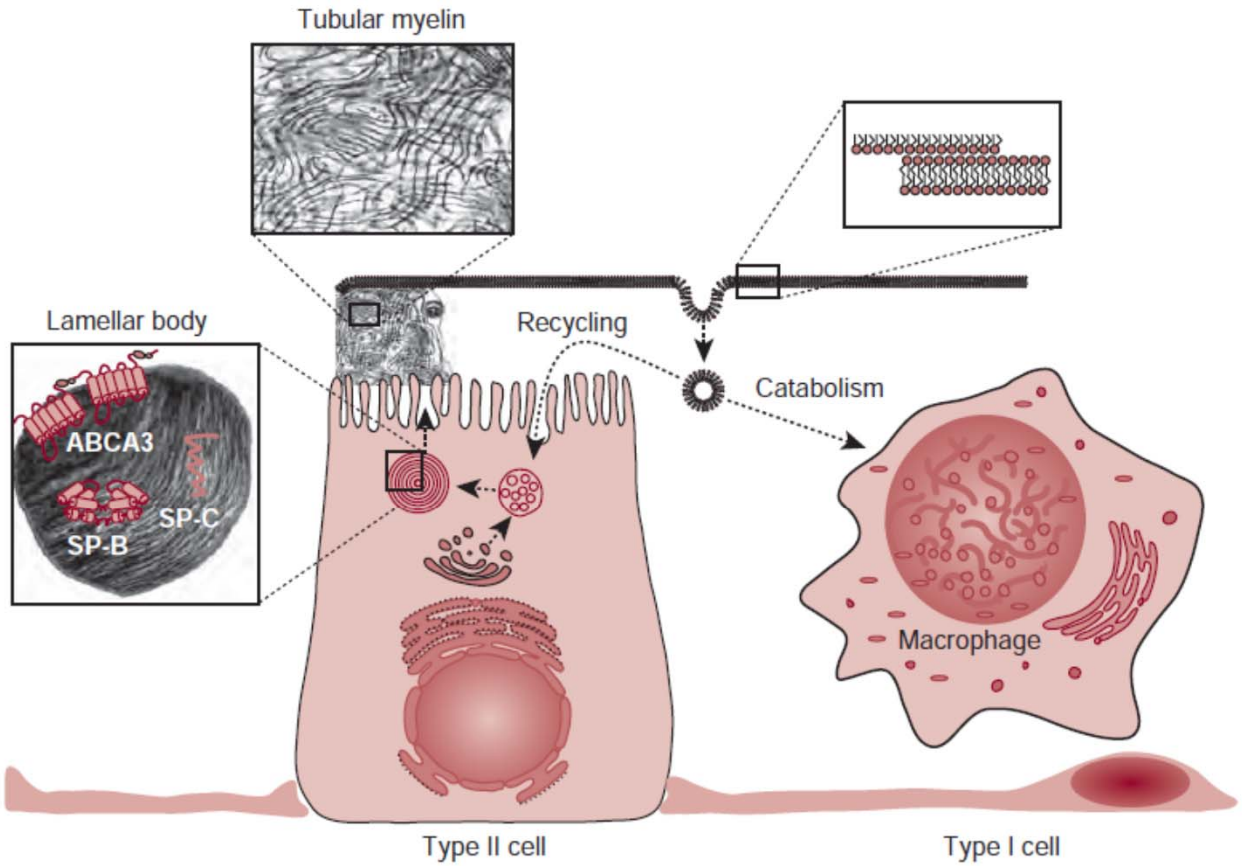
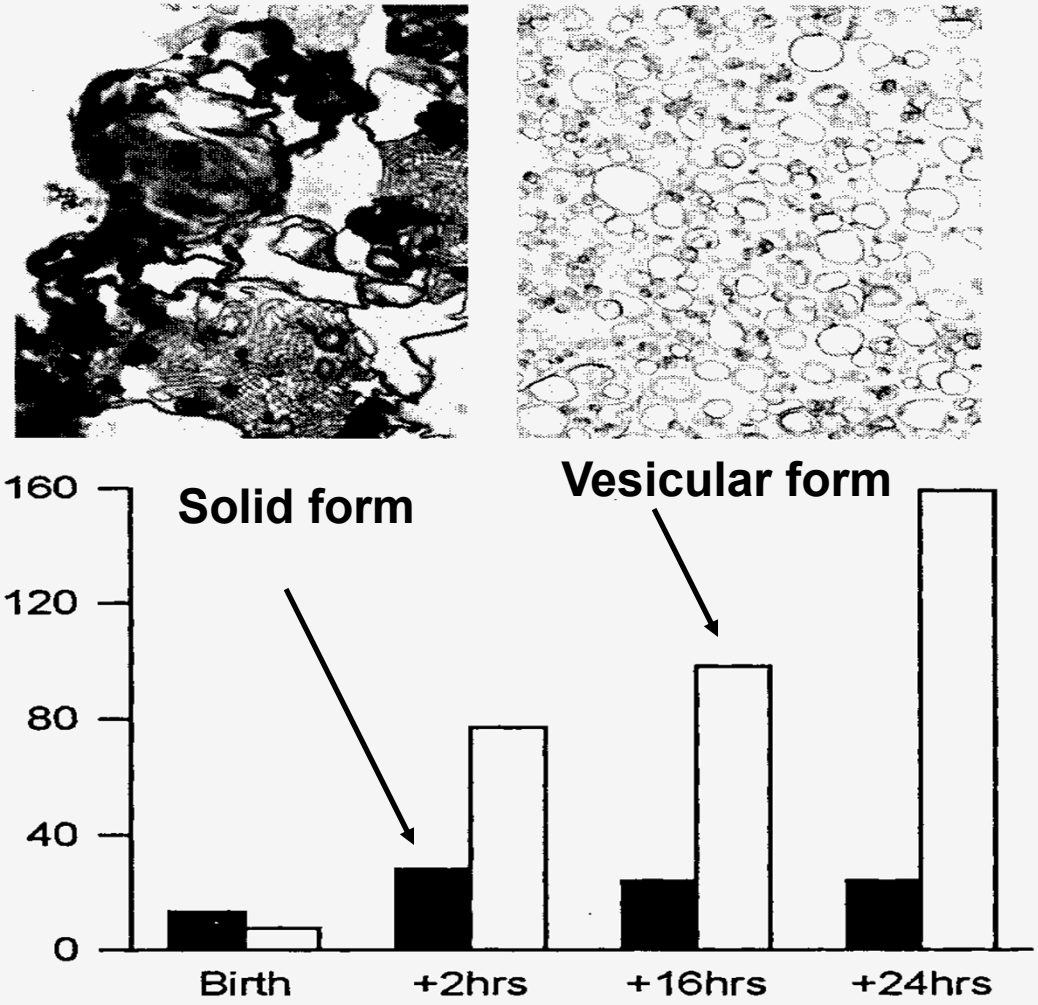


Figure 2-1 Surfactant homeostasis. Surfactant lipids and proteins are synthesized by type II alveolar cells, routed through the ER and Golgi to the lamellar bodies. Lamellar bodies are secreted into the airspace forming tubular myelin and the surface active lipid layers. Surfactant is reutilized by type II cells and catabolized by alveolar macrophages.

Respuesta Natural de las células productoras de surfactante al nacer

Spain CL et.al. Ped. Research, 1987



Al iniciar la respiraciòn,el pool de surfactante aumenta en forma significativa

ARTICLES

THE SIGNIFICANCE OF GRUNTING IN HYALINE MEMBRANE DISEASE

V. C. Harrison, M.B.Ch.B., M.Med., H. de V. Heese, M.D., M.R.C.P.E., and M. Klein, M.B., Ch.B.

From the Neonatal Respiratory Unit, Groote Schuur Hospital and Department of Child Health, University of Cape Town, South Africa

V. C. Harrison, H. de V. Heese and M. Klein
Pediatrics 1968;41;549

HISTORY OF PEDIATRIC ANESTHESIA TIMELINE

The development of continuous positive airway pressure: an interview with Dr. George Gregory

Pediatric Anesthesia **23** (2013) 3–8

Gregory et al, NEJM 1971;284:1333

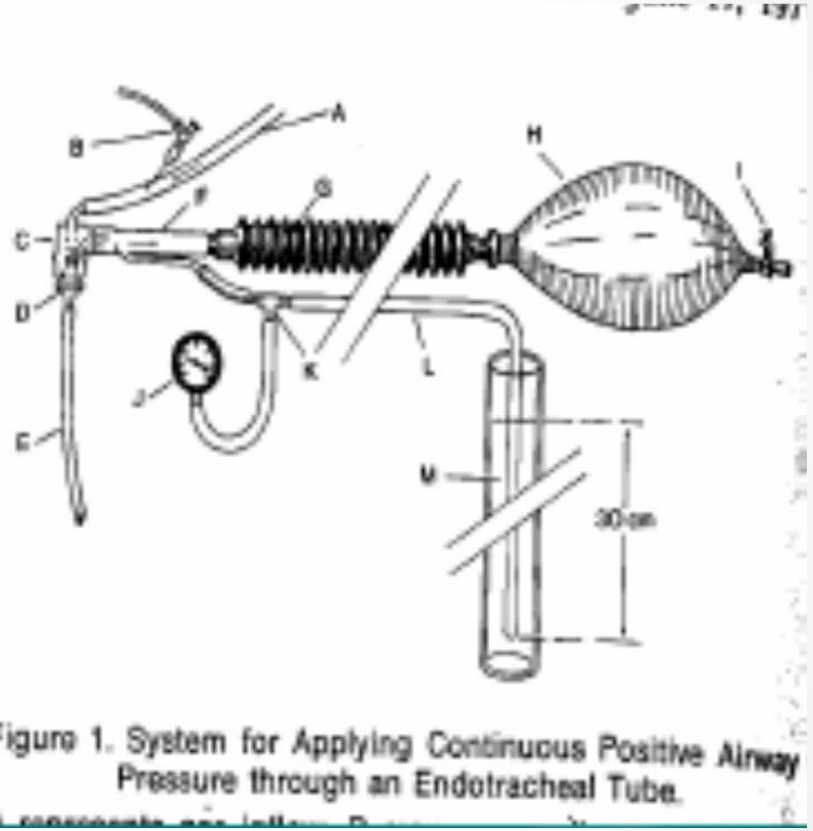


Figure 1. System for Applying Continuous Positive Airway Pressure through an Endotracheal Tube.

CPAP surgió como resultado de la demostración de lo significativo que es el “quejido” en la patogenia del SDR

Harrison et al, Pediatrics 1968; 41:549-559

¿Qué es CPAP,?

- ContinuousPositiveAirwayPressure: presión positiva de la via aérea a través de todo el ciclo respiratorio en un paciente que ventila espontáneamente

¿Qué es CPAP,PEEP,CDP?

- **CPAP**: presión positiva a través de todo el ciclo respiratorio en un paciente que ventila espontáneamente
- **PEEP**: aplicación de presión positiva a la via aérea durante la espiración a un paciente ventilado mecánicamente
- **CDP** :aplicación de presión positiva o negativa para mantener la presión transpulmonar elevada a través de todo el ciclo respiratorio a un paciente que respira espontáneamente

Efecto de CPAP sobre el pulmón

Kamper J. Acta Paed 1993

Acta Pædiatr 82: 193–7. 1993

Early treatment with nasal continuous positive airway pressure in very low-birth-weight infants

J Kamper, K Wulff, C Larsen and S Lindequist

Department of Paediatrics and Diagnostic Radiology, Odense University Hospital, Odense, Denmark

Kamper J, Wulff K, Larsen C, Lindequist S. Early treatment with nasal continuous positive airway pressure in very low-birth-weight infants. Acta Pædiatr 1993;82:193–7. Stockholm. ISSN 0803–5253

During 1988 and 1989, a regional cohort of 81 infants with birth weights less than 1501 g were treated with oxygen only ($n=11$), early continuous positive airway pressure (CPAP) ($n=68$) or mechanical ventilation from birth ($n=2$). We used an easily applicable lightweight CPAP system with nasal prongs and a gas jet supplemented with ventilator treatment if necessary, but with conservative criteria for ventilator treatment with tolerance of high PCO_2. A total of 65 infants (80%) survived to discharge, 61 of whom were supported solely with CPAP or oxygen. Nineteen infants (26%) developed periventricular–intraventricular haemorrhage, but only 4 survivors (6%) developed prognostically significant bleedings grade 2–4. No survivors had bronchopulmonary dysplasia. Follow-up at 12–39 months of age revealed definite disabilities in 6 (10%) and suspected disabilities in 2 of 62 long-term survivors. The results suggest that treatment by early CPAP with nasal prongs with tolerance of high PCO_2 may be effective and lenient in most infants more than 25 weeks' gestation. □ *Clinical outcome, continuous positive airway pressure, intracerebral haemorrhage, very low-birth-weight infants*

J Kamper, Department of Paediatrics, Odense University Hospital, DK-5000 Odense C, Denmark

Escepticismo y CPAP

Skepticism and CPAP

The fundamental concept of the Kamper* study that the "*softly-softly*" approach will decrease morbidity is fundamentally flawed. Putting seriously ill babies on CPAP alone gives the clinician much less control of cardio-respiratory function at a time when the baby is at major risk of sudden deterioration"

NRC Robertson Cambridge UK 1993

**Kamper et al Acta Paediatr. 1992*

Acta Pædiatr 82: 900. 1993

LETTER TO THE EDITOR

Early CPAP/minimal handling

Sir,

In the February (1993) issue of *Acta Pædiatrica* we showed early CPAP, with tolerance of high PCO_2 administered via nasal prongs to be effective—and lenient—in most very-low-birth-weight infants of more than 25 weeks' gestation (1). Not unexpectedly, our "early CPAP/minimal handling" approach has been met with considerable scepticism by colleagues who, like Roberton (2), believe the opposite to be the case: the "respiratory control" approach with routine intubation in the labour ward and mechanical ventilation when PCO_2 rises above 6 kPa (45 mm) (3).

"Where lies the truth" and "What is the way forward" are therefore relevant and constructive questions posed by Halliday (4), who calls for a prospective randomized trial.

Before commenting on the latter I have to emphasize a few pertinent facts. First, the "early CPAP/minimal handling" approach in various modifications is in common use in Denmark and Sweden today, with results that on the whole confirm our own results (e.g. 5, 6). Second, admittedly the Scandinavian populations benefit from good socio-economic conditions, which most likely have a positive impact even on the health of our very-low-birth-weight infants, but the impact is certainly not of a magnitude that makes them "extremely healthy", as Roberton seems to believe. In fact, the majority of our cohort (1) would have been intubated and mechanically ventilated because of rising PCO_2 had the babies been born in Cambridge. Third, early NCPAP works well also outside Scandinavia, e.g. in the Columbia Presbyterian Medical Center (7), where 58% of very-low-birth-weight infants could be treated without intubation and ventilation with a survival rate of 79%.

Now then, will a randomized, controlled study be necessary, and will it be feasible? Yes, I believe the answer to both questions is yes. But I also believe that it will be very difficult to conduct for the following reasons: the investigating center(s) must master both techniques and also have no ethical problems with either. While the first condition is fulfilled in a number of centers in Scandinavia I am not aware of any "early CPAP/minimal handling" center that could participate because of problems with the ethical aspects. We find that till now the documented facts: survival rates, complication rates (including BPD) and—in particular—the health outcome of the survivors dictate that we develop the "early CPAP/minimal handling" technique further by giving surfactant to selected infants with RDS instead of adopting the "early intubation/respiratory control" approach.

References

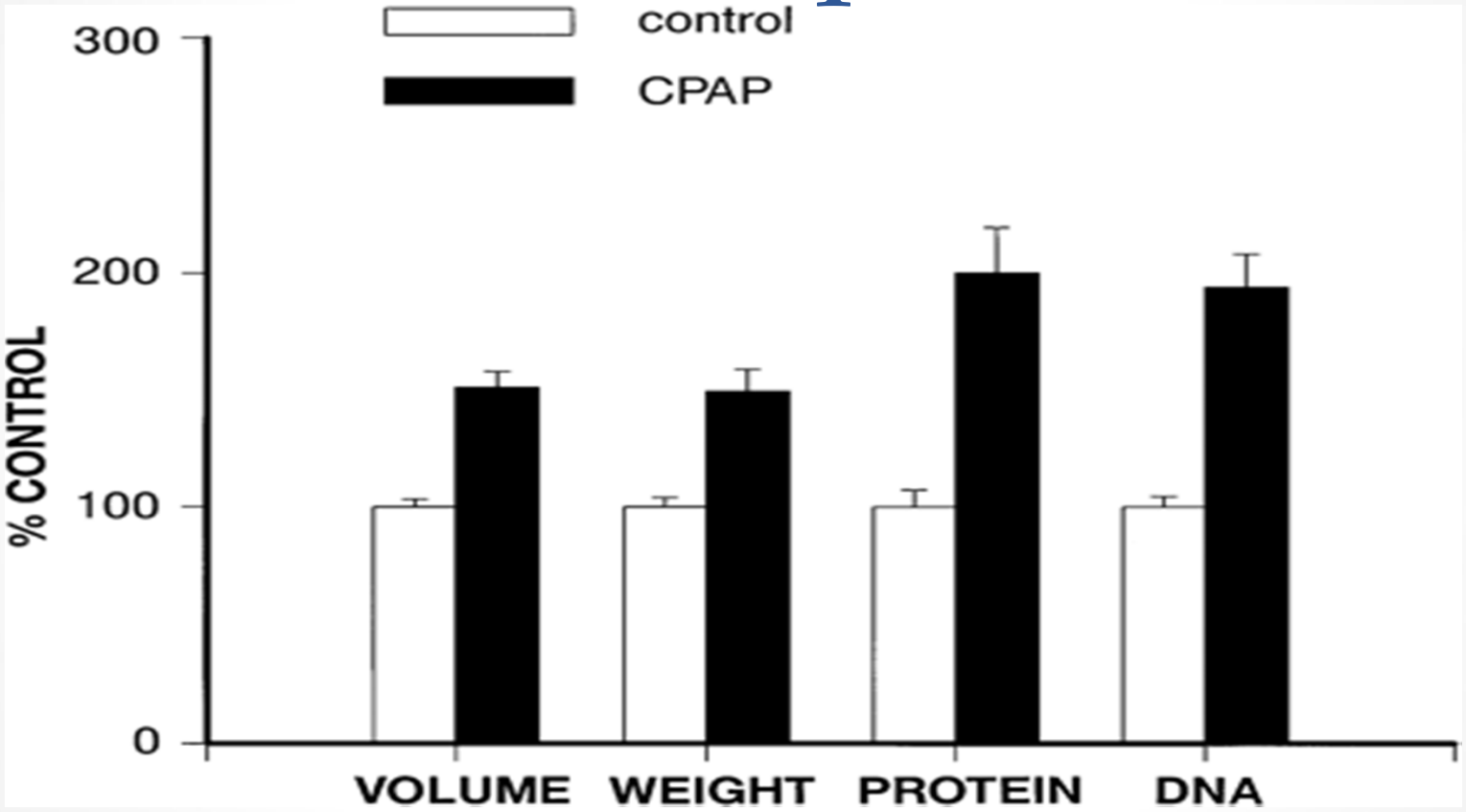
1. Kamper J, Wulff K, Larsen C, Lindequist S. Early treatment with nasal continuous positive airway pressure in very-low-birth-weight infants. Acta Pædiatr 1993;82:193–7
2. Roberton NRC. Does CPAP work when it really matters? Acta Pædiatr 1993;82:206–7
3. Greenough A, Morley CJ, Roberton NRC. Acute respiratory disease in the newborn. In: NRC Roberton, ed. Textbook of Neonatology. 2nd ed. London: Churchill Livingstone, 1992;407
4. Halliday HL. Letter to the editor. Acta Pædiatr 1993;82: in press
5. Jacobsen T, Grønvall J, Petersen S, Andersen GE. "Minitouch" treatment of very-low-birth-weight babies. Acta Pædiatr 1993;82: in press
6. Lundstrøm K, Greisen OG. Early treatment with nasal-CPAP. Letter to the editor. Acta Pædiatr 1993;82:856
7. Avery ME, Tooley WH, Keller JB. Is chronic lung disease in low birth weight infants preventable? A survey of eight centers. Pediatrics 1987;79:26–30

Jens Kamper and Karl Wulff, Odense Sygehus, DK-5000 Odense C, Denmark

CPAP-¿Cómo funciona?

- Aumenta la Capacidad Funcional Residual
- Mejora la oxigenación
- Dilata la laringe y reduce la resistencia supraglótica
- Reduce la incidencia de apneas obstructivas
- Mejora la sincronía de los movimientos respiratorios tóraco abdominales
- Preserva surfactante
- Estimula el crecimiento pulmonar

CPAP estimula crecimiento pulmonar



Lung volume, lung weight, and protein and DNA contents at end of study were higher in CPAP-exposed than in control animals (all $P < 0.01$). Strain-induced growth of the immature lung. Zhang S. et al. J. Appl Physiol 1996;81:1471-6

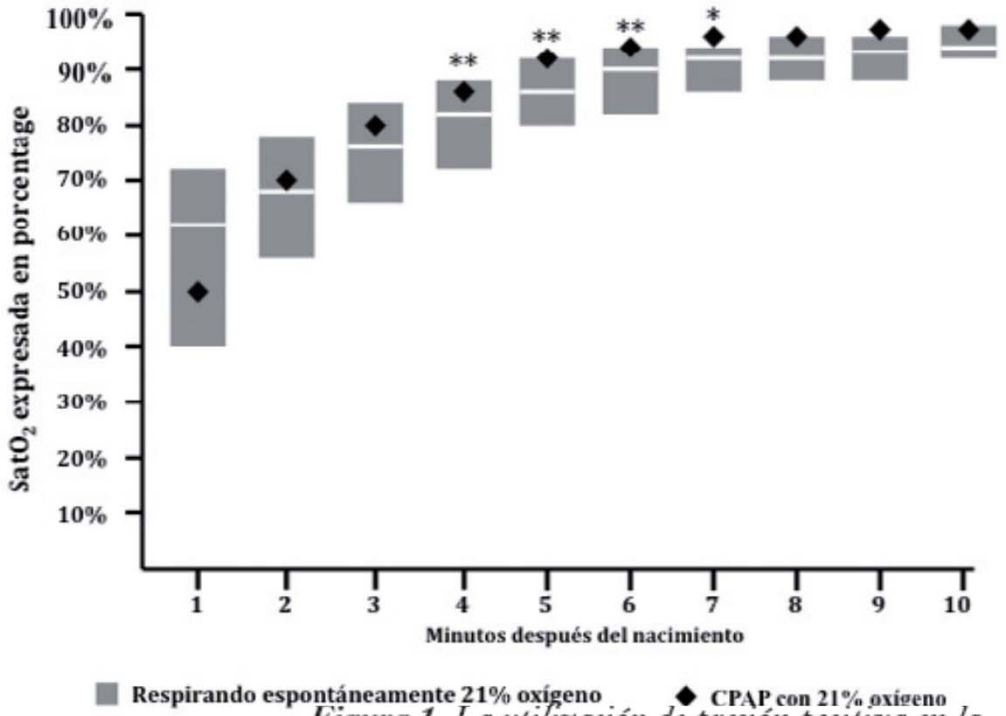
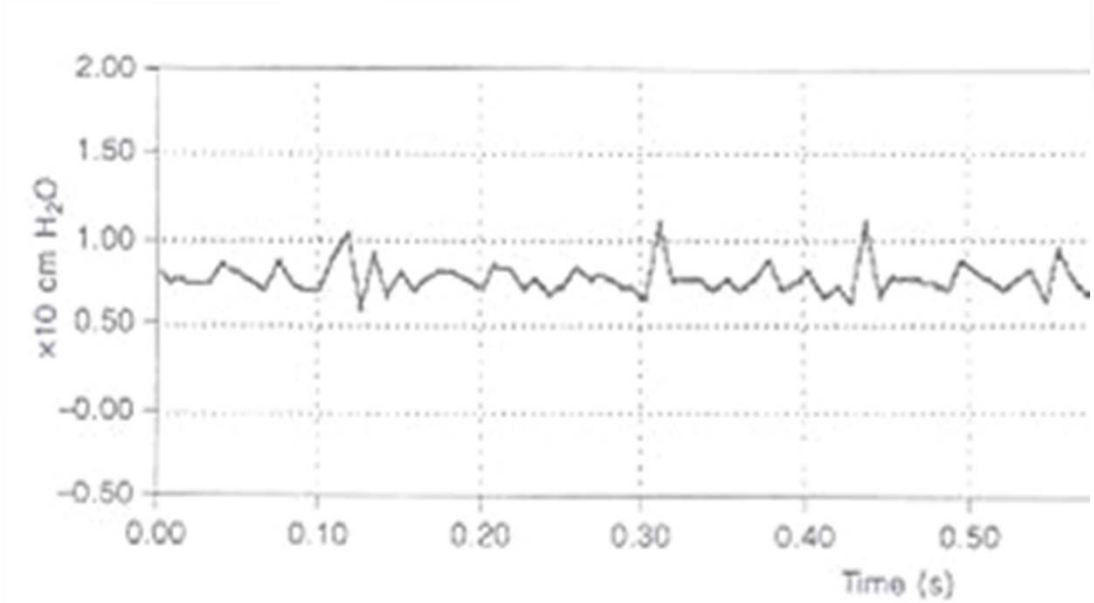
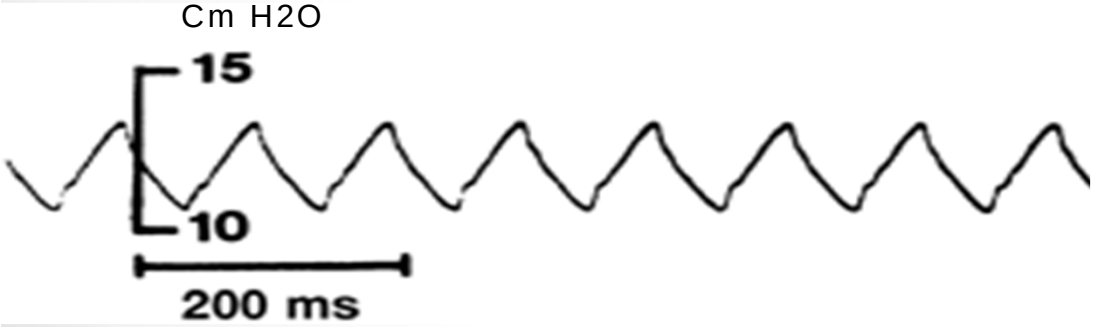


Figura 1. La utilización de presión positiva en la vía respiratoria en prematuros (normalizada en las más recientes recomendaciones de reanimación neonatal, véase Vento y Saugstad[13]) provocan un incremento más rápido de la saturación de oxígeno arterial que la respiración espontánea reflejada en el nomograma de Dawson et al[9]. La figura muestra cómo en los minutos sucesivos al nacimiento los prematuros que recibieron presión positiva continua y aire alcanzaron saturaciones significativamente más elevadas minuto a minuto comparativamente con el nomograma (adaptado de Vento et al[15]).



