Pulmonary embolism and atrial fibrillation: A complicated relationship

Saroj Lohani, Niranjan Tachamo, Bidhya Timilsina, Salik Nazir

ABSTRACT

Introduction: Atrial fibrillation (AF) and pulmonary embolism (PE) share a complicated relationship. Pulmonary embolism has been associated with increased incidence and prevalence of AF. On the other hand, AF has also been associated with increased risk of PE in multiple cohort studies. What complicates the relationship further is that in some cases as in our case, patients presented with AF and were found to have PE.

Case Report: A 72-year-old female presented to the emergency department with respiratory distress and was found to have atrial fibrillation with rapid ventricular response. She worsened despite appropriate treatment for atrial fibrillation. She was found to have massive pulmonary embolism after she underwent echocardiogram and CT scan of chest. However, she deteriorated quickly and died within five hours of presentation to the emergency department.

Conclusion: Pulmonary embolism can precede, coexist or occur after atrial fibrillation. Clinicians should be alert about the complicated relationship of AF and PE.
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Keywords: Atrial fibrillation, Anticoagulation, Cardioversion pulmonary embolism

INTRODUCTION

We present a case of 72-year-old female presenting to hospital with atrial fibrillation (AF) with rapid ventricular response and was diagnosed with massive pulmonary embolism (PE) after she deteriorated despite cardioversion and rate controlling agents. The relation between atrial fibrillation and pulmonary embolism has been extensively studied. Pulmonary embolism has been associated with increased incidence and prevalence of AF [1]. The main mechanism for AF in these patients has been proposed as right ventricular dilation and strain. On the other hand, AF has been associated with increased risk of pulmonary embolism in multiple cohort studies [2–4]. What complicates the relationship further is that in some cases [5, 6] and in our case, patients presented with atrial fibrillation and were found to have pulmonary embolism. Thus clinicians should be alert about the complicated relationship of AF and PE.

CASE REPORT

A 72-year-old female was presented to the emergency department after she was found gasping for breath. She had come from Florida few days back and was
complaining of symptoms suggestive of upper respiratory tract infection for the past one day. Past medical history was significant for deep venous thrombosis, paroxysmal atrial fibrillation not on anticoagulation, non-ischemic cardiomyopathy and hypertension. She did not smoke or drink alcohol. She was non-compliant with her medication for the past one and half years.

On arrival at the scene, she was found to have undetectable blood pressure by Emergency Medical System. On the spot electrocardiogram (EKG) revealed atrial fibrillation with rapid ventricular response (Figure 1). She received three electrical cardioversions with shock of 100 J, 150 J and 200 J en route to the emergency department but was unsuccessful in restoring normal sinus rhythm. On initial evaluation in the emergency department, she was sedated and on bag and mask ventilation (BMV). Her initial vital signs included blood pressure of 107/48 mmHg, pulse 160 s, respiratory rate 15/minute, and oxygen saturation 99% on BMV. Physical examination revealed irregularly irregular heart rate in 170 s but clear bilateral breath sounds. No jugular venous distension was noted. She was intubated in the emergency department and started on diltiazem drip for her rapid atrial fibrillation, following which her blood pressure dropped to 54/43 mmHg and she was started on pressor support with norepinephrine and epinephrine. Arterial blood gas on 100% oxygen on AC/CMV mode of ventilation revealed pH 7.03 (normal: 7.35–7.45), pCO2 69.2 mmHg (normal: 35–48 mmHg), pO2 157.4 mmHg (normal: 83–108 mmHg), bicarbonate 18.6 mEq/L (normal 21–28 mEq/L).

Patient’s labs included troponin I 0.04 ng/mL (normal <0.03 ng/mL), white blood cell count 7700/mm³ (normal: 4800–10800/mm³), hemoglobin 14 g/dL (normal: 12–16 g/dL), platelets 183000/mm³ (normal: 130000–400000/mm³), blood glucose 327 mg/dL (normal: 70–99 mg/dL), D-dimer 11809 ng/ml (normal: <500 ng/mL), Brain natriuretic peptide (BNP) 200 pg/mL (normal: 0–200 pg/mL) and INR 1.2 (normal: 0.9–1.1). Transthoracic echocardiogram revealed severely dilated right ventricle with severely decreased systolic function and moderate to severe tricuspid regurgitation. Computed tomography (CT) scan of chest showed large volume diffuse bilateral pulmonary emboli with a large saddle embolus (Figure 2). Computed tomography scan of chest also revealed reflux of contrast into the inferior vena cava and hepatic veins and bowing of the interventricular septum, suggestive of right heart strain. Shortly afterwards, she developed multiple episodes of cardiac arrest with pulseless electrical activity (PEA) and was successfully resuscitated each time. She was started on tissue plasminogen activator (tPA) infusion and transferred to intensive care unit. Cardiosurgery consultation deemed surgical embolectomy to be futile. Her family opted for no more resuscitation efforts and she passed away from subsequent PEA within five hours of presentation to the emergency department.

