UTILIDAD DE LA ECOGRAFIA PULMONAR EN NEONATOLOGÍA

CASOS PRÁCTICOS.

Fátima Rivera.
Almudena Alonso.
Hospital Universitario Puerta del Mar (Cádiz)

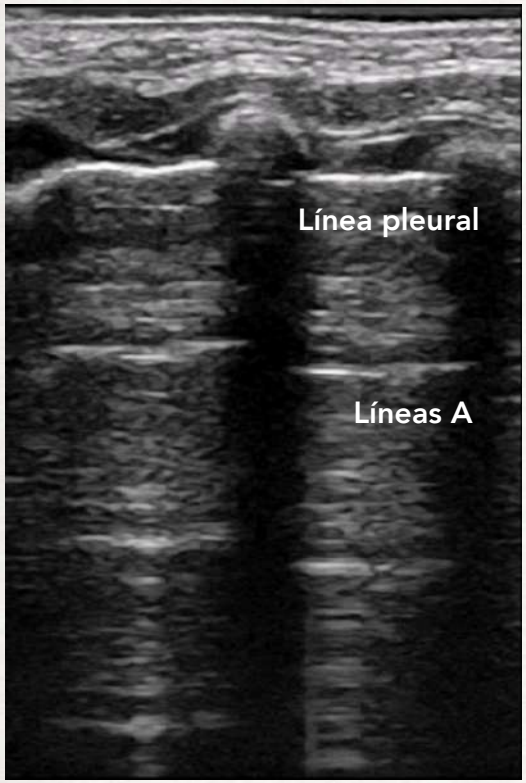
INTRODUCCIÓN

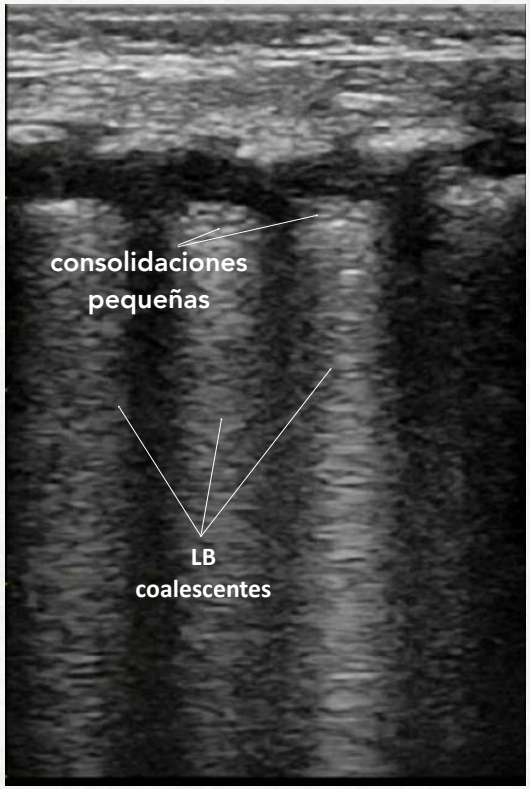
ECOGRAFÍA PULMONAR EN UNIDADES DE CUIDADOS INTENSIVOS.

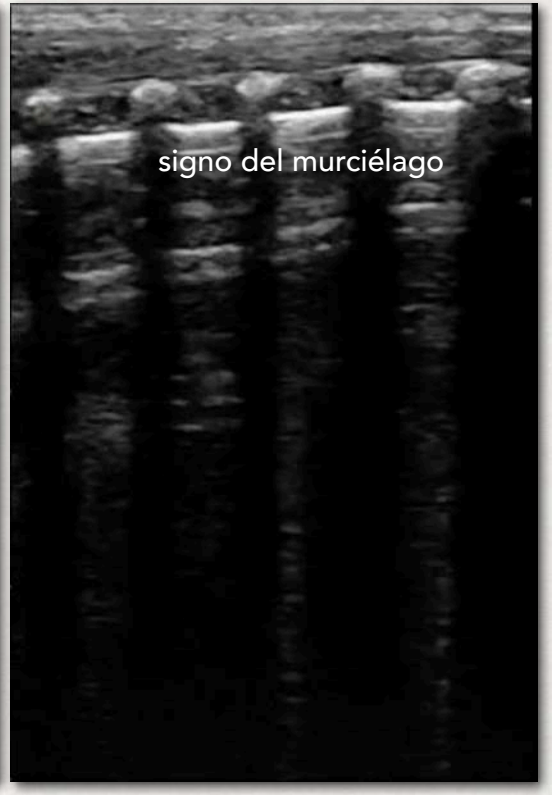
- Modalidad diagnóstica igualmente efectiva respecto a la radiografía.
- Más rápida, más barata y no expone a los pacientes al riesgo de radiación.
- Segura. A pie de cuna.

INTRODUCCIÓN.

ASPECTOS TECNICOS DE LA ECOGRAFÍA PULMONAR.







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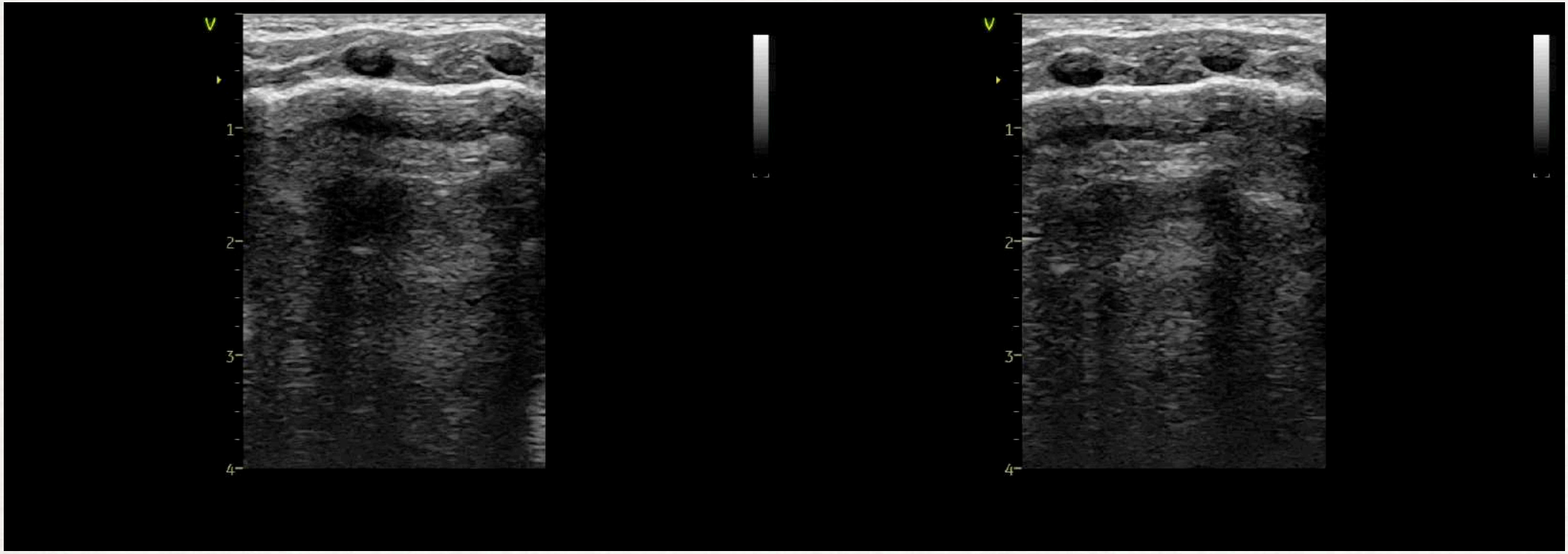


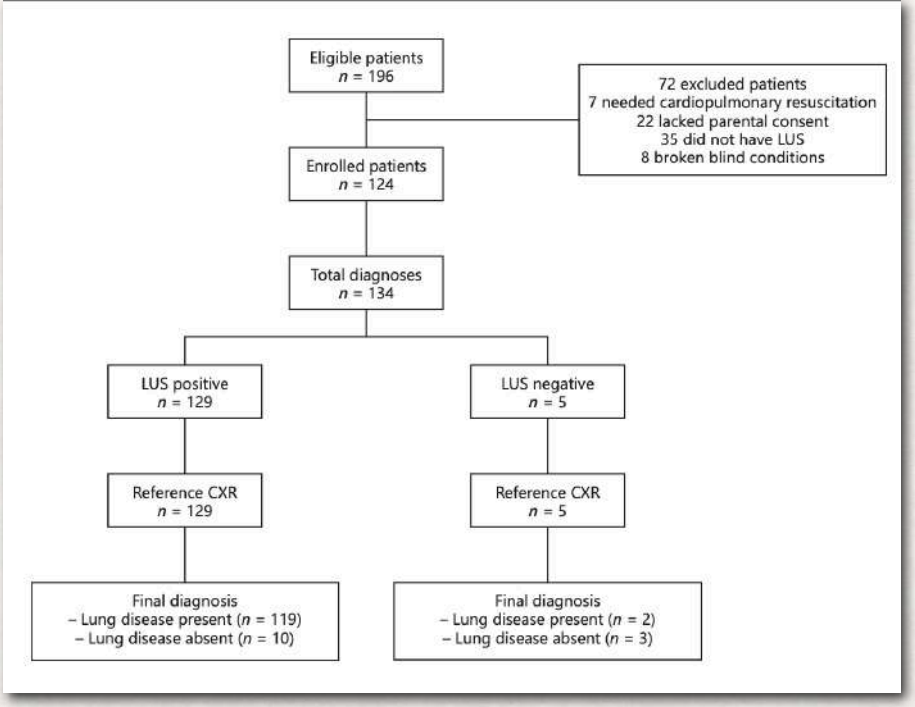
UTILIDAD ECOGRAFÍA PULMONAR EN UCIN.

¿CUÁL ES LA EXPERIENCIA?

- Diagnóstico diferencial del Distrés Respiratorio Precoz: EMH, TT, SAM, Neumotórax.
- Predicción de necesidad de ingreso.
- Predicción de fracaso de VNI.
- Administración de surfactante guiado por ecografía.
- Predicción DBP.

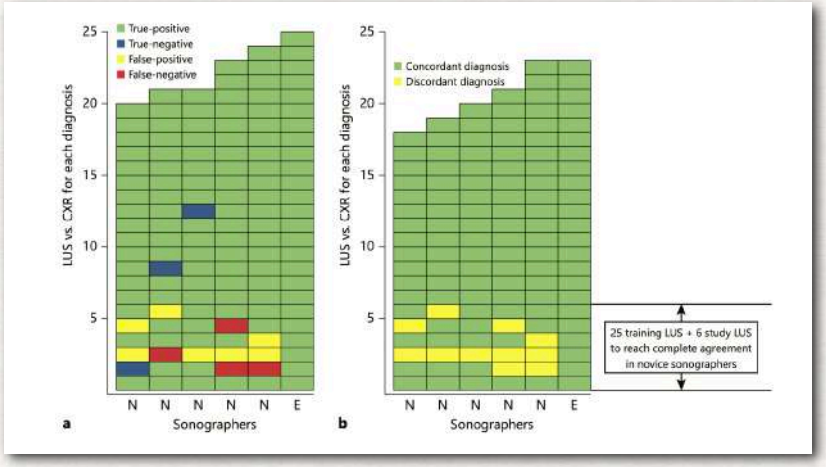
Lung Ultrasound for the Differential Diagnosis of Respiratory Distress in Neonates

Iuri Corsini[a] Niccolò Parri[b] Elena Gozzini[a] Caterina Coviello[a]
Valentina Leonardi[a] Chiara Poggi[a] Martina Giacalone[c] Tommaso Bianconi[a]
Lorenzo Tofani[d] Francesco Raimondi[e] Carlo Dani[a, d]



	CXR (reference standard)									
	RDS	TTN	pneu-monia	MAS	CDH	PE	PNX	CPAM	normal findings	total
LUS										
RDS	**58**	2	0	0	0	0	0	0	0	60
TTN	2	**30**	0	0	0	0	0	0	0	32
Pneumonia	0	0	**6**	0	0	0	0	0	0	6
MAS	0	0	0	**6**	0	0	0	0	0	6
CDH	0	0	0	0	**7**	0	0	0	0	7
PE	0	0	0	0	0	**2**	0	0	5	7
PNX	0	0	0	0	0	0	**8**	0	0	8
CPAM	0	0	0	0	0	0	0	**2**	1	3
Normal findings	0	0	0	0	0	0	2	0	**3**	5
Total	60	32	6	6	7	2	10	2	9	**134**