Ondas producidas en la via aérea con **Bubble CPAP**

Amplitud 2-4 cm H2O,
Frecuencia 15-30 Hz



Ondas producidas en la via aérea con VAFO **(Sensormedics)**

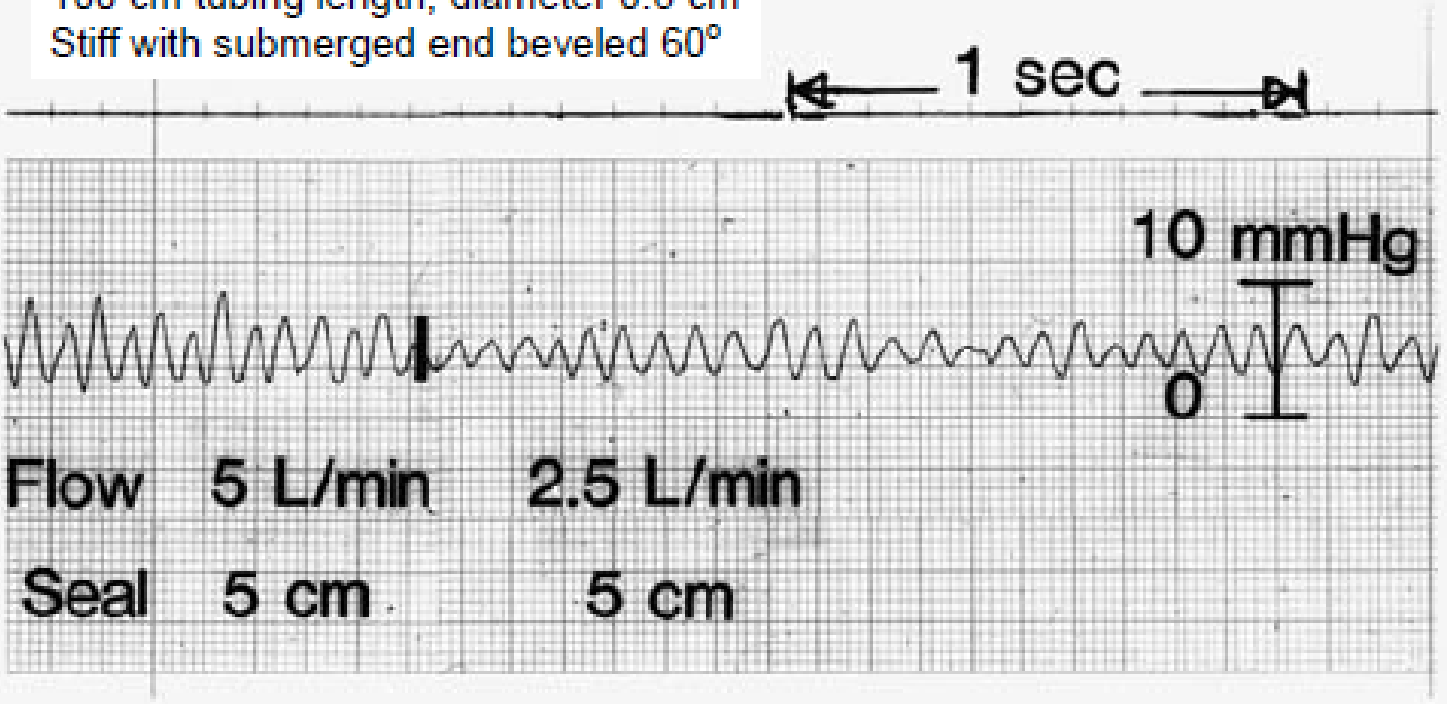
Set I-time 0.3
Set Frecuencia 10 Hz

Dunn MS: Biol Neonate 73: 69-75, 1998

Thome U: J Appl Physiol: 84(5):1520-7, 1998

BUBBLE CPAP: PRESSURE OSCILLATIONS

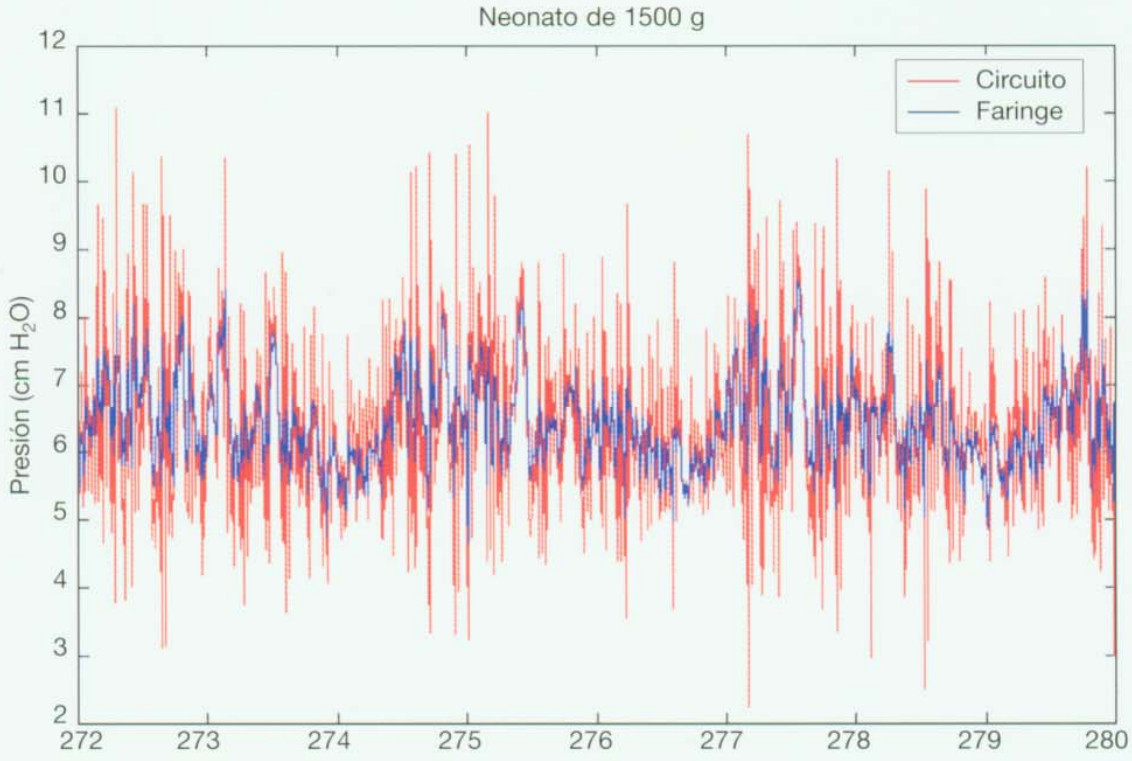
100 cm tubing length, diameter 0.8 cm
Stiff with submerged end beveled 60°



Versmold HT, Brünstler I, Schlosser R (1982), in: Huch R, Duc G, Rooth G: Klinisches Management des „kleinen" Frühgeborenen (<1500g). Thieme, Stuttgart, p. 159-162

FISIOLOGIA DEL CPAP DE BURBUJA

Medidas tomadas en un neonato de 1500 g (2001)[4]



Nota: Las oscilaciones de presión están presentes tanto en la luz de las vías respiratorias como en la faringe

¿Quién requiere CPAP?

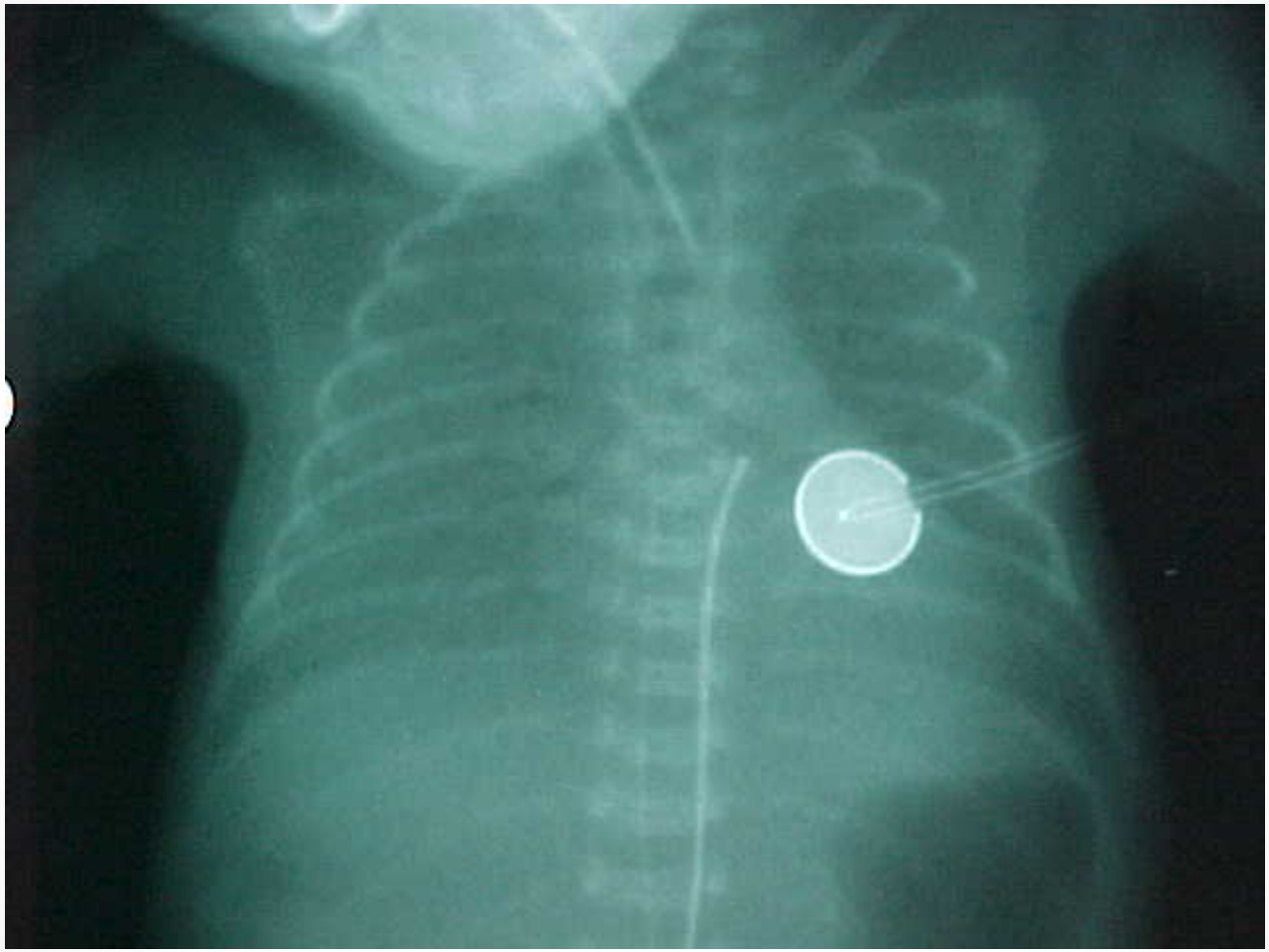
- un niño que al nacer respira espontáneamente y que presenta dificultad respiratoria
- (quejido, retracción, aleteo nasal, y taquipnea)
- Niño con elevado requerimiento de O2
- Pulmones pobremente expandidos o infiltrados en la Rx Tx.

El soporte respiratorio sin intubar se denomina “no invasivo”, porque sustenta la premisa de evitar las complicaciones asociadas al Tubo

Entre otros:
-riesgo de infección
-riesgo de hipoxia al intubar
-injuria mecánica aguda o crónica a la vía aérea alta
Volutrauma derivado de la ventilación mecánica

Aplicaciones Clínicas

- SDR (membrana Hialina)
- SDRTransitorio
- Displasia Broncopulmonar
- Apneas del PreTérmino
- Postextubación de prematuros
- Atelectasias
- Edema pulmonar
- Neumonías
- Hemorragia pulmonar
- DAP
- Laringomalacia, traqueomalacia, broncomalacia
- Sd aspirativo meconial y otros sd aspirativos
- Parálisis del Nervio frénico
- Postoperatorio de onfalocele, gastrosquisis, hernia diafragmática,cx tórax
- Post reanimación en inmediato
- Durante ECMO



SDR

- La clave del éxito del CPAP es el inicio precoz ,es decir , al inicio del distress
- El objetivo es intervenir lo antes posible, de modo de :
- -prevenir atelectasias progresivas
- -evitar la intubación endotraqueal
- -para minimizar el baro-volutrauma de la vía aérea y del parénquima pulmonar

Criterios de inicio de CPAP

- FR > 60 x minuto
- Quejido moderado a severo
- Retracción
- Sat0_2 preductal < 93%
- Requerimiento de 02> 30 %
- Apneas frecuentes

Injuria Pulmonar en el Rn

- El pulmón es un órgano delicado
- Los resultados pulmonares adversos se relacionan más con las intervenciones sobre el pulmón que con la enfermedad misma
- Si no se ventila a un niño, resulta difícil causar DBP
- Esto sugiere un rol importante de la Ventilación mecánica en la patogenia de la injuria pulmonar.

Injuria Pulmonar

- Cualquier Ventilación a Presión Positiva(aunque sea breve) puede inducir una cascada inflamatoria que lleve al daño pulmonar crónico (especialmente si existe déficit de surfactante)
- El predictor más importante de daño pulmonar crónico parece ser el inicio de la VM
- Young et al Pediatrics, 1999; 104:e17

Editorial

TRANSITION/ADAPTATION IN THE DELIVERY ROOM AND LESS RDS: "DON'T JUST DO SOMETHING, STAND THERE!"

"There is perhaps nothing more dangerous for the preterm lung than an anxious physician with an endotracheal tube and a bag".

Dr. Alan H. Jobe, *editor* of "The Journal of Pediatrics"

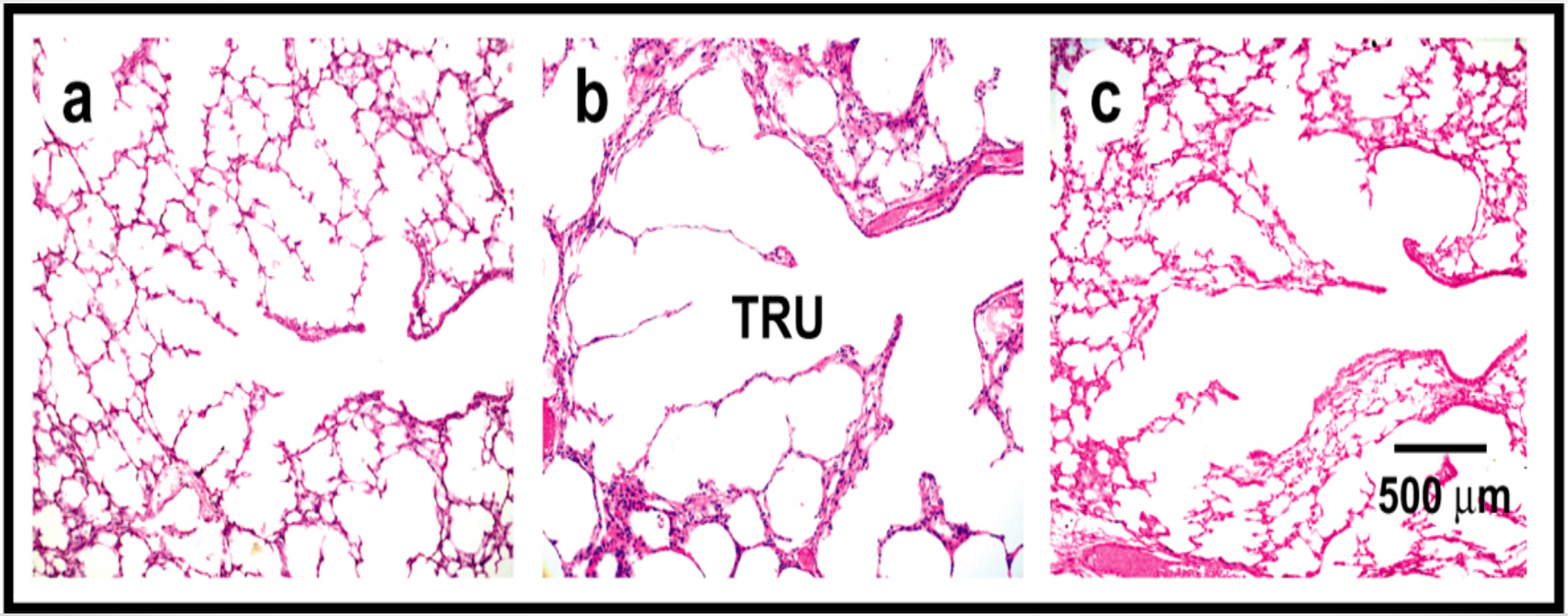
The Journal of Pediatrics • September 2005

- La introducción de estrategias ventilatorias más complejas, tales como la Ventilación de alta frecuencia, ventilación sincronizada y técnicas volumétricas, no se asocian con una reducción en la incidencia de Displasia Broncopulmonar

Corderos PreT 72 Hours

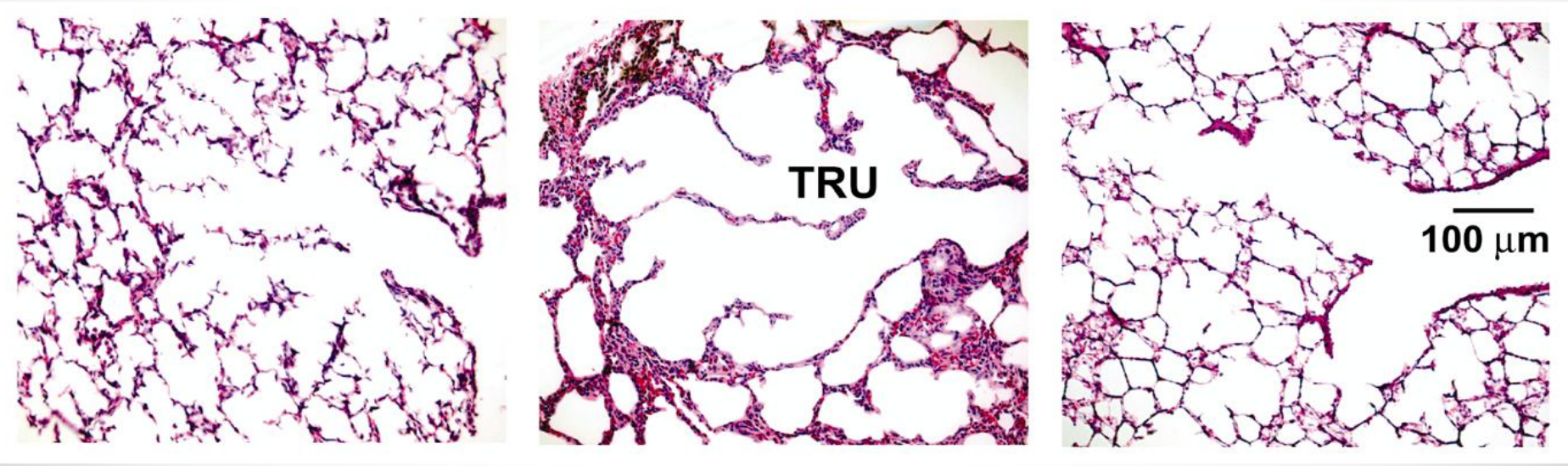
-Septación Alveolar -

nCPAP VM VM + vitamina A



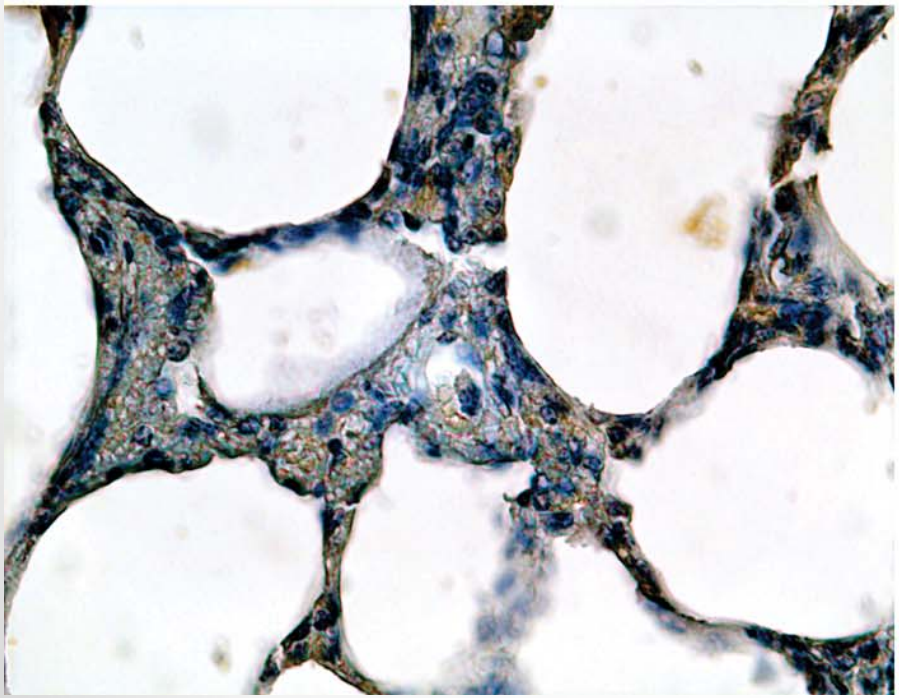
Corderos PreT a los 21 Días- Septación Alveolar -