**DISCUSSION**

There are many ways in which we can define the relationship between atrial fibrillation (AF) and pulmonary embolism (PE). Pulmonary embolism has been associated with increased prevalence and subsequent incidence of AF. The prevalence of atrial fibrillation in PE patients is 18126 per 100,000 persons. The possible predictors of subsequent AF in PE patients include age, diabetes mellitus, obstructive sleep apnea, congestive heart failure, and admission sodium (hypernatremia) [1]. It has been proposed that the right ventricular dilation and strain associated with pulmonary embolism is the main mechanism for atrial fibrillation in these patients [7]. History of atrial fibrillation or presence of atrial fibrillation at admission in patients with pulmonary embolism also has prognostic implications. In a study done by Barra et al. [8], history of atrial fibrillation or atrial fibrillation at admission in patients with PE was associated with higher one month and six months mortality risk.

On the other hand, atrial fibrillation has been associated with increased risk of pulmonary embolism in multiple cohort studies [2–4]. In a study by Enga et al. [2], atrial fibrillation was associated with increased risk of pulmonary embolism during the first six months of diagnosis of atrial fibrillation and after six months.
CHADS\textsubscript{2}VASc score is associated with increased incidence of pulmonary embolism [9]. Multiple mechanisms have been proposed for increased risk of pulmonary embolism in patients with atrial fibrillation. One of them is clot formation in right atrium. Spontaneous echo contrast has been noted in right atrium in patients with atrial fibrillation [10, 11]. The echo contrast is believed to proceed to frank clotting. Another mechanism is that atrial fibrillation is associated with hypercoagulability that might lead to clot formation in right atrium and subsequently lead to pulmonary embolism [12, 13].

It is not entirely clear whether atrial fibrillation precedes pulmonary embolism or vice versa. It is not clear if clarifying this relationship carries any clinical significance. Any patients with atrial fibrillation with CHADS\textsubscript{2}VASc score of 2 should be anticoagulated to prevent stroke and other ischemic events. The increased risk of pulmonary embolism in atrial fibrillation and relation of pulmonary embolism with CHADS\textsubscript{2}VASc score carries no implication for prescribing anticoagulation in atrial fibrillation. Chwan et al. suggested that patients presenting with pulmonary embolism should be screened for atrial fibrillation post pulmonary embolism as the cardiovascular cause specific deaths were higher in patients who developed atrial fibrillation during or after hospitalization [1]. The screening criteria however were not clearly defined. Kenneth M Flegel suggested that if further studies prove that atrial fibrillation is associated with a particular pulmonary embolus then it might be worthwhile intervening the atrial fibrillation [7].

Many of the clinical features like palpitations, shortness of breath, syncope, hypoxia, chest pain can be present in both atrial fibrillation and pulmonary embolism and focusing the treatment only on atrial fibrillation can mask the hidden pulmonary embolus as in our patient and lead to delay in diagnosis. Pulmonary embolism has been diagnosed during workup of patients presenting with new onset atrial fibrillation [14] or in patients with prior history of atrial fibrillation [15] as in our patient. The presence of AF in patients with acute PE independently predicts mortality [8]. Hence, it is important for clinicians to be aware of the association between atrial fibrillation and pulmonary embolism as it has clinical and prognostic implications.

**CONCLUSION**

Atrial fibrillation and pulmonary embolism have a complicated relationship. The risk of pulmonary embolism should be considered in patients presenting with new onset atrial fibrillation or with history of atrial fibrillation. Pulmonary embolism should also be kept in mind if patient presenting with atrial fibrillation with rapid ventricular response worsens despite appropriate treatment. Clinicians should be aware of increased incidence and prevalence of atrial fibrillation in patients with pulmonary embolism.

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**Author Contributions**

Saroj Lohani – Substantial contributions to conception and design, Acquisition of data, Analysis and interpretation of data, Drafting the article, Revising it critically for important intellectual content, Final approval of the version to be published

Niranjan Tachamo – Analysis and interpretation of data, Revising it critically for important intellectual content, Final approval of the version to be published

Bidhya Timilsina – Analysis and interpretation of data, Revising it critically for important intellectual content, Final approval of the version to be published

Salik Nazir – Analysis and interpretation of data, Revising it critically for important intellectual content, Final approval of the version to be published

**Guarantor**

The corresponding author is the guarantor of submission.

**Conflict of Interest**

Authors declare no conflict of interest.

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