Stress B-lines with lung ultrasound: the optimal scan technique of comet-watching

MC. Scali, A. Zagatina, N. Zhuravskaya, I. Simova, M. Paterni, M. De Nes, R. Citro, P. Colonna, B. Villari, A. Arystan, C. Carpeggiani, Q. Ciampi, E. Picano

(1) Nottola Hospital, Pisa (2) Medika cardiocenter, Cardiology, St Peterburg, Russian Federation (3) City Clinic, Sofia, Bulgaria (4) Institute of Clinical Physiology of CNR, Pisa, Italy (4) AOU S. Giovanni e Ruggi, Salerno, Italy (5) Bari University Hospital, Bari, Italy (6) Ospedale Fatebenefratelli, Benevento, Italy

**Background.** Different lung ultrasound (LUS) scanning modalities have been proposed for the detection of B-lines, also called ultrasound lung comets, which are a prognostically important sign of extravascular lung water at rest and after exercise stress echo (ESE).

**Purpose:** To assess the lung water spatial distribution ("comet map") at rest and after ESE.

**Methods:** We performed LUS at rest and immediately after semi-supine ESE in 135 patients (86 males; age 63 ± 11 years, resting left ventricular ejection fraction = 43 ± 11 %) with known or suspected heart failure (n=115) and/or coronary artery disease (n=20). Data were collected by centres of 3 countries (Italy, Russia, Bulgaria) by readers quality controlled for regional wall motion and B-line reading. B-lines were measured by scanning 28 intercostal spaces (IS) on the anterolateral chest, from second to fifth IS, along with the midaxillary (MA), anterior axillary (AA), mid-clavicular (MC), and parasternal (PS) lines. A complete 28-region, 16-region (3rd and 4th IS), 8-region (3rd IS), 4-region (3rd IS, only AA and MA) and 1-region (left 3rd IS, MA) scan were analyzed. In each space, the B-lines were counted from 0= black lung to 10= white lung.

**Results:** Interpretable images were obtained in all spaces (feasibility = 100 %). B-lines (>0 in at least 1 space) were present at ESE in 100 patients (74%) and absent in 35. At per space horizontal analysis, B-lines were more frequent in the 3rd and 4th IS: see figure. "Wet spots" were vertically aligned with AA and MA spaces. The B-lines cumulative distribution was asymmetric with a dominance of right lung at rest (right/left =1.10) and left lung during stress (right/left =0.67). At per-patient analysis, the sensitivity (>0 B-lines in any space) was 100 % with 28- and decreased to 98 % with 16-, 96 % with 8, 94 % with 4- and fell to 77 with the 1-region scan. The average imaging and on-line analysis time were 5 s per space.

**Conclusion.** During ESE, the comet map of lung water accumulation follows a predictable spatial pattern with "wet spots" preferentially aligned horizontally in 3rd and 4th IS, and vertically with AA and MA. The exhaustive but time-consuming 28-region scan can be reduced to almost lossless, time-saving 4-region scan, especially convenient during stress, simply dismissing dry regions and focusing on wet regions only.