nCPAP VM Término, 1d

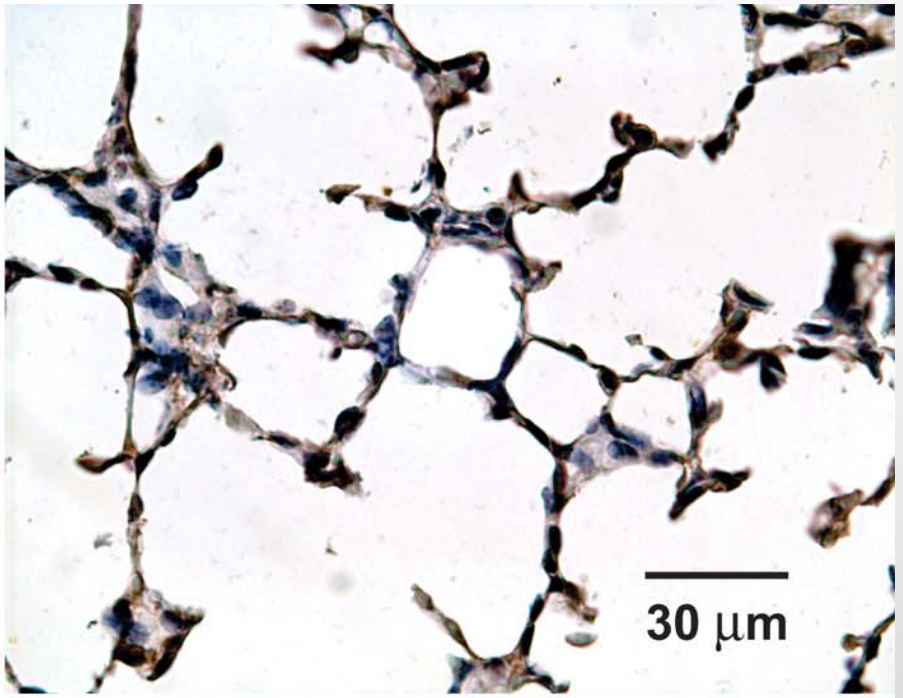


Corderos PreT a las 72 Horas
-Grosor de la pared distal de la Via Aérea

Vent.Mecánica



nCPAP

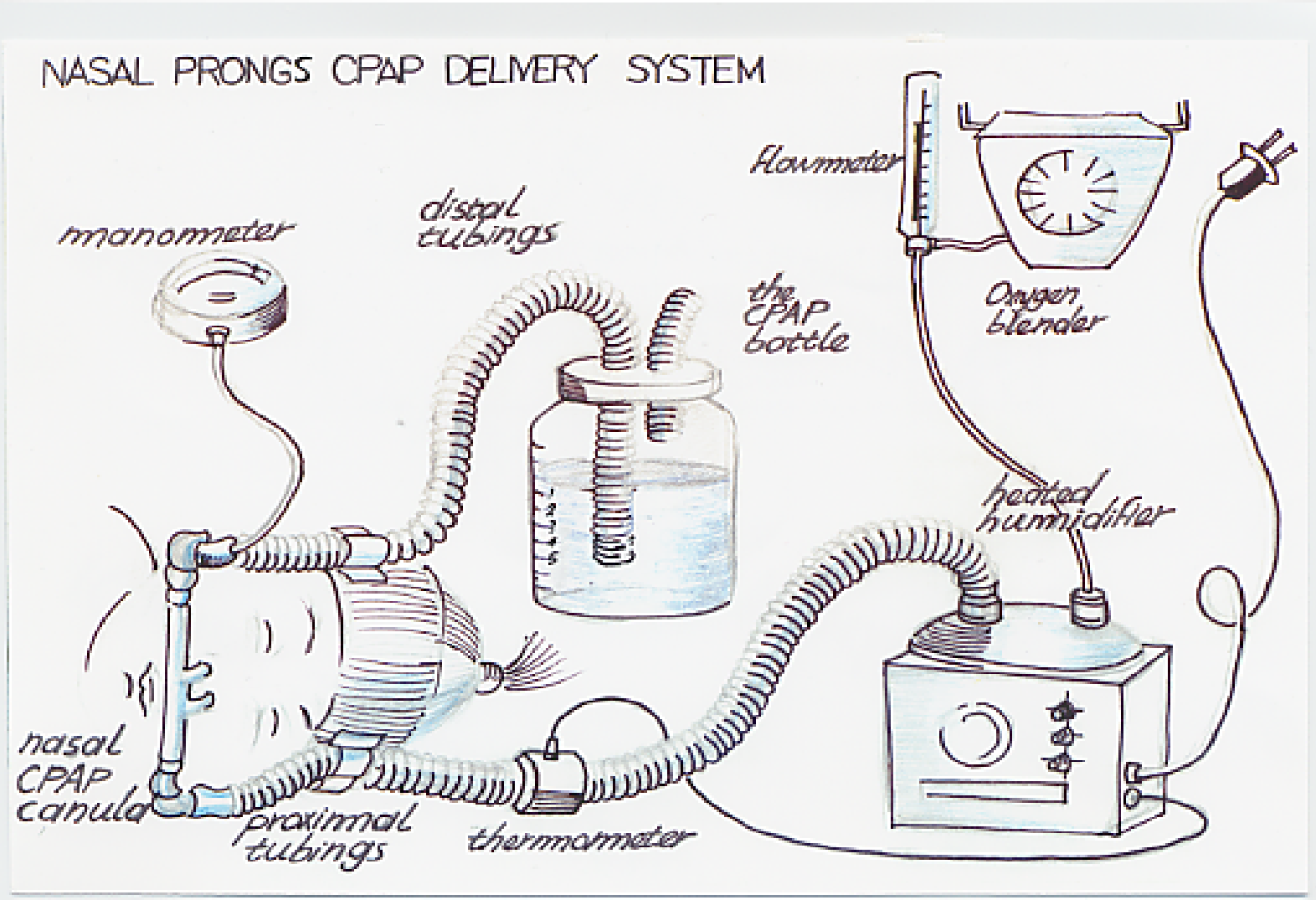


Métodos de Aplicación de CPAP

Tipos de CPAP (Interface)

- Tipo Hood X
- Máscara facial X
- Máscara nasal √
- Cánulas nasales – *Hudson*, √ *INCA*,*Silmag* √ *Draeger*, *Fisher&Pakel* √ *SiPAP, Arabella, NeoPAP*
- Cánula Nasal – *Vapotherm X*
- Tubo nasofaringeo X Benveniste X √
- Tubo endotraqueal X

CPAP DE BURBUJAS

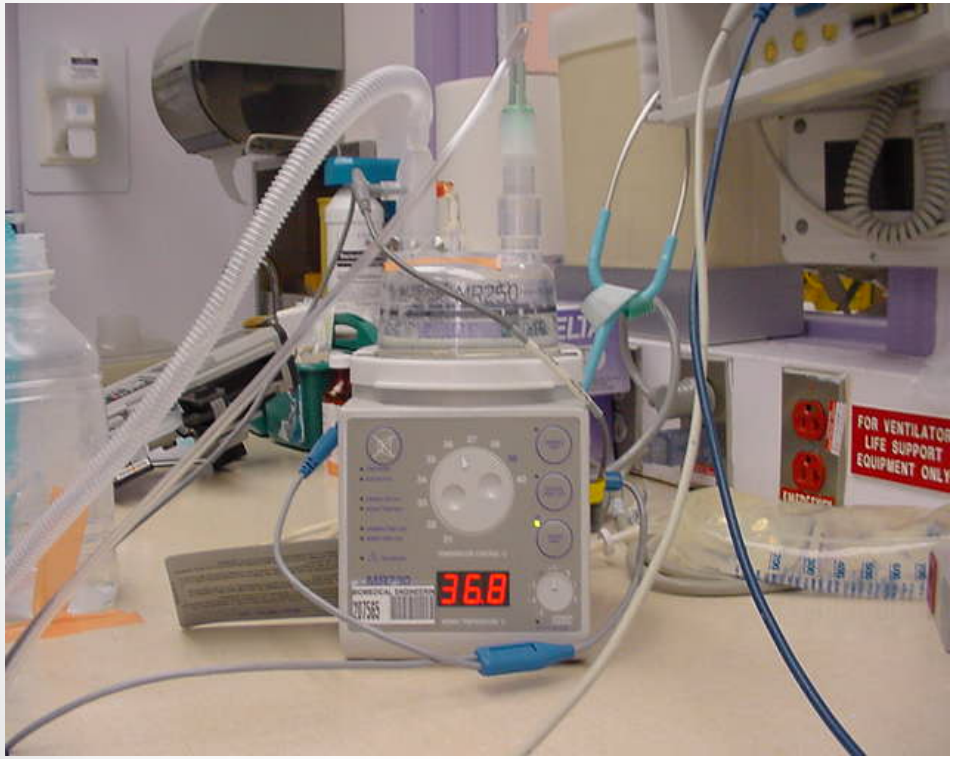

NASAL PRONGS CPAP DELIVERY SYSTEM
flowmeter
manometer
distal tubings
the CPAP bottle
Oxygen blender
heated humidifier
nasal CPAP canula
proximal tubings
thermometer

Fluómetro/blender

Fija FiO_2 para mantener PaO_2 en +/- 50's o sat O_2 en 83 – 93%

CPAP Nasal

Aplicación



Mantener tº del gas inspirado entre 36 y 40 °C

GENERADOR DE PRESIÓN

Fisher & Pakel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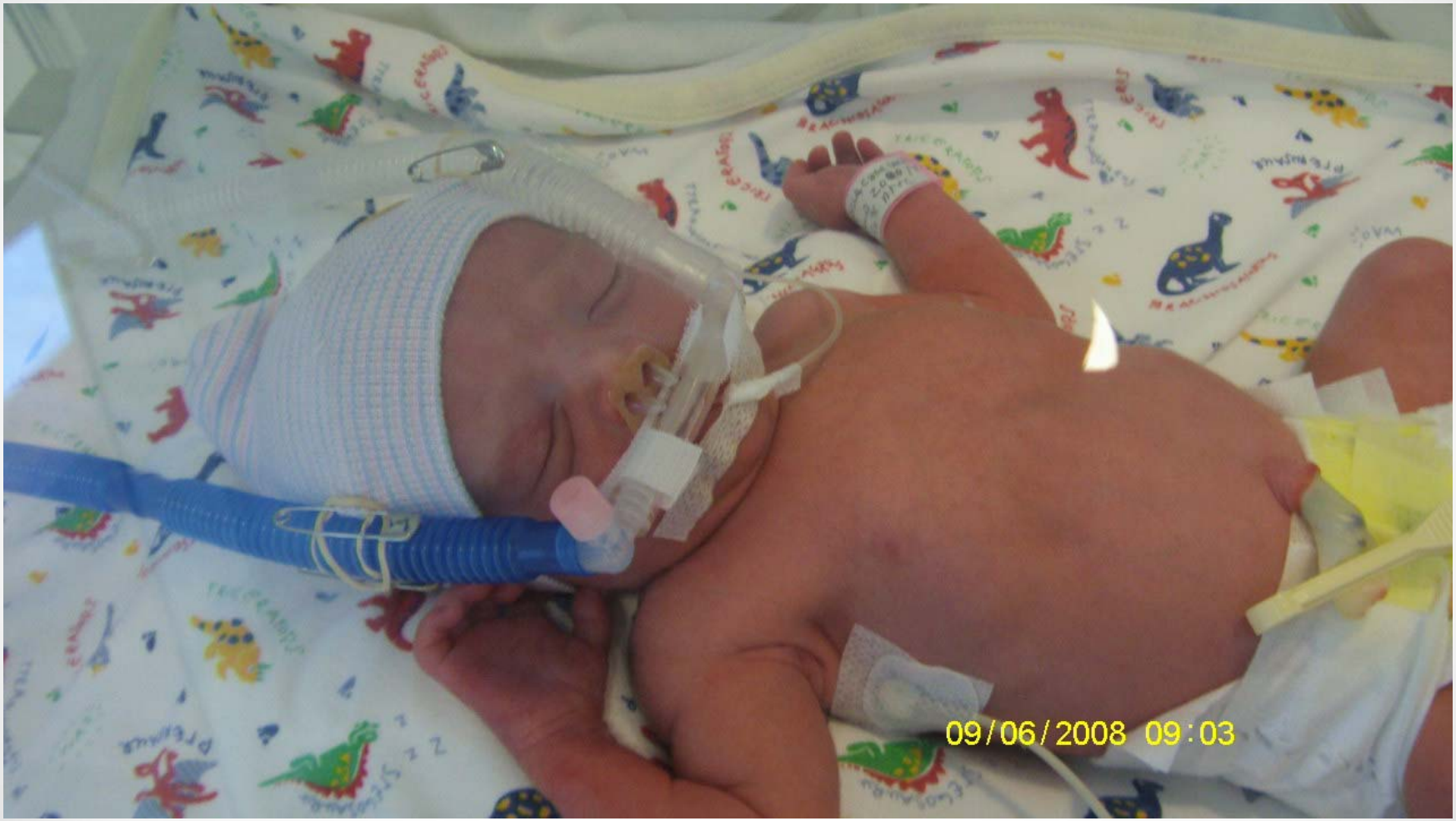
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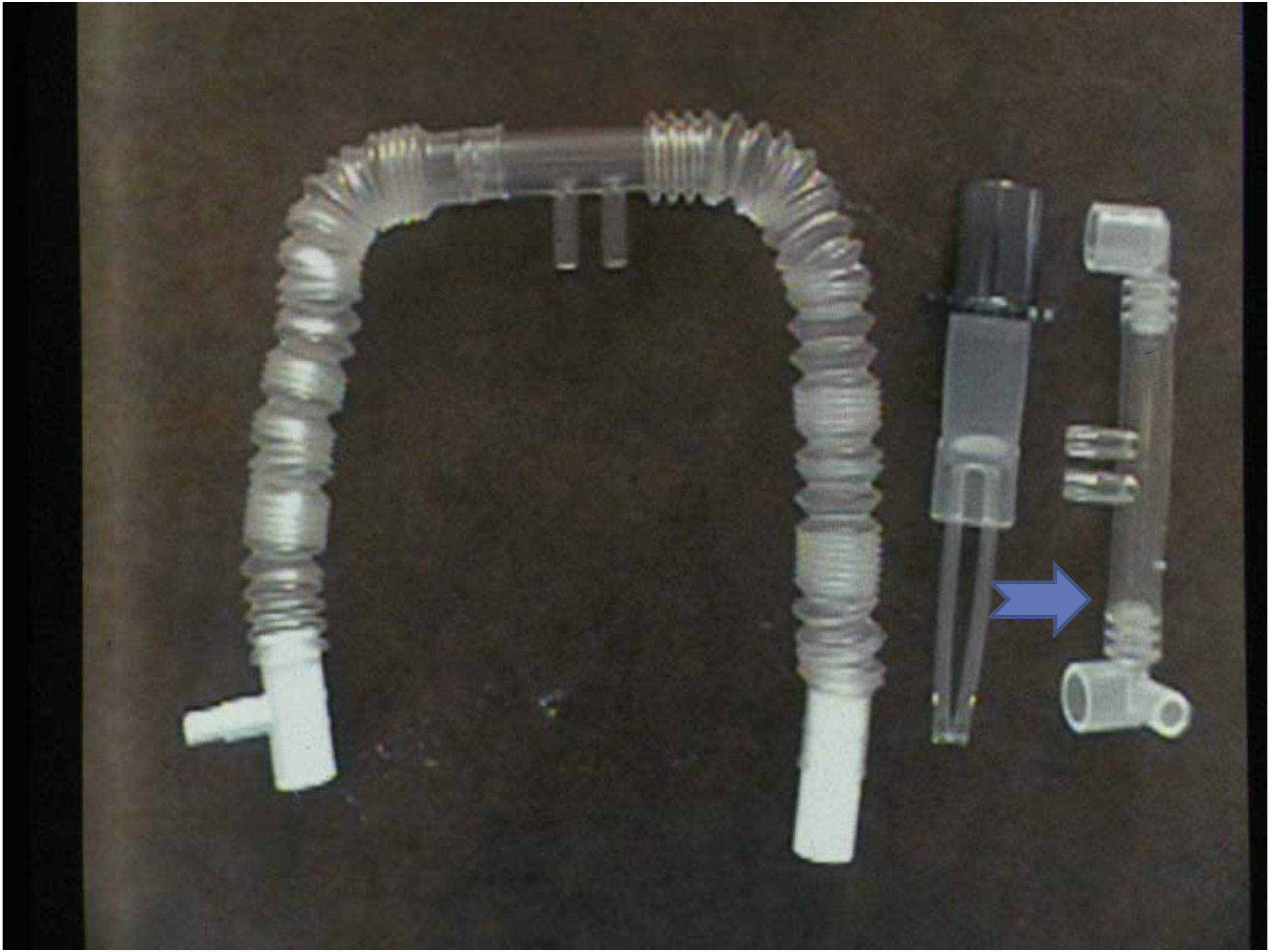
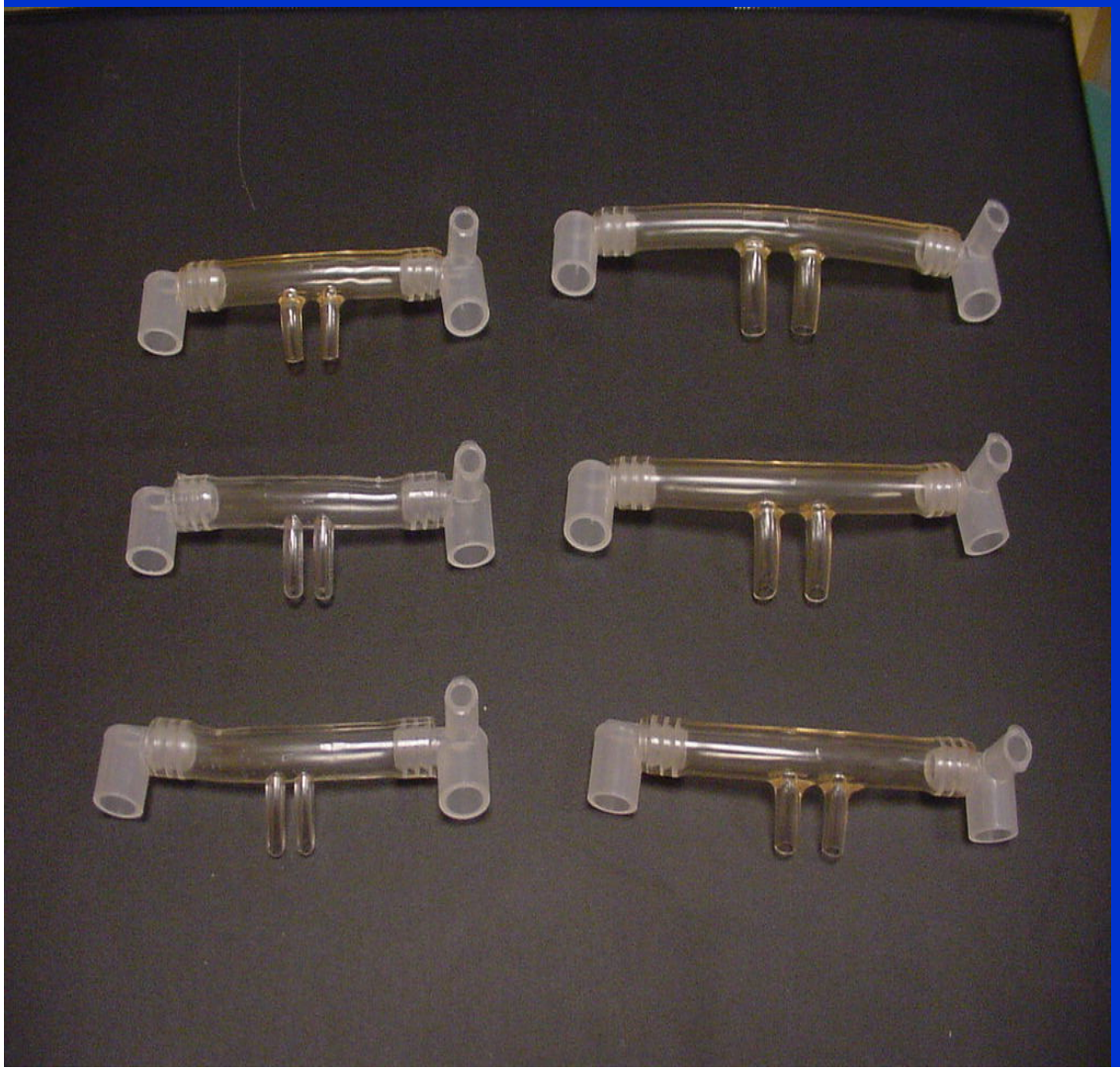
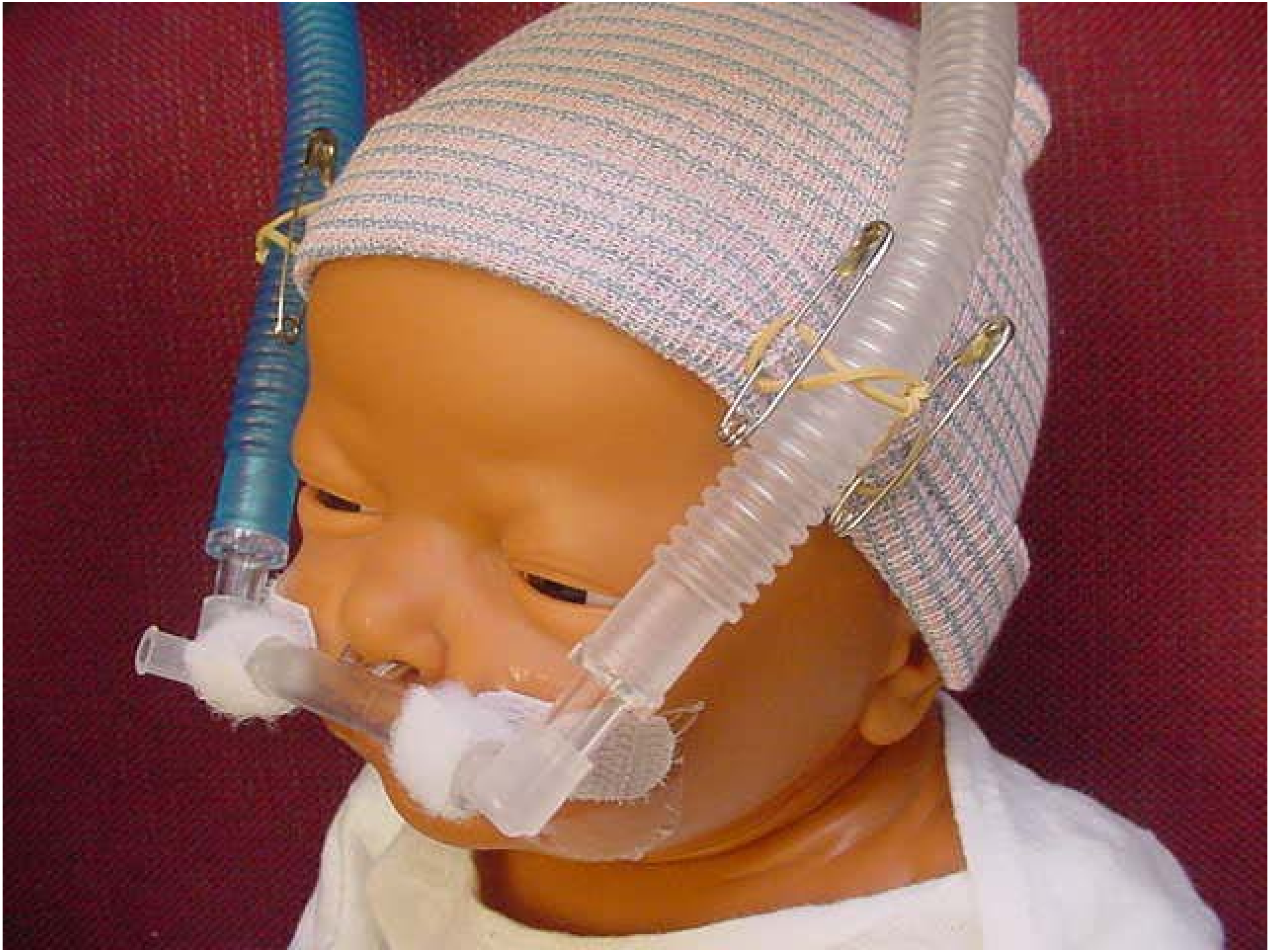
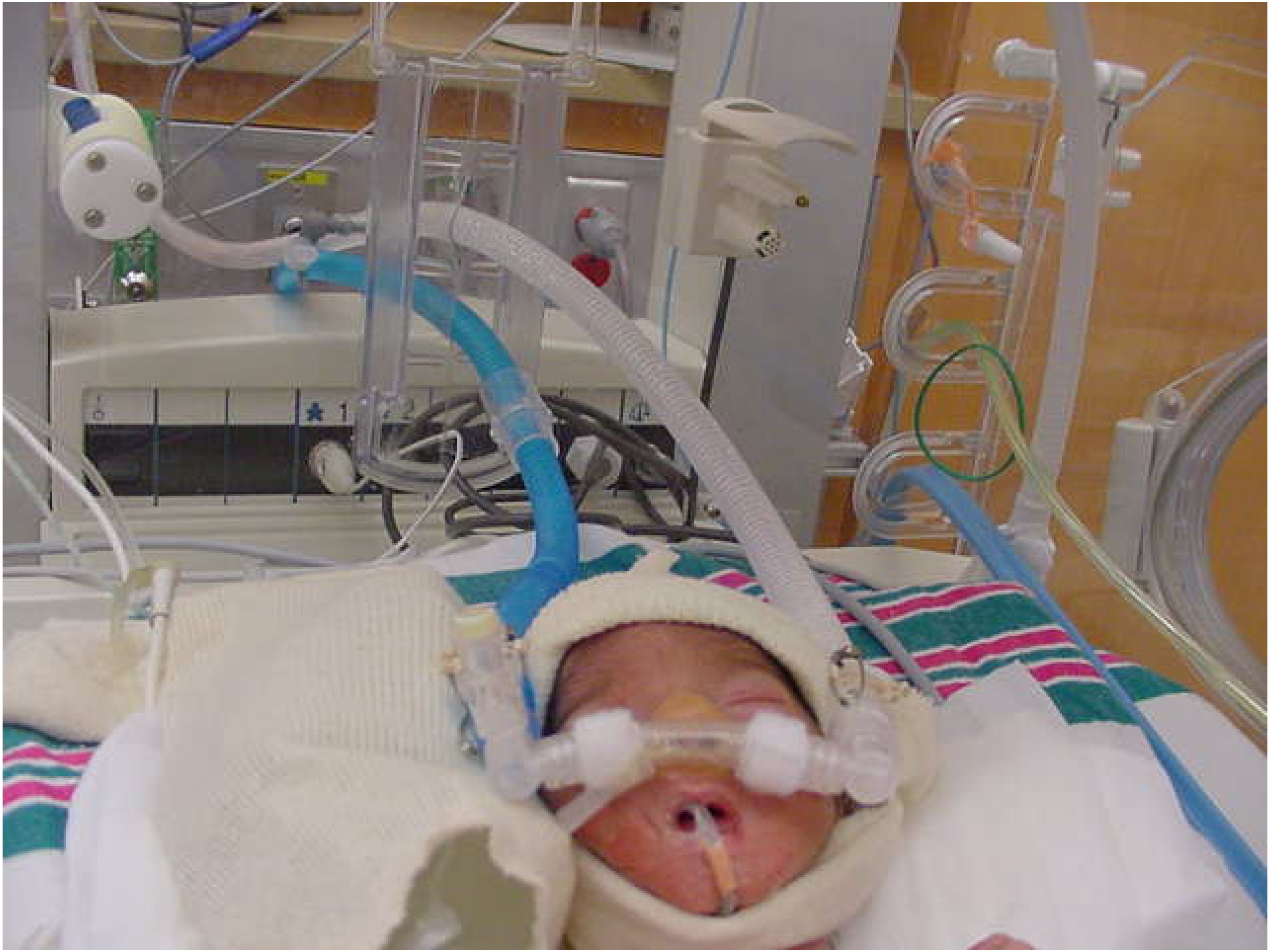


