Pulmonary embolism in an ESRD patient following minimal venotomy and milking for salvage of dysfunctional autogenous arteriovenous fistula

Ankit Rimal[1], Bipin Karki[1], Ashmita Paudel[1], Utsav Pradhan[1], and Kabi Bhusal[1]

[1]Tribhuvan University Institute of Medicine

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Abstract

Pulmonary embolism can be a complication following an attempted salvage of a dysfuctional arteriovenous fistula (AVF). We report a case of bilateral pulmonary embolism in a patient with underlying pericardial effusion who, following minimal venotomy and milking of the AVF, developed sudden and significant respiratory distress, and later improved.

Title

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Keywords

End-stage renal disease, hemodialysis, pulmonary embolism, arteriovenous fistula

Introduction

Patients with chronic kidney diseases were long considered to have protection against venous thromboembolism (VTE). Although there are risk factors associated with the renal disease process itself and to dialysis, this protection was traditionally attributed to "uremic coagulopathy". Recent data however indicates this to be untrue. In end-stage renal disease (ESRD) patients, pulmonary emboli usually arise from thrombus in the large femoral and iliac veins, especially following femoral vein catheterization. With the dramatic increase in the number of patients living with ESRD attributable to better modalities of renal replacement therapy and general care, the number of autogenous arteriovenous fistulas (AVF) is increasing. As a result, they have become not-so-uncommon sources of thrombus and emboli, often harboring a large volume of thrombi. Modalities to salvage thrombosed AVF with percutaneous interventions are used more commonly. The following case demonstrates the risk of pulmonary embolism following attempted salvage of a dysfunctional AVF in a patient with ESRD and co-existing comorbidities.

Case History / Examination

A 41-year-old female presented to the emergency with a history of dizziness for 6 hours, shortness of breath for 1 day and chest pain and shortness of breath characterized by orthopnea and paroxysmal nocturnal dyspnea for the past 2 weeks. She had been under regular maintenance hemodialysis for end-stage renal disease (ESRD), secondary to systemic hypertension of 17 years, for the past 6 months. An autogenous brachiocephalic arteriovenous fistula (AVF) was created on her left arm 10 months back citing future requirement for hemodialysis. Although renal transplantation had been contemplated, a proper match had not been found. The patient had had her regular scheduled hemodialysis 2 days before her visit to the emergency. There was no history of trauma to the AVF.

At presentation, vital signs included a bradycardia of 46/m, blood pressure of 60/40 mm of Hg, SpO2 of 86% in room air, respiratory rate of 16/m and she was afebrile. She was drowsy, but oriented to time, place and person. No focal neurological deficits were evident and there were no flaps. Heart sounds were muffled and jugular venous distension was obvious. No bruit was appreciated in her native AVF.

Differential Diagnosis, Investigations and Treatment

The differential diagnoses considered at presentation were cardiac tamponade, acute coronary syndrome and hyperkalemia.

Electrocardiography revealed a prolonged PR interval with tall T waves. The serum potassium was 6.6 mmol/L and serum creatinine was 10.2 mg/dL. Cardiac enzymes were not elevated and transthoracic echocardiography revealed moderate pericardial effusion, not in tamponade, with dilated inferior venacava, normal left ventricular systolic function, mild concentric left ventricular hypertrophy, grade II left ventricular systolic dysfunction with no clots or vegetations (Figure 1). D-dimer was elevated to 5 mcg/ml from a baseline of 0.9 mcg/ml.

She underwent emergency hemodialysis through a right internal jugular vein hemodialysis catheter for refractory hyperkalemia, associated with arrhythmia and hemodynamic instability. Her condition gradually improved over the next 48 hours with a return to sinus rhythm with blood pressure of 130/70 mm of Hg.

Two days later vascular surgeons attempted to salvage the AVF by manual manipulation. Under local anesthesia, milking was attempted to salvage the fistula through a venous incision. A thrombus 0.5 X 0.5 cm was removed. Although a thrill was appreciated after the procedure, she acutely developed shortness of breath with a continuous cough followed by gradual drop in SpO2. Oxygen requirements increased from nasal prongs to Venturi mask with FiO2 0.6. She became drowsy and was intubated in view of her worsening respiratory distress and shifted to the intensive care unit (ICU). She had sinus tachycardia of 130/m, BP was 90/60 mm of Hg with support of noradrenaline, SpO2 was 89% with FiO2 70%.

An acute coronary event and pulmonary embolism were the diagnoses contemplated. Electrocardiography showed sinus tachycardia. Echocardiography showed no regional wall abnormalities and there was no tamponade. Troponin I was elevated. A CT-pulmonary angiography was done. Findings included completely occluding thrombosis in ascending, descending branches of right and descending branch of left pulmonary artery with moderate pericardial effusion and dilated inferior venacava and hepatic veins (Figure 2 Plate A and Figure 2 Plate B).

