Case Report

A rare case of left dominant pulmonary edema in acute mitral regurgitation

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ABSTRACT

Unilateral pulmonary edema (UPE) due to cardiac causes is an unusual clinical finding and typically emerges on the right side. UPE poses a diagnostic challenge due to difficulty distinguishing infiltrative pneumonia from cardiogenic edema on chest imaging. Consequently, corrective clinical management is significantly delayed in UPE compared to bilateral cardiogenic pulmonary edema. We present a very rare case of left-sided cardiogenic pulmonary edema due to acute severe MR wherein a prompt cardiac evaluation for UPE led to successful corrective surgery and favorable outcome.

Abbreviations list

Unilateral pulmonary edema (UPE)
Mitral regurgitation (MR)
Pulmonary Chest Tomography Angiography (CTA)
Aortic valve (AV)
Mitral valve (MV)
Pulmonary veins (PVs)
Infective endocarditis (IE)
MV replacement (MVR)

1. Introduction

Unilateral pulmonary edema (UPE) of cardiogenic etiology is an unusual clinical finding that represents roughly 2.1% of cardiogenic edema [1]. In one single-center retrospective study, all presentations of UPE were due to severe mitral regurgitation (MR) and involved mostly the right side [2]. To our knowledge, there exist only three reported cases of left sided cardiogenic pulmonary edema:

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two cases as a complication from mitral valve replacement and one case due to acute mitral regurgitation causing decompensated heart failure [3-5]. The direction of the regurgitant flow in relation to the anatomy of mitral valve likely contributes to the right-side predominance [6].

2. Case presentation

A 57-year-old man with no known medical history presented with sharp, substernal chest pain for 15 hours which radiated to the back and was improved by sitting upright. Associated symptoms included a cough productive of pink-tinged sputum. He denied having any fevers, chills, sick contacts, or leg swelling. On examination, he appeared in distress using accessory muscles to breathe. He had a respiratory rate of 44, a pulse of 90 beats/min, a blood pressure of 111/56 mmHg, and a temperature of 37.1 °C. His oxygen saturation was at 90% on room air. Auscultation of the heart and lungs revealed a harsh pansystolic murmur at the apex with radiation to the axilla and bilateral diffuse cracks more pronounced on the left side. Laboratory results demonstrated a white blood cell count of $11.1 \times 10^9/L$, a troponin of 0.312 ng/mL (normal $<0.04$ ng/mL) and a brain natriuretic peptide titer of $492 \text{ pg/mL}$ (normal $<100 \text{ pg/mL}$). The electrocardiogram showed normal sinus rhythm. The chest radiograph revealed bilateral airspace opacities predomi-
nantly extending from the left hilum to the left upper and lower lung fields (Fig. 1). Pulmonary CT Angiography demonstrated nodular ground glass opacities and consolidation in bilateral lung fields, more pronounced on the left, and interlobular septal thickening without any filling defects within the arteries. The patient was initially diagnosed with community acquired pneumonia and received ceftriaxone and azithromycin. He subsequently became hypotensive and increasingly tachypneic, requiring fluid resuscitation, norepinephrine and mechanical ventilation. The repeat troponin decreased to 0.28 ng/mL 3 h after the presentation.

Transthoracic echocardiography (TTE) revealed a hyperdynamic ejection fraction of 70–75%, moderate regurgitation of the aortic valve and moderate regurgitation of mitral valve with abnormal valvular morphology (Fig. 2, Videos). Transesophageal echocardiogram (TEE) displayed moderate to severe regurgitation in the aortic valve and clarified that mitral regurgitation was due to severe flail motion involving the anterior leaflet with wide-open regurgitation (Fig. 3, Video). The previously obtained pulmonary CT angiogram was reprocessed to further investigate the left atrium and mitral valve. Multiplanar reconstruction (MPR) was performed with software designated for Cardiac CT imaging (Vitrea Advanced Visualization, Canon Medical, Minnetonka, Minnesota, USA). Contrast bolus timing and slice thickness were suboptimal but nevertheless diagnostic for cardiac interrogation. The patient's clinical instability prohibited a return to the scanner for a dedicated cardiac CT. The reconstructed CT Chest demonstrated four pulmonary veins draining into the left atrium (Fig. 4). However, the right superior pulmonary vein and right inferior pulmonary vein were noted to be positioned anteriorly and superiorly, which aligned the mitral valve regurgitant jet preferentially towards the left superior and left inferior pulmonary veins and likely explained the left sided unilateral pulmonary edema.

Supplementary video related to this article can be found at https://doi.org/10.1016/j.rmcr.2022.101746
Fig. 3b. Transesophageal echocardiography view at 70°. White arrowhead, indicating mitral regurgitation vena contracta (narrowest portion of regurgitant flow). Purple arrowheads, indicating mitral regurgitant jet area. Green arrow, indicating the direction of flow and its orientation towards the left sided pulmonary veins. White star, indicating regurgitant flow into the left upper pulmonary vein. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

Fig. 4a. Multiplanar reconstructions of CT pulmonary angiography using Vitrea software (Vitrea Advanced Visualization, Canon Medical, Minnetonka, Minnesota, USA). While bolus timing and slice thickness are suboptimal for ideal cardiac CT interpretation, unusual angulation of the pulmonary veins with respect to the mitral annulus can nevertheless be appreciated. This alignment likely contributed to the patient’s left sided unilateral pulmonary edema. This modified axial 2 chamber view demonstrates the anterior position of the mitral valve relative to the left inferior pulmonary vein.