CPAP Cánulas Hudson

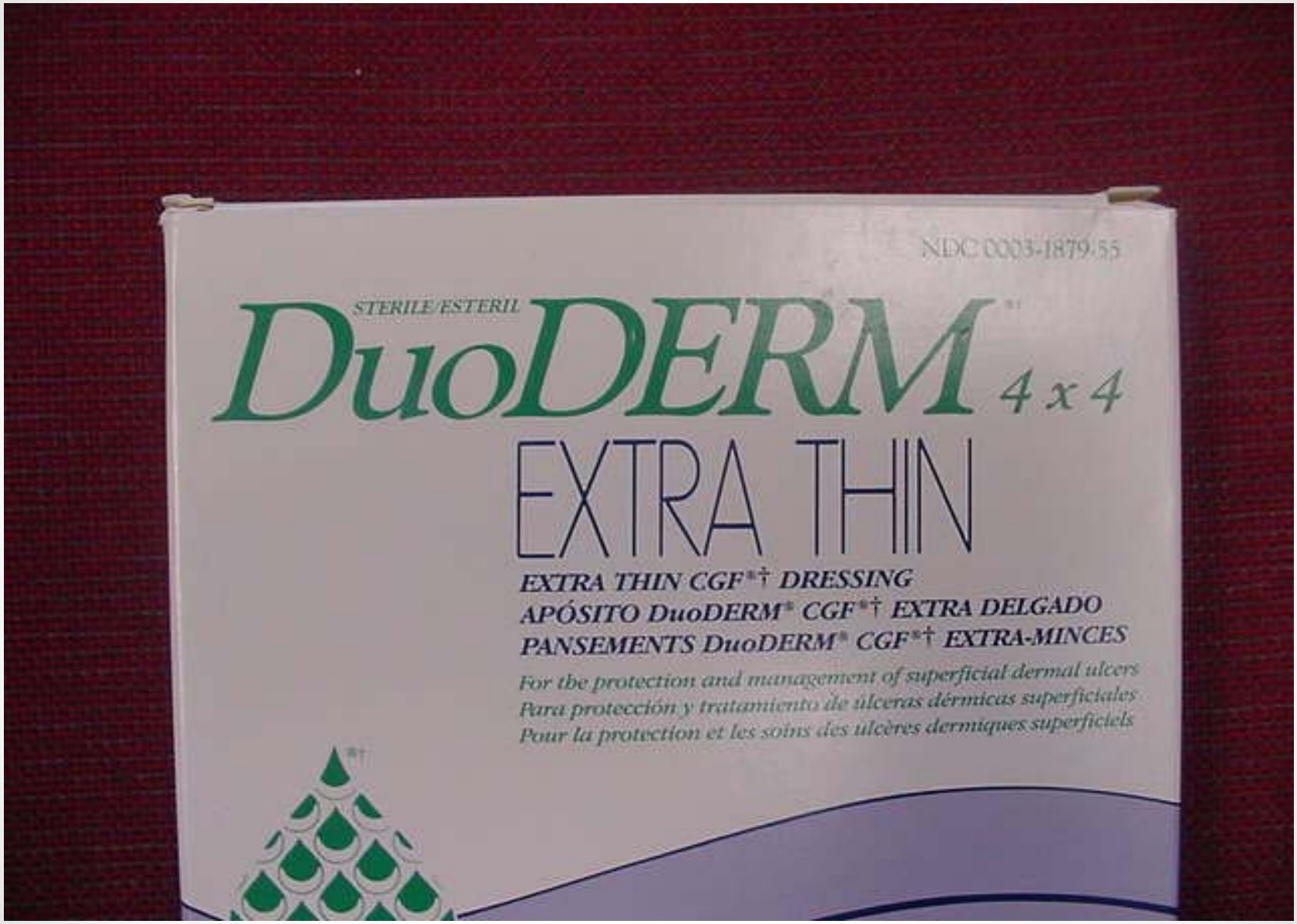


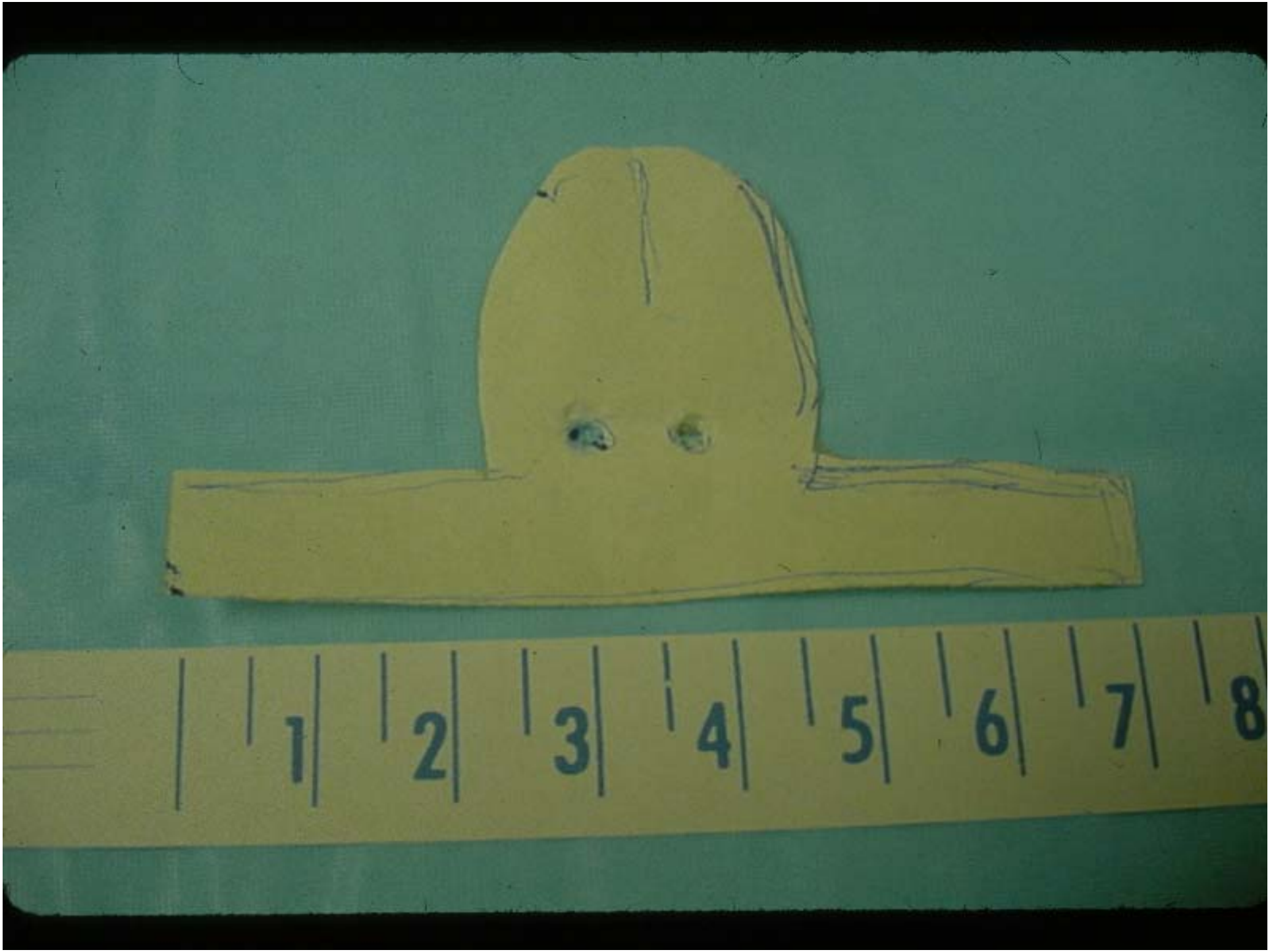
Tamaño	Peso
0	< 700g
1	~ 1000g
2	~ 2000g
3	~ 3000g
4	~ 4000g
5	infant






395 gms , On CPAP since birth


NDC 0003-1879-55
STERILE/ESTERIL
DuoDERM 4 x 4
EXTRA THIN
EXTRA THIN CGF*† DRESSING
APÓSITO DuoDERM® CGF*† EXTRA DELGADO
PANSEMENTS DuoDERM® CGF*† EXTRA-MINCES
For the protection and management of superficial dermal ulcers
Para protección y tratamiento de úlceras dérmicas superficiales
Pour la protection et les soins des ulcères dermiques superficiels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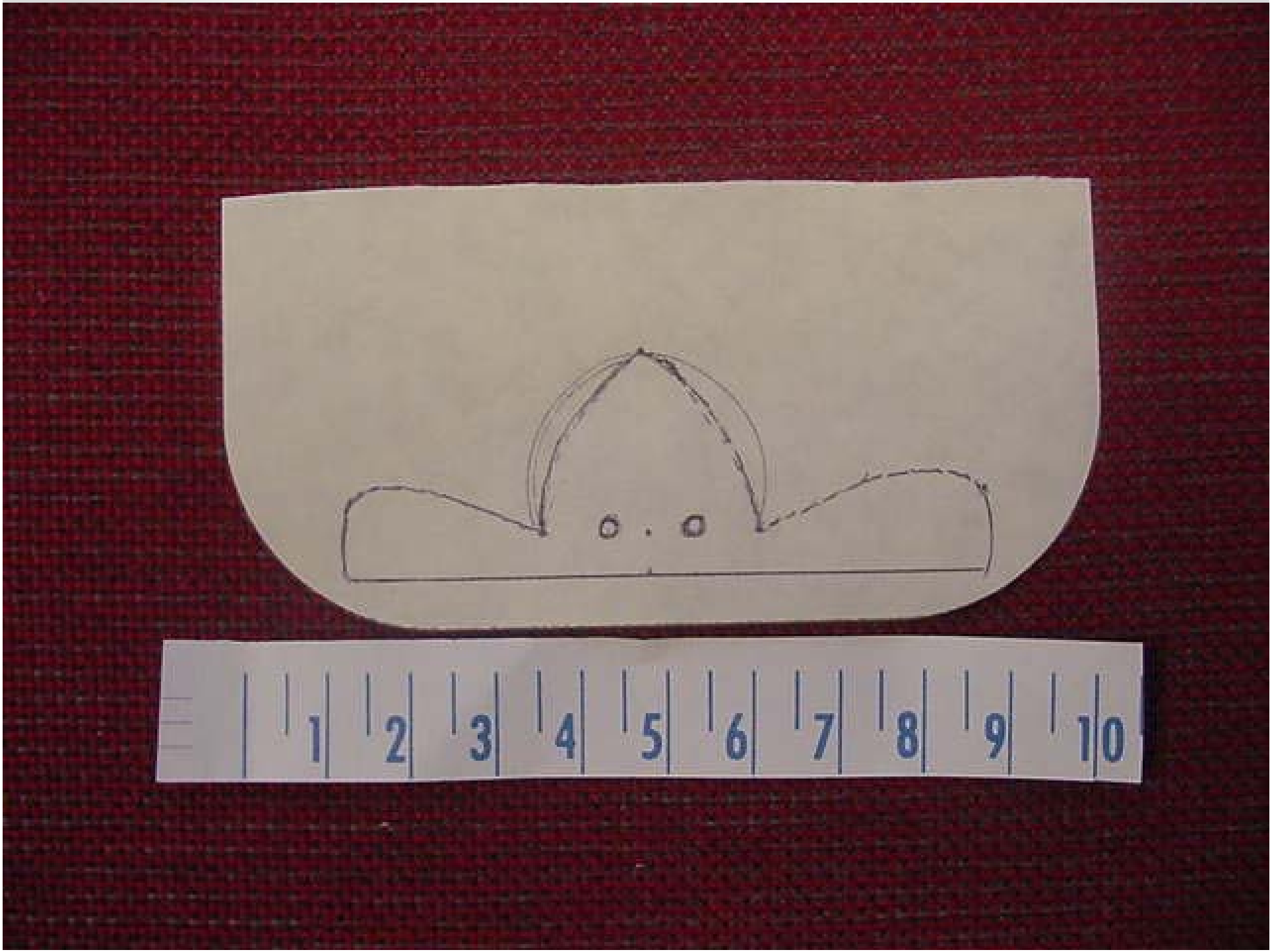
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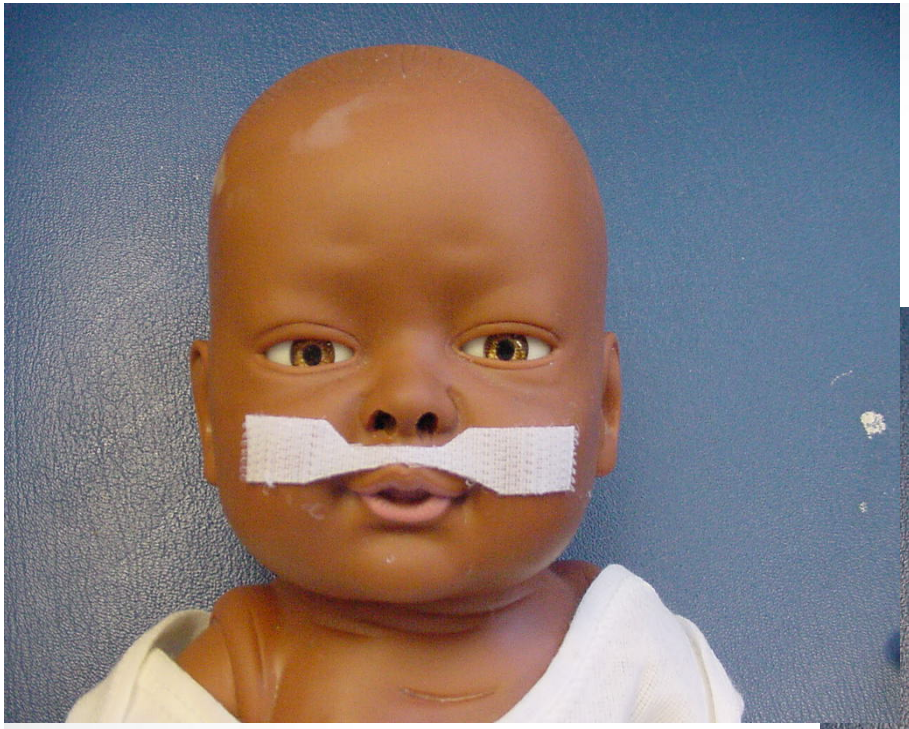
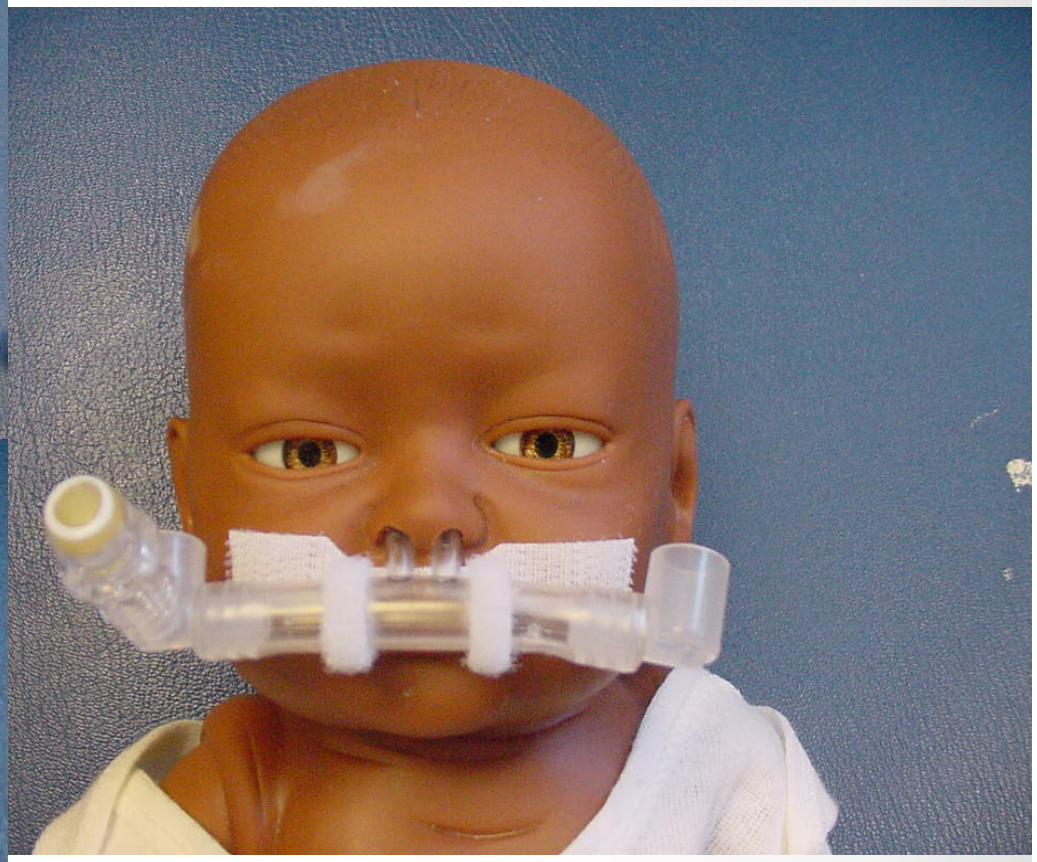
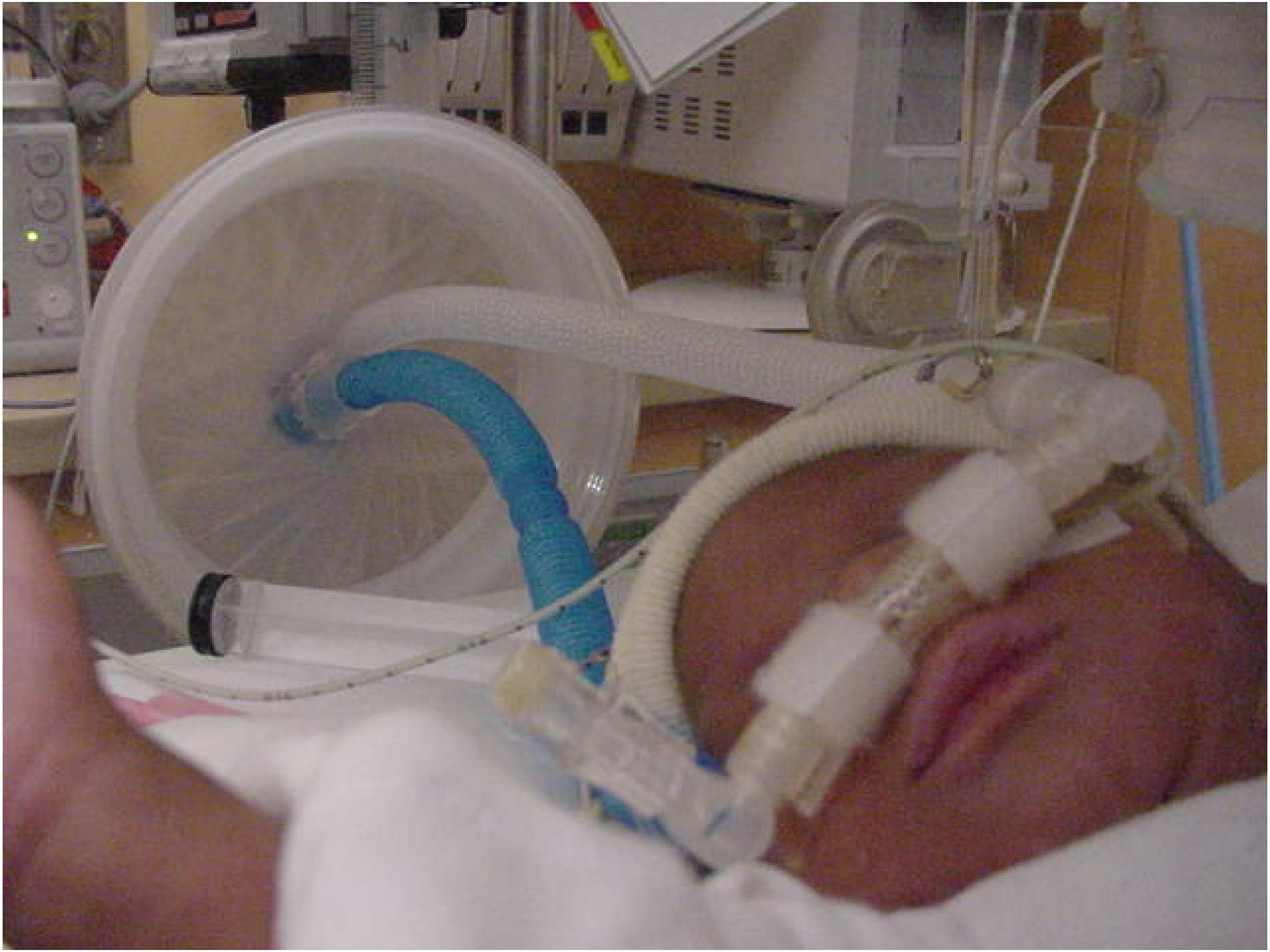
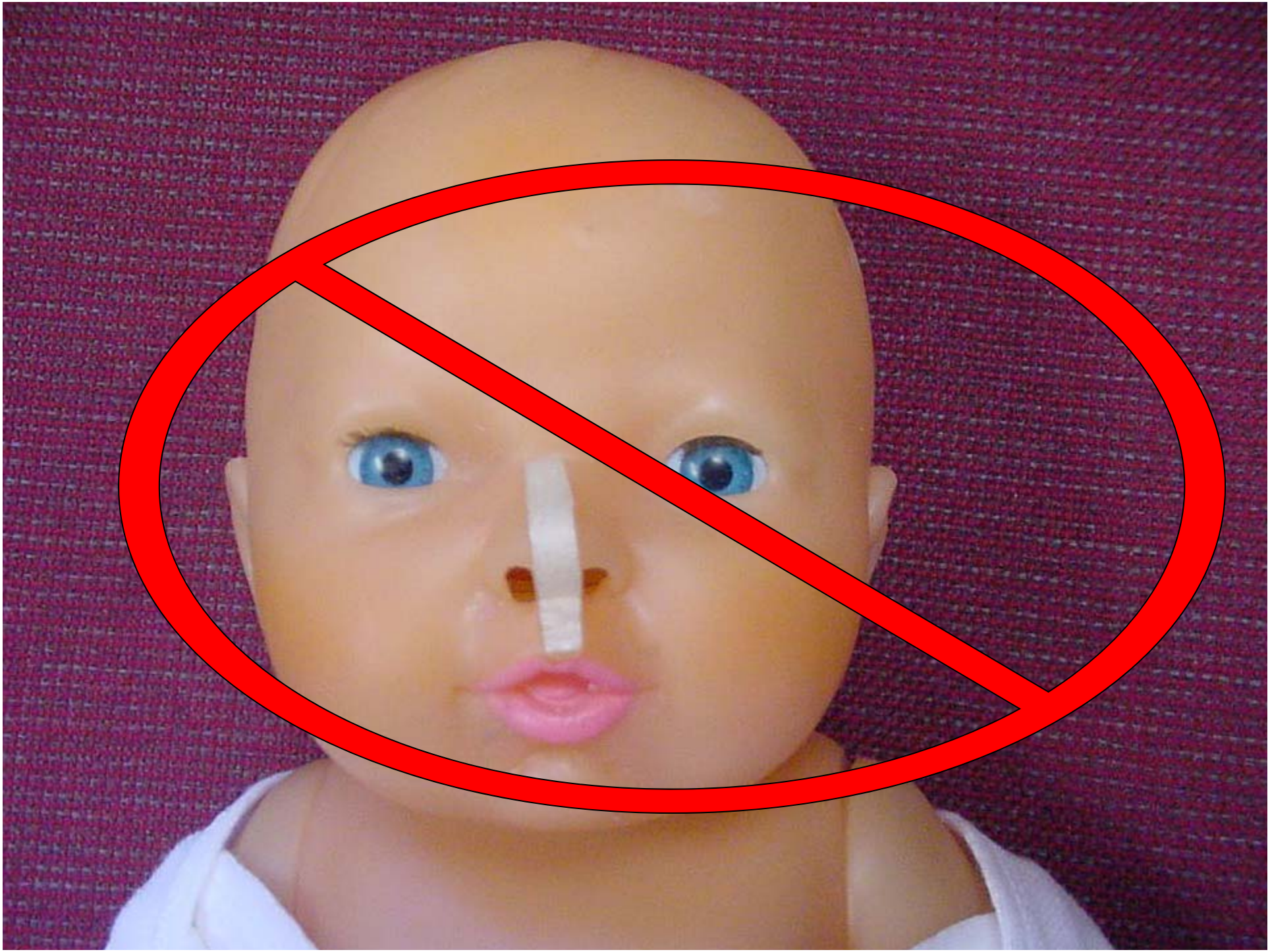
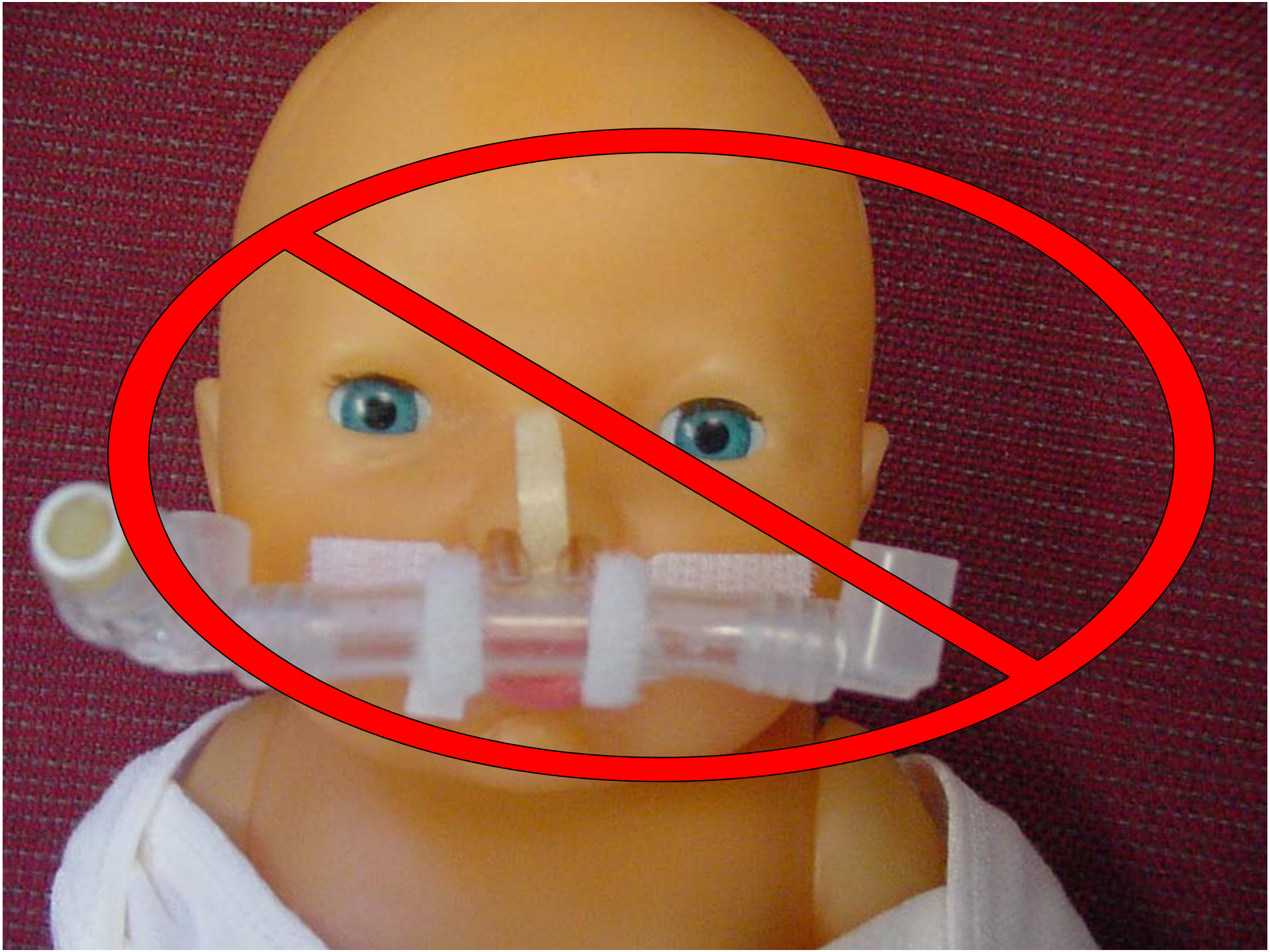