CDH, congenital diaphragmatic hernia; CPAM, congenital pulmonary airway malformation; CXR, chest X-ray; LUS, lung ultrasound; MAS, meconium aspiration syndrome; PE, pleural effusion; PNX, pneumothorax; RDS, respiratory distress syndrome; TTN, transient tachypnea of the newborn.



	n (%)	Sensitivity (95% CI)	Specificity (95% CI)	Agreement	κ statistic (95% CI)
RDS	60 (45%)	96.7 (88.5–99.6)	100.0 (94.4–100.0.0)	96.7%	0.97 (0.92–1.00)
TTN	32 (24%)	100.0 (89.1–100.0)	97.8 (92.4–99.7)	98.4%	0.96 (0.90–1.00)
Pneumonia	6 (5%)	100.0 (54.1–100.0)	100.0 (96.9–100.0)	100%	1 (1.00–1.00)
CDH	7 (5%)	100.0 (59.0–100.0)	100.0 (96.9–100.0)	100%	1 (1.00–1.00)
MAS	6 (5%)	100.0 (54.1–100.0)	100.0 (96.9–100.0)	100%	1 (1.00–1.00)
PNX	10 (7%)	80 (44.4–97.5)	100.0 (96.8–100.0)	98.3%	0.88 (0.72–1.00)
PE	7 (5%)	100.0 (15.8–100.0)	95.9 (90.7–98.7)	95.9%	0.43 (0.03–0.83)
CPAM	3 (2%)	100.0 (15.8–100.0)	99.2 (95.5–99.9)	99.2%	0.80 (0.41–1.00)

CDH, congenital diaphragmatic hernia; CPAM, congenital pulmonary airway malformation; MAS, meconium aspiration syndrome; PE, pleural effusion; PNX, pneumothorax; RDS, respiratory distress syndrome; TTN, transient tachypnea of the newborn.

DISTRES RESPIRATORIO PRECOZ EN EL RN

ENFERMEDAD MEMBRANA HIALINA

Lung Ultrasound in Respiratory Distress Syndrome: A Useful Tool for Early Diagnosis

Roberto Copetti[a] Luigi Cattarossi[a] Franco Macagno[b] Marco Violino[b] Riccardo Furlan[b]

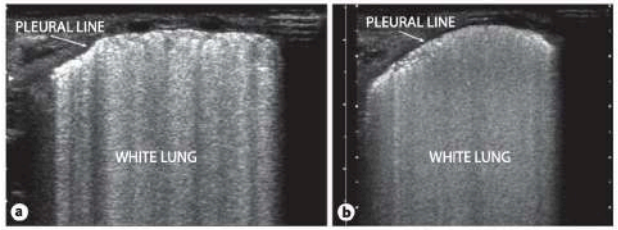


Fig. 4. a, b Evidence of very compact B lines with echographic 'white lung' appearance. Pleural line is coarse and not well defined.

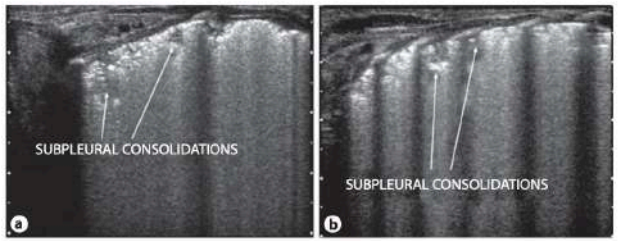


Fig. 5. a, b Multiple small subpleural consolidations.

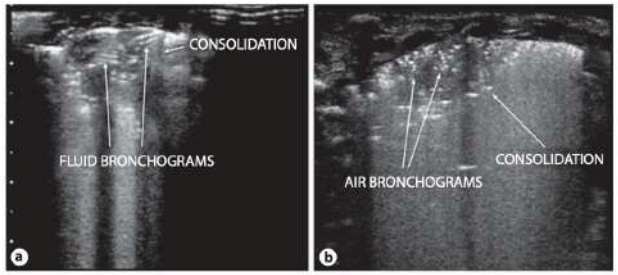


Fig. 6. a Large consolidation with tissular pattern and evidence of fluid bronchograms. **b** Large consolidation with presence of air bronchograms.

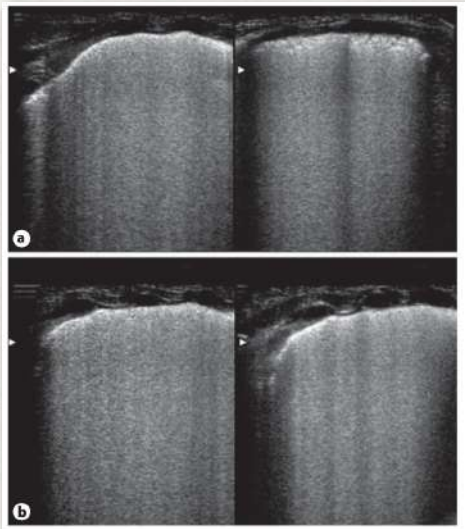


Fig. 7. a Lung appearance before surfactant administration: evidence of echographic 'white lung'. **b** Lung appearance 14 h after surfactant administration the ultrasound lung picture is not substantially changed.

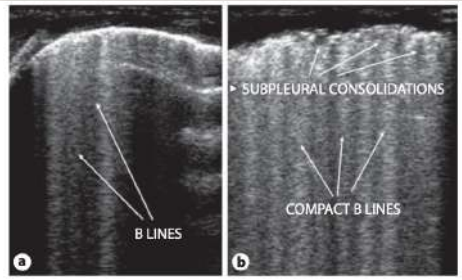


Fig. 8. a Few B lines are present in this area of the lung. **b** In the same infant, there is evidence of an area with compact B lines and multiple small subpleural consolidations that cause an irregular pleural line.

DISTRES RESPIRATORIO PRECOZ EN EL RN

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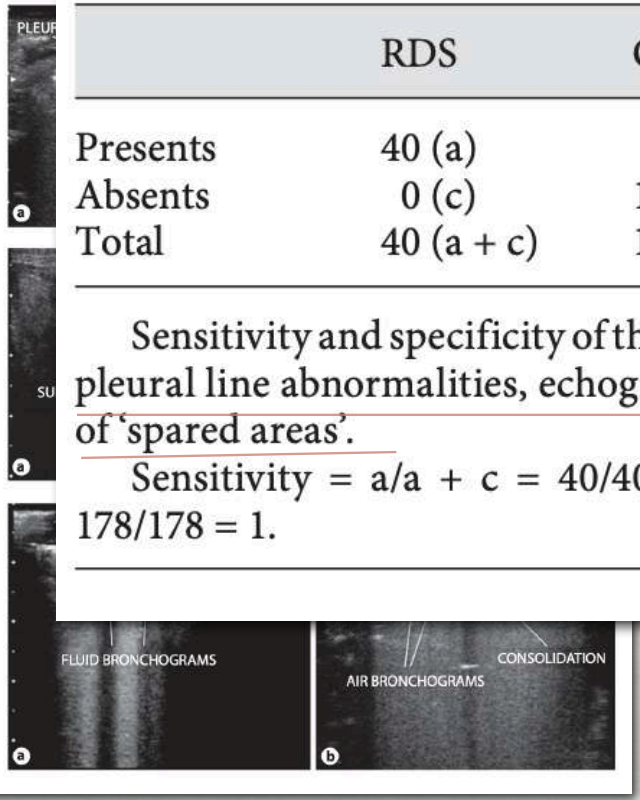

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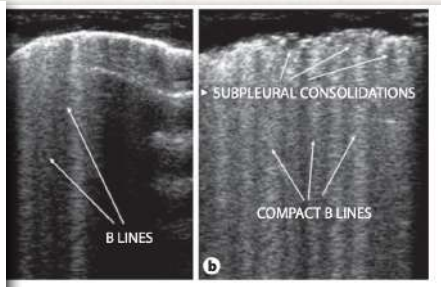
	RDS	Other	Total
Presents	40 (a)	0 (b)	40 (a + b)
Absents	0 (c)	178 (d)	178 (c + d)
Total	40 (a + c)	178 (b + d)	218

Sensitivity and specificity of the contemporaneous presence of pleural line abnormalities, echographic 'white lung' and absence of 'spared areas'.

Sensitivity = a/a + c = 40/40 = 1; specificity = d/b + d = 178/178 = 1.



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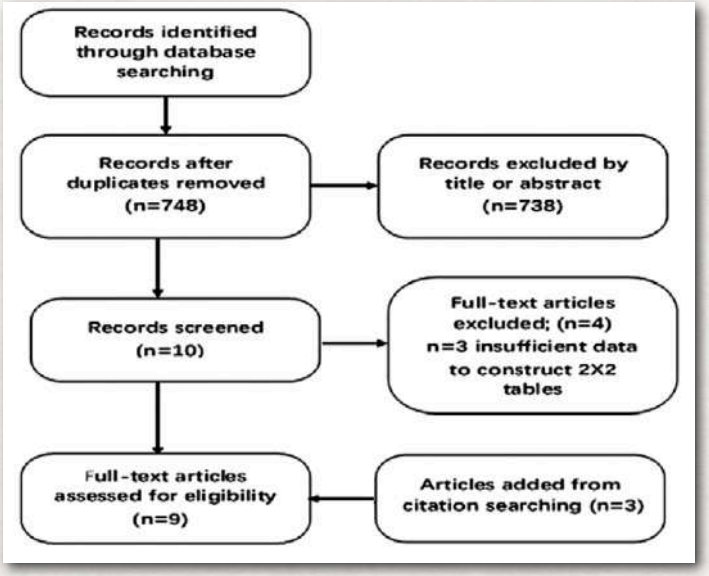
DISTRES RESPIRATORIO PRECOZ EN EL RN

ENFERMEDAD MEMBRANA HIALINA

Diagnostic value of lung ultrasound for neonatal respiratory distress syndrome: a meta-analysis and systematic review

Hai-Ran Ma[1,2], Jing Liu[2], Wen-Kang Yan[1]

[1]Department of Neonatology and Neonatal Intensive Care Unit, Huizhou Municipal Central Hospital, Huizhou Guangdong, [2]Department of Neonatology and Neonatal Intensive Care Unit, Beijing Chaoyang District Maternal and Child Healthcare Hospital, Beijing and National Neonatal Lung Ultrasound Training Base, Beijing, China



