



ORIGINAL ARTICLE

# Lung ultrasound as a tool to guide the administration of surfactant in premature neonates<sup>☆</sup>



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## KEYWORDS

Premature newborns;  
Lung ultrasound;  
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## Abstract

**Objectives:** The aim of this study was to assess the usefulness of lung ultrasound (LUS) to estimate the endotracheal tube (ETT) depth position during the INTubation–SURfactant–Extubation (INSURE) procedure.

**Material and methods:** The ETT insertion depth was estimated using the weight (insertion depth (cm) = weight (kg) + 5.5). After intubation, two independent neonatologists using bilateral auscultation or LUS checked the ETT depth.

**Results:** Twelve newborns with respiratory distress syndrome were included. In two cases LUS helped to correctly replace the ETT. All the patients progressed well, with normal X-ray and LUS before discharge.

**Conclusions:** LUS appears to be a safe and non-invasive technique and is useful in clinical situations where X-ray is not routinely performed, as it is fast and radiation free.

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## PALABRAS CLAVE

Neonatos prematuros;  
Ecografía pulmonar;  
Surfactante

## La ecografía pulmonar como herramienta para guiar la surfactación en neonatos prematuros

### Resumen

**Objetivos:** El objetivo del presente estudio es la valoración mediante la ecografía pulmonar de la profundidad del tubo endotraqueal (TET) durante el procedimiento de Intubation-Surfactant-Extubation (INSURE).

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**Material y métodos:** La profundidad de inserción del TET se calculó mediante el peso del neonato (profundidad de inserción [cm] = peso [kg] + 5,5). Después de la intubación, la profundidad del TET fue valorada por 2 neonatólogos independientes mediante la auscultación bilateral y la ecografía pulmonar.

**Resultados:** Doce neonatos con membrana hialina fueron reclutados. En 2 casos la ecografía pulmonar ayudó a posicionar correctamente el TET. Todos los pacientes presentaron una buena evolución con una radiografía y una ecografía pulmonar normal al alta.

**Conclusiones:** La ecografía pulmonar es una técnica segura y no invasiva útil en situaciones donde la radiografía de tórax no se usa habitualmente, siendo además rápida y libre de radiación.

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## Introduction

Respiratory distress syndrome (RDS), also known as hyaline membrane disease, is caused by a deficiency of surfactant.<sup>1</sup> Its management includes noninvasive or mechanical ventilation and, depending on oxygen requirements, the use of exogenous surfactant. In the past decade, early administration of surfactant over a brief period of intubation followed by rapid extubation to noninvasive ventilation (Intubation–SURfactant–Extubation [INSURE]) has become standard practice<sup>2</sup> in neonatal units.

One of the main risks of this procedure is the inadvertent administration of surfactant to only one lung, as chest radiography is not routinely performed during the procedure.

There is evidence that lung ultrasound can be useful in the diagnosis of RDS in newborns<sup>3</sup> and for assessing the position of endotracheal tubes (ETTs) in adults as well as children.<sup>4</sup>

This article describes the usefulness of lung ultrasound during the INSURE procedure in helping to avoid inadvertent administration of surfactant to only one lung.

## Materials and methods

We conducted a study between January and December 2014 at the Hospital Sant Joan de Déu (Esplugues de Llobregat, Barcelona), a tertiary care hospital with a volume of 3300 deliveries per year and a neonatal intensive care unit (NICU) with 700 admissions per year.

We obtained the informed consent of parents, and the study was approved by the ethics board of the hospital.

The patients included in the study were newborns with a clinical and radiographic diagnosis of RDS. The choice to carry out the INSURE procedure was made based on the judgement of the neonatologist in charge of the patient. The criteria for administration of surfactant in infants born at more than 32 weeks' gestation with a weight of more than 1000 g are requiring a  $\text{FiO}_2$  of more than 0.4, a mean alveolar pressure of more than 6  $\text{cmH}_2\text{O}$  and chest radiography findings compatible with RDS. During the INSURE procedure, the position of the ETT is verified by means of bilateral auscultation and without chest radiography, as the goal is to perform rapid extubation following surfactant administration.

A consulting senior neonatologist oversaw the procedure as it was performed by a master's student in neonatology. Infants on noninvasive ventilation were sedated according to the NICU protocol prior to intubation. The insertion depth of the ETT was estimated based on the weight (insertion depth [cm] = weight [kg] + 5.5), which is the method used to calculate the initial depth of ETT placement in our unit, consistent with the recommendations of the Sociedad Española de Neonatología (Spanish Society of Neonatology)<sup>5</sup>; placement was confirmed by means of bilateral lung auscultation performed by a different neonatologist blinded to the ETT insertion depth that did not modify the depth and documented whether the auscultation suggested asymmetry. Once the ETT insertion depth had been assessed, a lung ultrasound was performed by a neonatologist experienced in lung ultrasonography and blinded to the ETT placement depth and the results of lung auscultation.

Lung ultrasound was performed with a portable device (Siemens Acuson X300, Siemens Healthcare GmbH, Erlangen, Germany) with a 10 MHz linear transducer suitable for the correct visualization of superficial structures. The transducer was placed at the suprasternal level for tracheal ultrasound, and on each hemithorax on a longitudinal plane at the level of the midaxillary line for lung ultrasound.

- Verification of correct placement by lung ultrasound required scanning in search of four features:
- Visualization of the tip of the ETT in the tracheal region.
- Bilateral lung sliding sign: sign that reflects the visceral pleura sliding against the parietal pleura during inspiration and expiration
- Bilateral diaphragmatic excursion.
- Lung pulse sign: sign observed in the absence of lung sliding, allowing the clear visualization of cardiac pulsations at the level of the pleural line. This sign reflects main stem intubation of the contralateral lung.

In patients in whom ultrasound revealed a unilateral absence of lung sliding and diaphragmatic excursion and/or the presence of the lung pulse sign, the ETT was retracted to the point where the sonographic signs became normal.

This was followed by administration of the surfactant Curosurf (200 mg/kg) monitored by ultrasound.

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