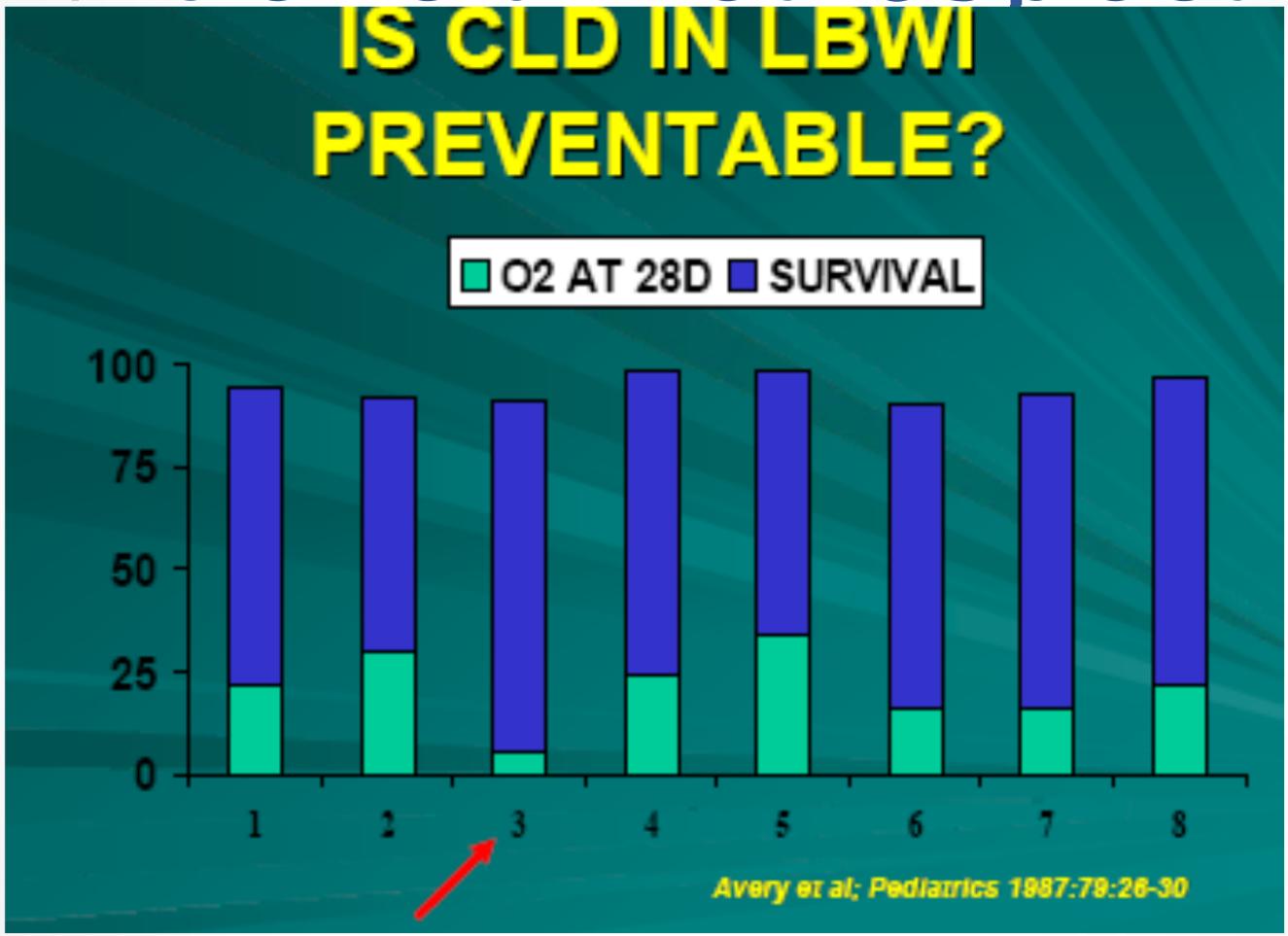






- *Eficacia del CPAP*

Evidencia Retrospectiva



Van Marter LJ. Curr Opin Pediatr. 2005;17(2):174-80

- Ha resurgido el interés por el CPAP durante la última década
- El efecto deseado es que el CPAP mantenga los alvéolos abiertos y permita un intercambio gaseoso suficiente

EXPERIENCIAS PUBLICADAS

- Nasal CPAP or Intubation at Birth for Very Preterm Infants
- Colin J. Morley, M.D., Peter G. Davis, M.D., Lex W. Doyle, M.D.,
- Luc P. Brion, M.D., Jean-Michel Hascoet, M.D., and John B. Carlin, Ph.D.,

N Engl J Med 2008;358:700-8.

A Device for Administration of Continuous Positive Airway Pressure by the Nasal Route

JOHN KATTWINKEL, M.D.
DAVID FLEMING, Ph.D.
CHUL C. CHA, M.D.
AVROY A. FANAROFF, M.B., M.R.C.P.E. D.C.H.
MARSHALL H. KLAUS, M.D.
Department of Pediatrics
School of Medicine
Case Western Reserve University and University Hospitals
Cleveland, Ohio 44106

Pediatrics 1973;52:131

- La conclusión mayor del protocolo COIN, fue que: a **lo menos 55 % de los niños de esta edad gestacional (26,9 sem promedio) pudieron ser manejados solo en CPAP, con reducción de alrededor de 80% en el uso de surfactante, y menor gasto de insumos relacionados a la ventilación**

ESTRATEGIAS DE SOPORTE VENTILATORIO EN UK

	Acute RDS	Weaning
IPPV	73%	N/A
HFO	2%	N/A
IMV	N/A	13%
A/C	4%	15%
SIMV	13%	73%
VG	5%	6%
CPAP	2%	N/A

Sharma A & Greenough. Acta Paediatrica 96: 1115-1117, 2007

Morbilidad pulmonar según edad gestacional en pretérminos

Characteristic	22 wk	23 wk	24 wk	25 wk	26 wk	27 wk	28 wk	Total
Severe BPD	56%	39%	37%	26%	17%	13%	8%	18%
Surfactant	97%	97%	95%	90%	86%	78%	65%	82%
Ventilation	96%	94%	89%	76%	61%	49%	40%	62%
CPAP	0%	3%	8%	18%	30%	36%	38%	26%

N = 8575 VLBW infants (2003-2007)

Stoll B et al Pediatrics 126: 443, 2010

SURFACTANTE: REVISIONES SISTEMATICAS :

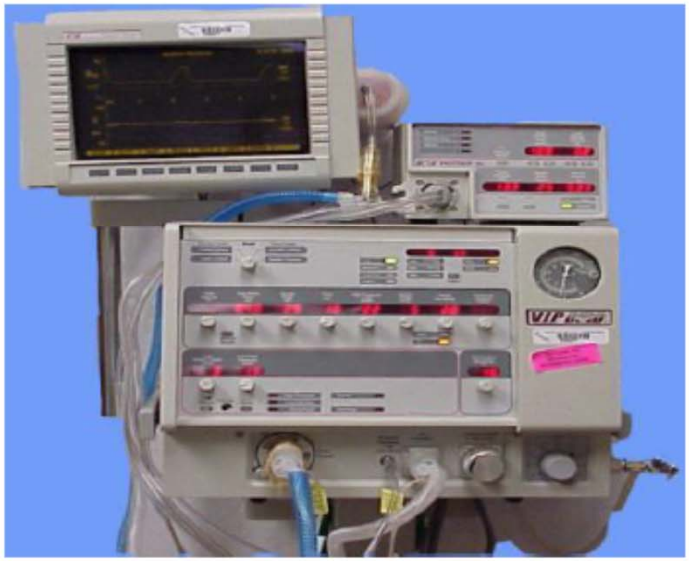
MORTALIDAD

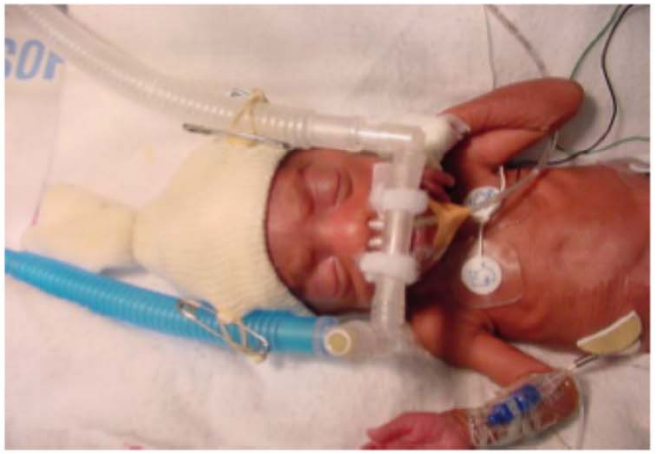
	RR	95%CI	NNT	95% CI
Natural surfactant	0.86	0.76-0.98	50	20-1000
Multiple doses	0.63	0.39-1.02	14	7-1000
Prophylaxis	0.61	0.48-0.77	20	14-50
Early	0.87	0.77-0.99	33	17-1000

HL Halliday Journal of Perinatology 28: s47, 2008

"Simplicity is the Ultimate sophistication"

KISS: Keep it simple stupid!





¿Está basado en la evidencia el uso inicial de CPAP en prematuros ?

si

Resumen de series de CPAP

	Gestational age	N	*Death or BPD*	*Air-leaks*
			CPAP/control	CPAP/control
Support	$24^{0/7}$-$27^{6/7}$	1316	47.8%/51.1%	6.8%/7.4%
COIN	$25^{0/7}$-$28^{6/7}$	610	33.9%/38.9%	9.1%/3.0%
VON	$26^{6/7}$-$29^{6/7}$	648	29.6%/36.5%	4.8%/5.4%
Neocosur	800-1500g	256	13.7%/19.2%	3.1%/5.6%
CURPAP	$25^{0/7}$-$28^{6/7}$	208	21.0%/21.9%	4.9%/9.5%
Total		3038	29.2%/33.52%	5.7%/6.18%

Columbia

-

- Análisis retrospectivo de 4 años(2008-11)

- 297 pretérminos consecutivos < 1000 grs

Outcome Respiratorio con CPAP 2008-2011

Started	*CPAP success@*	*CPAP failure*	*Ventilated*
	(n = 151)	(n = 84)	(n =62)
Weeks	26.9 ± 1.8*	25.6 ± 1.3*	24.8 ± 1.5*
Weight (g)	792.7 ± 136.1	723.1 ± 152.0	658.6 ± 141.2

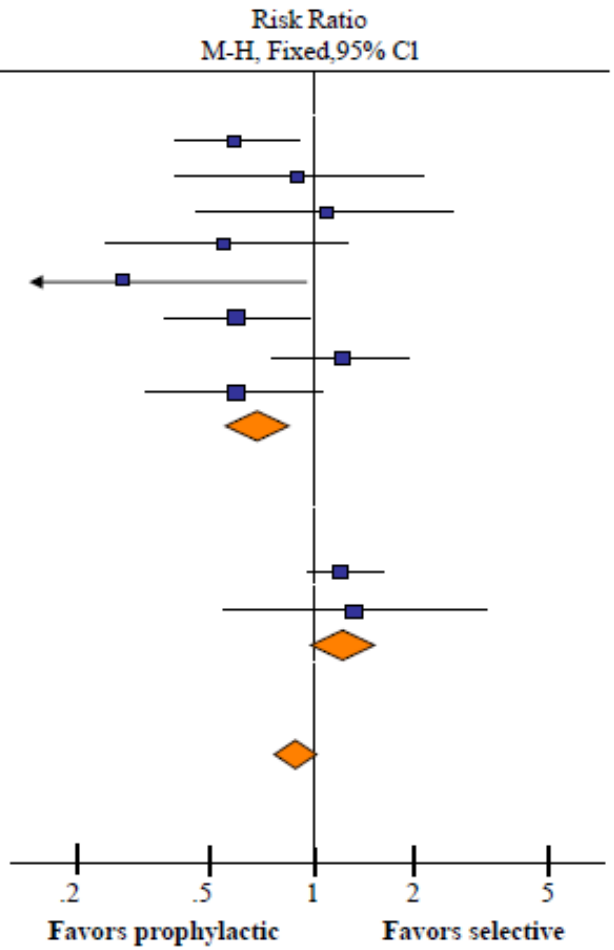
*P < .001 CPAP success vs. CPAP failure & ventilated vs. CPAP failure
@ CPAP success rate 64%

Outcome Respiratorio con CPAP 2008-2011

	CPAP success (n = 151)	CPAP failure (n = 84)	Ventilated Started (n =62)
Oxygen at 28 days	31.8%	73.8%	72.9%
Oxygen at 36 weeks	3.6%	15.4%	13.5%
Severe BPD (NICHD)	23.9%	50.7%	54.0%
Pneumothorax	3.2%	13.4%	8.1%
Mortality	8.6%	22.6%	40.3%
Death or O_2 (36 wks)	11.9%	34.5%	48.4%

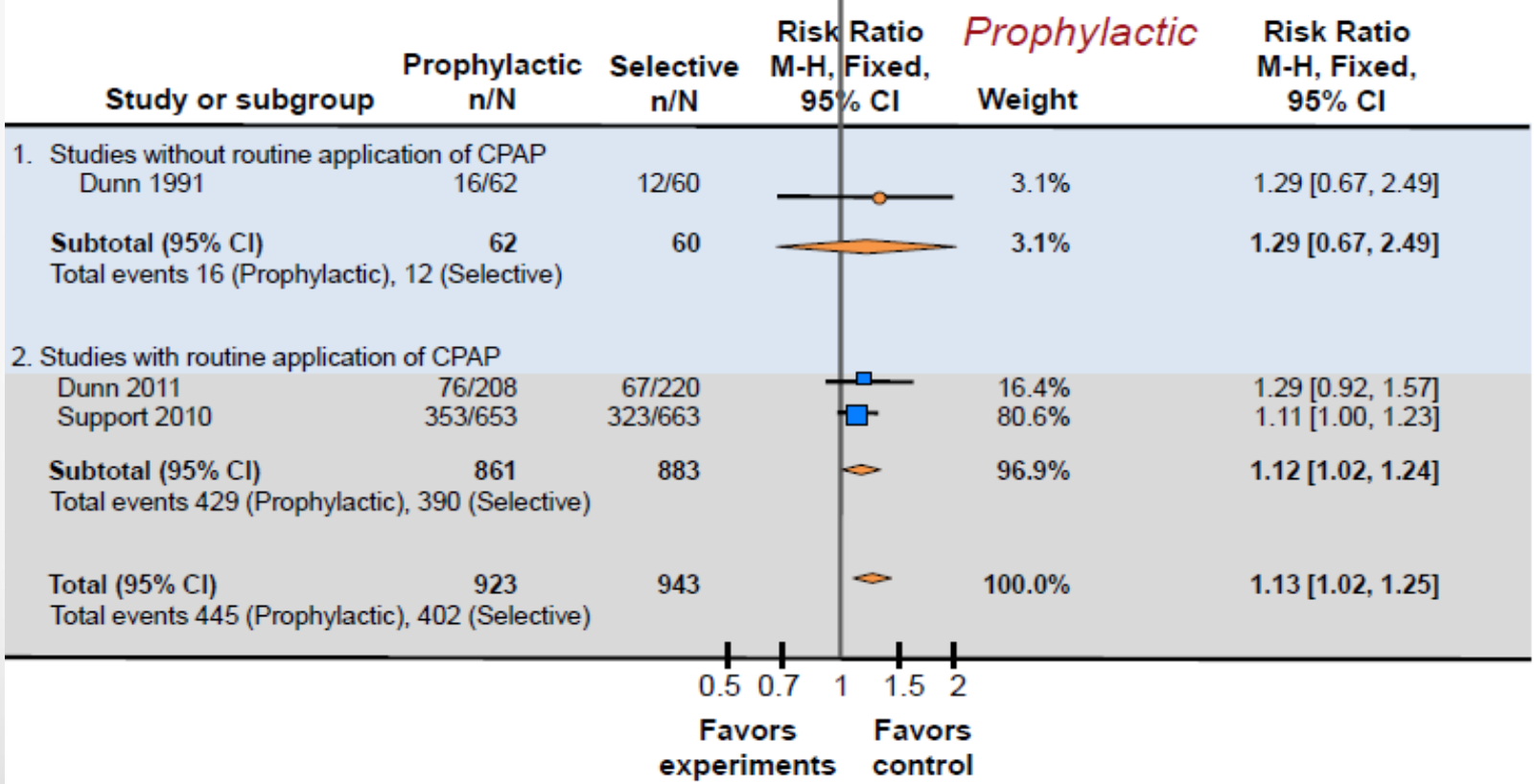
SURFACTANTE PROFILACTICO VS SELECTIVO EN SDRI Y MORTALIDAD

Study or Subgroup	Prophylactic Events	Prophylactic Total	Selective Events	Selective Total	Weight	Risk Ratio M-H, Fixed,95% CI
1.6.1 Studies without routine application of CDP						
Bevilacqua 1996	28	136	46	132	16.9%	0.59 [0.39, 0.89]
Bevilacqua 1997	9	49	9	44	3.4%	0.90 [0.39, 2.06]
Dunn 1991	9	62	8	60	3.0%	1.09 [0.45, 2.63]
Egberts 1993	8	75	14	72	5.2%	0.55 [0.24, 1.23]
Kattwinkel 1993	3	627	11	621	4.0%	0.27 [0.08, 0.96]
Kendig 1991	23	235	40	244	14.2%	0.60 [0.37, 0.97]
Merritt 1991	27	76	21	72	7.8%	1.22 [0.76, 1.95]
Walti 1995	15	134	23	122	8.7%	0.59 [0.33, 1.08]
Subtotal (95% CI)		**1394**		**1367**	**63.3%**	**0.69 [0.56, 0.85]**
Total events	122		172			
1.1.2 Studies with routine application of CDP						
Support 2010	114	653	94	663	33.8%	1.23 [0.96, 1.58]
Von 2010	10	209	8	221	2.8%	1.32 [0.53, 3.28]
Subtotal (95% CI)		**862**		**884**	**36.7%**	**1.24 [0.97, 1.58]**
Total events	124		102			
Total (95% CI)		**2256**		**2251**	**100.0%**	**0.89 [0.76, 1.04]**
Total events	246		274			



Rojas & Soll 2010 unpublished

Prophylactic surfactant vs. treatment of established respiratory distress in preterm infants, Chronic lung disease or death



INSURE

Intubation >> Surfactant >> Extubation

Cochrane Database Analysis of the Need for Mechanical Ventilation ≥ 1 hr & Air-leak Using the INSURE Approach.

