Applications in neonatology and ultrasound of lung

David Humphry

Humphry D. Applications in neonatology and Ultrasound of lung. J Pulmonol. 2022; 6(2):22-24.

ABSTRACT

Lung ultrasound is rapidly being employed in both adult and paediatric populations, allowing for the quick assessment of a wide range of lung and pleura illnesses. The method's popularity stems from various factors, including its low cost, speed, lack of ionising radiation, accessibility at the bedside, and reproducibility. These characteristics are even more significant now that the SARS-CoV-2 pandemic has broken out, because ultrasound can detect the indications of interstitial lung syndrome, which is a type of pneumonia caused by the virus. The goal of this study is to go over the available data for lung ultrasonography (LUS) in children, as well as the main applications of LUS in paediatric disorders.

KeyWords: *Lungultrasound; Infants; Children; Pneumonia; Broncolitis; COVID-19*

INTRODUCTION

Clinical therapy of children lung illnesses has always been difficult due to the wide range of clinical presentations and frequently overlapping symptoms and indications. The Chest X-Ray (CXR) has traditionally been an important tool in the detection of respiratory illnesses. However, the potentially dangerous effects of CXR radiation exposure limit its use, particularly in youngsters [1]. Lung UltraSound (LUS) is a new imaging application of sonography that has gained popularity in emergency rooms and clinical practise in recent years [2]. It is rapid, portable, repeatable, and does not emit ionising radiation, therefore it may be used in a variety of settings, both inpatient and outpatient, for both acute and chronic illnesses [3]. Growing data demonstrates the method's efficacy as a diagnostic tool for a variety of paediatric disorders [4]. Because of their smaller lung capacities and thinner chests, infants and youngsters are considered good candidates for this type of examination. These traits aid in the visibility of any lesions since, in smaller lungs, such lesions are more likely to reach the pleura, allowing the linear probe to complete the test. Furthermore, in the era of the Coronavirus disease 2019 (COVID-19) pandemic, lung ultrasonography has demonstrated its use by being used in the early diagnosis, follow-up, and therapy of SARS-CoV-2 infected patients.

Technique and equipment

To obtain substantial compliance in noncollaborating children, the exam can be performed with a warmed-up gel and the kid seated in the caregiver's lap during breastfeeding or by utilising age-appropriate distraction tactics to lessen anxiety. The most often utilised transducer for LUS evaluation is a 10 Mhz linear probe [5]. Due to the use of high frequencies, this sort of transducer is ideal for exploring up to 4 cm into the chest and then properly viewing the pleural line and any probable modifications. Lesser-frequency probes, such as the curvilinear transducer (1–5 MHz) or the phased-array transducer (1–3 MHz), provide higher and wider penetration, making them helpful for a general evaluation of the lung or in suspects of diffuse disease with a lower resolution than high-frequency linear probes. The compound should also be switched off because when the pleura are insonified from multiple angles, as in compound imaging, the B-lines vanish. The reverberation artefact will be removed, and the brightness of B-lines will be reduced. Each hemithorax is divided into three sections: (1) the anterior area, which is delimited by the parasternal and anterior axillary lines; (2) the lateral area, which is delimited by the anterior and posterior axillary lines; and (3) the posterior area, which is delimited by the posterior axillary line. Every area is separated into two halves: upper and bottom. The probe is positioned vertically, obliquely, and horizontally to the ribs in the anterior, lateral, and posterior thorax, and it is moved from one intercostal gap to the next in a caudal manner, from the apices to the costophrenic angles, to cover the complete lung surface [6]. This methodical technique to lung exploration should be used in all cases, especially during the patient's first imaging test. To date, several scoring systems have been proposed to assess the degree of lung involvement in different lung diseases to evaluate the distribution of B-lines, one of the most common ultrasound artifacts. These systems divide the thorax into a different number of zones and assign a score based on the distribution of B-lines in the different explored areas during the scan. Among these, the most frequently used in critical care settings are the 4-zone, 6-zone and 8-zone systems introduced and

Editorial Office, Journal of Pulmonology, United Kingdom

Correspondence: David Humphry, Editorial Office, Journal of Pulmonology United Kingdom, E-mail: pulmonol@esciencejournals.org

Received: 08 February,2022, Manuscript No. PULJP-22-4346; Editor assigned: 12-Feb-2022, PreQC No. PULJP-22-4346(PQ); Reviewed: 18-Feb-2022, QC No.:- PULJP-22-4346(Q)-; Revised:- 19-Feb-2022, Manuscript No.:- PULJP-22-4346(R); Published: 28-Feb -2022, DOI:- 10.37532/puljp.22.6(2).22-24

the 14-zone system. [6].

