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The importance of echocardiographic pulmonary flow notch ratio in the assessment of patients with acute pulmonary embolism

Kurnicka K.¹; Furdyna A.¹; Goliszek S.¹; Lichodziejewska B.¹; Ciurzynski M.¹; Dzikowska-Diduch O.¹; Kostrubiec M.¹; Palczewski P.²; Pruszczyk P.¹

¹Dept of Internal Medicine and Cardiology, Medical University of Warsaw, Warsaw, Poland

²Medical University of Warsaw, First Department of Radiology, Warsaw, Poland

Background: There are several echocardiographic features such as right ventricle dilatation, interventricular septum flattening, McConnell sign and 60/60 sign reflecting the extent and severity of acute pulmonary embolism (APE). In quite a large number of APE patients we can observe a pulmonary flow (PF) profile abnormality in the form of a mid-systolic notch (MSN).

Purpose: To assess the profile of pulmonary Doppler flow in consecutive patients with acute pulmonary embolism and to establish its clinical utility.

Methods: We reviewed pulmonary Doppler flow profiles from 127 consecutive patients (m. age 64 years, 72 F) with symptomatic APE managed in our department. APE was confirmed by contrast-enhanced multi detector computed tomography when thromboemboli were visualized at least in segmental pulmonary arteries. Individuals with preexisting pulmonary arterial hypertension were excluded. The pulmonary flow notch ratio (PNR) defined as the time from onset of PF until mid-systolic notch divided by the time from notch to the end of pulmonary ejection was evaluated. The comparison of patients with PNR < 1 (Group 1) and PNR > 1 (Group 2) was performed.

Results: We found the MSN in 50 patients (39.4%). Seventy seven patients had a normal shape of Doppler PF envelope. The presence of MSN was associated with more pronounced echocardiographic signs of right ventricle overload (RVOT diameter 32.4 ± 5.2 vs 29.1 ± 3.3 mm, $p < 0.001$; TRPG 42.3 ± 14.4 vs 24.8 ± 9.5 mmHg, $p < 0.0001$; RVSP 49.4 ± 14.9 vs 31.2 ± 10.6 mmHg, $p < 0.0001$; TAPSE 20.3 ± 4.1 vs 23.4 ± 4.0 mm, $p < 0.001$; PF Acceleration Time 64.5 ± 13.7 vs 109.8 ± 24.6 ms, $p < 0.001$, and a presence of septal flattening). Obviously, patients with MSN presented more proximal location of thrombi in comparison to those with symmetrical shape of PF envelope (in MPA 18% vs 5.2%, $p = 0.038$ and in both LPA + RPA 22% vs 9%, $p = 0.08$, respectively). The PNR < 1 was found in 35 (70%) of 50 patients with MSN (Group 1). In these patients thrombi were located more proximally than in patients with PNR > 1 (Group 2), and angio-CT confirm anatomically massive PE. A percentage of patients with thrombi in both, left and right pulmonary arteries, in both lobar pulmonary arteries and lobar + segmental arteries was higher in Group 1 (PNR < 1) than in Group 2 (PNR > 1): LPA + RPA: 28.6 vs 6.7%, lobar L and R: 57 vs 26.6%, lobar + segmental: 31 vs 20%. A number of patients with thrombi in the MPA was similar in both groups.

Conclusion: A noninvasive pulmonary flow notch ratio (PNR) may be useful for indicating APE patients with more extensive disease and proximal location of thrombi, at least in lobar pulmonary arteries.