Mechanical Ventilation

	RR	CI
FiO2 < 0.45	0.72	(0.58-0.87)
FiO2 ≥ 0.45	0.55	(0.40-0.77)
Total	0.67	(0.57-0.79)

Air-Leak

	RR	CI
FiO2 < 0.45	0.46	(0.23-0.93)
FiO2 ≥ 0.45	0.80	(0.22-2.89)
Total	0.52	(0.26-0.96)

Decreased need for O_2 (RR 0.51 (0.26. 0.99) at 28 days, but not 36 weeks

Stevens Cochrane Database 2007

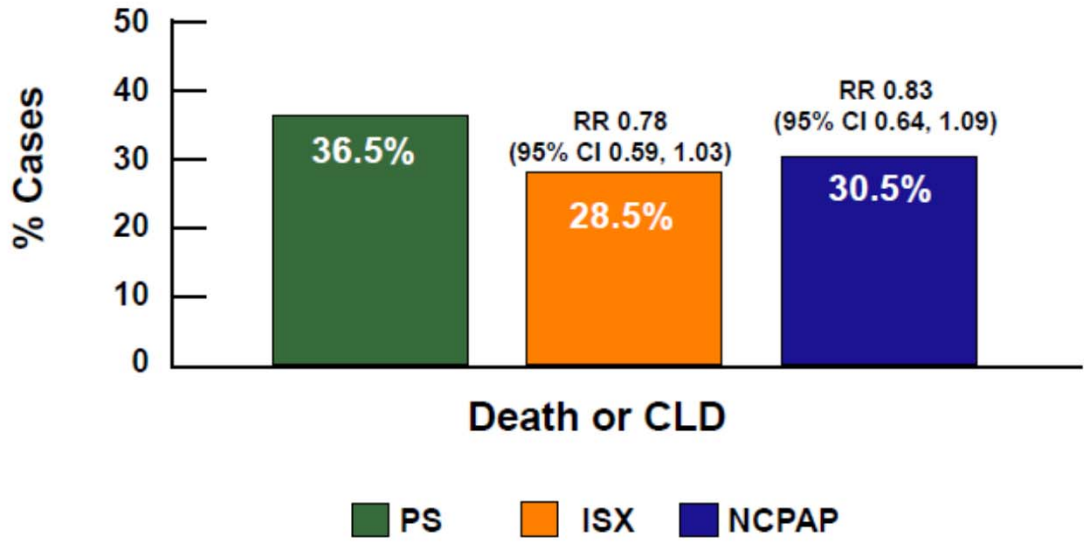
VON Delivery Room Management (DRM) Groups

- Intubation, prophylactic surfactant administration with subsequent stabilization on ventilator support (*PS Group*)
- Intubation, prophylactic surfactant administration and rapid extubation to NCPAP (*ISX Group*)
- Early stabilization on NCPAP and selective intubation and surfactant administration for clinical indications (*NCPAP Group*)

Gestational age 26+0 to 29+6 weeks
Study assignment was made prior to delivery

Von Delivery Room Management Trial

Death or CLD At 36 Weeks Post Menstrual Age



Rojas and Soll 2010 unpublished

VON-DRM

- **En el grupo CPAP nasal, el 48% se manejó sin intubar y 54% sin surfactante**

INSURE

- **Cuando se vislumbra la necesidad de ventilar, debiéramos administrar surfactante con método INSURE**
  En caso contrario ,no administrar surfactante

CPAP Precoz vs Cuidado Estándar

Estabilización rutinaria en CPAP=menos DBP y < mortalidad que surfactante profiláctico

COIN

SUPPORT

VON-DRM

Table 1
Early CPAP versus STD care (intubate, surf, mechanical ventilation)

Author, Year	n	Gest Age	Comparison	Status in DR	Primary Outcome	Results of Primary Outcome	Notes
Morley et al,[21] 2008	610	25–28 + 6	CPAP in DR vs STD care	Mild-mod resp distress Spontaneously breathing	CLD @ 36 wk or mortality	OR 0.80 (95% CI 0.58–1.12)	CPAP group spent less time on mechanical vent, less postnatal steroids 9.1% vs 3.0% PTX rate in CPAP group vs in STD care Only 77% of intubated infants received surfactant CPAP failure threshold high (FIO_2 >0.6) Initial CPAP at 8 cm H_2O
Finer et al,[23] 2010	1316	24–27 + 6	CPAP in DR vs STD care	All comers independent of respiratory status	CLD @ 36 wk or mortality	OR 0.95 (95% CI 0.85–1.05)	High antenatal steroids rates CPAP group spent less time on ventilator, received less postnatal steroids One part of a 2 × 2 factorial design also investigation 2 oxygenation saturation target ranges
Dunn et al,[25] 2011	648	26–29 + 6	CPAP in DR vs STD care	All comers independent of respiratory status	CLD @ 36 wk or mortality	RR 0.83 (95% CI 0.64–1.09)	High antenatal steroids rates 48% in CPAP group were never intubated Third comparison group received INSURE

Abbreviations: CI, confidence interval; CLD, chronic lung disease; CPAP, continuous positive airway pressure; DR, delivery room; FIO_2, fraction of inspired oxygen; Gest, gestational; INSURE, intubate, surfactant, and extubation; mod, moderate; OR, odds ratio; PTX, pneumothorax; resp, respiratory; RR, relative risk; STD, standard.

CONCLUSIONES

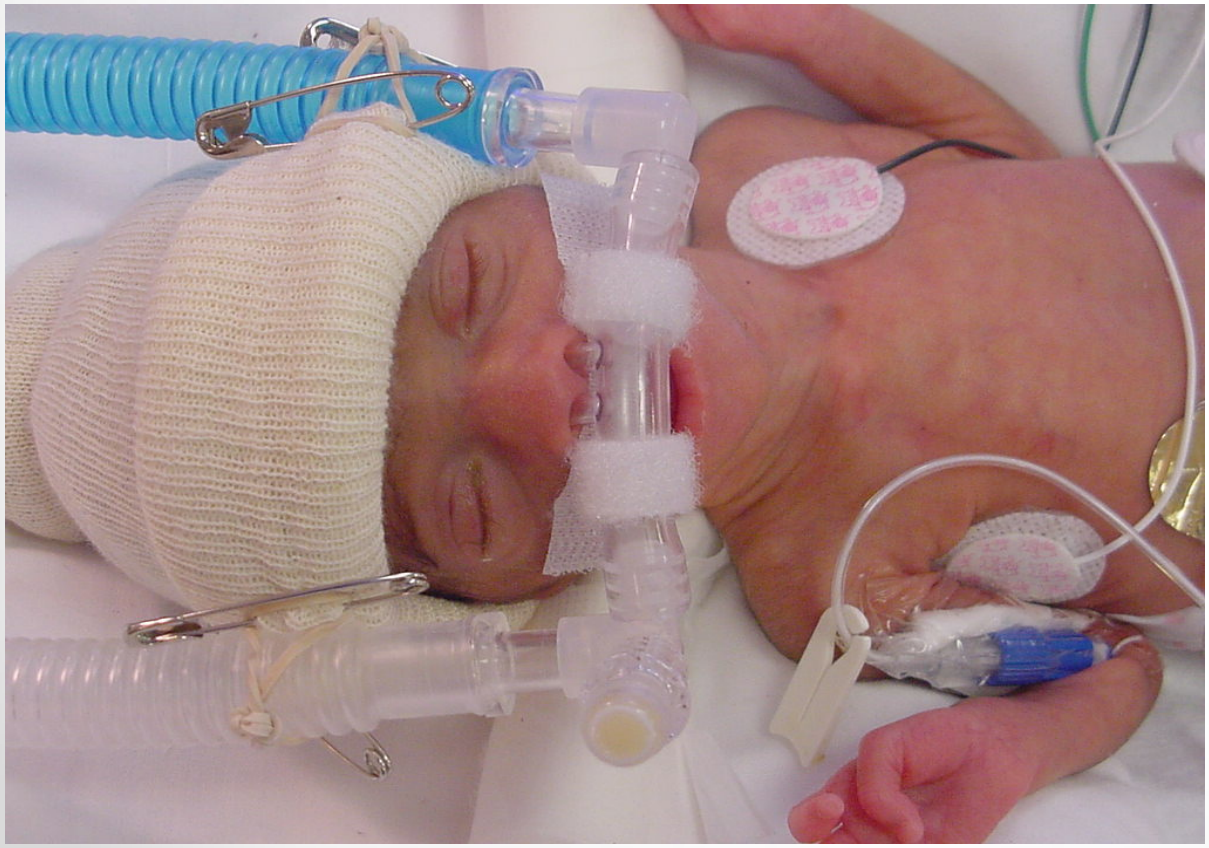
- Los hallazgos de los 3 estudios son consistentes:

- Aunque los criterios de entrada e indicación de intubación y surfactante fueron distintos, ninguno de los estudios pudo demostrar diferencias en mortalidad o DBP cuando los niños fueron manejados inicialmente con CPAP

- Un metanálisis reciente de Cochrane que revisó surfactante profiláctico vs selectivo(Rojas-Reyes et al+ SUPPORT trial+e VON DRM trial) **mostró una tendencia importante a mayor mortalidad o DBP en el grupo de uso prof**
Rojas-Reyes MX, Morley CJ, Soll R. Prophylactic versus selective use of surfactant in preventing morbidity and mortality in preterm infants. Cochrane Database Syst Rev 2012;(3):CD000510.
estabilización temprana con CPAP+surfactante selectivo (n = 1744) (typical RR 1.12 [95% CI 1.02–1.24], typical RD 0.06 [95%)

Los investigadores concluyeron que la estabilización rutinaria con CPAP se asoció a menos riesgo de DBP o muerte,comparado con Surfactante profiláctico.

The Columbia Experience with CPAP

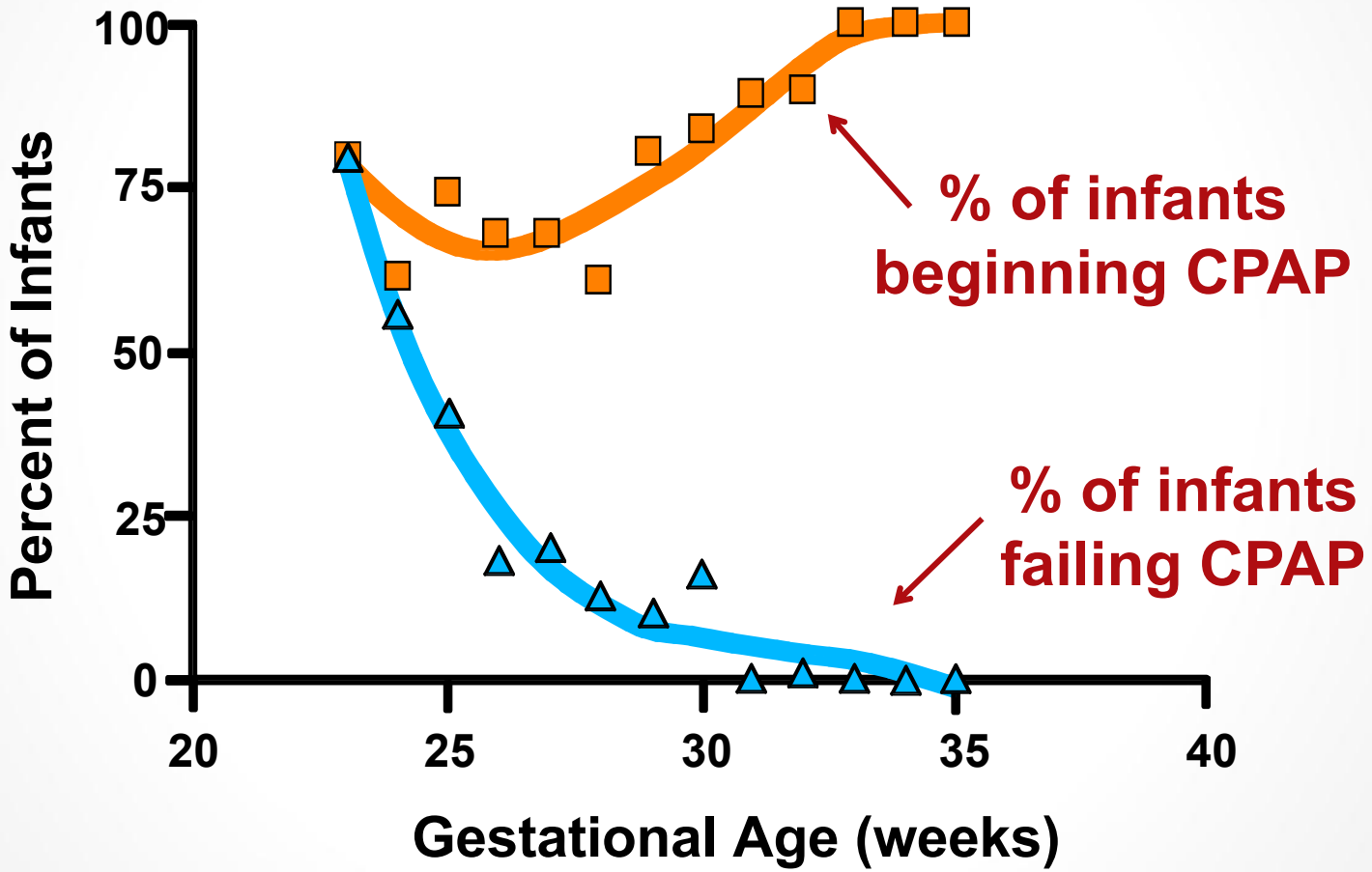


Morgan Stanley
Children's Hospital
of NewYork-Presbyterian
Columbia University Medical Center

La estrategia de Cpap nasal precoz PRIMERO, y surfactante solo para el rescate, no compromete el outcome para los prematuros de bajo peso

Experiencia en otros centros

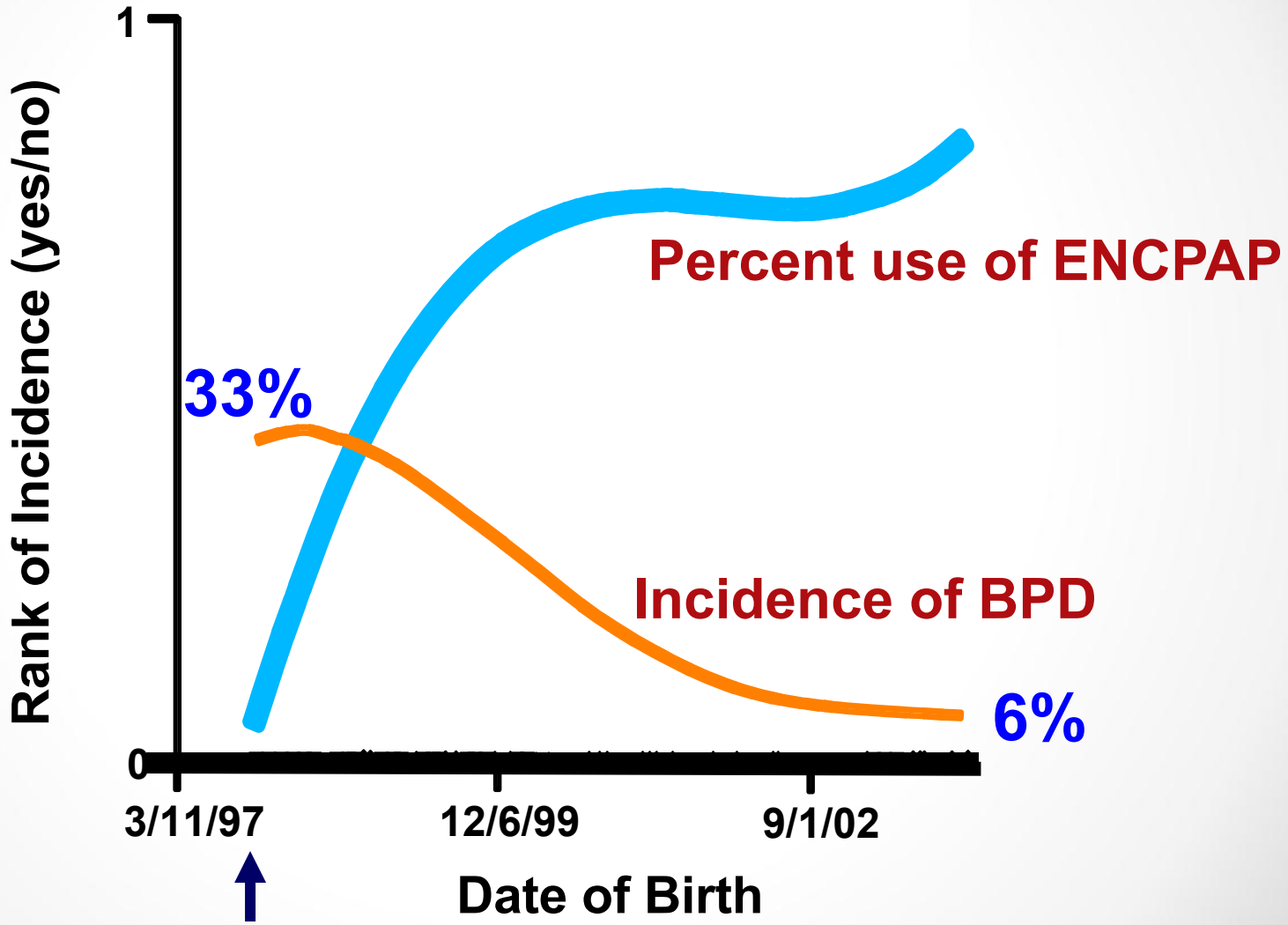
CPAP precoz y fracaso a varias edades gestacionales



Tasa global de exito 77.5%

Aly, H. et al. Pediatrics 115:1660-5,2005.

Exito con CPAP precoz y tasas de DBP



Aly, H. et al. Pediatrics 115:1660-5, 2005.

Table 1. **Incidence of Respiratory Distress Syndrome in Very Low Birthweight Infants**

Study	Infants Reported	% Treated With Surfactant	Ref. No.
Danish Experience	27 ± 2 weeks	30%	5
COIN Trial	950 g average	38% (CPAP arm)	6
NICHD–Support Trial	24–27 weeks	67% (CPAP arm)	7
Vermont-Oxford CPAP Trial	26–29 weeks	45% (CPAP arm)	8

CPAP=continuous positive airway pressure; COIN=continuous positive airway pressure or intubation at birth; NICHD=National Institute of Child Healt and Human Development.

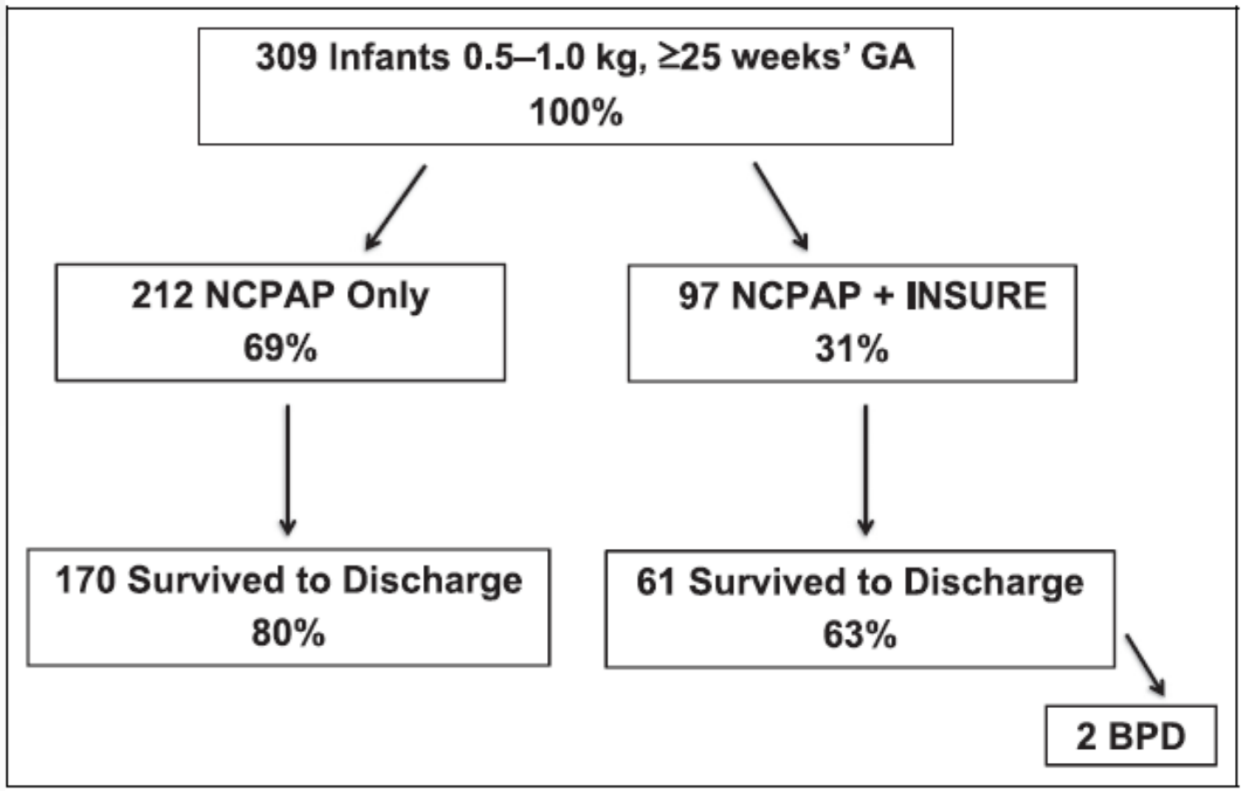


Figure 1. Outcomes of infants treated with continuous positive airway pressure (CPAP). A clinical experience with infants of birthweight 500 to1,000 g and ≥25 weeks' gestational age in a low resource academic neonatal intensive care unit (NICU) in South Africa that did not support infants with mechanical ventilation. The majority of the infants were managed with CPAP alone, and some infants were intubated and given surfactant and then extubated back to CPAP (intubate, surfactant, and extubate [INSURE]). Data from Kirsten et al. (9)

BPD = bronchopulmonary dysplasia; GA = gestational age; NCPAP = nasal CPAP.