Findings from lung ultrasound in healthy people

Subcutaneous tissue and muscles make up the earliest layers of the chest. The ribs show as curving structures with a posterior acoustic shadow in longitudinal slices. The intercostal acoustic window is utilised to analyse tissues deep under the skin and muscle in axial sections. The pleura is the only observable structure in a regularly aerated lung. It appears as a continuous hyperechogenic line that shifts with the breaths. "Lung sliding" is another name for this activity. The lung is filled with air below the pleural line. Although the normal pulmonary parenchyma cannot be seen directly, various artefacts and echographic findings can be described. Some of these artefacts can be found in a perfectly healthy lung and are represented by "A-lines." They are horizontal echogenic lines that are equidistant and parallel to each other and the pleura, representing pleural reverberations that occur when the ultrasound beam reflects off the pleura and partially reflects off the probe face back to the pleura before returning to the machine rather than entering the probe. The "Z-lines" are another type of sonographic artefact. These artefacts are caused by reverberation echoes from abnormalities on the lung surface, and they show as vertical echogenic lines (less echogenic than a pleural line) emanating from the pleura, which do not obliterate the A-lines and do not move with lung sliding. B-lines, which seem similar to Z-lines but usually indicate the presence of fluid in the interstitial compartment or, in general, an abnormality in the alveolar or interstitial compartment, should be distinguished. B-lines emerge from the pleura as a vertical line, typically erasing the A-lines and moving with the lung slide. Although these artefacts do not exist in a normal lung, they may be visible in an infant's lung during the first 48 hours of life due to a probable delay in lung fluid resorption. Until 2020, paediatric lung ultrasound studies were predicated on the idea that the ultrasound appearance of a healthy adult lung was the same as that of a kid, and no research had been done to describe the look of the healthy lung in children, particularly newborns. Buonsenso et al. recently performed an ultrasound at 10 days, 1, 3, and 6 months to describe the normal ultrasound appearance of the lung in newborns during the first 6 months of life. The study found that a healthy infant's lung has a B-pattern with many vertical artefacts in the first few months of life, but that by six months of age, it has normalised to the normal A-pattern seen in adults. In healthy newborns, no consolidations, pleural line anomalies, or pleural effusion were found.

Ultrasound applications in children's Lungs and chest walls

The following are the main indications for lung and chest wall ultrasonography in children: Diagnosis and follow-up of neonatal lung disorders; Diagnosis and follow-up of paediatric lung infectious diseases (such as bronchiolitis and pneumonia) and lung complications (such as pneumothorax, pleural effusion, and lung abscess); Diagnosis and follow-up of pulmonary edoema; Diagnosis of thoracic trauma and early detection of signs of child abuse; Diaphragm ultrasound. Respiratory distress in newborns can be caused by a variety of lung illnesses, including respiratory distress syndrome, transitory tachypnea, pneumonia, atelectasis, and pneumothorax, especially in premature infants. The differential diagnosis of these disorders might be difficult, however LUS can help distinguish them [7]. Neonatal Respiratory Distress Syndrome (NRDS) is a condition in which the lungs are functionally and structurally immature, resulting in respiratory distress during delivery. Coalescent B-lines, diffuse and symmetrically distributed in both lungs, are the ultrasonography findings of NRDS. These lines are caused by fluid in the interstitial or alveolar compartment, and the number of them varies depending on the degree of the disease, from "white lung" in the most severe instances to "white lung" in the least severe. The pleural line is skewed and ill-defined.

The inability of fluid reabsorption from the foetal lung causes transient tachypnea of the newborn (TTN), often known as "wet lung." In the case of a rapid delivery or caesarean section, it is common in term or post-term infants. In one or both lungs, infants with TTN have compact B-lines in the lower lung fields and fewer and less compact B-lines in the upper fields. These symptoms, also known as double-lung points, are defined by a prominent ultrasonic demarcation line between the upper and lower lung fields of both lungs. They develop because the lower lung fields are more involved in the disease. The pleural line is normal, with normal echogenicity and movement in response to respiratory acts.
The pleural line is normal, with normal echogenicity and movement in response to respiratory acts. In contrast to NRDS, there are no subpleural consolidations. Because of these typical ultrasonographic features, pulmonary ultrasonography has been demonstrated to be effective in the early diagnosis of TTN and the differentiation of TTN from NRDS as early as the first hours of life.

