CHEST

Lung Ultrasonography to Diagnose Transient Tachypnea of the Newborn

Jing Liu, MD, PhD; Xin-Xin Chen, MD; Xiang-Wen Li, MD; Shui-Wen Chen, MD, PhD; Yan Wang, MD, PhD; and Wei Fu, MD

VIDEO

BACKGROUND: This study explored the sensitivity and specificity of ultrasound for diagnosing transient tachypnea of the newborn (TTN).

METHODS: Ultrasound was performed by one export. Patients were placed in a supine, lateral recumbent, or prone position. The probe was placed perpendicular or parallel to the ribs, and each region of the lung was scanned. The scan results were compared with conventional chest radiographic results.

RESULTS: A total of 1,358 infants were included in this study. We identified 412 cases without pulmonary diseases, 228 TTN cases, 358 respiratory distress syndrome (RDS) cases, 85 meconium aspiration syndrome (MAS) cases, 215 infectious pneumonia cases, and 60 other cases. The primary ultrasonic characteristic of TTN was pulmonary edema. "White lung" or a "compact B-line" were only observed in severe cases, whereas TTN primarily presented as pulmonary interstitial syndrome or "double lung point." Furthermore, double lung point could appear during the recovery period of severe TTN or RDS, MAS, and pneumonia. Lung consolidation with air bronchograms was not observed in TTN patients. The results showed that white lung or a compact B-line exhibited a sensitivity of 33.8% and a specificity of 91.3% in diagnosing TTN, whereas double lung point exhibited a sensitivity of 45.6% and a specificity of 94.8% in diagnosing severe TTN.

CONCLUSIONS: Pulmonary edema, alveolar-interstitial syndrome, double lung point, white lung, and compact B-line are the primary ultrasound characteristics of TTN. Ultrasonic diagnosis of TTN based on these findings is accurate and reliable. TTN can be ruled out in the presence of lung consolidation with air bronchograms. CHEST 2016; 149(5):1269-1275

KEY WORDS: compact B-line; double lung point; infant; lung ultrasound; newborn; pulmonary edema; pulmonary interstitial syndrome; transient tachypnea syndrome; white lung

ABBREVIATIONS: AIS = alveolar-interstitial syndrome; MAS = meconium aspiration syndrome; RDS = respiratory distress syndrome; TTN = transient tachypnea of the newborn

AFFILIATIONS: From the Department of Neonatology and NICU of Bayi Children's Hospital, the Army General Hospital of the Chinese PLA, Beijing, China.

FUNDING/SUPPORT: This work was supported by the Clinical Research Special Fund of Wu Jieping Medical Foundation [320.6750.15072].

CORRESPONDENCE TO: Jing Liu, MD, PhD, Department of Neonatology and NICU of Bayi Children's Hospital, the Army General Hospital of the Chinese PLA, No. 5 Nanmen Cang, Dongcheng District, Beijing 100700, China; e-mail: liujingbj@live.cn

DOI: http://dx.doi.org/10.1016/j.chest.2015.12.024

Transient tachypnea of the newborn (TTN), also known as wet lung, is one of the most common causes of dyspnea in newborns. Some epidemiologic studies indicate that the incidence of TTN is 4% to 5.7% in full-term newborns and 10% in preterm infants.[1] Although TTN rarely leads to neonatal death, it must be accurately differentiated from other causes of dyspnea, such as respiratory distress syndrome (RDS), meconium aspiration syndrome (MAS), pneumonia, and congenital heart disease, among others, to aid in the correct management of TTN. Generally, TTN is primarily diagnosed based on medical history, typical clinical presentation, arterial blood gas analysis, and chest radiographic examination, among other factors; lung ultrasound is typically not included in the diagnostic workup of TTN. Recently, chest ultrasound has been used in the diagnosis of many types of neonatal and children's lung diseases, including RDS, MAS, pneumonia, and atelectasis.[2,3] However, there exists limited literature concerning the diagnosis of TTN using lung ultrasound. This study used a large series of lung ultrasonography findings to characterize the ultrasound imaging features of TTN and to explore the specificity and sensitivity of lung ultrasonography for the diagnosis of TTN.