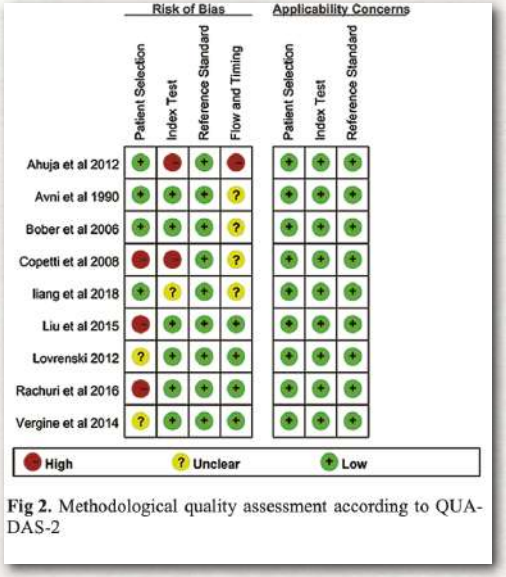
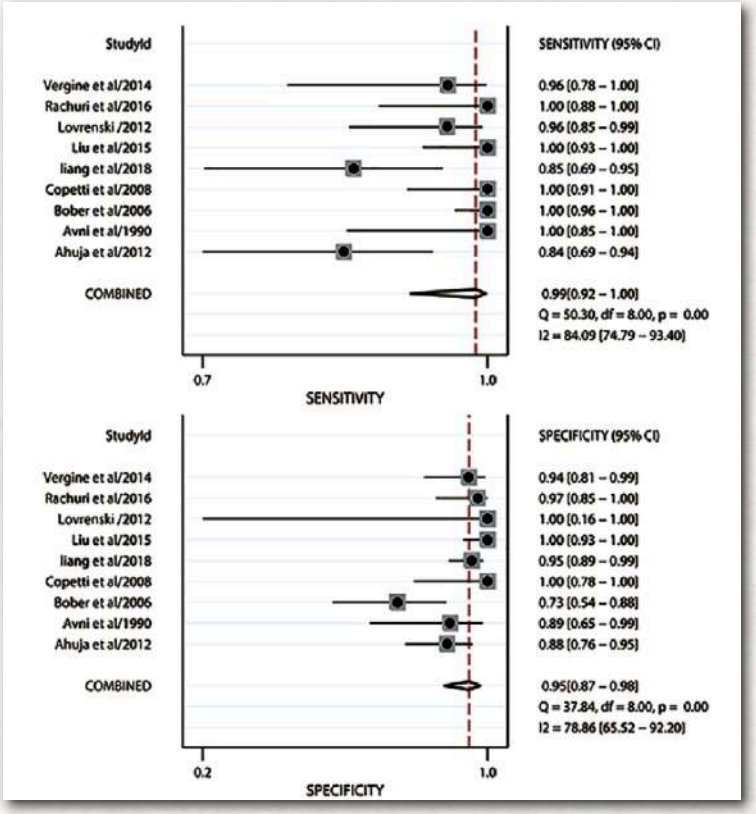
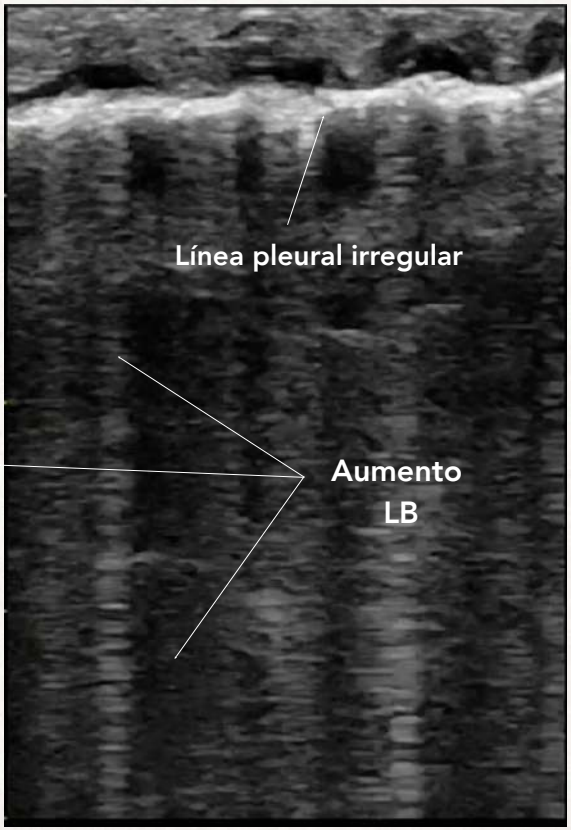


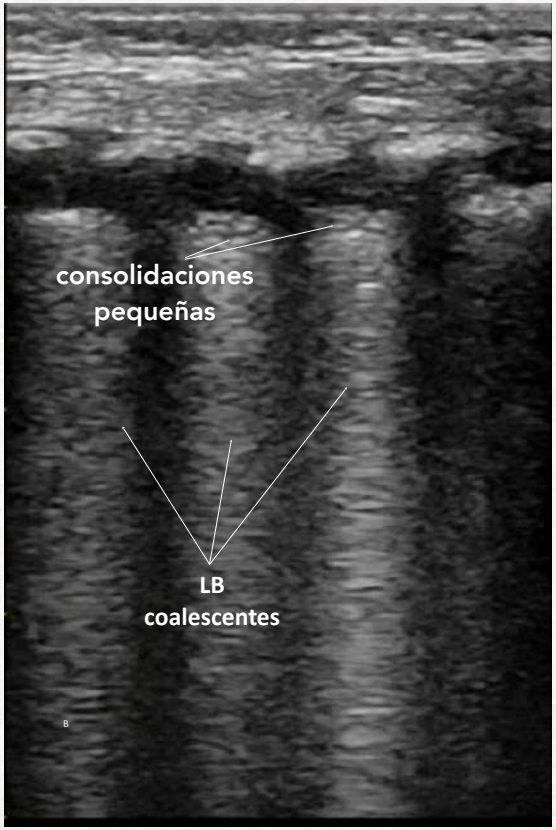
Fig 2. Methodological quality assessment according to QUA-DAS-2



DISTRES RESPIRATORIO PRECOZ EN EL RN

ENFERMEDAD MEMBRANA HIALINA





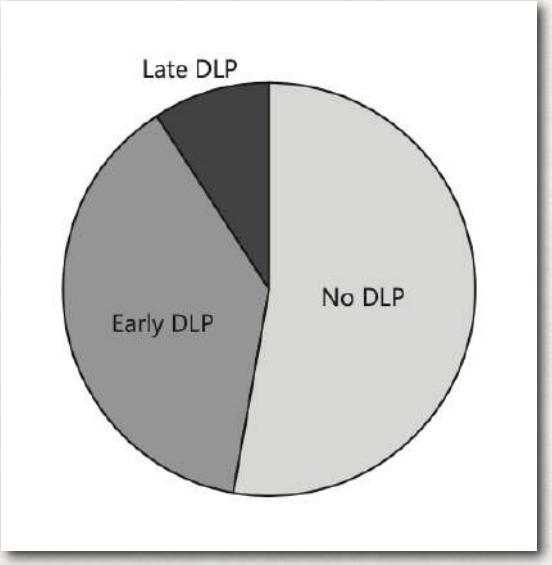
DISTRES RESPIRATORIO PRECOZ EN EL RN

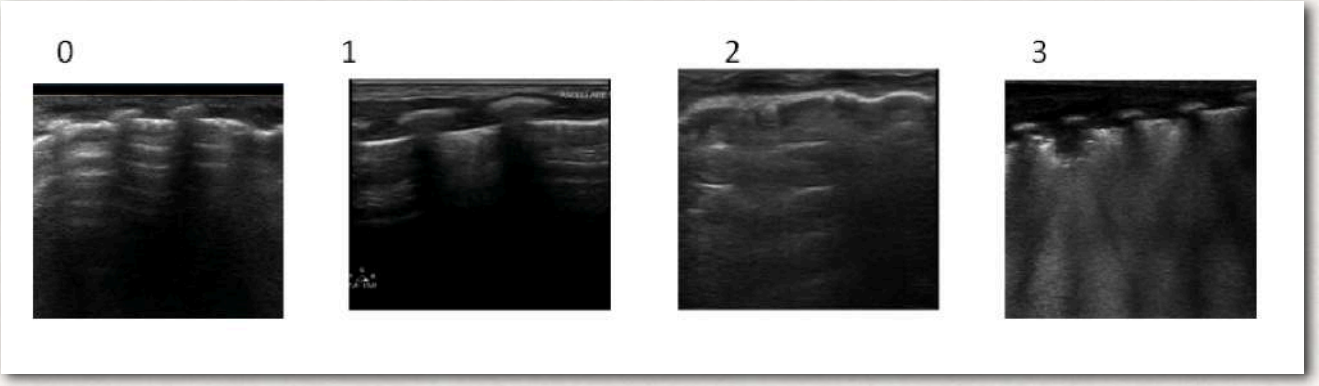
TAQUIPNEA TRANSITORIA DEL RECIÉN NACIDO.

A Multicenter Lung Ultrasound Study on Transient Tachypnea of the Neonate

Francesco Raimondi[a] Nadya Yousef[b] Javier Rodriguez Fanjul[c]
Daniele De Luca[b, d] Iuri Corsini[e] Shivani Shankar-Aguilera[b] Carlo Dani[e]
Vito Di Guardo[f] Silvia Lama[g] Fabio Mosca[g] Fiorella Migliaro[a]
Angela Sodano[a] Gianfranco Vallone[h] Letizia Capasso[a]

	Total (n = 65)	With DLP (n = 31)	Without DLP (n = 34)	p value[a]
Birth weight, g	2,794±676	2,855±590	2,732±759	0.47
Gestational age, weeks	36.4±1.8	36.6±1.5	36±2	0.39
Age at onset of respiratory distress, h	1.7±0.79	1.6±0.78	1.8±0.79	0.84
Duration of respiratory distress, h	25.2±30	32±38.6	18±15.4	0.06
Silverman score at onset	4.0±1.8	4.0±1.5	4±2.1	0.9
LUS score at onset	6.7±3.4	7.6±2.6	5.6±3.8	0.12
PaO_2/FiO_2 at onset	250±108	249±93	252±125	0.91
Need for CPAP	48/65 (73%)	24/32 (75%)	24/32 (75%)	0.724





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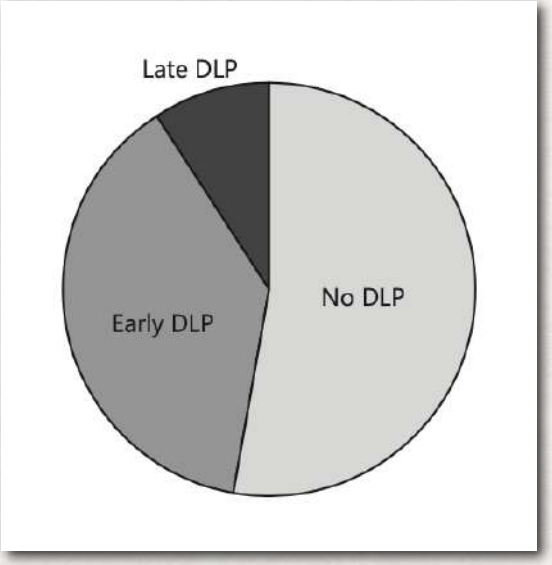
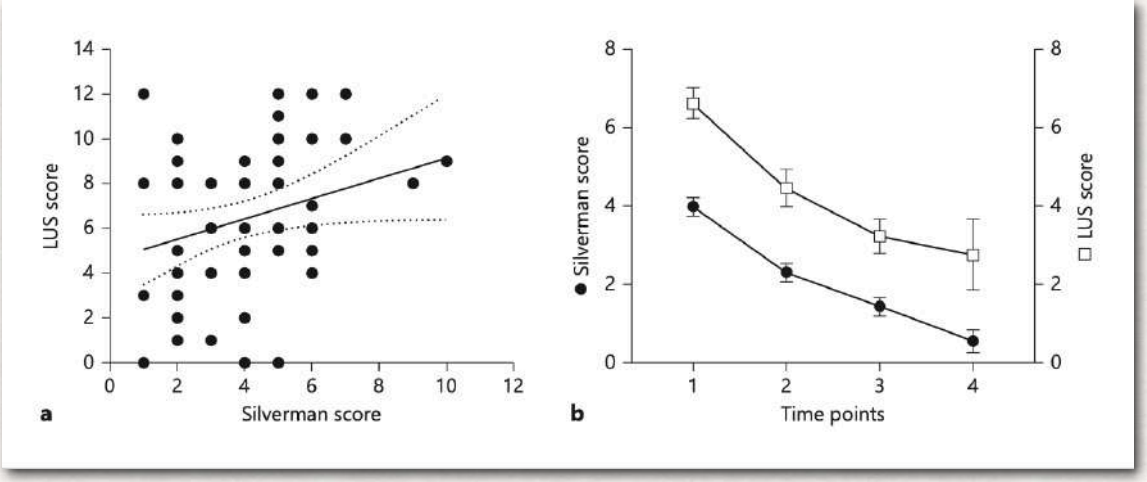
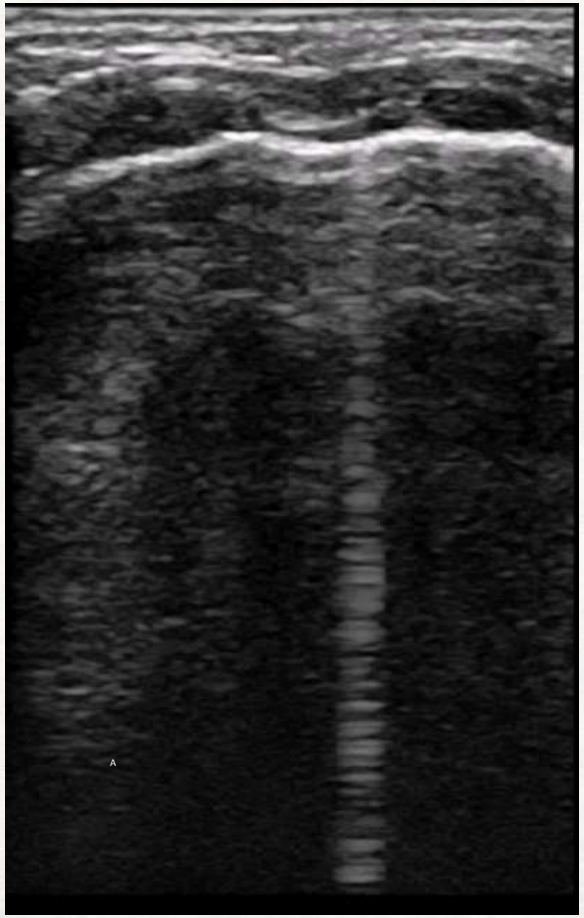
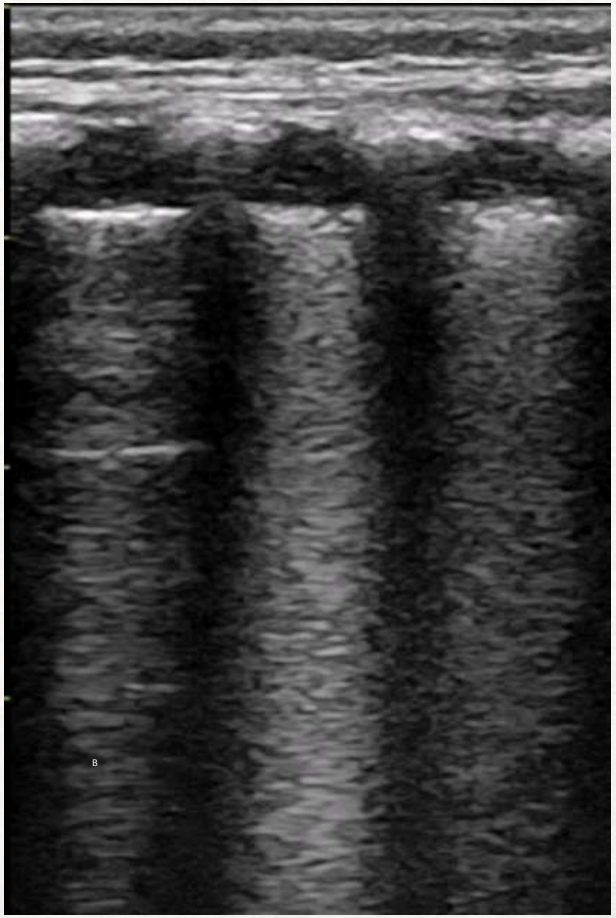