Children's infectious respiratory diseases

Bronchitis and Community-Acquired Pneumonia are the most common respiratory illnesses in children (CAP). The majority of these disorders are diagnosed clinically, and chest X-rays are only suggested in severe clinical situations or when the diagnosis is unclear. A consensus of specialists in 2020 well established the importance of point-of-care ultrasound in the management of bronchiolitis and pneumonia in the paediatric population, and several writers concentrated on the application of ultrasound in these children, with encouraging evidence Consolidations that appear as hypoechoic areas with evidence of an air bronchogram within and an ecostructural "liver pattern," with clear margins (indicating a lobar consolidation) or surrounded by confluent B-lines are the most common ultrasound findings in Community-Acquired Pneumonia (CAP) [7]. The filling of the alveoli with an inflammatory and purulent substance, which determines a solid and isoechogenic look of the lung, results in a liver-like ultrasonography appearance, which characterises hepatization of the lung. Due to the presence of air persisting inside the small bronchioles, a fine hyperechogenic arborescent pattern that defines the air bronchogram can be seen often within the consolidations. The air bronchogram typical of pneumonic consolidations is classified as dynamic since the air can be seen moving back and forth with the breaths, demonstrating their patency. This ultrasonography indication is distinct from the static air bronchogram, which shows no air movement and is associated with atelectasis. Large consolidations might be difficult to detect, especially in overweight persons. Mller-Srensen et al. recently published an ultrasonic finding that may be useful in detecting larger consolidations: when the underlying lung tissue is consolidated, the pleural line becomes thinner and less brilliant. LUS is a useful tool for monitoring lung consolidation in children without exposing them to a high dose of ionising radiation on a regular basis. Changes in the extent of the lung consolidation and bronchogram distribution can be observed as the infectious process resolves. Because the lung begins to re-expand, deciding increased air circulation into the consolidated lung, air bronchograms are visible more peripherally. Furthermore, by evaluating certain ultrasonography findings, several etiologies of CAP in children might be assumed. Multiple consolidations, smaller and typically bilateral, are signs of viral CAP rather than bacterial CAP. Obviously, these findings must be interpreted in light of clinical and laboratory findings. Ultrasound can also detect early problems (such as pleural effusion or pneumothorax), making it an ideal tool for disease monitoring and follow-up. Many studies have shown that LUS has a higher sensitivity and specificity than CXR in diagnosing and monitoring CAP, and the 2020 consensus established that LUS has at least the same diagnostic value as CXR in detecting pneumonia, suggesting ultrasound as the method of choice in children with suspected pneumonia who require diagnostic imaging.

The presence of coalescent B-lines (three or more B-lines in each intercostal space) up to the "white lung" or focal presence of multiple B-lines (one or two B-lines in each intercostal space) and abnormalities of the pleural line are the main ultrasound findings in bronchiolitis. Several studies have shown that lung ultrasound findings in babies with bronchiolitis are highly correlated with clinical evaluations, and the 2020 consensus recognised LUS as a valuable tool in determining the severity of the condition.

Lung abscess, pneumothorax, pleural effusion emphysema

LUS has been used for the diagnosis of pneumothorax since 1995. Since then, pulmonary ultrasonography has been increasingly popular as a supplement to the CXR in medical and trauma patients. In reality, CXR has a low sensitivity for pneumothorax because air tends to concentrate in the anterior-medial and apical portions of the chest, which are difficult to check with CXR but may be assessed adequately with ultrasonography. The absence of lung sliding due to the presence of air in the pleural cavity is a common LUS indication of a pneumothorax. The semeiotics of the healthy and sick lung is better defined as a result of accumulating evidence, and ultrasonography is increasingly employed in the diagnosis, therapy, and follow-up of lung illnesses in children and infants. In the hands of a paediatrician, especially in an emergency department setting, lung ultrasonography is quickly becoming a valuable tool. This method's strengths are its speed, repeatability, low cost, and ability to be performed at the bedside. The widespread adoption of this strategy could result in a number of advantages, including better utilisation of the health-care system's financial resources and more careful treatment of children to avoid radiation exposure during lung and thoracic disease diagnosis and follow-up.

REFERENCES

1. Thomas KE, Parnell-Parmley JE, Haidar S, et al. Assessment of radiation dose awareness among pediatricians. Pediatric Radiology. 2006;36(8):823-32.

2. Zechner PM, Seibel A, Aichinger G, et al. Lung ultrasound in acute and critical care medicine. Der Anaesthesist. 2012;61:608-17.

3. Volpicelli G, Elbarbary M, Blaivas M, et al. International evidence-based recommendations for point-of-care lung ultrasound.. Intensive Care Medicine. 2012;38(4):577-91.

4. Joshi P, Vasishta A, Gupta M. Ultrasound of the pediatric chest. Br J Radiol. **2019**:92.

5. Cattarossi L. Lung ultrasound: its role in neonatology and pediatrics. Early Human Development. 2013;89:17-Google

6. Copetti, R.; Cattarossi, L. Ultrasound diagnosis of pneumonia in children. Radiol Med. **2008**;113:190.

7. Denina M, Scolfaro C, Silvestro E, Pruccoli G, et al. Lung ultrasound in children with COVID19. Pediatrics **2020**:146