

Visual identification of pulmonary ventilation and perfusion: a new application of lung ultrasound

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A 32-year-old lady with a history of haemochromatosis with iron infiltration of the myocardium and aplastic anaemia was admitted with H1N1-related severe adult respiratory distress syndrome with dense bilateral consolidations in all lobes at chest X-ray and CT scan (figure 1A, B). The severe hypoxaemia requiring mechanical ventilation and refractory to inhaled nitric oxide and pronation led ultimately to venovenous extracorporeal membrane oxygenation placement. Transthoracic echocardiography (TTE) demonstrated a mildly biventricular systolic impairment alike the last TTE done during the follow-up for the haemochromatosis, without any intracardiac shunt as demonstrated by agitated-saline bubble study. Lung ultrasound (LUS) showed bilateral complete consolidation of the lung (tissue-like pattern) in the mid-lower lobes, which was present from admission. On the day 3, the decline in minute volume, worsening gas exchange and decrease of V_{CO_2} from the native lung corresponded to the presence of arterial systolic and venous diastolic flow on colour Doppler within the consolidation as sign of worsening V/Q mismatch (figure 1C, D; see online supplementary Videos 1 and 2).

The detection of intrapulmonary shunting has been always derived from static imaging techniques, clinical assessment and interpretation of arterial blood gases. LUS is widely used as an integrative tool in the diagnosis of the underlying cause of acute respiratory failure and extent of the pathology. Protocols and guidelines have standardised and validated the nomenclature of the various patterns of alveolar–interstitial syndrome and loss of aeration.^{1 2} The ‘tissue-like pattern’ corresponds to consolidation with complete loss of aeration, which may be associated with a degree of V/Q mismatch, therefore intrapulmonary shunt, and corresponding hypoxaemia.

Although the relation between V/Q mismatch and intrapulmonary shunt with colour Doppler (using standard LUS protocols¹) has not been appropriately demonstrated yet, the demonstration of pulsatile flow in non-aerated lung is associated with severe consolidation and likely to be an indirect demonstration of extreme V/Q mismatch/intrapulmonary shunt, in a manner that can be monitored real-time in response to therapeutic manoeuvres including bronchoscopy, positioning and recruitment manoeuvres.³

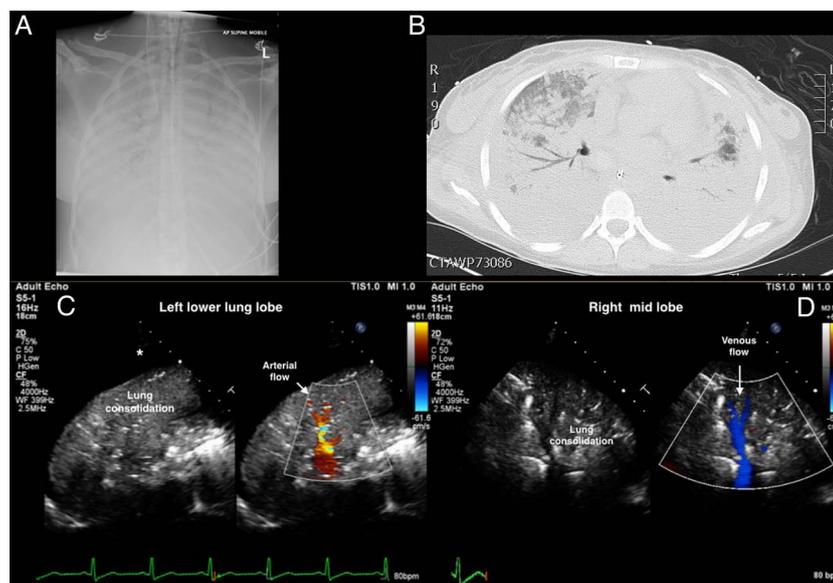


Figure 1 (A) Chest X-ray showing bilateral consolidation and air bronchogram, confirmed at CT scan (B). (C) Lung ultrasound transversal scan of the left lower lobe using the cardiac probe. Left side of the panel complete consolidation of inferior lobe (tissue-like pattern) surrounded by a small amount of pleural effusion (*). On the right side, colour flow Doppler technique is applied showing the arterial flow into the lung parenchyma (arrow—red flow). (D) The same technique applied to the right middle lobe and the venous flow is shown (arrow—blue flow).



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