Materials and Methods

Study Subjects

The institutional review board of the Beijing Military General Hospital approved the study protocol (No. 2011-LC-Ped-01). This was a retrospective series study that included a total of 1,358 newborn infants hospitalized in the neonatal intensive care unit of the Bayi Children's Hospital, affiliated with Beijing Military General Hospital, from January to December 2014 who underwent lung ultrasonography. All of the lung ultrasonography examinations were performed by one doctor, the clinical data were collected by different doctors, and the ultrasound operator was blinded to the clinical condition of the neonates.

The diagnostic criteria for TTN are as follows[1,4]: (1) typical clinical symptoms: rapid, labored breathing of more than 60 breaths a minute within the first several hours after birth, grunting or moaning sounds when the baby exhales, flaring nostrils, retractions, and cyanosis around the mouth and nose; (2) chest radiographic findings: prominent perihilar pulmonary vascular markings, flattening of the diaphragm, and fluid in the horizontal fissure of the right lung; and (3) exclusion of and vigilance for other reasons for respiratory distress. Patients who required mechanical ventilation support (including invasive or noninvasive) were defined as having severe TTN, whereas those who needed supplemental oxygen but not mechanical ventilation were defined as having mild TTN.

Lung Ultrasound Examination Methods

Instruments: GE Voluson E6 or E8 and Logiq C9 ultrasound equipment were used. The frequency of the linear array probe was 10 to 14 MHz.

Examination Method: In a resting state, each patient was placed in a supine, lateral recumbent, or prone position. Using the anterior and posterior axillary lines as boundaries, each side of the lung was divided into three regions: anterior, lateral, and posterior. The probe was held perpendicular or parallel to the ribs, and each region of both sides of the lung was scanned.

Observation Indices: ***Pleural Line:*** On an ultrasound, the organ and the parietal pleura present as smooth, regular, linear hyperechoic echoes, namely the pleural line.[5]

A-Line: Because of the horizontal artifacts formed by the multiple reflections generated by the differences in acoustic impedance of the pleura-lung interface, the ultrasound reveals a series of linear hyperechoic echoes that are parallel to and below the pleural line and are equidistant from each other.[6]

B-Line: Linelike artifacts originate from and are perpendicular to the pleural line and present as a radial divergence to the deep parts of the lung field (Video 1).[7]

Lung Consolidation: On the ultrasound, this presents as "hepatization" and may be accompanied by air bronchograms or fluid bronchograms of the lung tissues.[5]

White Lung: This is characterized by compact B-line or A-line disappearance in all six regions of the lung. Compact B-line refers to a type of ultrasonography in which the dense existing B-line makes the acoustic shadows of the ribs in the entire scan area disappear when the probe scans in a direction that is perpendicular to the ribs. White lung and compact B-line are manifestations of severe alveolar-interstitial syndrome (AIS) and are caused by the presence of a large amount of lung fluid (including pulmonary interstitial and alveolar fluid).[6,8]

Alveolar-Interstitial Syndrome: AIS is characterized by the presence of more than three B-lines with the disappearance of A-lines in the lung field (Video 2); however, the acoustic shadows of the ribs may also be present. Severe AIS can manifest as white lung or compact B-line.[6,8]

Double Lung Point: The stark demarcation point that is formed between the upper and lower lung on an ultrasound because of the differences in the severity or nature of the lesions indicates double lung point.[9]

Statistical Analysis

SPSS 16.0 software (IBM Corp) was used to conduct the statistical analysis. Fisher exact test was used to compare the rate of positive neonatal ultrasound findings between the two groups. The specificity and sensitivity of the primary examination results for diagnosing TTN were calculated based on this test, and a P value of less than .05 was considered statistically significant.