DISTRES RESPIRATORIO PRECOZ EN EL RN

TAQUIPNEA TRANSITORIA DEL RECIÉN NACIDO.



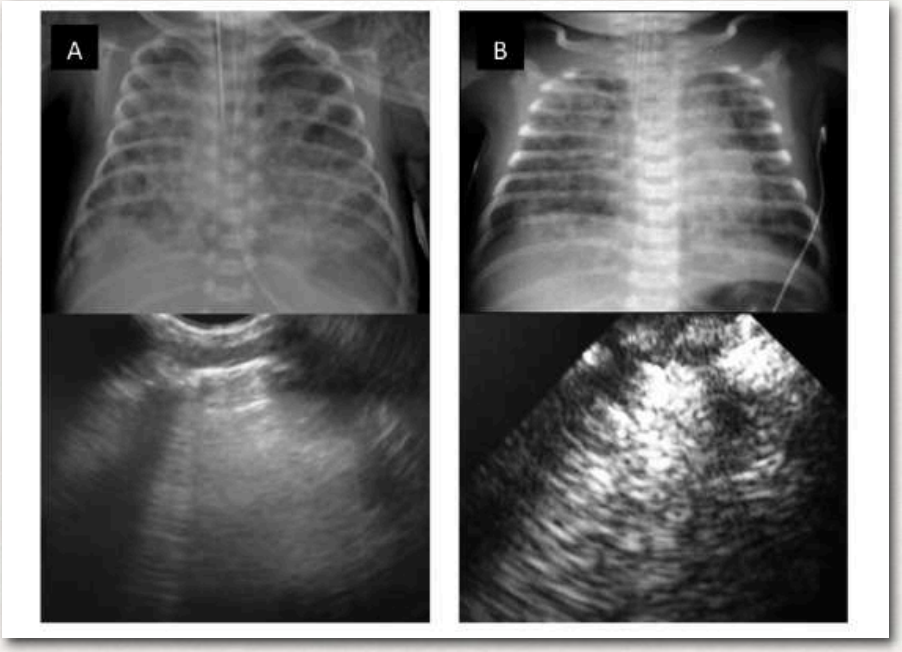


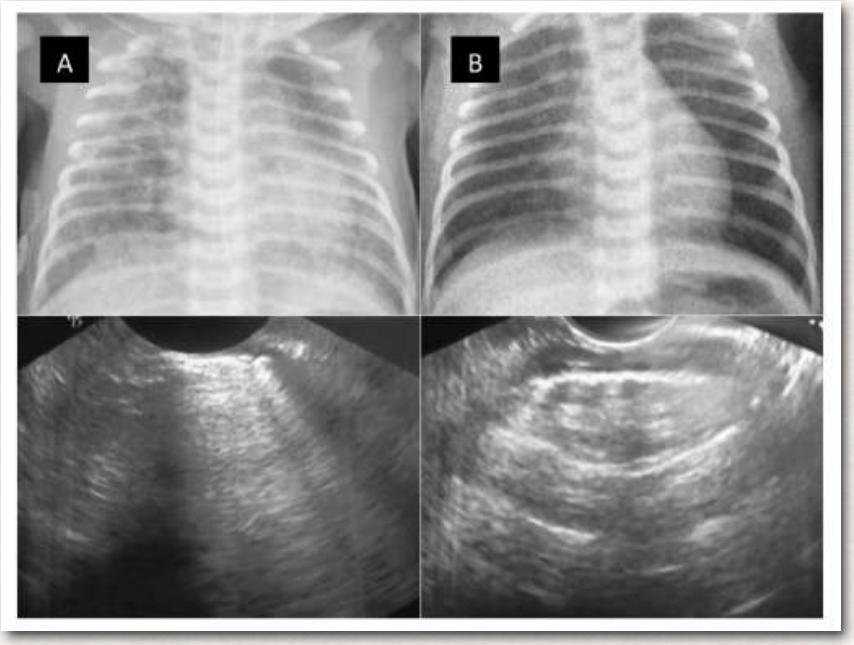
DISTRES RESPIRATORIO PRECOZ EN EL RN

SÍNDROME DE ASPIRACIÓN MECONIAL

Lung ultrasound findings in meconium aspiration syndrome

Marco Piastra [a], Nadya Yousef [b,c,*], Roselyne Brat [c], Paolo Manzoni [d], Mostafa Mokhtari [b], Daniele De Luca [a,c]





DISTRÉS RESPIRATORIO EN EL RN

Lung ultrasound findings in meconium aspiration syndrome

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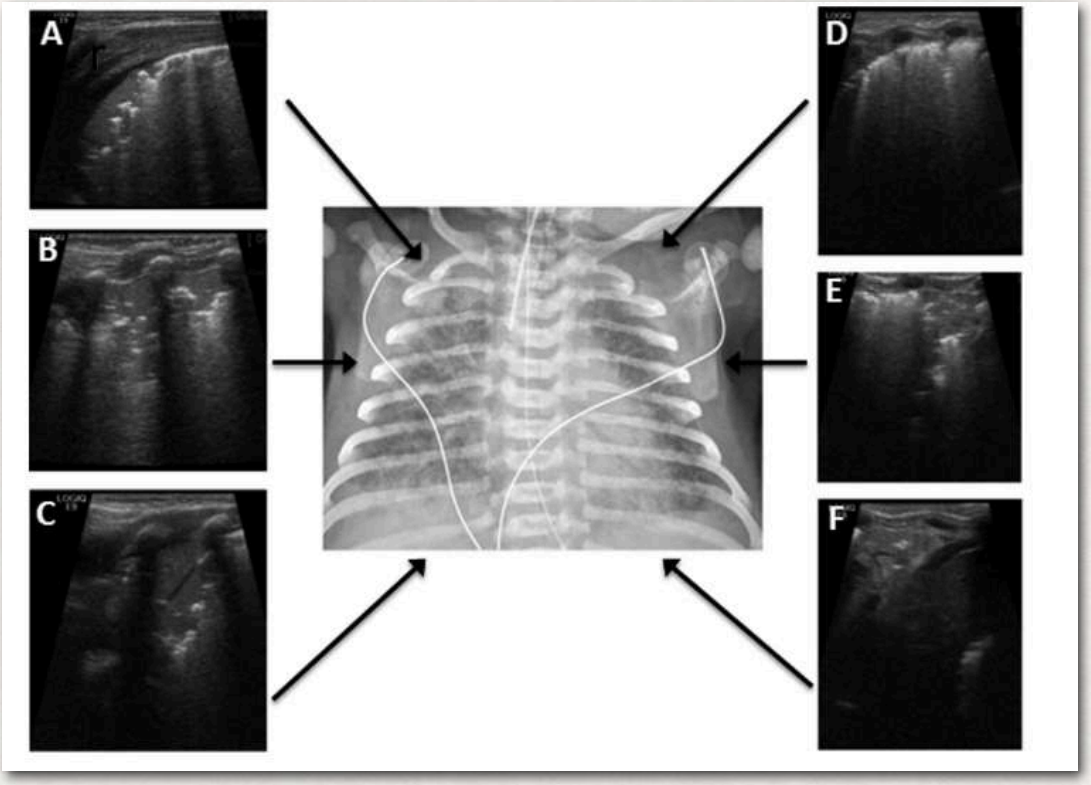
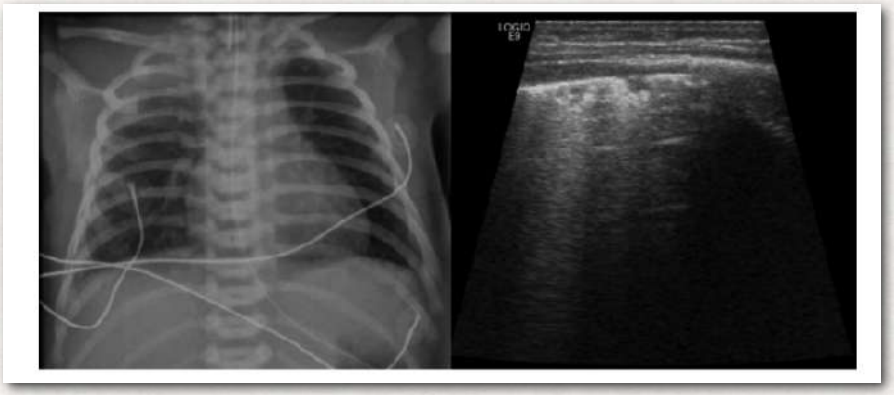
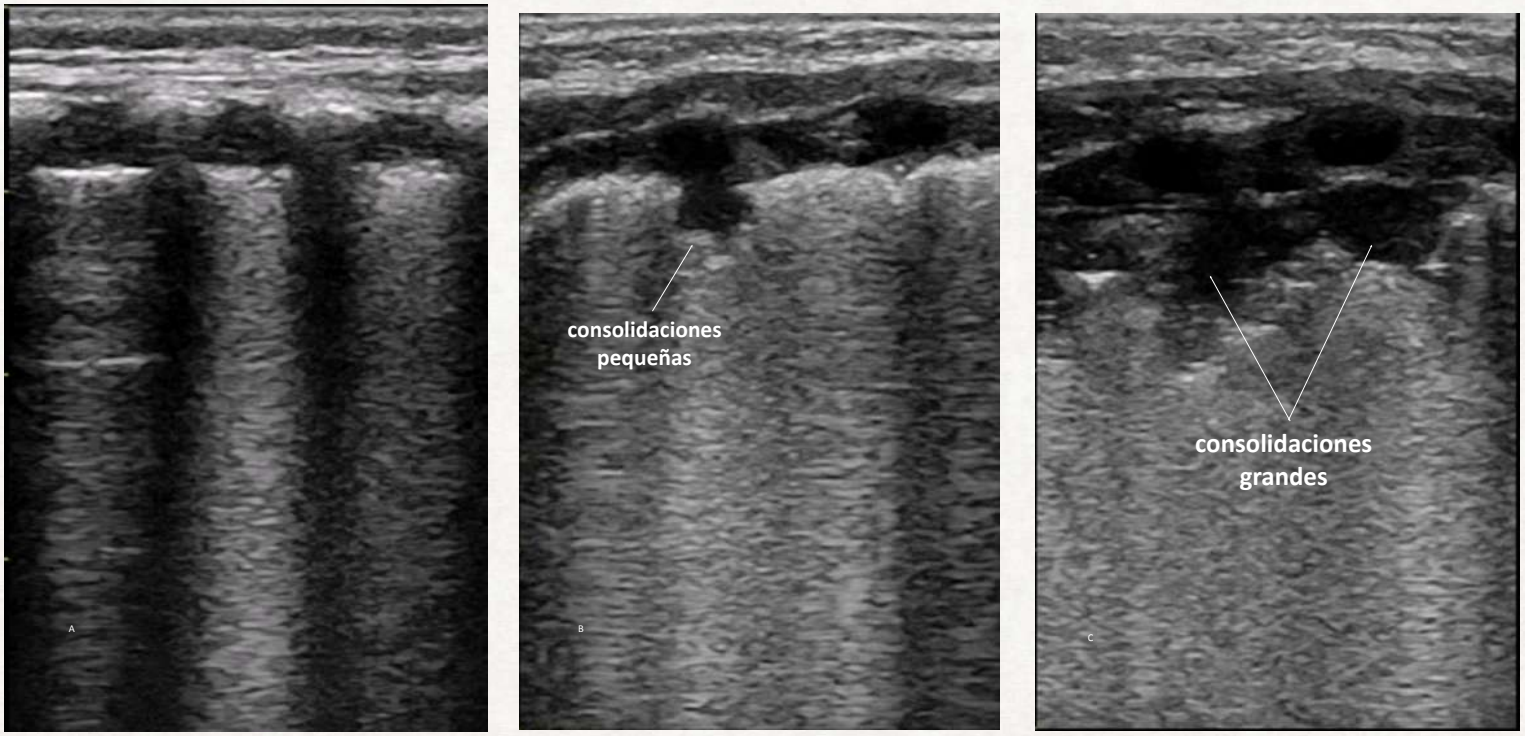




