Lung ultrasound imaging used during transport of patients with neonatal respiratory compromise

Uso de la ecografía pulmonar en el compromiso respiratorio en transporte neonatal

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Respiratory compromise is one of the main reasons for neonatal transfers in Spain. The role of pulmonary ultrasound (PU) in the differential diagnosis of this type of patient has been widely described. The Vall d'Hebron pediatric emergency medical service team (SEM-P VH) is a specialized pediatric and neonatal ground transport unit. specialized neonatal ground transport unit. The daily care team consists of a pediatrician, a nurse, and a health technician. It performs between 600 and 700 interhospital transfers per year, of which 30-35% are neonatal patient transports, and provides ground assistance throughout Catalonia and Andorra.

The aim of this study is to know and analyze the use of PU in the care of neonates with respiratory pathology by a pediatric and neonatal land transport service.

Observational, descriptive, and retrospective study during the period from January 2021 to June 2022. We also included all critically ill neonatal patients with respiratory compromise transferred by the pediatric and neonatal advanced life support ground transport unit of the EMS of Catalonia of the Hospital Vall d'Hebron (Barcelona) who had undergone PU during their care activity. The study was approved by the Vall d'Hebron Hospital Ethics Committee (CEIC PR(AMI)415/2022).

The records obtained were retrieved from the RedCap database, where the data of each transfer are collected, as well as a follow-up of each patient 72 hours after the transfer by means of telephone contact with the receiving center and ultrasound scans by the team pediatrician,

Table 1. Main clinical and demographic characteristics (n = 52)

	Value n (%)
Age (mean)	20 hours alive
Women/men (ratio)	31/21 (1.5:1)
Weigh [mean (range)]	3110 g (700-4.640 g)
Gestational age	37 weeks (27-41)
Premature	12 (23)
Full-term newborn	40 (77)
Apgar 1 min	7 (7)
Apgar 5 min	8 (6)
Apgar 10 min	9 (5)
Light respiratory distress*	16 (30.8)
Mild respiratory distress*	19 (36.5)
Severe respiratory distress*	3 (5.7)
Mechanical ventilation*	9 (17)

*Prior to transportation assistance

Table 2. Main diagnostic orientations (n = 52)

	n	%
TTN	12	23
NRDS	5	9.6
Vertically transmitted sepsis	4	7.7
Meconium aspiration	6	11.5
Pulmonary hypertension	4	7.7
Pneumothorax	6	11.5
Lung hemorrhage	1	1.9
Others (atelectasis, ascites without pleural effusion, asymmetry in pulmonary pattern, SPT, non-diagnostic)	14	26.9

TTN: transient tachypnea of the newborn; NRDS: neonatal respiratory distress syndrome; SPT: supraventricular paroxysmal tachycardia.

with training and experience in pediatric and neonatal critical patients as well as in transport.

We analyzed demographic variables, initial suspected diagnosis, reason and place of PU and diagnostic utility, probe used and time invested. The ultrasound scanner used was Sonosite Edge II with linear probes (13-6 MHz).

A total of 379 neonatal patient transfers were performed. In 221 (58.3%), the main reason for transfer was respiratory compromise, of which 52 (23.5%) underwent PU by the transport team. The demographic characteristics of the patients included are summarized in Table 1. The main diagnostic orientations according to clinical and complementary examinations are shown in Table 2.

Of the sample studied, in 47 cases (90.3%) PU was performed with diagnostic intent, and the place of performance, indications and implications are shown in Table 3. The mean time spent was 5.3 minutes, considering that on some occasions other areas were also explored. As for the diagnostic usefulness of PU, in 35 patients (65%) it served to confirm the previous suspicion, while in 6 cases (11.5%) it led to a change in the main diagnostic orientation.

Respiratory compromise in the newborn is one of the most frequent reasons for admission to neonatal intensive care units (NICU). Among its most common causes are neonatal respiratory distress syndrome (NRDS), transient tachypnea of the newborn (TTN), vertically transmitted sepsis or air leak.[1]

Bedside PE has proven to be a useful tool to guide the diagnosis of these patients. It allows us to discern the typical patterns of neonatal pulmonary pathology and also to monitor whether these are modified by the therapeutic actions performed.[2,3,5-8,10-12] In specialized neonatal transport, it has the advantage of being able to be performed as many times as needed at any stage of the transport and provides immediate information. For this reason, it is of great relevance when caring for critical patients in an initial phase, with a dynamic evolution and environment. This paper describes the use of PU in the different phases of the transport of neonatal patients requiring transfer from a regional hospital to a tertiary hospital with NICU.

Analyzing the data on its use in the transport setting, a high proportion of PUs aimed at confirming or

Table 3. Main characteristics of the ultrasound scans performed (n = 52)

	Value n (%)
Place of execution	
Sending hospital	34 (65.4)
Ambulance	18 (34.6)
Indications	
Parenchymal study	27 (51.9)
Rule out pneumothorax	20 (38.4)
Interventional control	3 (5.8)
Other	2 (3.8)
Implications	
Had some implication	16 (30.8)
Therapeutics	6 (11.5)
Change in respiratory support	4 (7.6)
Add treatment	1 (1.9)
Procedure	1 (1.9)
Avoids other complementary examinations	2 (3.8)
Avoids procedures	8 (15.3)

ruling out the presence of pneumothorax stands out, leaving the final diagnostic orientation of the respiratory pathology in the background. In most cases in which the presence of air leakage was observed, the findings were suggestive of small pneumothorax with mild repercussions and made it possible to adjust respiratory support to prevent possible complications. This is of particular importance in interhospital transport, where it is necessary to establish a clear order of priorities in which patient stabilization is paramount. PU plays an important role in the early identification of complications or in assisting in the initial management.