9. Kirsten GF, Kirsten CL, Henning PA, et al. The outcome of ELBW infants treated with NCPAP and InSurE in a resource-limited institution. *Pediatrics*. 2012;129(4):e952–e959

CPAP vs Surfactante +SIMV-Metanálisis

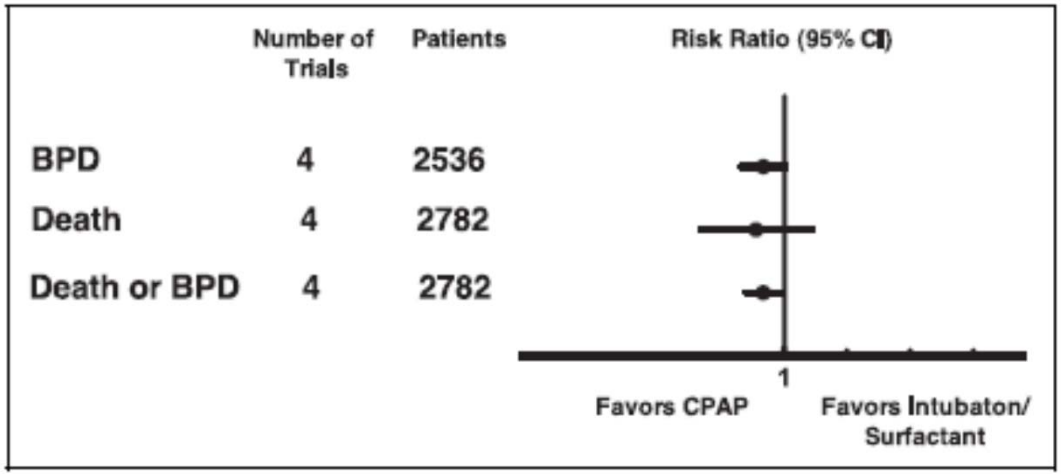


Figure 2. Outcomes for infants randomly assigned to continuous positive airway pressure (CPAP) initiated in the delivery room or intubation and surfactant treatment in the delivery room. The combined outcome of death or bronchopulmonary dysplasia significantly favored the CPAP group. Data from Schmölzer et al. (24)

¡Cuidado con el flujo!

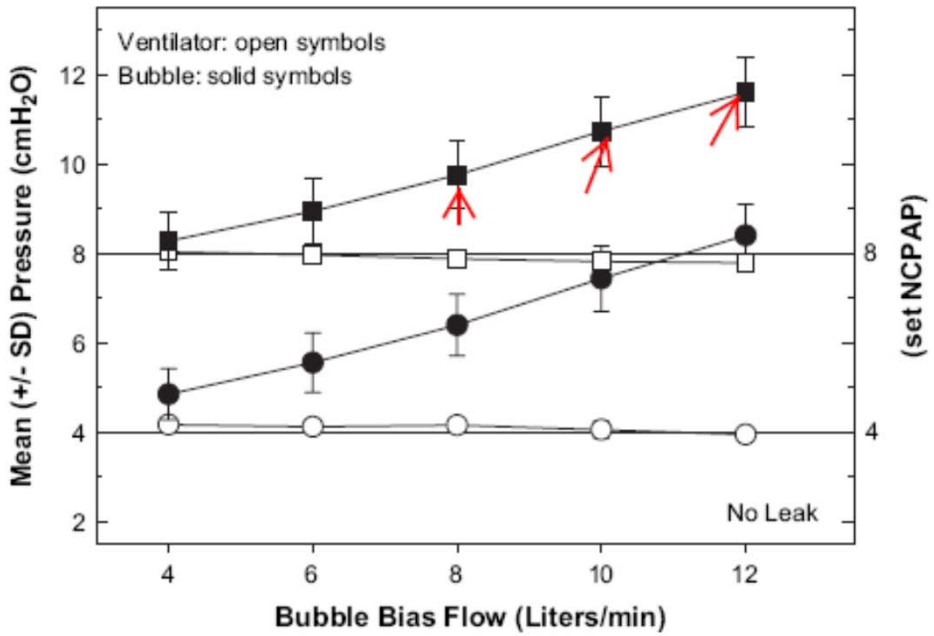


Fig. 5. In vitro study of NCPAP generated with a bubble system (*solid symbols*) and an infant ventilator under no-leak conditions. Set NCPAP levels of 4 and 8 cm H_2O, shown on the right-hand Y-axis, were maintained constant with the ventilator despite increasing flow levels. With the bubble system, increasing flow resulted in dramatic increases in NCPAP pressure as measured at the prongs. (*Courtesy of* Doron Kahn, MD, New Hyde Park, NY.)

- No todos los sistemas de CPAP son iguales

- Existe una curva de aprendizaje del uso de CPAP

No debe rotularse una terapia como inútil, cuando en realidad fue solo aplicada en forma incorrecta

Bubble-CPAP vs Ventilator-CPAP

Todos los niños con B-CPAP tenían:

- Un vol. minuto menor con una reducción media del **volúmen minuto de 39%** ($p<0.001$)
- **7 % reducción de la Frecuencia respiratoria** ($p=0.004$)
- Sin cambios en la Co2 transcutánea y la saturación

- **Lee K-S et al: Biol Neonate 73: 69-75, 1998**

Ventajas Fisiológicas del B-CPAP frente a CPAP del ventilador

- Menor $PaCO_2$
- Mayor PaO_2, pH, Capacidad Funcional Residual
- Menos alteración V/Q
- Menos proteínas alveolares

Bubble Continuous Positive Airway Pressure Enhances Lung Volume and Gas Exchange in Preterm Lambs

Jane Pillow et al. Am J Respir Crit Care Med. 2007 ; 176(1): 63–69.

B-NCPAP vs V-NCPAP

- Estudio randomizado con crossover en 18 prematuros (<1500 g) con SDR leve
- El trabajo respiratorio,la sincronía ,FR,VC,FC ventilación minuto ,la compliance y la $PCO_{2\ Tc}$ **fueron similares**
- PO_2Tc fue mayor con B-NCPAP (P=0.01)

Courtney, SE et al.:Journal of Perinatology (2011) 31, 44–50;

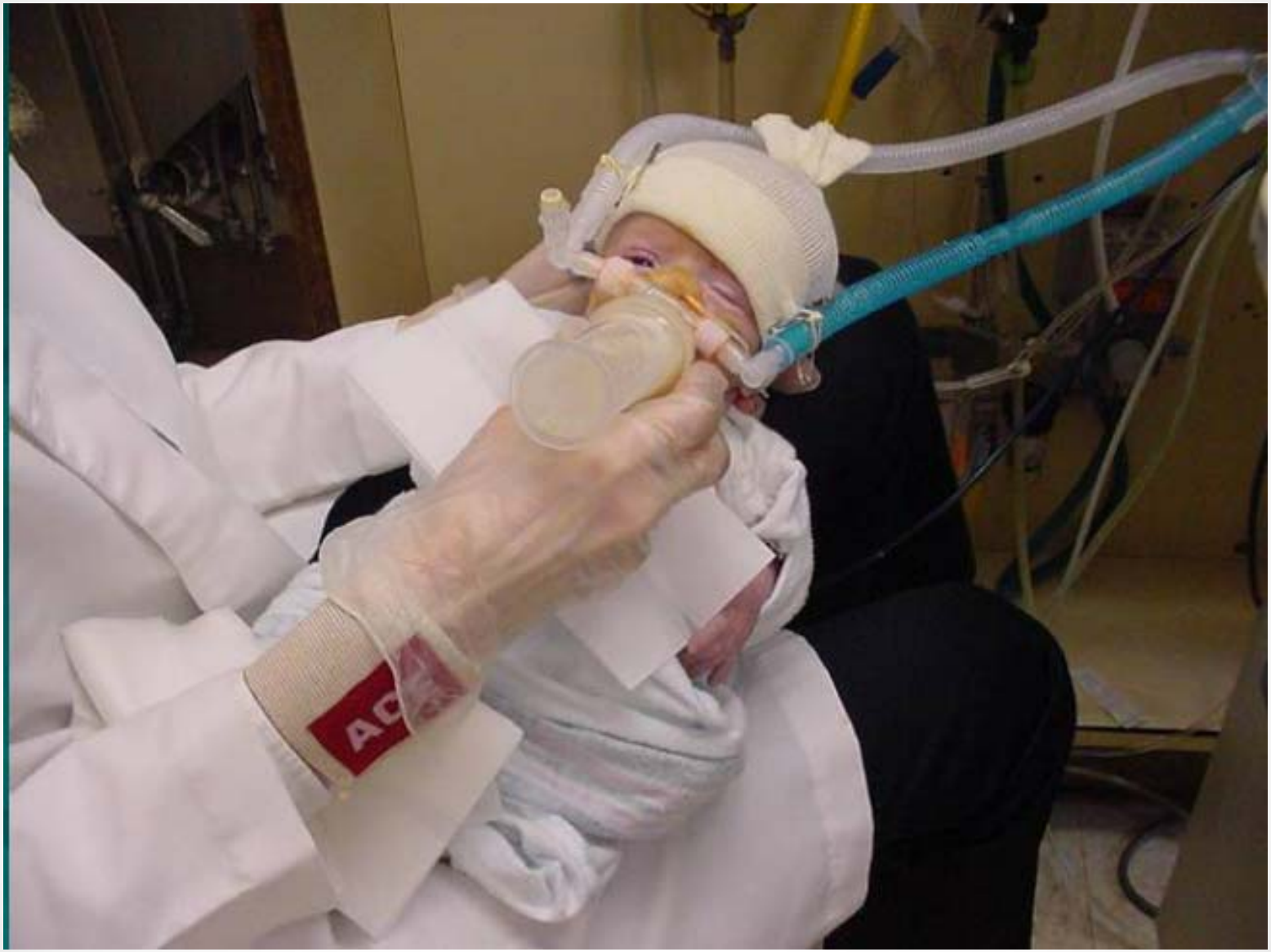
¿Debe usarse CPAP después de la extubación ?

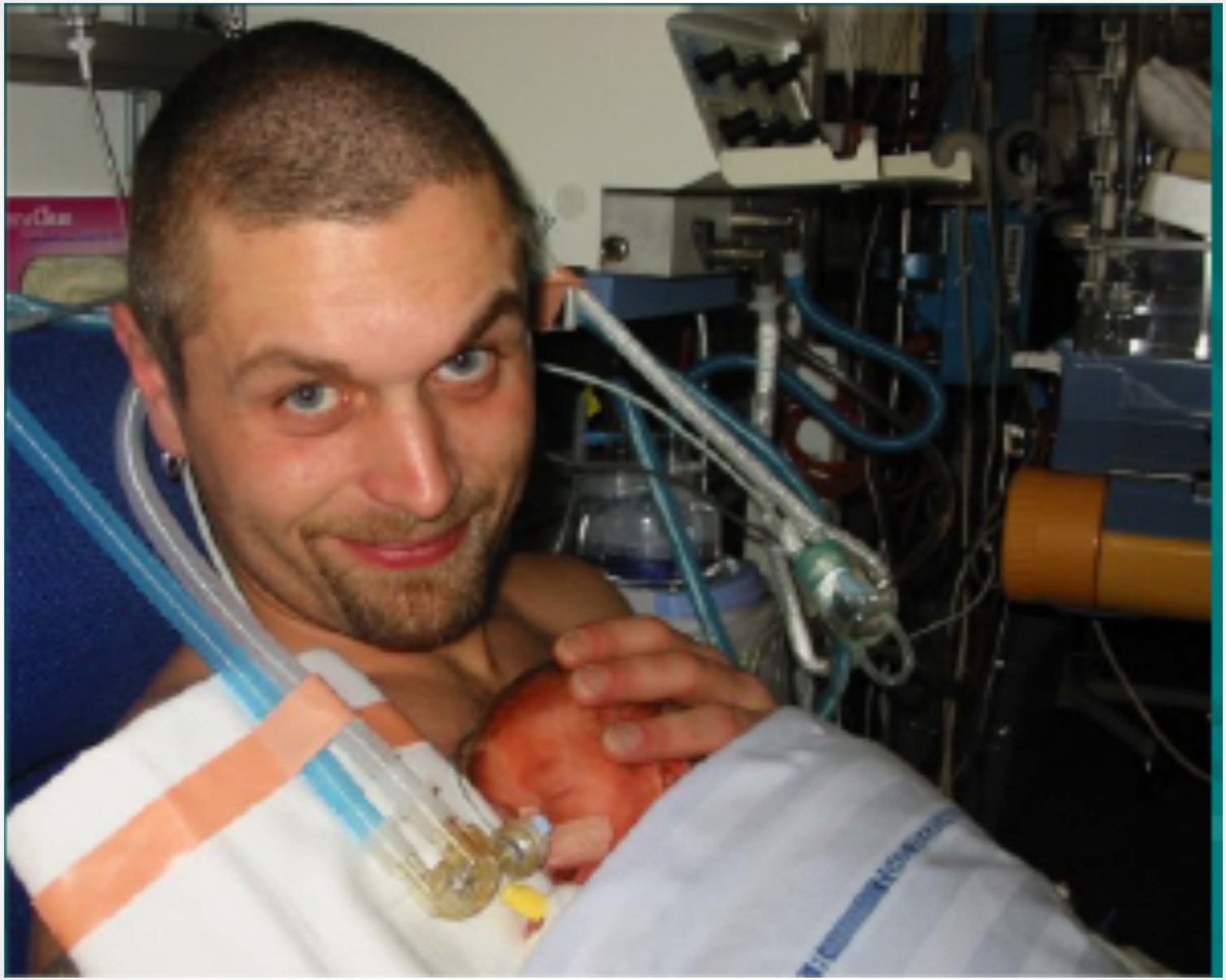
- Davis PG, Henderson-Smart DJ. Nasal continuous positive airway pressure immediately
- after extubation for preventing morbidity in preterm infants. Cochrane Database Syst
- Rev 2003;2:CD000143.

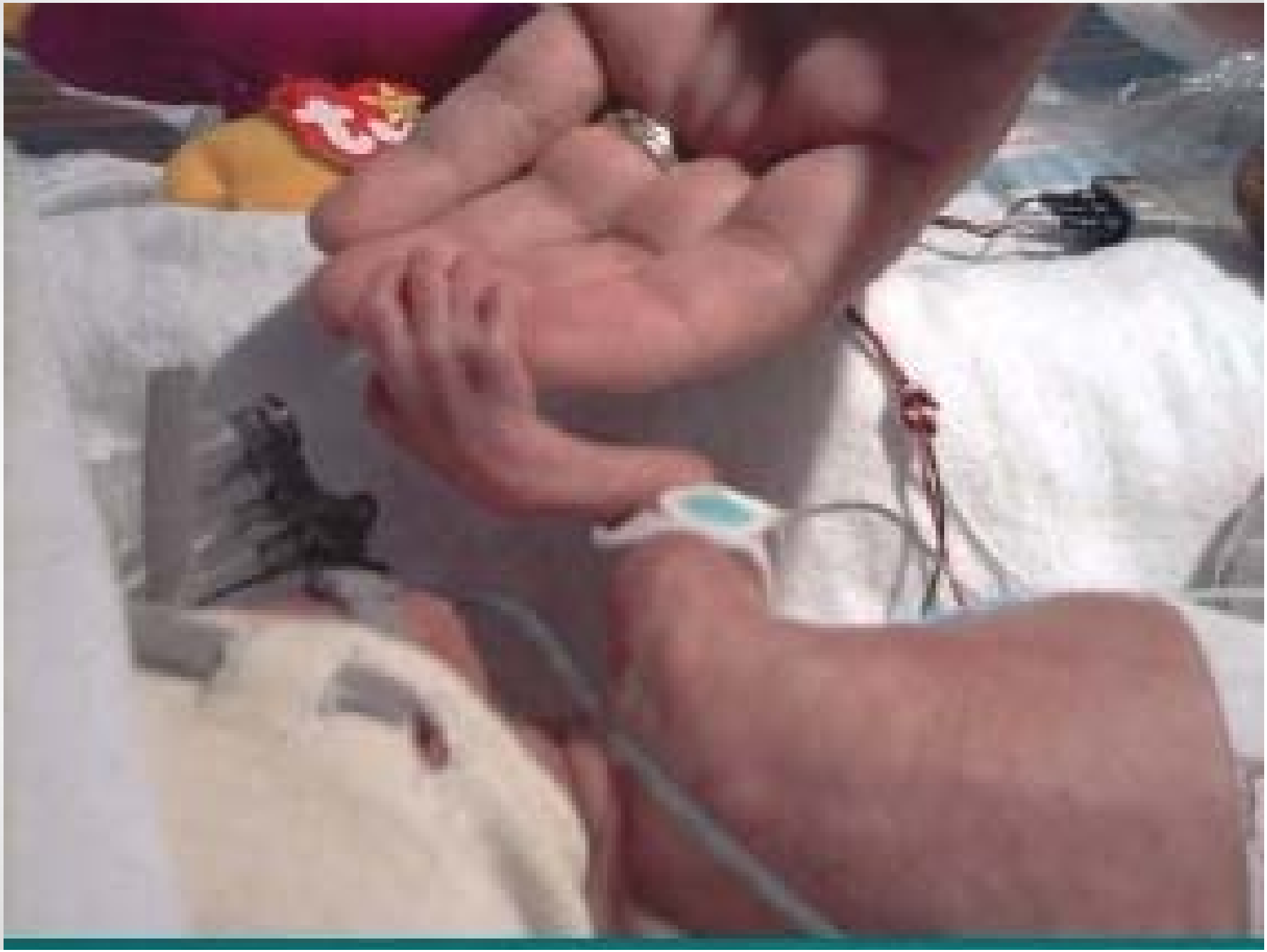
Cochrane review of NCPAP after extubation incluyó un total de 8 trabajos en los cuales 629 niños fueron tratados en series randomizadas o casi randomizadas.

La revisión concluyó que el nCPAP es efectivo en prevenir la reintubación después de ventilación mecánica.

El RR para falla de extubación cuando se utiliza CPAP en vez de ventilación espontánea fue de 0.57, 95% confidence intervals (0.46, 0.72).
El NNT con CPAP para prevenir una falla de extubación es solo 5.





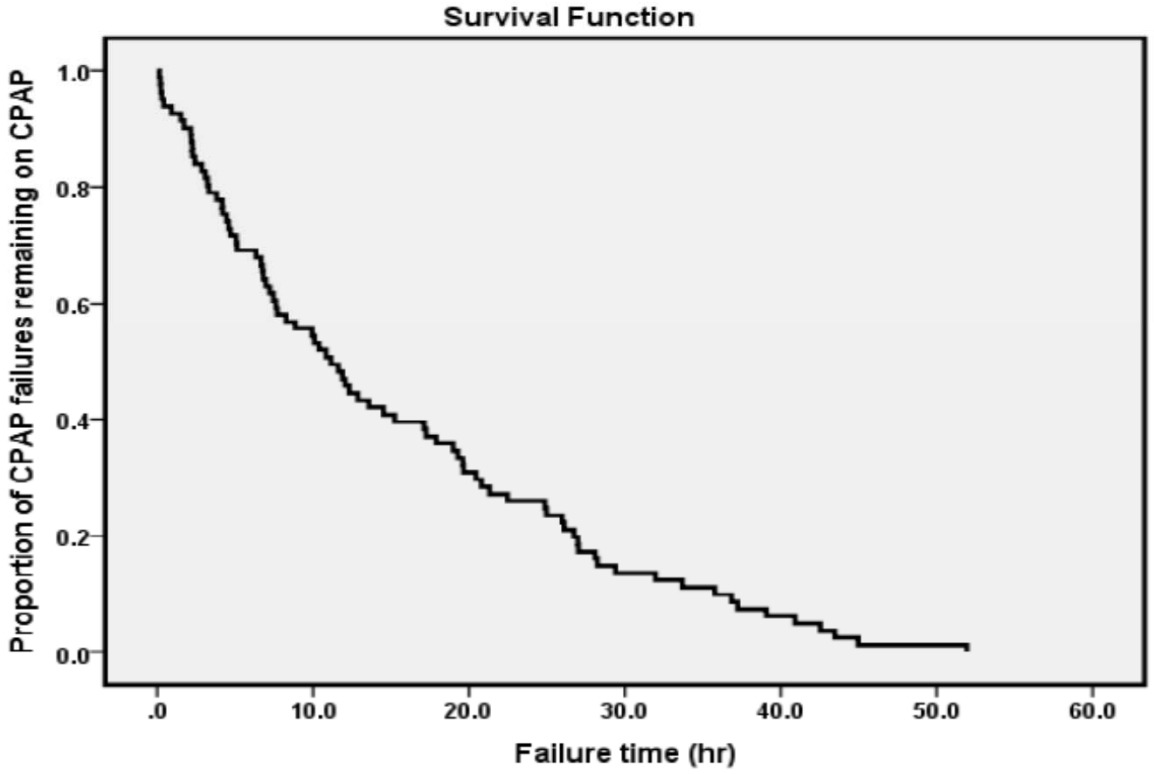


Falla del CPAP

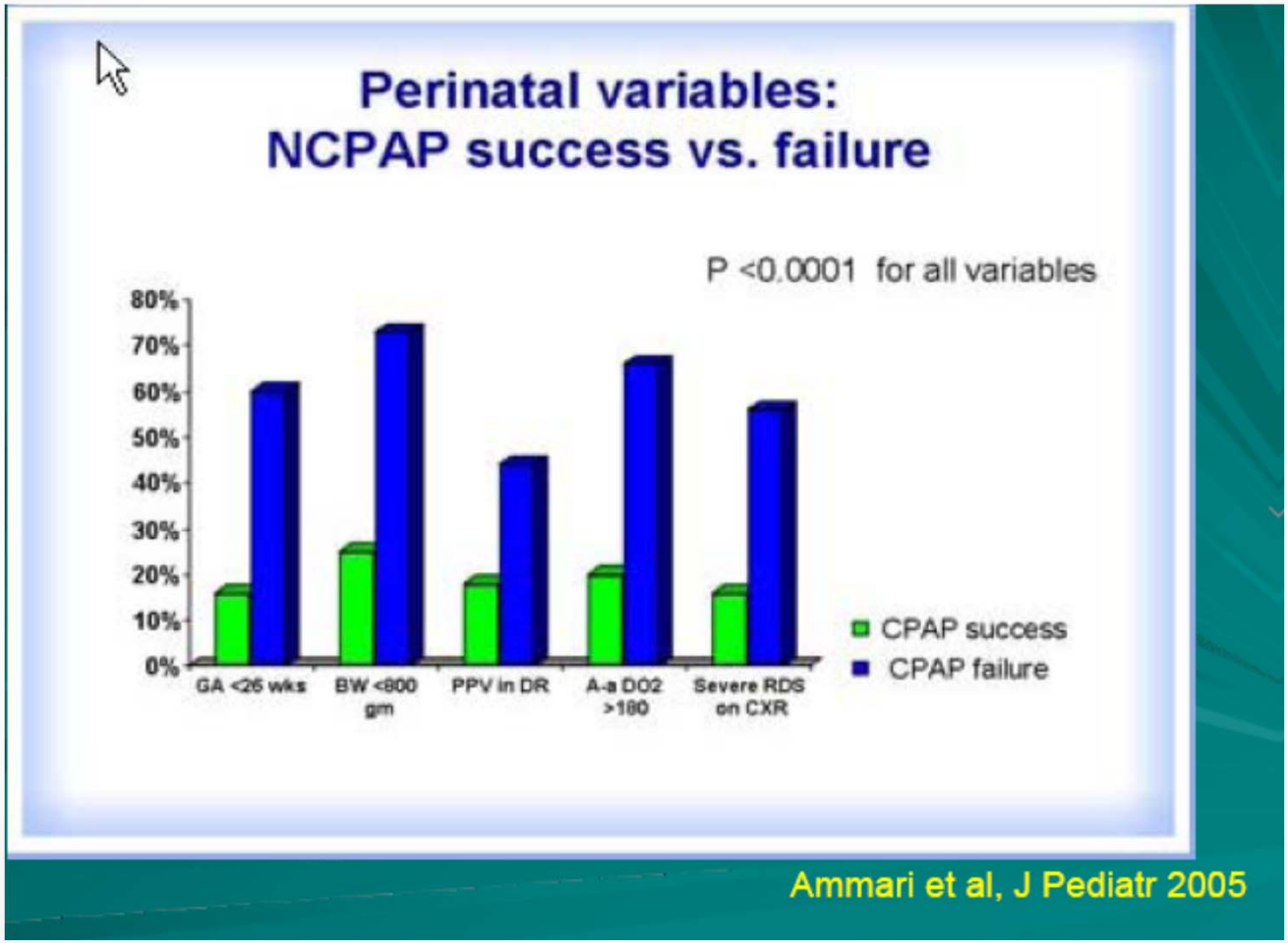
- **Durante el "escalamiento" de la terapia**:
- niños de menos de 25 semanas
- Niños muy hipóxicos
- SDR severo en Rx Tórax
- Niños que requieran uso de surfactante
- **Durante el retiro**:
- Al suprimir V.mecánica,
- por fatiga,apneas, hipoxia

