

Acute pulmonary oedema with normal left ventricular function in a patient with resistant hypertension – what is the likely diagnosis?

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Abstract

We report the case of a 75-year old woman who presented with shortness of breath and haemoptysis. She had been treated for presumed essential hypertension for many years. On admission she was found to be severely hypertensive. Chest X-ray showed pulmonary oedema. However, an echocardiogram reported good systolic ventricular function. Her hypertension and pulmonary oedema did not respond to medical treatment necessitating intubation. A CT angiogram identified the cause – undiagnosed bilateral severe renal artery stenosis. We discuss this increasingly common condition that is difficult to manage and easily missed.

Keywords

Renal Artery Stenosis, Refractory Cardiac Failure, Flash Pulmonary Oedema, Malignant Hypertension

Learning Points

1. Bilateral renal artery stenosis due to atherosclerosis is increasingly common in an aging population
2. Think of this condition in patients presenting to the acute medical take with severe hypertension that doesn't respond to treatment and is associated with refractory or "flash" pulmonary oedema and renal failure
3. The finding of normal LV function in a patient with acute pulmonary oedema should trigger a search for alternative causes, including renal disease
4. The diagnosis is by CT-angiogram or magnetic resonance angiography
5. Aggressive medical management with antiplatelet and LDL-cholesterol lowering therapy is indicated.
6. There may be a role for percutaneous renal angioplasty and stent placement (or open surgical revascularization); Stenoses should be treated one side at a time.

Case Report

A 75-year old woman presented with a 6-week history of increasing shortness of breath on exertion. Two days prior to admission she had developed a cough and haemoptysis. She had a long history of "essential" hypertension. Her blood pressure had been increasingly difficult to control in the months before she was admitted. She had started methyl-dopa 500 mg tds and nifedipine 20 mg LA, furosemide 40 mg and spironolactone 25 mg od. Previously, she had been managed with losartan, bendroflumethiazide and amlodipine. The losartan had been stopped due to a rise in her creatinine. There was no history of coronary, cerebral or peripheral vascular disease. She took atorvastatin for hypercholesterolaemia. She was a life-long non-smoker.

On examination, her blood pressure was 201/88, heart rate 96 per minute, respiratory rate 26 per minute, and oxygen saturation was 91% on 4 litres of oxygen. Her temperature was 37.8c. Her JVP was elevated and she had a pan systolic murmur. On auscultation of her chest there were bilateral crepitations but there was no peripheral oedema.

A chest X-ray showed diffuse alveolar shadowing with bilateral blunting of the costo-phrenic angles

and upper lobe diversion with normal cardiothoracic ratio. (Figure 1) ECG showed sinus rhythm and a left ventricular strain pattern. Bloods results showed: Hb 10.9 g/L, WCC 15.5 10⁹/L platelets 171 10⁹/L, C-reactive protein 156 mg/L, sodium 132 mmol/L, potassium 3.2 mmol/L, creatinine 146 µmol/L and urea 8.3 mmol/L. Clotting was normal. Troponin was mildly elevated 0.14 (range 0–0.04 mcg/L). Urine dipstick revealed blood +++ and protein +. Urine albumin was 18.8 mg/L.



Figure 1: Chest X-ray showing pulmonary oedema

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Figure 2: CT angiogram showing a heavily calcified aorta with bilateral ostial renal artery stenosis

The albumin/creatinine ratio was 3.3 mg/mmol (range: 0–3.5). A bedside echocardiogram reported good left ventricular function with left ventricular hypertrophy and mild mitral regurgitation.

A working diagnosis of malignant hypertension with pulmonary oedema and superimposed community-acquired pneumonia was made. She was started on an intravenous infusion of glyceryl trinitrate, intravenous furosemide and broad-spectrum antibiotics. Over the next 24 hours she remained hypertensive (systolic BP ranging between 150–200 mm Hg) and her respiratory status deteriorated necessitating intubation and transfer to intensive care.

In intensive care, she had further episode of haemoptysis and her renal function deteriorated. A CT chest and abdomen showed bilateral extensive

consolidation, effusions and interlobular septal thickening consistent with pulmonary oedema, infection or pulmonary haemorrhage. Kidney bipolar length was 7.8 (left) and 8.2 cm (right) with no evidence of hydronephrosis and extensive aortic calcification. She had a negative antinuclear cytoplasmic (ANCA) antibody (ANCA) and antiglomerular basement membrane (GBM) antibody. A renal biopsy, performed to exclude a vasculitic process showed only hypertensive changes (focal glomerulosclerosis) with superimposed acute tubular injury. A CT renal angiogram (Figure 2) revealed severe bilateral ostial renal artery stenosis.