- Signos dinámicos erráticamente distribuidos.
- Todos los signos son cambiantes.

DISTRES RESPIRATORIO PRECOZ EN EL RN

SÍNDROME DE ASPIRACIÓN MECONIAL



DISTRES RESPIRATORIO PRECOZ EN EL RN

NEUMOTÓRAX.

Lung Ultrasound for Diagnosing Pneumothorax in the Critically Ill Neonate

Francesco Raimondi, MD, PhD[1], Javier Rodriguez Fanjul, MD[2], Salvatore Aversa, MD[3], Gaetano Chirico, MD[3], Nadya Yousef, MD[4], Daniele De Luca, MD, PhD[4], Iuri Corsini, MD[5], Carlo Dani, MD[5], Lidia Grappone, MD[6], Luigi Orfeo, MD[6], Fiorella Migliaro, MD[1], Gianfranco Vallone, MD[7], and Letizia Capasso, MD, PhD[1], on behalf of the Lung Ultrasound in the Crashing Infant (LUCI) Protocol Study Group*

Table II. Diagnostic accuracy of individual pneumothorax signs on ultrasound scan

	Absence of sliding sign	Absence of B lines	Lung point
True positives	26	26	24
False positives	1	1	0
True negative	15	15	16
False negative	0	0	2

International Expert Consensus and Recommendations for Neonatal Pneumothorax Ultrasound Diagnosis and Ultrasound-guided Thoracentesis Procedure

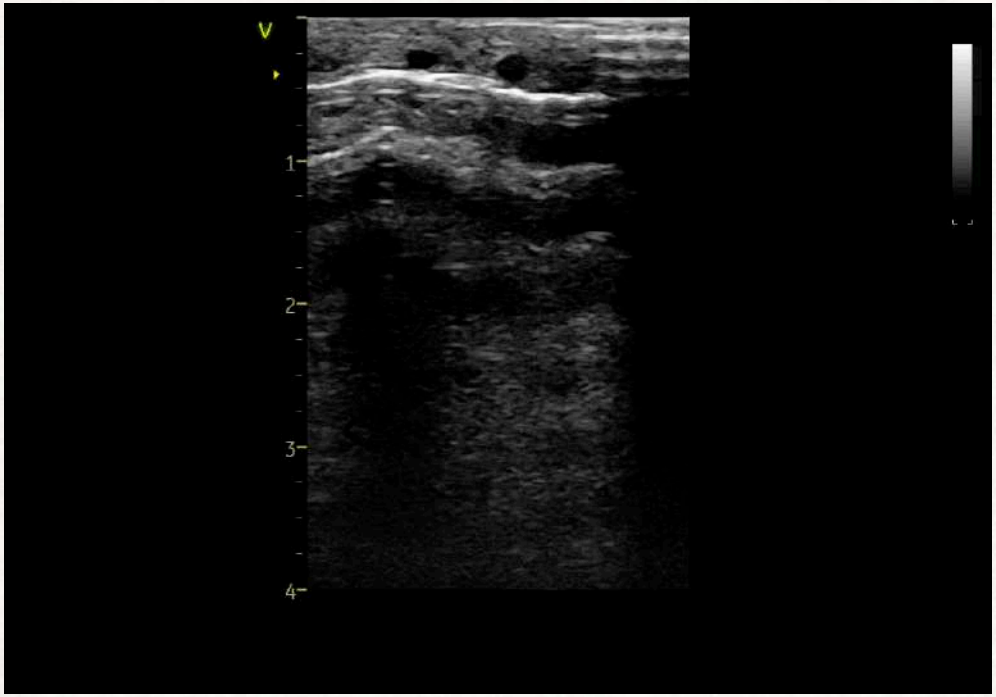
Jing Liu[1,2], Dalibor Kurepa[3], Francesco Feletti[4,5], Almudena Alonso-Ojembarrena[6], Jovan Lovrenski[7], Roberto Copetti[8], Erich Sorantin[9], Javier Rodriguez-Fanjul[10], Karishma Katti[3], Andrea Aliverti[4], Huayan Zhang[11,12], Misun Hwang[13], Tsu F. Yeh[14], Cai-Bao Hu[15], Xing Feng[16], Ru-Xin Qiu[1,2], Jing-Han Chi[17], Li-Li Shang[18], Guo-Rong Lyu[19], Shao-Zheng He[20], Yan-Fen Chai[21], Zhan-Jun Qiu[22], Hai-Ying Cao[2,23], Yue-Qiao Gao[1,2], Xiao-Ling Ren[1,2], Guo Guo[1,24], Li Zhang[1,2], Ying Liu[1,2], Wei Fu[1,2], Zu-Lin Lu[1,2], Hong-Lei Li[1,2]

* Ausencia de deslizamiento pleural.
* Ausencia de lineas B.
* Presencia de punto pulmonar.

La sensibilidad de la ausencia de deslizamiento pleural + ausencia de LB fue del 100%.
La especificidad del punto pulmonar fue del 100%

DISTRES RESPIRATORIO PRECOZ EN EL RN

NEUMOTÓRAX.



PREDICCION DE NECESIDAD SOPORTE

Can neonatal lung ultrasound monitor fluid clearance and predict the need of respiratory support?

Francesco Raimondi[1*], Fiorella Migliaro[1], Angela Sodano[1], Angela Umbaldo[1], Antonia Romano[1], Gianfranco Vallone[2] and Letizia Capasso[1]

S 77.7%
E 100%
VPP 100%
VPN 97%

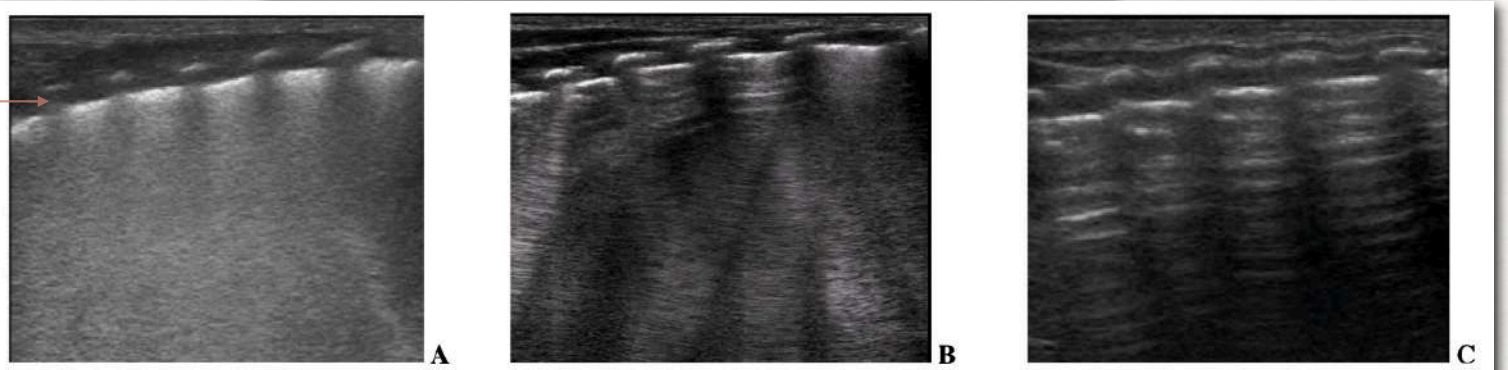


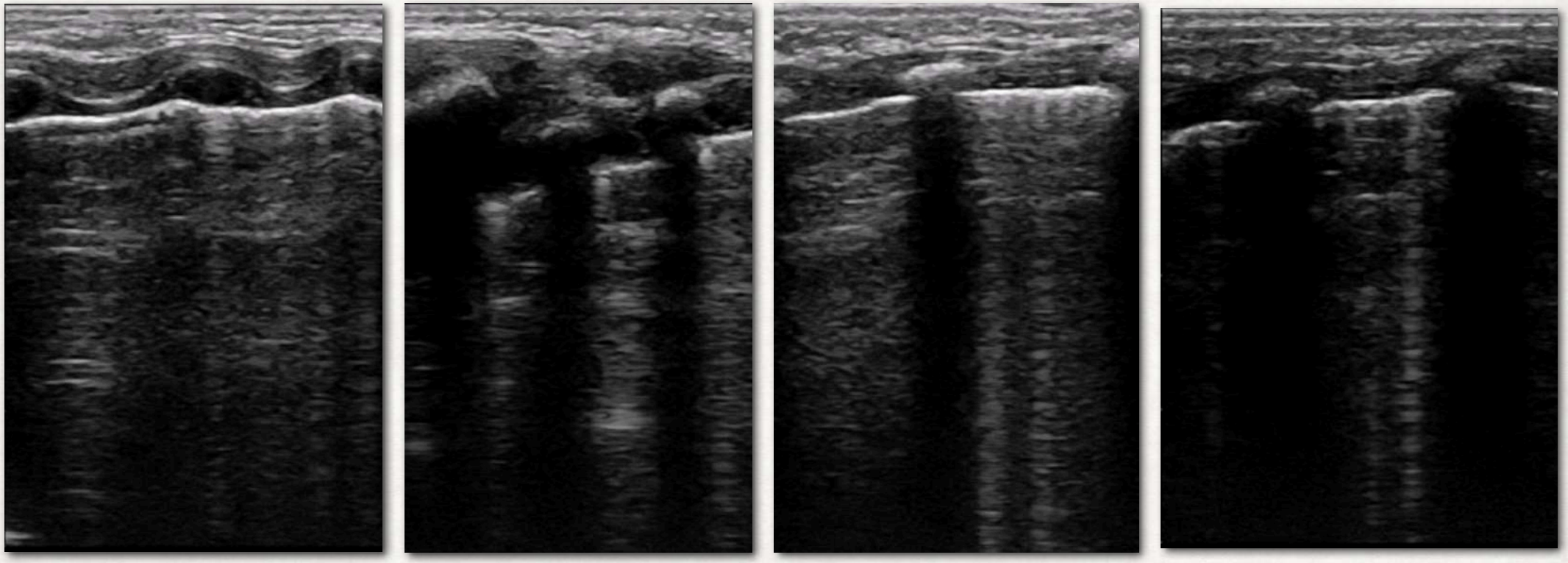
Figure 1 Neonatal lung ultrasound profiles. **A**) Type 1- full hyperechoic image of the lung fields or 'white lung'; **B**) Type 2- prevalence of B lines, that is, vertical, comet-tail artifacts; **C**) Type 3- predominance of A lines, that is, horizontal repetitions of the pleural line.

