PREDICTORS OF CHRONIC THROMBOEMBOLIC PULMONARY HYPERTENSION IN COMPUTED TOMOGRAPHY ANGIOGRAPHY IN A SINGLE-CENTER STUD [SUMMARY]

Chronic thromboembolic pulmonary hypertension (CTEPH) is a potentially life-threatening clinical condition classified under Group 4 of pulmonary hypertension according to the guidelines of the European Society of Cardiology (ESC) and the European Respiratory Society (ERS) [1,2].

CTEPH is a rare complication of acute pulmonary embolism (APE), and its pathogenesis remains not fully understood. It involves complex structural and functional changes within the pulmonary vasculature, leading to increased pulmonary vascular resistance (PVR) and progressive right ventricular failure. If left untreated, CTEPH is associated with poor prognosis; however, the development of modern therapeutic strategies has significantly improved patient survival. Early diagnosis is crucial, as patients diagnosed at an early disease stage benefit most from available treatments [1,2]. Imaging plays a key role in the work of the multidisciplinary team managing CTEPH—it enables early detection, precise assessment of the location and extent of vascular changes, appropriate treatment planning, and monitoring of therapeutic outcomes.

This doctoral dissertation is based on two publications: one review article and one original research article.

The first, a review article, discusses the current role of multimodal imaging techniques in the diagnosis of CTEPH. It presents the latest findings on lung perfusion assessment methods, including ventilation/perfusion scintigraphy (V/Q scan), single photon emission computed tomography (SPECT), dual-energy computed tomography (DECT), and perfusion magnetic resonance imaging (MRI). It also discusses techniques for anatomical evaluation, such as computed tomography pulmonary angiography (CTPA), magnetic resonance pulmonary angiography (MRPA), right heart catheterization (RHC), digital subtraction pulmonary angiography (DSPA), and standard chest X-ray. Furthermore, it outlines cardiological assessment in the course of CTEPH and highlights the role of artificial intelligence in imaging of this condition.

The second, original article, aimed to evaluate the frequency of characteristic radiological features in patients with confirmed CTEPH and compare them with their prevalence in clinically established cases of chronic thromboembolic disease (CTED), pulmonary arterial hypertension (PAH), and acute pulmonary embolism (APE). The study also assessed the predictive value of these features.

This retrospective cross-sectional study analyzed CTPA results from 115 patients divided into

four clinical groups: CTEPH (n = 35), CTED (n = 20), PAH (n = 24), and APE (n = 36). The groups were matched by age and sex, and final diagnoses were established according to current clinical guidelines. Examinations were performed using a 64-slice multidetector computed tomography (64-MDCT) scanner with ECG gating, 0.625 mm slice thickness, and a 0.5-second rotation time. The anonymized images were reviewed randomly for the presence of CTEPH-related features, which were categorized into three groups: features of chronic pulmonary embolism, features of pulmonary hypertension, and signs of right heart overload. The predictive value of the radiological findings was assessed using area under the curve (AUC) values derived ROC analysis, with sensitivity, specificity, diagnostic accuracy, positive predictive value (PPV), and negative predictive value (NPV) also calculated.

The highest predictive value was demonstrated by features associated with chronic pulmonary embolism, such as vessel narrowing, intimal irregularities, and the presence of bands and webs, particularly at the segmental level (AUC = 0.906; 95% CI: 0.863–0.950). When assessed across the pulmonary vasculature as a whole, these changes yielded an AUC of 0.894 (95% CI: 0.850–0.938).

Moderate predictive value was observed for mosaic perfusion of the lung parenchyma (AUC = 0.740), variability in the diameter of lobar and segmental vessels (AUC = 0.788), and bands and webs at the lobar level (AUC = 0.785).

Features of right ventricular overload, such as an RV/LV diameter ratio ≥ 1 (AUC = 0.641), interventricular septal flattening or bowing (AUC = 0.621), contrast reflux into the inferior vena cava (AUC = 0.504), and right ventricular wall hypertrophy (AUC = 0.546), showed lower predictive value in ROC-based diagnostic assessment.

Similarly, parameters indicative of pulmonary hypertension — including a pulmonary trunk-to-aorta diameter ratio (PT/Ao) ≥ 1 (AUC = 0.671), bronchial artery enlargement (AUC = 0.661), enlarged or calcified mediastinal lymph nodes (AUC = 0.555), and pericardial effusion or thickening (AUC = 0.550) — also demonstrated limited predictive value.

This doctoral dissertation enabled a comprehensive summary of the current state of knowledge on the role of imaging in CTEPH diagnostics and provided an original analysis of clinical data, assessing the prevalence and diagnostic significance of selected CTPA radiological features. The findings may contribute to improving the precision and timeliness of CTEPH diagnosis in everyday clinical practice.