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Case Report Open Access

Reflux of Contrast into the Inferior Vena Cava: A Sign of Right Ventricular Failure Due To Multiple Conditions

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Introduction

Reflux of contrast into the inferior vena cava (IVC) and hepatic veins on computerized tomographic pulmonary angiogram (CTPA) is a finding that has been associated with right heart failure due to pulmonary embolism and other conditions [1-4]. Some evidence suggests that the finding is predictive of increased mortality in pulmonary embolism [2], but other studies have not found an association between contrast reflux and severity [3,4]. A recent retrospective study reported that "extensive reflux" defined as contrast opacification of at least the proximal hepatic veins, was present on 20.3% of CTPAs in patients with acute pulmonary embolism and 28.7% of CTPAs in patients with a clinical diagnosis of pulmonary hypertension [5]. We sought to further explore the association between extensive reflux of contrast on CTPA and pulmonary arterial hypertension.

Case Report

Patients and methods

The Institutional Review Board of the University of South Florida approved the study.

We prospectively identified 11 consecutive patients from a single institution who underwent CTPA for dyspnea and were found to have extensive reflux of contrast, defined as contrast opacification to the level of the proximal hepatic veins or farther.

CTPA acquisition

CTPA was performed with a 64-detector helical CT (Philips Brilliance 64-detector CT, Holland) using 64×0.625 mm collimation and a table feed of 44.3 mm/revolution, a pitch of 1.11, 120 kV, 300 mA, and 0.5 second rotation. On the basis of these data sets, transverse images were reconstructed with an interval of 0.75 mm. The mean duration of data acquisition was 2-4 seconds. All studies were performed with a test dose of 20 ml of ioversol (Optiray 350, Mallinckrodt, St. Louis, Mo) administrated at a rate of 4-5 ml/s with an automatic dual chamber power injector (Optivantage, Mallinckrodt, St. Louis, Mo.) from a peripheral access. Start delay time was determined after the test injection. Start delay was determined by adding 2 seconds to the time-to-peak value. Scanning delays were 7-9 seconds. All patients underwent cranio-caudal scanning in a supine position and at end-inspiratory suspension during a single breath hold. The z-axis coverage and the field of view were chosen to include the entire thorax, from the apex to just below the base of the lungs.

Data collection

We recorded the cause of pulmonary hypertension and survival status at 30 days. Results of right heart catheterization were recorded for patients without pulmonary embolism. Two independent reviewers (BT, ST) assessed the CTPAs for additional signs of pulmonary hypertension, including right ventricular diameter to left ventricular diameter ratio >1, pulmonary artery diameter greater than 30 mm and bowing of the interventricular septum [6-9].

Results

Characteristics of patients with extensive reflux of contrast on CTPA are shown in Table 1. Of the eleven patients with extensive reflux, five had acute pulmonary embolism and six had pulmonary hypertension ultimately attributed other conditions, including interstitial lung disease, congenital heart disease (ventricular septal defect), chronic thromboembolic disease, and scleroderma. All of the patients with extensive reflux of contrast who did not have pulmonary embolism underwent right heart catheterization during the hospitalization (results are shown in Table 1). All patients met criteria for the diagnosis of pulmonary arterial hypertension at the time of right heart catheterization.

Results for other parameters measured on CTPA that have been associated with pulmonary hypertension are also shown in Table 1. All of the patients with extensive reflux also had a right ventricular diameter greater than left ventricular diameter, and all but one demonstrated enlargement of the pulmonary artery.

Three of the 5 patients with pulmonary embolism died as a result of RVF within 30 days. All of the patients with extensive reflux due to other conditions were alive at 30 days.

Discussion

Extensive reflux of contrast media on CTPA has been regarded as a pathophysiologic-radiologic marker of pulmonary hypertension and right ventricular failure. It has been reported to occur commonly in both acute pulmonary embolism and pulmonary hypertension due to other conditions. Our report serves to further support the association between extensive contrast reflux and pulmonary hypertension due to multiple causes but suggests the prognostic significance associated with the sign varies.

All of the patients with extensive reflux who underwent right heart catheterization met criteria for pulmonary arterial hypertension, suggesting that the sign may be a specific marker. This echoes the findings of Groves et al that semi-quantitative grading of reflux on CT correlated with RHC measurements of pulmonary artery pressure [10].

Three of the five patients with extensive reflux due to acute

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Case	Age/Sex	Clinical Diagnosis	PA Pressure (mmHg) s/d/m	PCWP (mmHg) a/v/m	RV/LV Ratio >1	PA Diameter >30 mm	Septal Bowing	Death within 30 days
1	37/F	PE	--	--	Yes	Yes	No	Yes
2	58/F	PE	--	--	Yes	Yes	No	Yes
3	80/F	PE	--	--	Yes	No	Yes	No
4	74/M	PE	--	--	Yes	Yes	No	Yes
5	50/F	PE	--	--	Yes	Yes	No	No
6	38/M	Idiopathic PAH	67/18/32	7/7/2005	Yes	Yes	Yes	No
7	62/M	ILD	84/23/49	18/14/10	Yes	Yes	Yes	No
8	56/M	COPD	71/32/48	13/9/11	Yes	Yes	No	No
9	71/M	CPED	42/28/32	13/10/9	Yes	Yes	No	No
10	51/M	VSD	67/19/39	16/10/13	Yes	Yes	Yes	No
11	29/F	Scleroderma	92/49/66	13/2/8	Yes	Yes	Yes	No

PE: Pulmonary Embolism; ILD: Interstitial Lung Disease; COPD: Chronic Obstructive Pulmonary Disease; CPED: Chronic Pulmonary Embolic Disease; VSD: Ventricular Septal Defect, PA: Pulmonaryy Artery; PCWP: Pulmonary Capillary Wedge Pressure, S/D/M: Systolic/Diastolic/Mean Blood Pressure. a/v/Mean.

Table 1: Features of patients with reflux of contrast into the IVC on CTA.

pulmonary embolism died within 30 days, consistent with previous data showing that reflux on CTPA is associated with increased short-term mortality in patients with acute pulmonary embolism [11,12]. In contrast, no patients with reflux due to PAH from conditions other than acute pulmonary embolism died within 30 days. In these patients, pulmonary vascular resistance likely increases at a much slower rate and retrograde flow of contrast may not be as reliable in predicting short-term mortality. However, early recognition of extensive contrast reflux on CTPA may facilitate the identification and treatment of right ventricular failure.

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