Pulmonary Hypertension in ESRD Patients

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Abstract:

Dialysis patients are at risk for development of pulmonary hypertension (PH). Although multifactorial, the increased risk is partly due to the presence of an arteriovenous (AV) access(1)and is strongly associated with an enlarged left atrium and poor prognosis .Multiple studies have been done to prove direct relationship between ESRD and PH. This review is based on a search of Medline and citation lists of relevant publications. The main goal of this review is to highlight the magnitude of the problem and need of early screening and management of PH in end stage renal disease (ESRD) patients so that morbidity and mortality can be reduced.

Key words: *Pulmonary hypertension, End stage renal disease, Arteriovenous fistula*

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1: Introduction

Pulmonary hypertension (PH) is a progressive disorder complicating heart, lung, or systemic diseases, with increased morbidity and mortality regardless of its etiology.PH is defined as an elevated mean arterial pressure ≥25 mmHg at rest as assessed by right heart catheterization

(RHC) (2).It is a recognized complication of ESRD which has major effect on long term survival and well-being of patients.

2: Epidemiology and risk factors

Reported prevalence of pulmonary hypertension in ESRD is 20-70% with relatively low prevalence of 9-39%& 0-42% in patients of chronic kidney disease (CKD) and peritoneal dialysis(PD) respectively(3,4,5). Prevalence of PH is high in all above mentioned categories as compared to general population because of increased risk of improper control of systolic blood pressure, fluid overload and hypoalbuminemia (6, 7, 8).Patients on HD carries an additional risk factor that is AV access especially when blood flow increases progressively with time (9). Even PH has been observed in pre-ESRD patients with AV access. Among patients of ESRD old age, high body mass index and low Hb have been seen to increase the risk (10).

3: Classification

The World Health Organization (WHO) has classified PH on the basis of etiology into the five groups. (11, 12)

- Group 1 – Pulmonary arterial hypertension (PAH)
- Group 2 – PH secondary to left heart disease
- Group 3 – PH secondary to chronic lung disease and/or hypoxemia
- Group 4 – PH secondary to chronic thromboembolic pulmonary hypertension
- Group 5 – PH secondary to unclear multifactorial mechanisms

ESRD patients belong to group 5.

4: Pathogenesis

Regardless of the initial trigger ,the elevated pulmonary arterial pressure and vascular resistance is caused by sustained pulmonary vasoconstriction and obliteration of lumen of small and medium-sized arteries and arterioles(13) .However the pathogenic mechanisms particularly in patients of ESRD are poorly understood but there are many theories to explain this.

- Hormonal and metabolic derangement associated with end-stage renal disease leading to pulmonary vascular calcification
- High cardiac output resulting from the arteriole-venous access itself, worsened by commonly occurring anemia and fluid overload leading to stiffness of ventricles (14)
- Active inflammation due to bioincompatible dialysis membranes leading to intimal fibrosis
- Recurrent embolization from repeated AV access thrombectomies (15)
- Endothelial dysfunction and decreases in the vasodilator nitric oxide (NO)

5: Clinical features

Bullet symptoms:

- Shortness of breath , initially while exercising and eventually while at rest
- Fatigue
- Dizziness or fainting spells
- Chest pain and palpitations
- Body swelling

Signs:

- Jugular vein distension
- left parasternal lift
- accentuated pulmonary component of second heart sound
- pansystolic murmur of tricuspid regurgitation
- diastolic murmur of pulmonary insufficiency
- hepatomegaly
- ascites
- peripheral oedema

6:Diagnosis

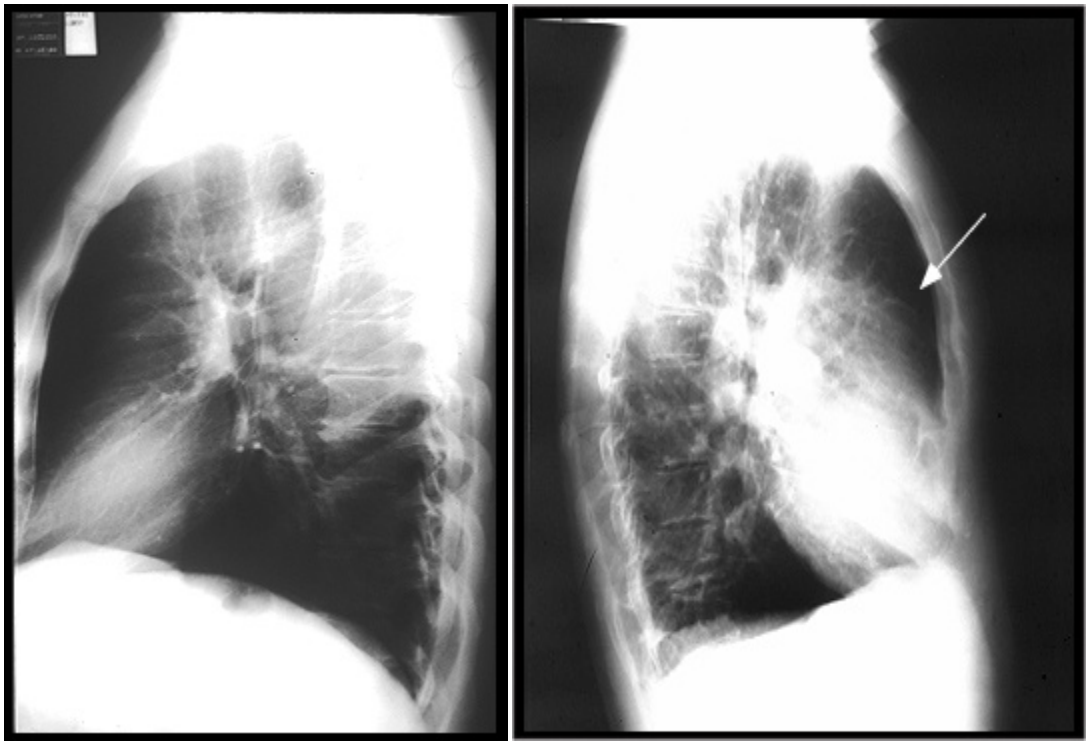
Diagnosis of pulmonary hypertension is difficult to make in ESRD patients solely on the basis of history and physical examination as they are usually suggestive of volume overload which is