	Type 1	Type 2	Type 3
Initial scan	14/154	46/154	94/154
Within 12 hours	6/154	12/154	136/154
Within 24 hours	2/154	4/154	148/154
Within 36 hours	0/154	2/154	152/154

	Type 1	Type 2	Type 3
NICU admissions	14/14	4/46	0/94
Oxygen therapy	14/14	4/46	0/94
nCPAP	10/14	4/46	0/94
SIMV	4/14	0/46	0/94

nCPAP, nasal continuous positive airways pressure; NICU, neonatal ICU; SIMV: synchronized intermittent mandatory ventilation.

PREDICCION DE NECESIDAD SOPORTE

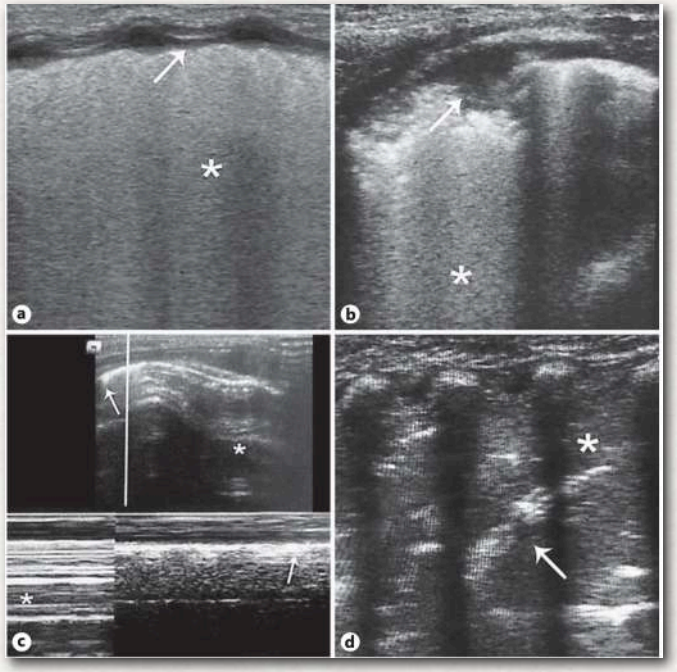


PREDICCIÓN FALLO DE VNI.

Lung Ultrasound as a Predictor of Mechanical Ventilation in Neonates Older than 32 Weeks

Javier Rodríguez-Fanjul[a] Carla Balcells[a] Victoria Aldecoa-Bilbao[b] Julio Moreno[a] Martín Iriondo[a]

[a]Neonatology Department, ICGON, BCNatal, Hospital Clínic – Sant Joan de Déu, Universitat de Barcelona, Barcelona, and [b]Neonatology Department, Hospital de Sabadell, Corporació Sanitària i Universitària Parc Taulí, Universitat Autònoma de Barcelona, Sabadell, Spain



Outcome	Low risk (n = 68)	High risk (n = 37)	p value
nCPAP or NIPPV, h	11.4±19.6	63.7±48.4	<0.01
MV	2 (2.9)	19 (51.4)	<0.01
MV, h	13±15.6	85.4±42.4	<0.05
Surfactant therapy	1 (1.5)	14 (37.8)	<0.01
FiO_2 admission >0.21	4 (5.9)	22 (59.5)	<0.01
Maximum FiO_2	0.22±0.1	0.50±0.03	<0.01
FiO_2 at 48 h	0.22±0.1	0.29±0.05	<0.01
Normalized LUS at 48 h	62 (91)	3 (9)	<0.01

Values are presented as means ± SD or numbers (%) unless otherwise stated. nCPAP = Nasal continuous positive airway pressure; FiO_2 = fraction of inspired oxygen; NIPPV = nasal intermittent positive pressure ventilation.

Sonographic pattern	Final clinical and X-ray diagnoses				
	TTN	RDS	MAS	PN	other[a]
Low risk (n = 68)	58	1	1	0	8
MV (n = 2)	1	0	0	0	1
High risk (n = 37)	3	22	8	4	0
MV (n =19)	1	15	3	0	0

MAS = Meconium aspiration syndrome; PN = pneumothorax.
[a] Metabolic acidosis or hypothermia.

	LUS (n = 100)	Chest radiography (n = 90)	p value
Sensitivity	95.0 (76.4–99.1)	90.0 (69.9–97.2)	NS
Specificity	82.5 (72.7–89.3)	78.6 (67.6–86.6)	NS
PPV	57.6 (40.8–72.8)	54.5 (38.0–70.2)	NS
NPV	98.5 (92.0–99.7)	96.5 (88.1–99.0)	NS
AUC	0.89 (0.81–0.94)	0.84 (0.75–0.91)	NS

Values are presented as percents (95% CI). AUC = Area under curve; NPV = negative predictive value; NS = not significant; PPV = positive predictive value.

PREDICCIÓN FRACASO DE VNI.

Use of Neonatal Chest Ultrasound to Predict Noninvasive Ventilation Failure

AUTHORS: Francesco Raimondi, MD, PhD,[a] Fiorella Migliaro, MD,[a] Angela Sodano, MD,[a] Teresa Ferrara, MD,[a] Silvia Lama, MD,[a] Gianfranco Vallone, MD,[b] and Letizia Capasso, MD[a]

S 88.9%
E 100%
VPP 100%
VPN 94.7%

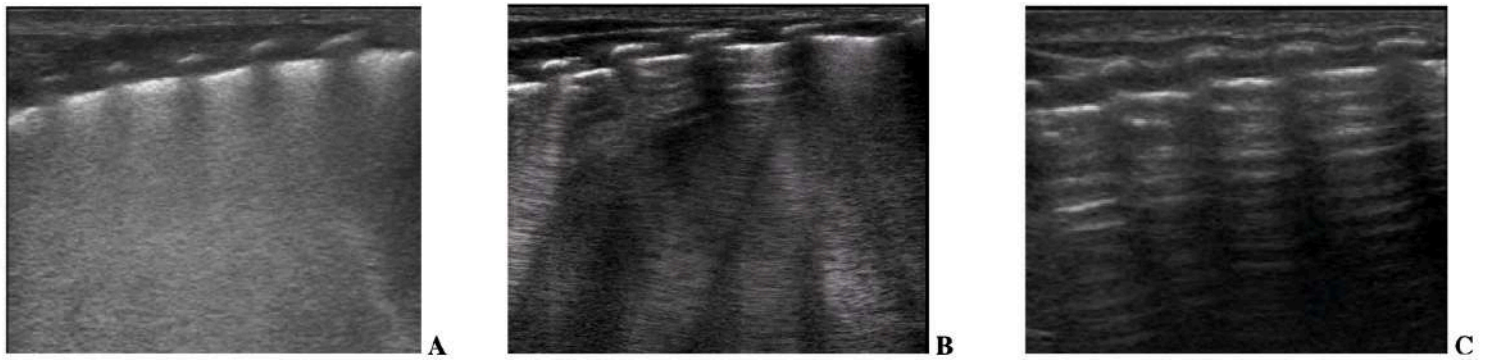


Figure 1 Neonatal lung ultrasound profiles. **A**) Type 1- full hyperechoic image of the lung fields or 'white lung'; **B**) Type 2- prevalence of B lines, that is, vertical, comet-tail artifacts; **C**) Type 3- predominance of A lines, that is, horizontal repetitions of the pleural line.

Todos los pacientes con patron tipo 1 uni o bilateral fueron intubados

TABLE 2 Concordance of Ultrasound and Radiographic Results

Ultrasound Result	Radiographic Result			
	Grade 4	Grade 3	Grade 2	Grade 1
Type 1	0	0	7	9
Type 2	0	0	6	6
Type 3	0	0	2	22
Type 1/2	0	0	0	2

PREDICCIÓN FRACASO DE VNI.

ECOGRAFÍA PULMONAR: lado izquierdo

PREDICCIÓN FRACASO DE VNI.

LADO DERECHO



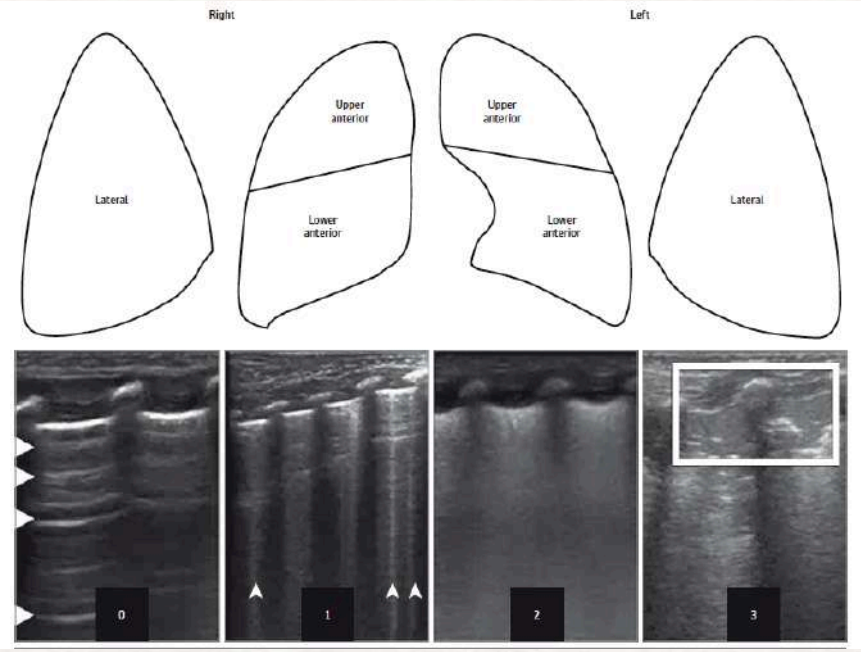

ADMINISTRACIÓN DE SURFACTANTE

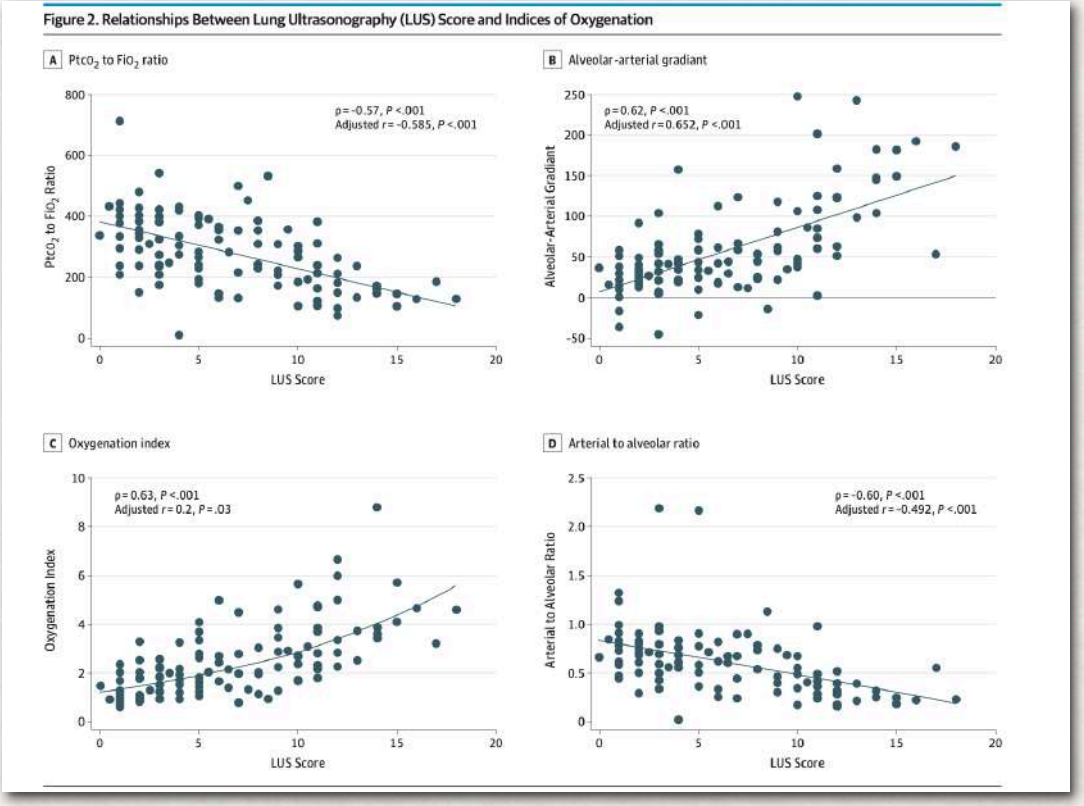
GUIADO POR ECOGRAFÍA

Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

Lung Ultrasonography Score to Evaluate Oxygenation and Surfactant Need in Neonates Treated With Continuous Positive Airway Pressure