In order to treat the cause of her refractory hypertension and pulmonary oedema, several attempts to perform renal artery angioplasty and stenting were made. However, it was not possible to pass a catheter or



Figure 3: catheter at the ostium of the left renal artery (femoral approach). Unfortunately, attempts to place a stent were unsuccessful



Figure 4: catheter at the ostium of the right renal artery (brachial approach). Unfortunately, attempts to place a stent were unsuccessful

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wire through the renal artery ostia (Figures 3 and 4). A vascular surgical opinion suggested open revascularisation was not feasible. Following the procedure, the patient became anuric and commenced haemofiltration, enabling treatment of her fluid overload and extubation. However, she did not regain renal function before she died from an asystolic cardiac arrest.

Discussion

Renal artery stenosis due to atheroma is becoming increasingly common in an aging population.¹ When the stenosis is bilateral the presentation can be very dramatic with severe hypertension that is refractory to treatment, associated with episodes of flash pulmonary oedema or heart failure refractory to diuretic therapy. There may also be a history of worsening renal function. A substantial rise in creatinine (greater than 20%) on starting an ACE-inhibitor or angiotensin II receptor blocker (ARB) is a diagnostic clue, as in the case. The patients may have been previously mis-labelled with essential hypertension – as was also noted in the case described. The finding of preserved left ventricular function on echocardiography should trigger a search for a non-cardiac causes of pulmonary oedema, such as infection or a pulmonary renal syndromes. Some patients have multiple episode of flash pulmonary oedema before the diagnosis is made.

Recurrent flash pulmonary oedema due to bilateral renal artery stenosis was first described by Pickering et al in 1988.² He reported 11 patients with severe hypertension and recurrent episodes of pulmonary oedema. 7 of the patients had bilateral renal artery stenosis. Revascularisation was successful in treating blood pressure and pulmonary oedema.

The mechanism of flash pulmonary oedema in bilateral renal artery stenosis is thought to be a combination of defective pressure natriuresis due to reduced kidney perfusion and acute-on-chronic activation of the renin-angiotensin-aldosterone (RAAS) and sympathetic nervous systems (SNS). Chronic RAAS and SNS activation results in hypertension and volume overload that, over time, causes diastolic heart

failure. Flash pulmonary oedema is then precipitated by small fluctuations in blood pressure, intravascular volume and/or renal perfusion, resulting in a surge of RAAS and SNS activation, worsening hypertension and volume overload, but also increasing pulmonary vasculature permeability.³

The diagnosis can be made by duplex doppler renal ultrasound in experienced hands, and more reliably by CT or magnetic resonance angiography. The latter is preferred if risk of contrast nephropathy is a concern.

Medical treatment must include antiplatelet therapy to reduce risk of vascular events⁴ and LDL-cholesterol lowering therapy.⁵ Hypertension will usually need multiple agents, even after successful stenting.⁶ ACE inhibitors and ARBs are not recommended in untreated bilateral severe renal artery stenosis but are the treatment of choice in unilateral disease.⁷ Calcium-channel blockers may also be effective.

Although percutaneous renal artery balloon angioplasty can improve the angiographic appearance of kidney perfusion (and placing a stent has the best long-term result), the ASTRAL trial has raised serious doubts over its utility to slow renal progression, lower blood pressure and prevent future cardiovascular events (even in those with bilateral severe disease).⁶ About 1 in 10 procedures have serious complications such as renal artery occlusion, arterial rupture and cholesterol embolisation into distal vasculature structures.⁶ However, revascularisation may be the only therapeutic option in cases of critical bilateral severe renal artery stenosis complicated by treatment refractory flash pulmonary oedema. Such cases need careful discussion with experience nephrologists and radiologists before attempting revascularisation. Because treatment of a single renal artery (supplying a reasonably sized kidney) should be enough to prevent further episodes of flash pulmonary oedema, it would be prudent not to attempt bilateral renal artery angioplasty in a single procedure.³ Open surgical revascularisation may be possible.⁸

Conflict of Interest

The authors have no conflict of interest to declare.

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