Cultures of sputum and blood demonstrated no growth. Regardless, considering the findings from the echocardiogram and the acuity and severity of his presentation, infective endocarditis was highly suspected. Antibiotics were broadened to include vancomycin and the patient underwent emergency aortic and mitral valve replacement followed by a rapid hemodynamic recovery. The intraoperative findings revealed the complete rupture of the anterior leaflet and thinning of the mitral valve as well as bicuspid aortic valve sclerosis. Sputum and blood cultures failed to yield microorganism growth throughout hospitalization, and pathology specimens were also negative for microorganisms. The infectious disease service was consulted and recommended empiric treatment of infective endocarditis. The left sided congestion improved dramatically over the course of a few days after mitral valve replacement and
Fig. 4b. This modified transverse 2 chamber view redemonstrates the mitral valve angulation with respect to the pulmonary veins.

Fig. 5. The Cardiac CT 12 months after the replacement of the mitral valve showed a well seated bioprosthetic valve in the mitral position.
aggressive diuresis. The patient was discharged in a stable condition to complete a six-week course of ceftriaxone. The Cardiac CT 12 months after the valve replacement showed well seated bioprosthetic valve in mitral position (Fig. 5).

3. Discussion

Unilateral pulmonary edema (UPE) poses a diagnostic challenge due to difficulty differentiating infiltrative pneumonia from cardiogenic edema on chest imaging. Empiric use of antibiotics and delay in correct management appears significantly higher in unilateral cardiogenic pulmonary edema than bilateral cardiogenic pulmonary edema[1]. Pneumonia is often suspected as a more probable diagnosis before exploration of cardiogenic causes, even in the presence of compelling contrary evidence, such as a harsh murmur, an elevated BNP and troponin, and absence of fever. The largest retrospective cohort study on UPE cases due to MR revealed a significantly higher mortality in UPE of 39% as compared to bilateral pulmonary edema of 8% likely due to the initial misdiagnosis [7]. Antibiotics were administered more frequently in MR cases with UPE than in those with bilateral pulmonary edema (BPE). In the same study, the average time to initiation of diuresis was 12.6 hours and was delayed up to 72 hours. All patients with UPE had severe MR as opposed to 6% in BPE (p < 0.0001). Patients with MR due to organic etiology require urgent surgery; in this study, those who were able to undergo surgery survived. However, only 1 out of 5 patients who did not receive surgery survived. Given a high chance of initial misdiagnosis and a corresponding high mortality rate, a cardiogenic etiology should always be considered in UPE. Especially in cases where clinical findings and the disease course are not completely consistent with pneumonia, detailed assessment of the heart including transthoracic echocardiography is pivotal.

Most of the previously published cases of UPE were associated with mitral regurgitation and demonstrated a predilection for the development of right-sided edema [7]. This may be explained by the position of the mitral valve, which faces superiorly, posteriorly and to the right side, and directs the regurgitant flow toward the right pulmonary veins [8]. Additionally, most cases presenting with right sided pulmonary edema demonstrated posterior leaflet pathology [2]. However, in our case, the patient had an anterior leaflet flail leading to UPE with left sided predominance. Another difference in this case was the cause of acute MR; infective endocarditis as the cause of UPE from acute MR appears rare[1,9]. Alternatively, it can also be postulated that a clinically silent anatomic variation of pulmonary veins led to the MR jet flow to be directed towards the left side. Anatomic variants of pulmonary vein anatomy exist in approximately 38% of the population [10]. CT postprocessing with multiplanar reconstruction of the left atrium demonstrated atypical angulation of the left superior and inferior pulmonary veins. The unique anatomical variation may explain the dramatic presentation involving mostly the left side. This case attests to the fact that undiagnosed anatomical differences in pulmonary venous architecture can result in predominantly left-sided pulmonary edema in acute MR. Furthermore, it demonstrates the added value of reprocessing pulmonary CT angiography studies for multiplanar reconstruction in well-selected, challenging clinical circumstances. CT pulmonary angiography studies are commonly obtained in the emergency room setting to exclude pulmonary embolism and can be subsequently reformatted with no additional cost when the patient fails to improve in response to initial management.

Our case was also unusual as the presenting hypoxic respiratory failure due to acute severe mitral regurgitation was worsened by the high afterload state caused by moderate aortic stenosis. The acute severe MR in the presence of aortic stenosis drove the cardiac output toward the lower pressure left atrium resulting a hyperdynamic ejection fraction.

The mortality rates associated with delay in treatment for both acute severe MR and infective endocarditis remain high. Prompt evaluation with echocardiography, both TTE and TEE, was essential in our case. Despite the unusual chest radiography, the echocardiography findings and the patient’s clinical deterioration even with appropriate treatment for pneumonia led to identification of the correct diagnosis followed by aggressive corrective surgery and a favorable outcome.

4. Conclusion

Unilateral pulmonary edema due to cardiac causes is rare and typically involves the right side. However, clinicians should not exclude cardiogenic etiologies of unilateral pulmonary edema solely based on which side it involves. Astute clinical judgment requires comprehensive review of history and physical exam for accurate and prompt management and diagnosis.

Declaration of competing interest

We have no conflicts of interest to disclose.

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