Roselyne Brat, MD; Nadya Yousef, MD; Roman Klifa, MD; Stephanie Reynaud, MD; Shivani Shankar Aguilera, MD; Daniele De Luca, MD, PhD





ADMINISTRACIÓN DE SURFACTANTE

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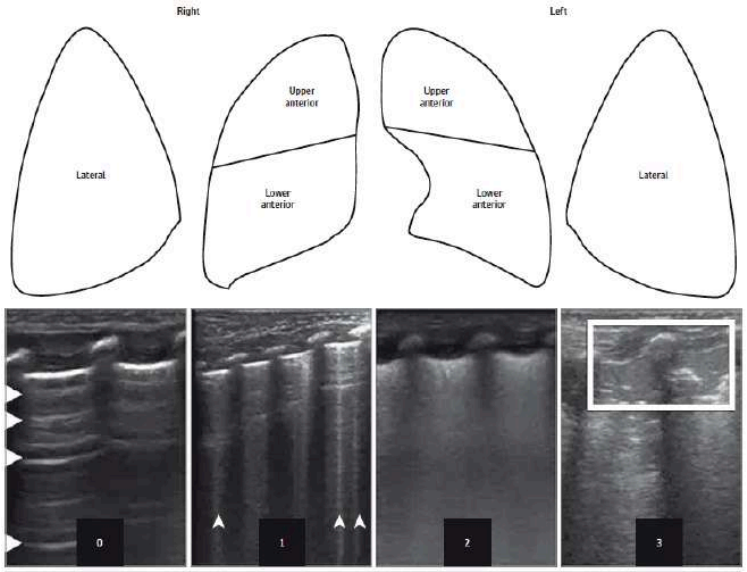
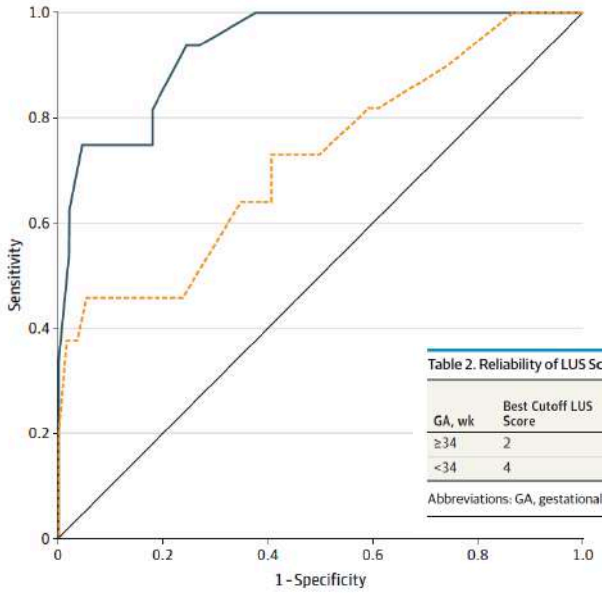


Figure 3. Receiver Operating Characteristic Analysis for the Prediction of Surfactant Administration



Dark blue line indicates lung ultrasonography score for babies with a gestational age less than 34 weeks; yellow line, lung ultrasonography score for babies with a gestational age of 34 weeks or greater. Area under the 2 curves is significantly different (P = .02).

The ROC analysis for the whole population yielded an AUC of 0.83 (95% CI, 0.74-0.92; P < .001). **Figure 3** shows the ROC analysis for the subgroups: AUC = 0.93 (95% CI, 0.86-0.99; P < .001) for babies with a GA less than 34 weeks and AUC = 0.71 (95% CI, 0.54-0.90; P = .02) for babies with a GA of 34 weeks or greater. The AUCs are significantly different

Table 2. Reliability of LUS Score for Surfactant Administration

GA, wk	Best Cutoff LUS Score	%		LR		PPV	NPV	Posttest Probability, %
		Sensitivity	Specificity	Positive	Negative			
≥34	2	91	25	1.2	0.4	20	93	39
<34	4	100	61	2.6	0.0	54	97	72

Abbreviations: GA, gestational age; LR, likelihood ratio; LUS, lung ultrasonography; NPV, negative predictive value; PPV, positive predictive value.

ADMINISTRACIÓN DE SURFACTANTE

GUIADO POR ECOGRAFÍA

Early surfactant replacement guided by lung ultrasound in preterm newborns with RDS: the ULTRASURF randomised controlled trial

Javier Rodriguez-Fanjul[1] · I. Jordan[2,3] · M. Balaguer[2] · A. Batista-Muñoz[4] · M. Ramon[4] · S. Bobillo-Perez[2]

Received: 1 April 2020 / Revised: 13 July 2020 / Accepted: 16 July 2020 / Published online: 24 July 2020

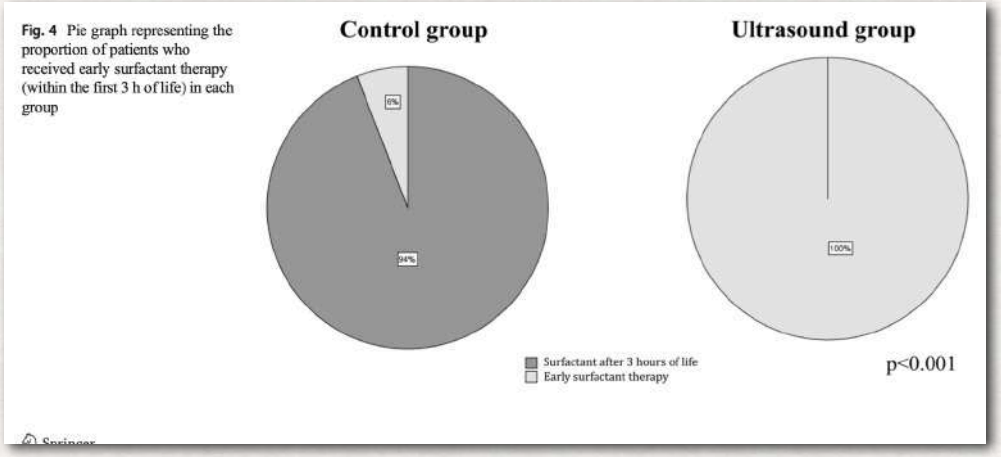


Fig. 4 Pie graph representing the proportion of patients who received early surfactant therapy (within the first 3 h of life) in each group

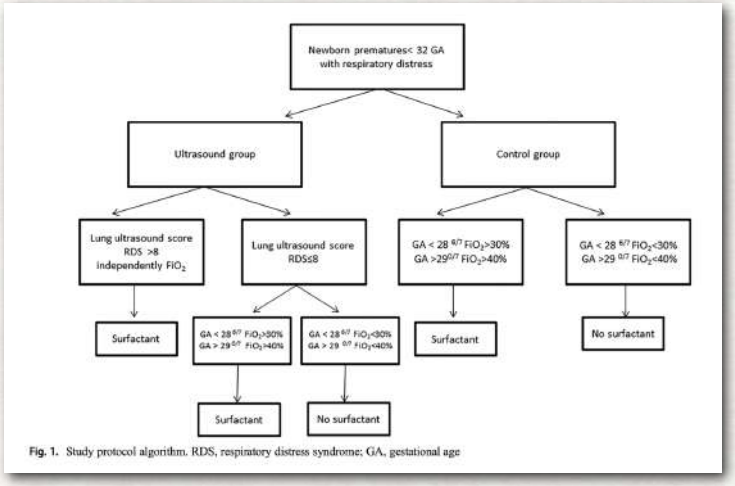


Fig. 1. Study protocol algorithm. RDS, respiratory distress syndrome; GA, gestational age

	Ultrasound group (n = 29)	Control group (n = 27)	p
FiO_2 after surfactant (%)	28 (25–30)	35 (31–40)	< 0.001
SpO_2 after surfactant (%)	93.5 (92–95)	90 (90-90.8)	0.001
S/F after surfactant	345 (290–381)	285 (241–300)	0.012
MV	5 (17.2%)	10 (37.0%)	0.095
Duration of MV (days)	2 (1–4.5)	2 (1.8–4.3)	0.523
Ventilator-free days	28 (28–28)	28 (26–28)	0.082
NIV	29 (100%)	27 (100%)	1.000
Duration of NIV (days)	3 (2–17)	4 (3–22)	0.428
Duration of oxygen (days)	6 (2–23.5)	5.5 (3–22.8)	0.926
Length of stay in the NICU (days)	47 (34–69)	52 (38–68)	0.780
BPD	3 (10.3%)	3 (11.1%)	1.000

ADMINISTRACIÓN DE SURFACTANTE

GUIADO POR ECOGRAFÍA

Echography-Guided Surfactant Therapy to Improve Timeliness of Surfactant Replacement: A Quality Improvement Project

Roberto Raschetti, MD[1,2,3,*], Nadya Yousef, MD[1,*], Giulia Vigo, MD[1], Gianluigi Marseglia, MD[3], Roberta Centorrino, MD[1], Rafik Ben-Ammar, MD[1], Shivani Shankar-Aguilera, MD[1], and Daniele De Luca, MD, PhD[1,2]

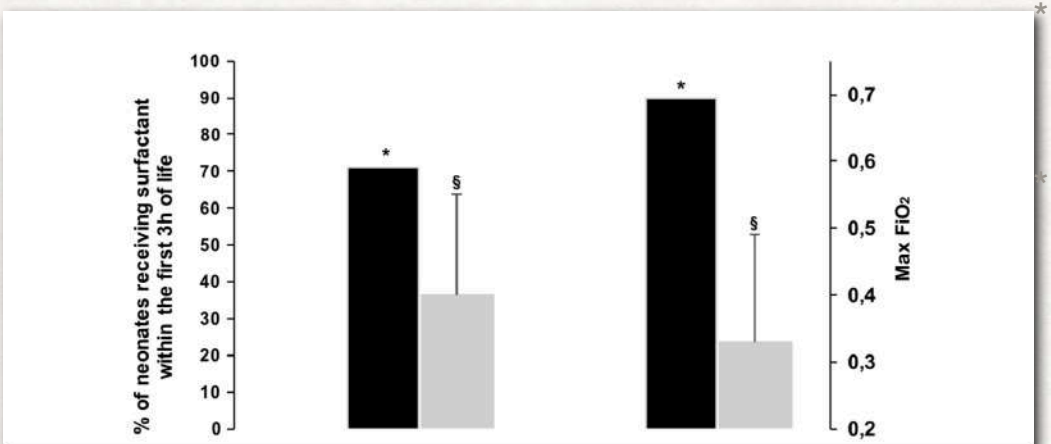
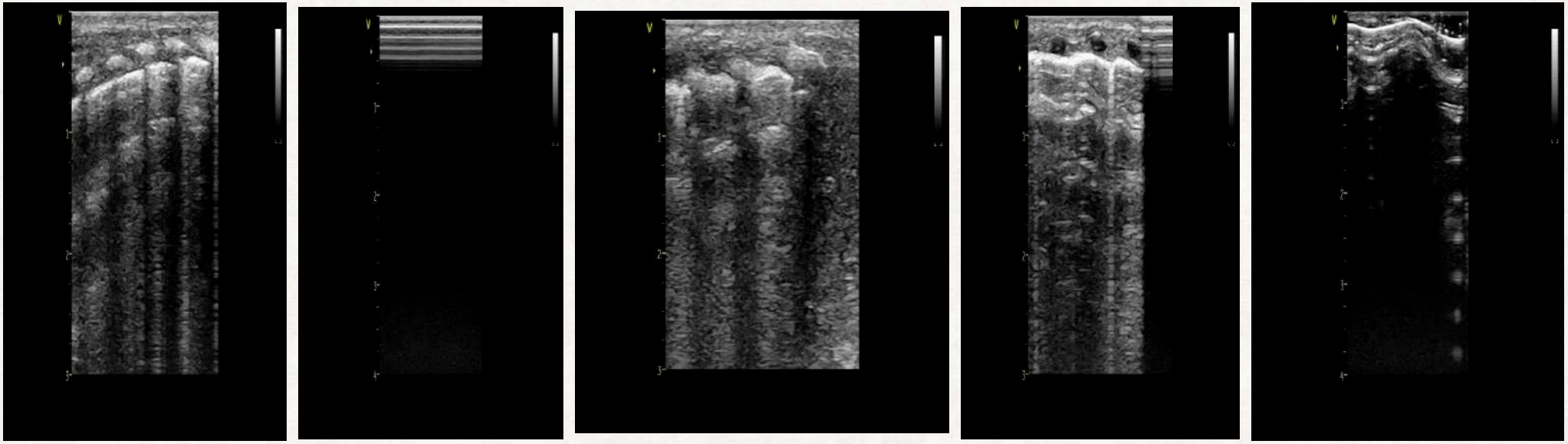


