The Functional Meaning of the "Wet Lung" with B-line Increase During Stress Echocardiography

Angela Zagatina, Maria Chiara Scali, Quirino Ciampi, Lauro Cortigiani, Pablo Martin Merlo, Ana Djordjevic-Dikic, Clarissa Borguezan Daros, Albert Varga, Karina Wierzbowska-Drabik, Jaroslaw D. Kasprzak, Alla Boshchenko, Milica Dekleva, Iana Simova, Clara Carpeggiani, Eugenio Picano on behalf of Stress Echo 2020 study group of the Italian Society of Echocardiography and Cardiovascular Imaging (SIECVI).

Background. B-lines at rest detected by lung ultrasound (LUS) mirror extra-vascular lung water accumulation, and are associated to a worse outcome. During stress echo (SE), B-lines increase ("wet lung") indicates an acute backward heart failure.

Aim: To assess the functional correlates of B-lines during SE.

Methods: We performed standard transthoracic echocardiography (TTE) and LUS evaluation at rest and at peak stress in 1533 patients referred for exercise (n=1012) or pharmacological SE (n=521: dipyridamole, n=418; dobutamine, n=95; adenosine, n=8) for known/suspected coronary artery disease or heart failure in 22 certified labs of 8 countries (Argentina, Brasil, Bulgaria, Hungary, Italy, Poland, Russian Federation, Serbia). By TTE, wall motion Score Index (WMSI) was calculated with a 17-segment model of left ventricle (LV) and positivity criterion was the induction of regional wall motion abnormalities (RWMA), with stress WMSI>rest. By LUS, B-lines were scored with the 4-site simplified scan, each site scored from 0= normal A-lines, to 10=coalescing B-lines in a white lung. The criterion for B-line positivity was a stress score > rest.

Results: LUS was feasible in all subjects, with additional scanning and analysis time <20 s for each stage (rest and peak stress). SE positivity by TTE was 752/1533 with RWMA (49 %), 562/1533 with B-lines (37%), 223/1533 with both criteria (14%), whereas 442/1533 patients had neither RWMA nor B-lines (29%). In patients with RWMA, there was a significant correlation between peak WMSI and peak B-lines score (r=.24, p<0.01). When compared to a "dry lung" without B-lines, a wet lung was more frequently associated with RWMA (40 vs 20%, p<.01), E/e' > 15 (36 vs 7%, p<.01), severe mitral regurgitation (34 vs 4 %, p<.01), peak systolic blood pressure > 220 mmHg (25 vs 7%, p<.01); see figure. Stress B-lines were detected in 41 % of exercise and 32 % of pharmacological SE (34% with dobutamine and 26 % with vasodilators).

Conclusion: B-lines are easy to obtain with LUS combined with conventional TTE during physical or pharmacological stress. A "wet lung" with de novo or worsening B-lines is found in about 1 out of 3 patients during SE, more frequently in presence of inducible RWMA or non-ischemic abnormalities such as diastolic dysfunction, severe mitral regurgitation or afterload mismatch for disproportionate systolic blood pressure rise. When there is a wet lung by LUS during stress, something is wrong by TTE-SE - even when ischemia and RWMA are missing.