To date, there is only one study in the literature that analyzes the usefulness of PU in newborns with respiratory compromise in interhospital transport. This one focuses only on PU prior to discharge from the sending hospital.[12] If we compare the two studies, both have a very similar total number of patients, but the difference in the distribution of the main pathologies stands out. In the study by Jagla et al. there is a predominance of NRDS (46%), while only 4% are NRDS. In contrast, in our sample, the majority pathology is TTN (23%), followed by NRDS (9.6%). We attribute this difference to the fact that our study retrospectively includes those neonates with respiratory distress who have undergone PU according to medical criteria, whereas the study by Jagla et al. prospectively includes all neonates with respiratory distress, with a mean gestational age significantly lower

than that of our sample. This change in the distribution could suggest that when the indication to perform PU is based exclusively on medical criteria, it is mostly performed on term newborns in whom there may be more doubts in the differential diagnosis than respiratory distress in preterm patients, who are also tried to avoid unnecessary manipulations that may be poorly tolerated.

Regarding the applicability of bedside PU in transport, it is a non-invasive, accessible, safe and fast tool that does not delay patient care and stabilization.[9]

In our sample, PU was performed in 23.5% of critically ill neonates with respiratory compromise. Although this is not a negligible number, we consider that the objective should be to integrate the use of PU in the care of this type of patient. However, it is important to adapt its application to transport, so the recommendation would be to use it rationally and reserve it for those cases in which the results lead to a change in diagnostic or therapeutic attitude, trying to avoid lengthening stabilization or transfer times.

We conclude that the use of PU in specialized neonatal transport is growing. It provides important benefits in the stabilization and management of these patients. Likewise, we consider that it would be necessary to carry out a prospective study to define the reliability of PU as a method to aid diagnosis and rule out complications in transport. Likewise, we encourage the establishment of training programs in ultrasound to facilitate the incorporation of this technique in transport.

References

1 Jagła M, Grudzien A, Starzec K, Tomasik T, Zasada M, Kwinta P. Lung ultrasound in the diagnosis of neonatal respiratory failure prior to patient transport. J Clin Ultrasound. 2019;47:518-25.

2 Corsini I, Parri N, Gozzini E, Coviello C, Leonardi V, Poggi C, et al. Lung ultrasound for the differential diagnosis of respiratory distress in neonates. Neonatology. 2019;115:59-67.

3 Woods PL. Utility of lung ultrasound scanning in neonatology. Arch Dis Child. 2019;104:909-15.

4 Corsini I, Parri N, Ficial B, Dani C. Lung ultrasound in the neonatal intensive care unit: Review of the literature and future perspectives. Pediat Pulmonol. 2020;55:1550-62.

5 Liu J, Copetti R, Sorantin E, Lovrenski J, Rodriguez-Fanjul J, Kurepa D, et al. Protocol and guidelines for point-of-care lung ultrasound in diagnosing neonatal pulmonary diseases based on international expert consensus. J Vis Exp. 2019;145.

6 Ibrahim M, Omran A, Abdallah NB, Ibrahim M, El-Sharkawy S. Lung ultrasound in early diagnosis of neonatal transient tachypnea and its differentiation from other causes of neonatal respiratory distress. J Neonatal Perinatal Med. 2018;11:335-8.

7 De Luca D, Autilio C, Pezza L, Shankar-Aguilera S, Tingay DG, Carnielli VP. Personalized Medicine for the Management of RDS in Preterm Neonates. Neonatology. 2021;118:127-38.

8 He L, Sun Y, Sheng W, Yao Q. Diagnostic performance of lung ultrasound for transient tachypnea of the newborn: A meta-analysis. PLoS ONE. 2021;16:1-13.

9 Subirana Campos L, Renter Valdovinos L, Oller Fradera O, Garcés Montolio L, Gómez Rodríguez J. Utilidad de la ecografía clínica en el traslado interhospitalario del paciente crítico pediátrico y neonatal. An Pediatr. 2021;95:201-3.

10 Sharma D, Farahbakhsh N. Role of chest ultrasound in neonatal lung disease: a review of current evidences. J Mater-Fetal Neonatal Med. 2019;32:310-6.

11 Wu J, Wang Y, Zhao A, Wang Z. Lung Ultrasound for the Diagnosis of Neonatal Respiratory Distress Syndrome: A Meta-analysis. Ultrasound Q. 2020;36:102-10.

12 Gregorio-Hernández R, Arriaga-Redondo M, Pérez-Pérez A, Ramos-Navarro C, Sánchez-Luna M. Lung ultrasound in preterm infants with respiratory distress: experience in a neonatal intensive care unit. Eur J Pediatrics. 2020;179:81-9.

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