Correspondence

Transthoracic ultrasound in neonatal respiratory distress syndrome (NRDS): Complementary diagnostic tool

Dear Editor,

In the interesting article *"Diagnostic value of lung ultrasound in evaluating the severity of neonatal respiratory distress syndrome (NRDS)"* by Pang et al. [1], the authors concluded that *"the LUS score"* (a score based on B-lines' number and consolidation areas) *"can discriminate NRDS from non-NRDS and the different grades of NRDS"*. Regarding these conclusions we have some consideration to make.

First and foremost a basic understanding of the physical principles of ultrasound seems to us essential for an accurate and reliable interpretation of ultrasound images. *During a TUS examination, since* ultrasound propagation speed in the lung is only 440 m/s, 96% of the ultrasound beam (initial speed of 1500 m/s) is reflected at tissue-chest wall/air-lung interface, resulting in a hyperechoic "pleural line" and artifacts, that are essentially imaging errors. The authors defined B-lines as *"vertical echoic comet-tail artifact"*. More correctly, B-lines, parallel hyper-echogenic striae extended for the entire ultrasound image, result by different acoustic impedance between liquid film trapped in gas micro-bubbles and/or fibrous edema areas; "comet tails", running out in a few mm of depth in a triangular shape, derive from solid structures (e.g. calcium crystals/metallic devices) or pleural thickenings.

B-lines' number may increase when lung air/liquid film proportion changes: that's why newborns respiratory diseases ultrasound patterns show variably distributed B-lines and/or areas of subpleural consolidation [2]. In particular, NRDS and transient tachypnoea of newborn (TTN) are characterized by B-lines artifacts with a variable compact structure and undefined sub-pleural blurring, showing a false "white lung" appearance of the interface.

Since it is not possible accurately correlate B-lines to a specific underlying disease, the correlation between B-lines' number and severity of a nonspecific pathology is doubtful. Furthermore, what happens in the lower lung cannot be seen with ultrasound, because of the sub-total reflection of the ultrasound wave, and speaking of "white lung" is not realistic [3].

B-lines' number also depends on probe used, degree of total gain compensation and tissue harmonic and electronic beam focusing. Nevertheless B-lines are absent during intraoperative lung ultrasound scan, demonstrating their nature of physical artifacts [4].

Regarding the authors' statement that consolidations, as US findings, could help to discriminate NRDS from TTN, Riccabona et al. [5] showed that US cannot reliably differentiate between atelectasis caused by pneumonia and other causes and, within first years of life, according with CT results, subpleural atelectasis are also found in healthy lungs.

Nevertheless the authors indicated the presence of "air bronchograms" within consolidations as an US sign more frequent in severe NRDS. Hovever, the term "air bronchogram" in US is inappropriate: there is no evidence that hyperechoic spots inside consolidations correlate to the CT imaging of an air bronchogram [6]; they may be due to interpositions of air micron between consolidation and pleural surface, fibrosis or vascular interfacing (Fig. 1).
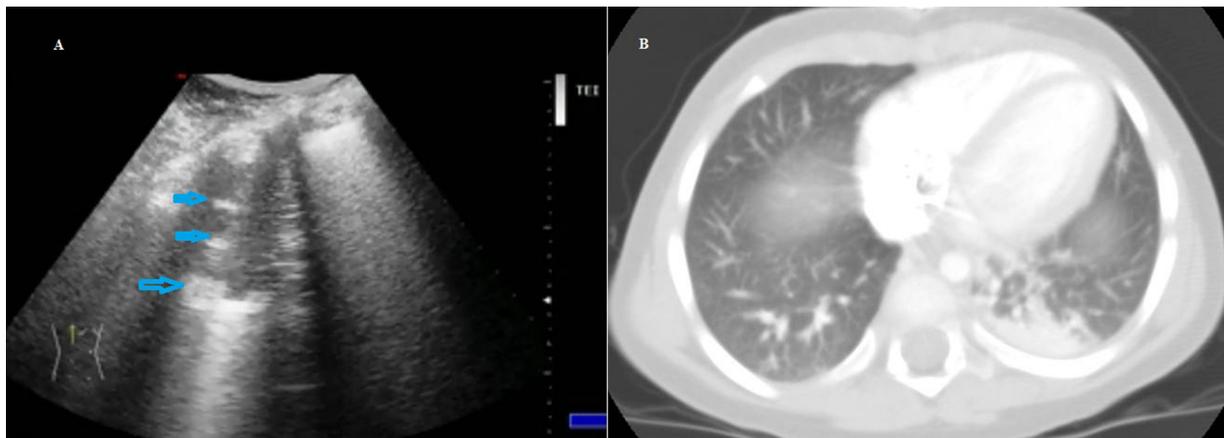

Fig. 1. US lower left lobe scan with a convex probe (3.5 − 5 MHz) in infant showing hyperechoic spots and/or bands (blue arrows), improperly called "air bronchograms", within a subpleural consolidation (A) and the corresponding CT scan showing no air bronchograms (B).

For these reasons, in our opinion, we can only rely on chest X-ray and CT for a correct diagnosis and evaluation of NRDS and other newborns' conditions and it's necessary not to over emphasize the substitutive role of a method useful but only complementary to the other radiological diagnostic investigations.

References

[1] H. Pang, B. Zhang, J. Shi, J. Zang, L. Qiu, Diagnostic value of lung ultrasound in evaluating the severity of neonatal respiratory distress syndrome, Eur. J. Radiol. 116 (2019) 186–191, https://doi.org/10.1016/j.ejrad.2019.05.004.

[2] P. Tomà, C.M. Owens, Chest ultrasound in children: critical appraisal, Pediatr. Radiol. 43 (11) (2013) 1427–1434, https://doi.org/10.1007/s00247-013-2756-4.

[3] G. Rea, M. Sperandeo, M. Di Serafino, G. Vallone, P. Tomà, Neonatal and pediatric thoracic ultrasonography, J. Ultrasound 22 (2) (2019) 121–130, https://doi.org/10.1007/s40477-019-00357-6.

[4] M. Sperandeo, E. Frongillo, L.M.C. Dimitri, et al., Video-assisted thoracic surgery ultrasound (VATS-US) in the evaluation of subpleural disease: preliminary report of a systematic study, J. Ultrasound (March) (2019), https://doi.org/10.1007/s40477-019-00374-5.

[5] M. Riccabona, Ultrasound of the chest in children (mediastinum excluded), Eur. Radiol. 18 (2) (2008) 390–399, https://doi.org/10.1007/s00330-007-0754-3.

[6] M. Sperandeo, M.G. Tinti, G. Rea, Chest ultrasound versus chest X-rays for detecting pneumonia in children: why compare them each other if together can improve the diagnosis? Eur. J. Radiol. 93 (2017) 291–292, https://doi.org/10.1016/j.ejrad.2017.05.038.

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