very common among ESRD patients.PH is suspected in these cases when there is no improvement in symptoms of patients even after achieving euvolemia.

Sometimes a clear correlation has been observed between onsets/worsening of symptoms with the formation of AV access. Among patients with AV access who are newly diagnosed with PH or who have worsening of PH, the contribution of the AV access can be initially assessed manually by compressing the AV access for one minute, while measuring pulmonary hemodynamics on right heart catheterization(RHC). If a significant component of the patient's PH is related to the AV access, the mean pulmonary artery pressure, right atrial pressure, and pulmonary vascular resistance will normalize or significantly decrease when the AV access is compressed. However, the definition of what constitutes a significant decrease is not established and is highly subjective (16).

6.1: Chest radiograph (CXR)

The classic chest radiograph of a patient with PH shows enlargement of the central pulmonary arteries with attenuation of the peripheral vessels (oligemic lung fields).Right ventricular and atrial enlargement may also be seen.



Normal lateral chest radiograph Pulmonary hypertension

Chest radiograph in lateral view showing decreased retrosternal space (arrow) due to right ventricular enlargement in pulmonary hypertension.

6.2: Electrocardiogram(ECG)

The ECG may provide suggestive or supportive evidence of PH by demonstrating RV hypertrophy and right atrial dilatation. Supraventricular tachycardia may be present in advance cases. However normal ECG does not exclude the diagnosis of PH as ECG has insufficient sensitivity (55%) and specificity (70%) to be a screening tool for detecting significant PH (2).

6.3: Echocardiography

Transthoracic echocardiography is done to assess pulmonary artery systolic pressure, systolic &diastolic dysfunctions and dimensions of heart .Echocardiographic signs of right ventricular pressure overload includes systolic flattening of the interventricular septum and hypertrophy of the right ventricular free wall. However echocardiography alone is not sufficient to diagnose pulmonary hypertension and must be done along with right heart catheterization.

6.4: Right heart catheterization (RHC)

Right heart catheterization is confirmatory test for diagnosis of PH. There are no clinical parameters or RHC features that anticipate the development or worsening of pre-existing PH with future AV access placement in ESRD patients.

7: MANAGEMENT

7.1: Dialysis modality in preexisting PH

In CKD patients with pre-existing pulmonary hypertension, evaluation for PD at the time of dialysis initiation can be considered.As with PD daily continuous UF will reduce the risk of worsening of PHsecondary to volume overload. For those who are not candidates for peritoneal dialysis because of co morbidities or other reasons,a tunneled catheter can be considered or an AV access based off a small artery (e.g., radiocephalic fistula) is a reasonable alternative but will require vigilant monitoring.

Among patients with pre-existing PH who do not worsen after dialysis initiation or AV access placement, three monthly echocardiography can be done though this practice is not a recommended approach yet.

Among those who worsen after dialysis initiation longer or frequent HD sessions will help to achieve a lower dry weight. If patients fail to improve at minimal possible dry weight Doppler AVF can be done to assess the flow in AVF. If the blood flow is higher than that minimally required for hemodialysis access (i.e., approximately 500 mL/min (17), flow reduction (e.g., banding) should be done .Patient may need ligation of AVF and further dialysis can be continued via tunneled catheter.

8: Renal transplant

Pulmonary artery pressures may become normal after kidney transplantation, even among patients who still have a functioning arteriovenous (AV) fistula. However, patients with PH require careful evaluation and management before transplantation. Patients with severe PH may not be suitable candidates for kidney transplant.

9: Conclusion

PH is an established complication of ESRD particularly in patients with AV access. PH increases the risk of cardiovascular events and overall mortality several folds. So evaluation of patients for pulmonary hypertension at the time of hemodialysis initiation and later has significant effect on long term survival and well-being of patient.

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