Transthoracic Ultrasound for Diagnosing Pneumothorax

To the Editor:
I read with interest the case report on intraoperative pneumothorax and transthoracic ultrasound by Ueda et al.1

Thoracic computed tomography should be regarded as the gold standard rather than chest radiography as suggested by the authors.2–4 The statement “because air does not reflect ultrasound” is puzzling. Ultrasound is reflected at the interface between two media with differing acoustic impedances, governed by the equation

\[ R = 100\left(\frac{Z_2 - Z_1}{Z_2 + Z_1}\right)^2 \]

where \( R \) is the percentage of ultrasound reflected and \( Z_1 \) and \( Z_2 \) are the acoustic impedances of the respective media.

Because the acoustic impedance of air is so low in comparison with soft tissue, ultrasound is more or less completely reflected at the air-tissue interface and cannot penetrate beyond the surface of the lung. This raises two important points: first, that by removing the air in the lung, e.g., atelectasis, or replacing it with fluid, e.g., consolidation, a tissular image of the lung can be created; and second, only those lesions that reach the surface of the lung can be imaged. This leads to the labeling of figure 2 in the case report where the ultrasound image labeled lung parenchyma is in fact artifact and not a tissular image of the lung parenchyma. The object labeled rib is most likely costal cartilage where the pleural line is easily seen below it. With high-resolution probes it is sometimes possible to delineate both the visceral and parietal pleura with a small space between the pleural gap.5 This appears to be the case in figure 2, in which the deeper and thicker hyperechoic line labeled parietal and visceral pleura most likely represents the visceral pleura-lung interface, above which is a hyperechoic layer, the pleural gap followed by a thinner, slightly less hyperechoic line, the parietal pleura. When air is in the pleural space, the visceral pleura will not be visible through it and the hyperechoic line represents the parietal pleura-air interface.

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References

(Accepted for publication December 30, 2011.)