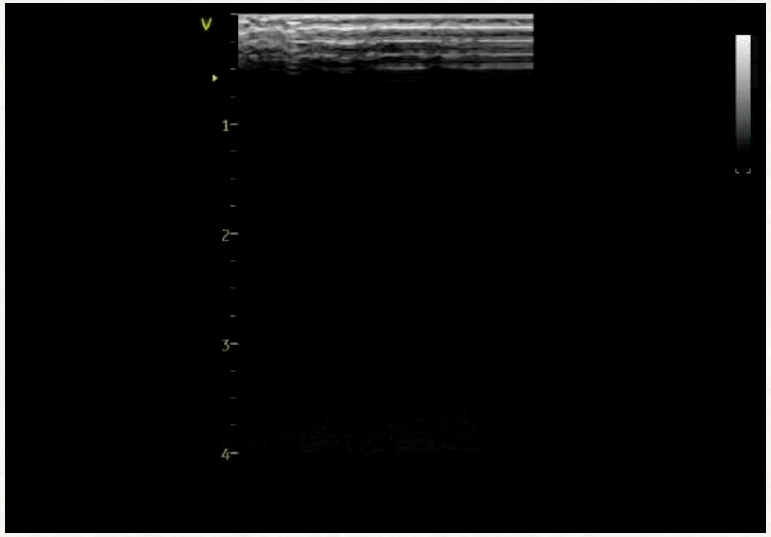
Figure 2. Primary quality improvement measures. *Black and gray columns* represent the proportions (% on the *left axis*) of surfactant-treated neonates receiving surfactant within the first 3 hours of life, and the maximal FiO_2 (median on the *right axis*) reached before surfactant replacement, respectively. *T-bars* represent interquartile range of FiO_2. *$P < .0001$; §$P = .005$.

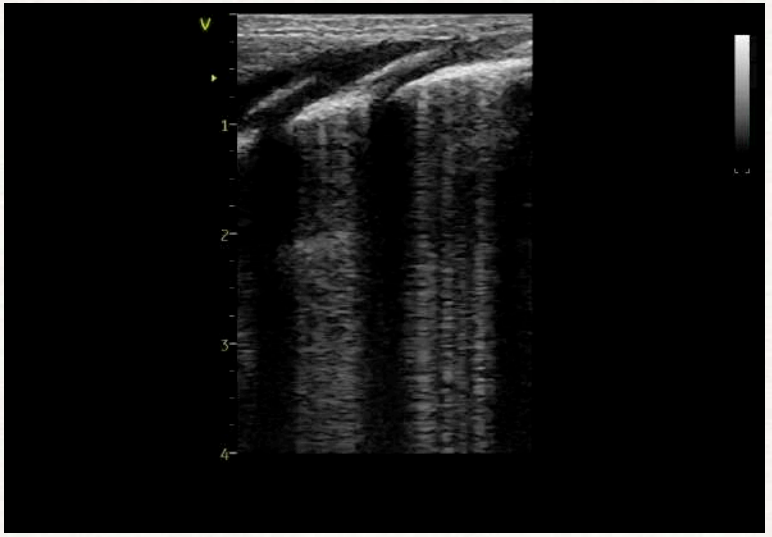
- La proporción de pacientes que recibió surfactante en las 3 primeras horas de vida aumento de manera significativa.
- La máxima FiO2 necesaria previa al tratamiento con surfactante fue menor (40 > 33%) y esta diferencia también fue significativa.
- La duración de VM se redujo de 48 a 11 días y esta diferencia fue significativa.

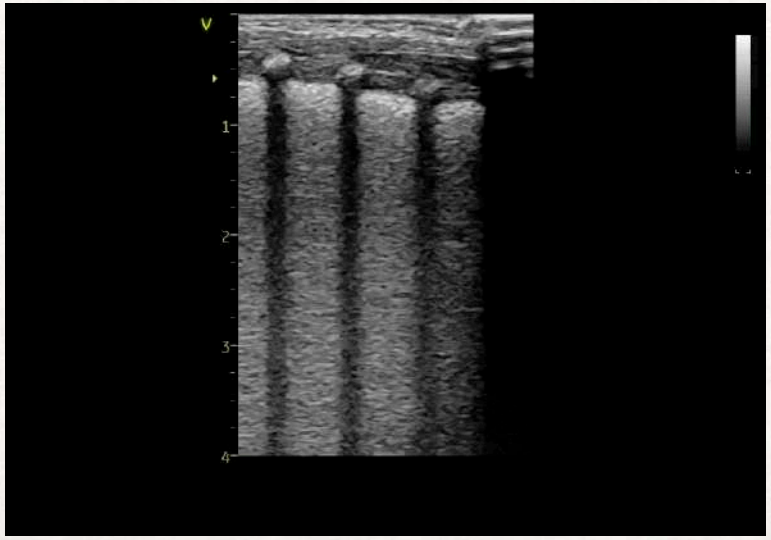
CASO 1

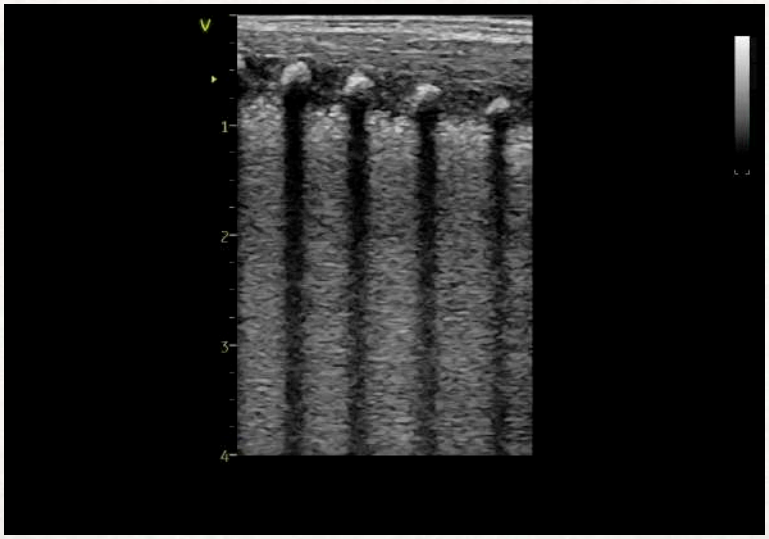


CASO 2



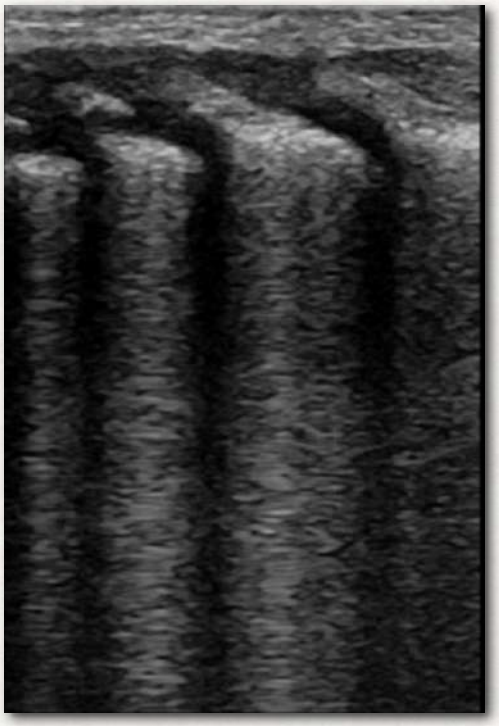




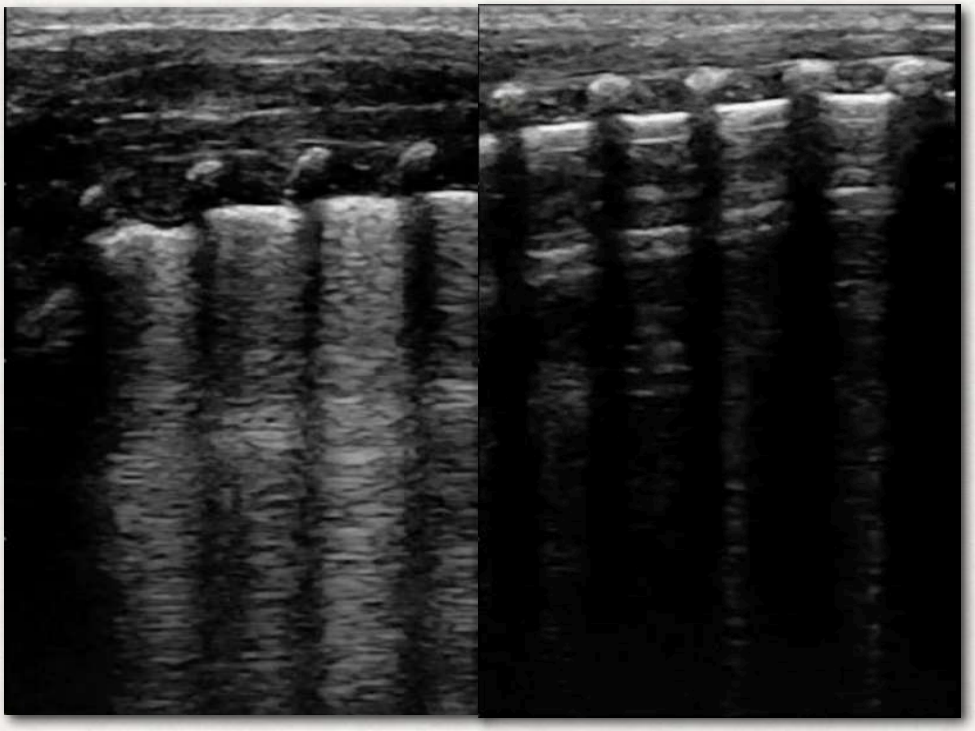


ADMINISTRACION DE SURFACTANTE

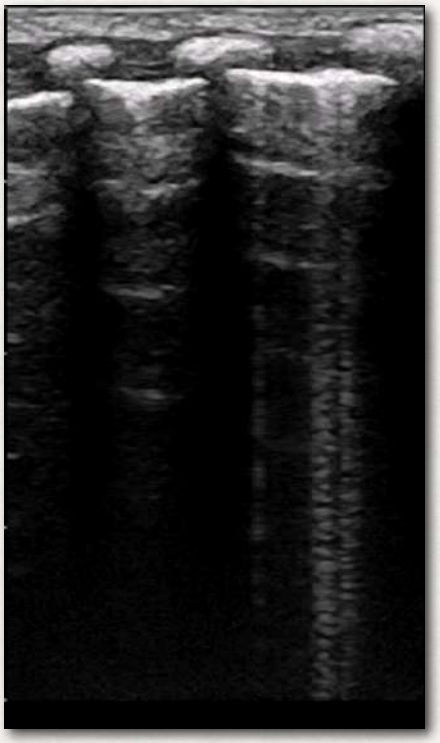
GUIADO POR ECOGRAFIA



2 h postsurfactante



6 h postsurfactante



24 h postsurfactante

CONCLUSIONES

- Util para el diagnóstico etiológico del distrés respiratorio en el recién nacido.
- En la práctica clínica ha demostrado su utilidad en predicción de necesidad de ingreso, predicción de fracaso de VNI o como guía en la administración de surfactante.
- Eficaz, segura y que permite una monitorización continua a pie de cama del estado respiratorio de nuestros pacientes.


Gracias por su atención.