Treatment was initiated with 60 mg of Enoxaparin Q24h, in view of her CKD. Over the next few hours, her vasopressor requirement gradually came down, repeat echocardiography did now show any cardiac dysfunction except for the effusion and it was concluded there was no need for thrombolytic therapy.

Outcome and Follow-up

Patient gradually improved with ventilatory and oxygen requirements gradually decreasing over the next few days. She received maintenance hemodialysis for two consecutive days and was extubated on the 4th day of the event. Warfarin was introduced the day following extubation and she was discharged from the ICU with overlap of Enoxaparin and Warfarin with the aim to achieve a PT/INR of 2-3 and discontinue Enoxaparin. She was discharged from the hospital on Warfarin and is expected to come for regular follow up.

Discussion

This case report illustrates the growing risk of thromboembolism from an AVF in ESRD patients. Risk factors for thromboembolism include a sedentary life-style, comorbidities such as atrial fibrillation, congestive heart disease, cancer, and predisposing factors such as the intrinsic renal disease itself, including nephrotic disorder and systemic lupus erythematosus.[1] A significant number of these patients are the elderly and this number most predictably will increase.[2]

Traditionally, dialysis patients were believed to be protected by "uremic coagulopathy", from developing VTE.[3] Both a bleeding tendency as well as thrombotic events, such as AVF thrombosis, DVT and peripheral arterial occlusive disease have been noted in ESRD. More recent studies indicate that patients with CKD have a higher risk of developing VTE than those with normal kidney function.[1] Factors established to be contributing to thrombotic events include hemodialyzer-induced platelet aggregation, increased release of Von Willebrand, thromboplastin, reduced protein C, increased plasminogen activator inhibitor-1, elevated oxidative stress, increased homocysteine, fibrinogen and activity of factors VII, VIII, and IX–XII.[4] In addition, use of erythropoietin to correct anemia and/or blood transfusion has been shown to increase the risk of DVT.[4] Frequent trauma from repeated AVF cannulation might be another cause for the development of thrombus in these patients.

Majority of dysfunctional fistulas including stenosis and thrombosis are treated by interventional approach. Currently the percutaneous modalities of treatment include mechanical thrombectomy, pharmaco-mechanical thrombolysis and infusion thrombolysis.[5,6] These are invaluable alternatives to surgical thrombectomy with the advantage of being less invasive and reducing the patient's venous reserve.[7] However, the thrombi in the aneurysm can age and organize and may become resistant to both thrombolysis and percutaneous thrombectomy devices. Dilated endoluminal space restricts maneuverability during intervention and decreases the effectiveness of percutaneous thrombectomy devices. In order to overcome these issues and to better the technical success rate of recanalization, minimal venotomy with antegrade and retrograde milking has been introduced as an alternative.[8]

The volume of thrombus in a thrombosed AVF has been estimated to be less than 3-9 ml.[9,10] The clinical implications, however, are influenced by other factors such as compromised cardiopulmonary reserve and release of various clinical mediators that initiate and perpetuate a systemic cascade of inflammation. In the general population, 6-month mortality rates in clinically stable patients with pulmonary embolism without major comorbidity are below 5%.[11] Moreover, there is considerable concern with respect to sustaining even a small pulmonary emboli in patients with diminished cardiac and pulmonary reserve, a common entity in the dialysis patient population.[4]

Literature review revealed one case in which massive pulmonary embolism occurred following fistula thrombectomy in a patient with prior thromboembolic disease.[12] Our patient had no previous history of VTE but her cardiac function appeared compensated in the background of moderate pericardial effusion. The pulmonary embolism in all likelihood tipped the balance in favor of decompensation.

Conclusion

An ever-growing population of patients with ESRD have AVF for maintenance HD. These fistulas may pose an unrecognized risk for the development of thrombosis and subsequently an increased risk of venous thromboembolism. Percutaneous vascular access procedures to relieve a dysfunctional AVF may be beneficial in the majority of cases. Minimal venotomy and milking may be an alternative but the clinician needs to be aware of the possibility of pulmonary embolism following native fistula thrombectomy.[13] Estimating the burden of the thrombus using a fistulogram may help determine which procedure is best. Regardless of the procedure, the physician must be abreast with the risks to the patients with extensive thrombi and diminished cardiopulmonary reserve.

Conflict of Interest

None declared.

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Ethical Approval

Not applicable.

Consent

The patient's husband provided consent for publication.

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