FRACASO DE CPAP EN PRIMERAS 72 HRS

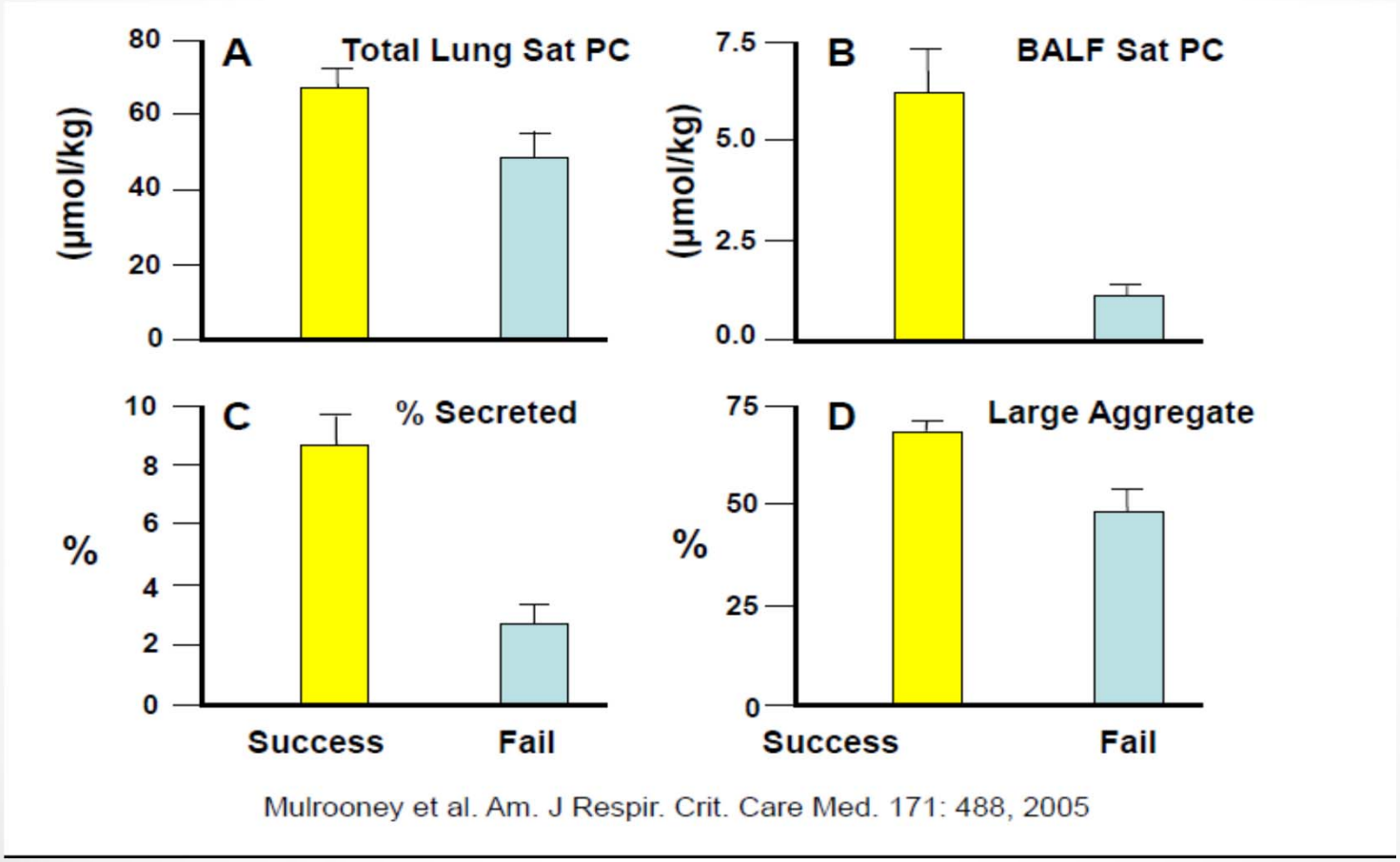
Time course of CPAP failure in first 72 hr life



Falla del CPAP: causas

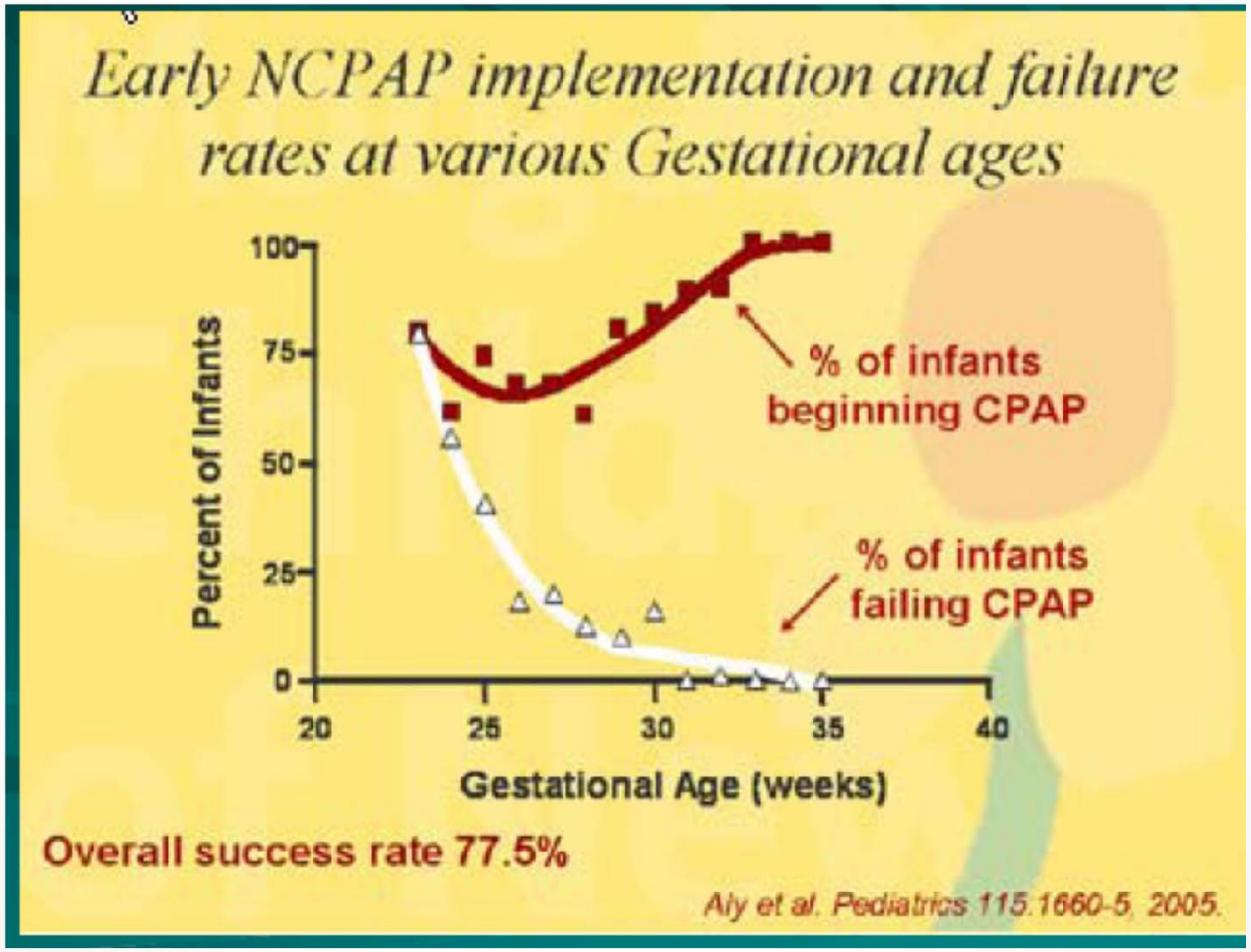


Menor Pool de surfactante en corderos que fracasaron en CPAP



Mulrooney et al. Am. J Respir. Crit. Care Med. 171: 488, 2005

Fracaso de CPAP



Claves del éxito

- Usar el dispositivo apropiado y personal entrenado
- CPAP en sala de inmediato (NeoPuff)
- Paciencia y persistencia en mantener los estándares de cuidado
- Mantención simple y consistente
- Relación Matrona/paciente= 1:2 ó 3

Ventilation Mecánica:
Indicaciones

1. Retración marcada en CPAP (no debida a obstrucción nasal)
2. Frecuentes apneas y bradicardia en CPAP
3. PaO_2 < 50 mm Hg con FiO_2 > 60%
4. $PaCO_2$ > 70 mm Hg (excepto 1°s GSA)
5. Acidosis metabólica intratable (EB > 10 meq/L después de bicarbonato)
6. Otros (Colapso Cardiovascular, trastornos Neuromusculares,Hernia diafragmática,en caso de cirugia, MRI, cateterismo cardiac etc.)

Contraindicaciones del CPAP

- Falla ventilatoria, con pH <7,25,pCO2 >65
- Apneas con bradicardia frecuentes(> 3 por hora)
- Anomalías de la vía aérea; fisura de paladar, atresia de coanas, fístula T-E
- Hernia diafragmática inestable
- Inestabilidad hemodinámica severa

Conclusión

- El pulmón es un órgano delicado y debe manipularse cuidadosamente
- Entender y manejar una situación específica es la clave
- No reaccionar a un solo Gas Arterial
- Usar CPAP precoz
- Ventilación Mecánica, aunque sea breve , se asocia a Daño pulmonar
- Curva de aprendizaje

Conclusión

- Dispositivo de bajo costo
- Se puede tratar con éxito 80% de niños sobre 800 grs al nacer
- Gran ahorro de surfactante($$$$)($ 200 mil 1 ampolla)
- Gran reducción de complicaciones:
- < daño pulmonar crónico, menor incidencia de hemorragias intracraneales,<incidencia de infecciones.

Conclusión

- Acorta estadías
- Mejora el apego
- Reduce otros costos(antibióticos, Oxigeno,cateteres,sondas etc)
- Reduce costos para aseguradoras

Consensus Guidelines

Neonatology

Neonatology 2013;103:353–368
DOI: 10.1159/000349928

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European Consensus Guidelines on the Management of Neonatal Respiratory Distress Syndrome in Preterm Infants – 2013 Update

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Consenso Europeo 2013

Recommendations

(1) CPAP should be started from birth in all babies at risk of RDS, such as those <30 weeks' gestation who do not need MV, until their clinical status can be assessed (A).

(2) The system delivering CPAP is of little importance; however, the interface should be short binasal prongs or mask and a starting pressure of at least 6 cm H_2O should be applied (A). CPAP level can then be individualized depending on clinical condition, oxygenation and perfusion (D).

(3) CPAP with early rescue surfactant should be considered the optimal management for babies with RDS (A).

(4) A trial of NIPPV can be considered to reduce the risk of extubation failure in babies failing on CPAP; however, this may not offer any significant long-term advantages (A).

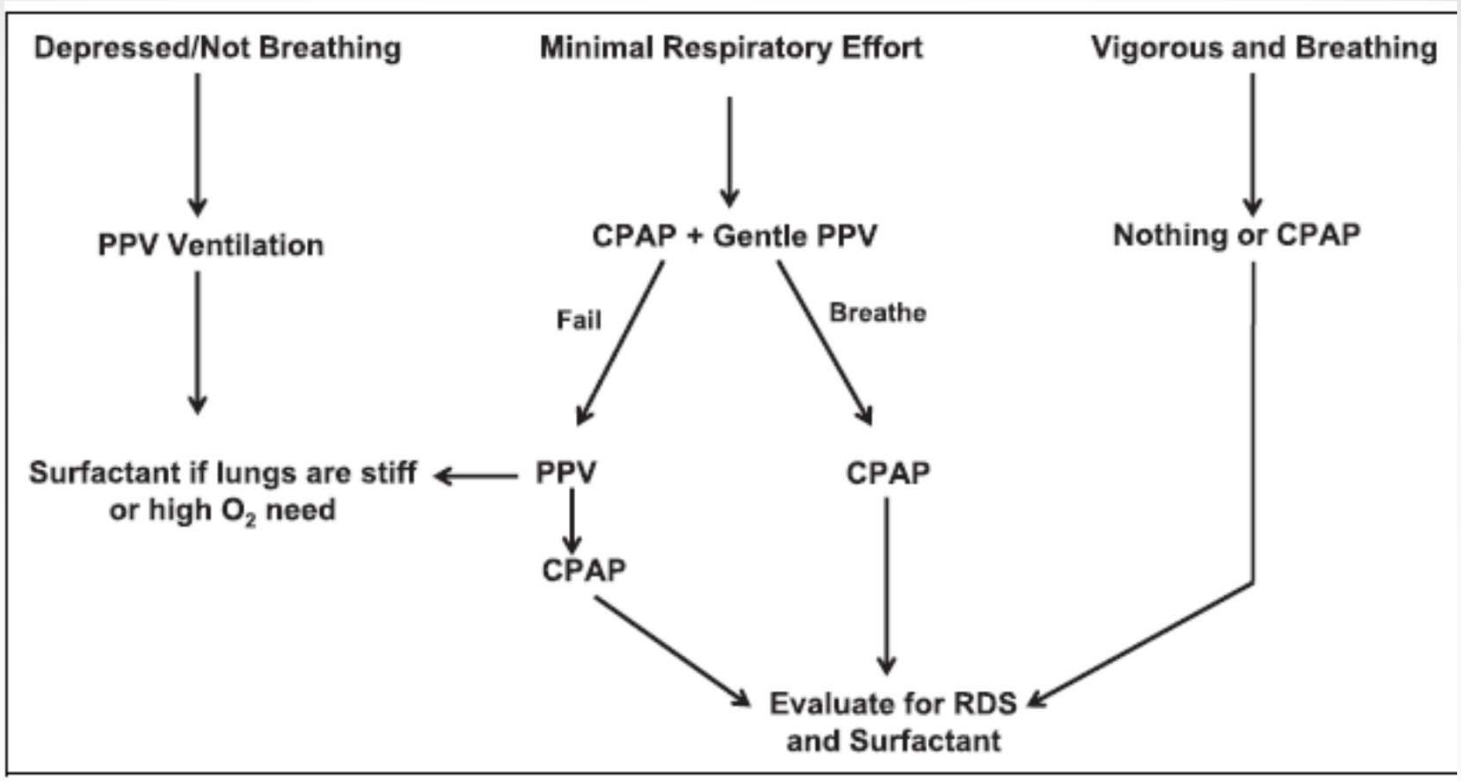


Figure 3. A flow diagram for an action plan following a 10-second Apgar (physiologic assessment of a very low birthweight infant). Based on appearance and breathing activity the clinician must decide how to initially support respiratory transition. Subsequently, all infants will need an evaluation for respiratory distress syndrome (RDS) and surfactant treatment. CPAP=continuous positive airway pressure; PPV=positive pressure ventilation.

Consenso Europeo 2013

Table 4. Summary of recommendations

Prenatal care	– Preterm babies at risk of RDS should be born in centres where appropriate care, including MV, is available – If possible, birth should be delayed to allow the maximum benefit of prenatal corticosteroid therapy
Delivery room stabilization	– Aim to delay cord clamping at birth by at least 60 s – Stabilize baby in a plastic bag under a radiant warmer to prevent heat loss – Stabilize gently, avoiding excessive tidal volumes and exposure to 100% oxygen, using pulse oximetry as a guide provided there is an adequate heart rate response – For extremely preterm infants, consider intubation in delivery suite for prophylactic surfactant administration if antenatal steroids have not been given; for most babies, CPAP should be initiated early
Respiratory support and surfactant	– Natural surfactants should be used and given as early as possible in the course of RDS – Repeat doses of surfactant may be required if there is ongoing evidence of RDS – More mature babies can often be extubated to CPAP or NIPPV immediately following surfactant, and a judgement needs to be made as to whether an individual baby will tolerate this – For those who require MV, aim to ventilate for as short a time as possible, avoiding hyperoxia, hypocarbia and volutrauma – Caffeine therapy should be used to minimize need for and duration of ventilation – Babies should be maintained on CPAP or NIPPV in preference to ventilation if possible
Supportive care	– Antibiotics should be started until sepsis has been ruled out unless the risk of infection is low, for example after an elective caesarean section – Maintain body temperature in the normal range – Careful fluid balance is required with early aggressive nutritional support using parenteral nutrition whilst enteral feeding is being established – Blood pressure should be monitored regularly, aiming to maintain normal tissue perfusion, if necessary using inotropes – Consideration should be given to whether pharmacological closure of the ductus arteriosus is indicated

Recommendation for Preterm Infants with RDS

- Preterm infants with RDS weighing < 1500 gms. should be allowed time to demonstrate if they can achieve acceptable ventilation and oxygenation on CPAP. During that time period, these infants must be monitored closely. If ventilation is not improving or oxygenation is worsening, or inadequate with an FiO_2 of 60%, these infants should be intubated.
- *Should infants < 26 weeks gestation receive prophylactic surfactant?*
- *Is there a role for aerosolized surfactant?*

CPAP nasal
Weaning

- CPAP se mantiene a 5 cmH_2O
- FiO_2 se ajusta para mantener PaO_2 en 50's, o saturaciones alrededor de 85 -95%

Weaning CPAP :3 métodos

•Retirar cuando el niño está estable con fiO2 de 21% y sin distress. Reiniciar CPAP si taquipnea, retracción o requiere oxígeno (método preferible)

•Ciclico: retiro gradual por períodos crecientes de tiempo, con reducción gradual de la presión.

•Switch a cánula de alto flujo, con presión inspiratoria desconocida

Arch Dis Child Fetal Neonatal Ed published online May 18, 2012

Methods of weaning preterm babies <30 weeks gestation off CPAP: a multicentre randomised controlled trial

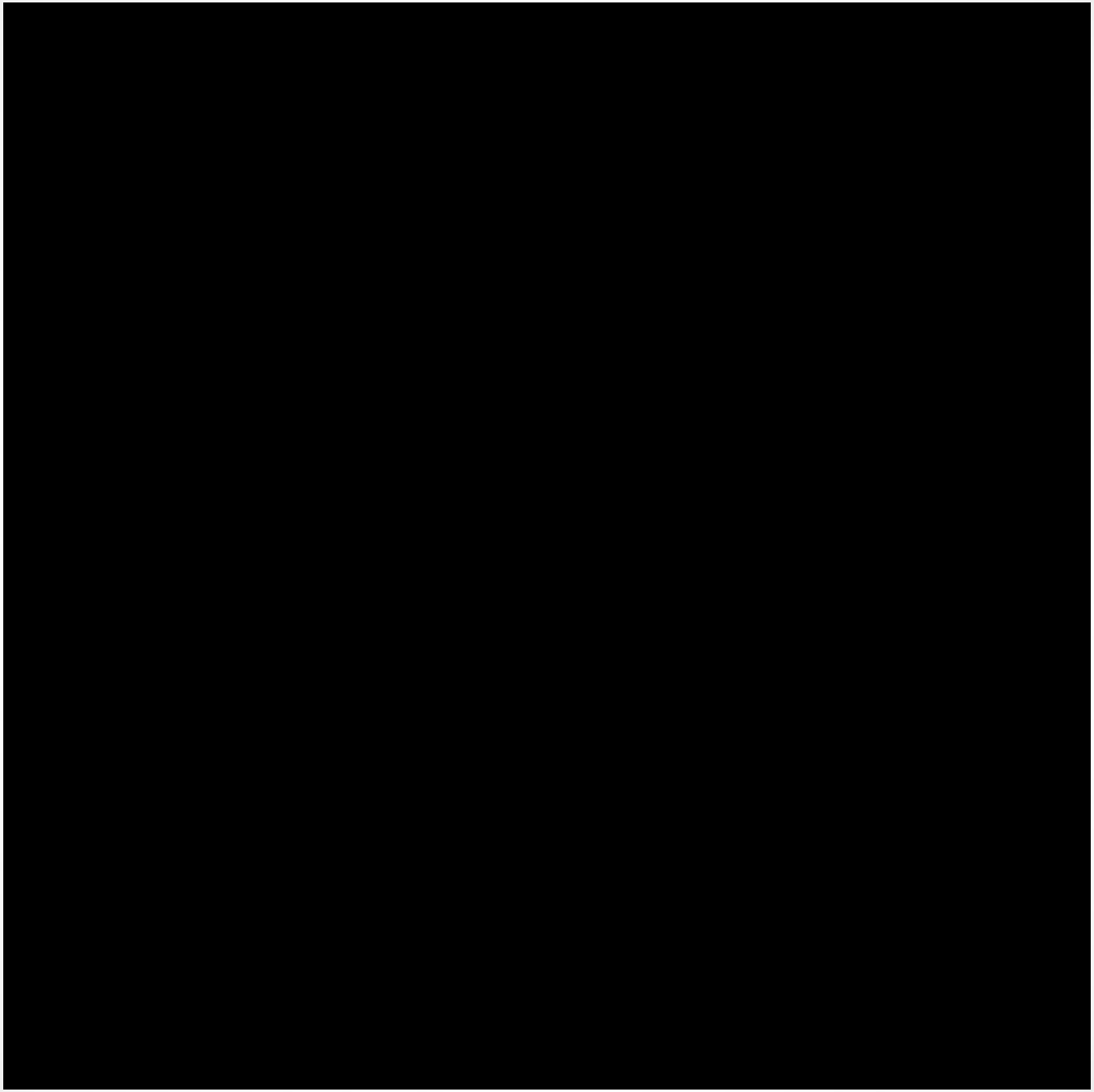
	M1 (n=56)	m² (n=69)	M3 (n=52)	Sig
Time of wean‡	11.3±0.8	16.8±1.0*	19.4±1.3*	p<0.0001
Total days CPAP	24.4±0.1	38.6±0.1*	30.5±0.1*	p<0.0001
CGA OFF CPAP	31.9±0.1	34.1±0.1*	32.8±0.2*	p<0.0001
Oxygen duration‡	24.1±1.5	45.8±2.2*	34.1±2.0*	p<0.0001
BPD	7/56 (12.5%	29/69 (42%)†	10/52 (19%)	p=0.011
Length of Admission	58.5±0.1	73.8±0.1*	69.5±0.1*	p<0.0001
CGA at D/C#	35.8±0.1	36.9±0.1*	36.9±0.1*	p<0.0001

CGA: corrected GA;

Arch Dis Child Fetal Neonatal Ed published online May 18, 2012

Nasal CPAP
Discontinuar

- No taquipnea o retraccion
- No apnea ni bradicardia
- FiO_2 0.21



Muchas Gracias