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Quantification of CTEPH Disease Burden on CT Angiogram Correlates with Patient Presurgical Hemodynamic Severity and Hemodynamic Improvement after PTE surgery

Authors: Elizabeth Bird, Albert Hsiao, Kim Kerr, Nick Kim, Micheal Madani, Seth Kligerman, Francisco Contijoch

Purpose: To evaluate the relationship between the burden of chronic thromboembolic disease quantified via CT pulmonary angiography and pre-operative hemodynamics and post-operative hemodynamic improvement in CTEPH patients undergoing PTE.

Methods: CTEPH patients who underwent pulmonary thromboendarterectomy surgery (PTE) between December 2017 and August 2019 were retrospectively screened for having 1) preoperative CT pulmonary angiogram (CTPAs) with corresponding preoperative vascular annotations, 2) preoperative right heart catheterization, 3) bilateral level 2 surgical disease (defined from surgically resected thromboembolic specimen) and 4) recorded postoperative hemodynamics. Clot burden was quantified in preoperative CTPAs using the Qanadli score, which weights the location and severity of thromboembolic lesions into a per-patient score. Mean pulmonary artery pressure, pulmonary vascular resistance, and total pulmonary resistance were obtained from right heart catheterization preoperatively and then on the day of Swan-Ganz removal in the ICU postoperatively. Linear regression was performed between measured clot burden and hemodynamic variables. Continuous variables are presented as mean \pm standard deviation.

Results: 15 patients (7 females, age: 36 ± 13 years, BMI: 35.0 ± 6.7 , preoperative mPAP: 40 ± 13 mmHg) met all inclusion criteria. Clot burden score ranged from 11 to 30, with a mean of 19 ± 6 . Level of surgical disease seen on imaging matched surgical findings in 87% and 67% of cases (right and left lungs, respectively). Figure 1 illustrates the significant linear correlations between clot burden and preoperative mPAP ($R^2 = 0.59$), PVR ($R^2 = 0.69$) and TPR ($R^2 = 0.58$), as well as post PTE improvement in PVR ($R^2 = 0.48$) and TPR ($R^2 = 0.35$).

Conclusion: Pre-operative CT-based quantitative assessment of the pulmonary vasculature is associated with the hemodynamic severity of CTEPH and surgical improvement in PVR after PTE.

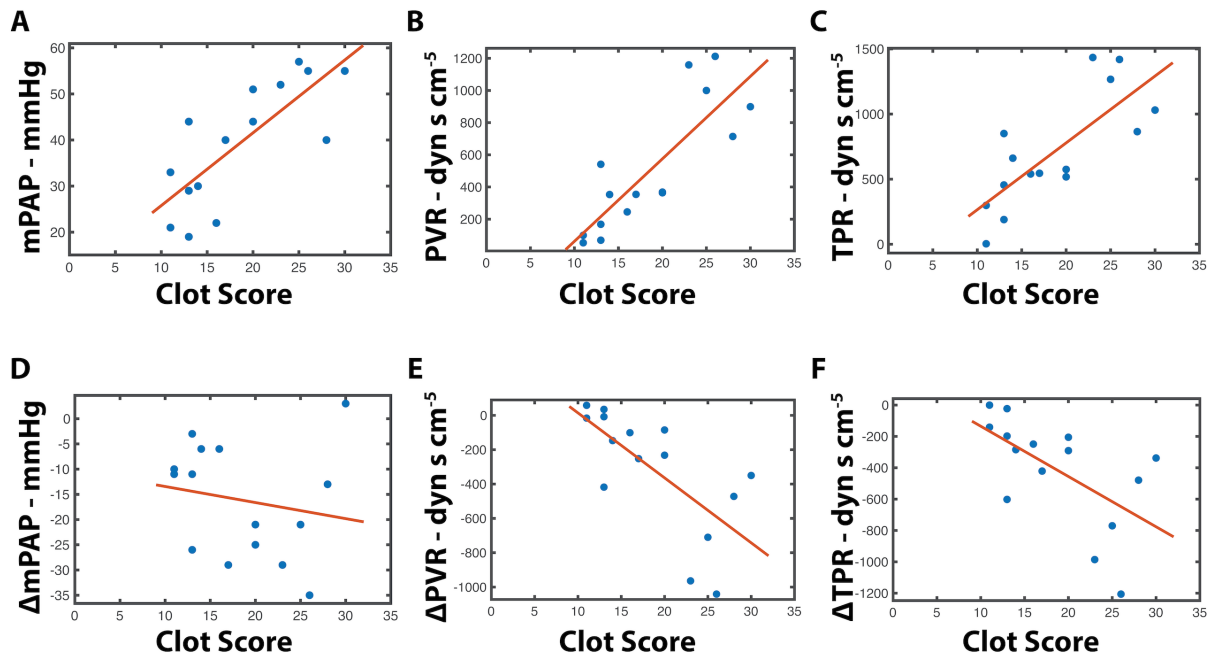


Figure 1. Preoperative CTA derived disease burden (“Clot Score”) correlates with **(A)** preoperative mPAP, **(B)** PVR, and **(C)** TPR. Correlation of the disease burden is **(D)** low for post operative change in mPAP but significant for post operative changes in **(D)** PVR and **(E)** TPR.