Coexistent renal and heart failure: the importance of recognizing 'congestive cardio-renal failure'

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INTRODUCTION

The coexistence of heart disease and renal failure is common in clinical practice (Packer et al, 1986). The pathophysiology of both conditions results in sodium and water retention. In accordance with Starling's law, cardiac function decreases once an optimum left ventricular end diastolic volume is exceeded, such that the dysfunctional heart will perform even less well when challenged by salt and water retention secondary to intrinsic renal disease. The differentiation between end stage heart disease and the failing heart that is exposed to salt and water overload in renal failure is important, both for determining clinical management and prognosis (Braunwald, 1991).

PATHOPHYSIOLOGY

Reduction in circulating volume results in the activation of mechanisms that lead to sodium and water retention, including:

- Stimulation of the sympathetic nervous system
- Release of vasopressin from the posterior pituitary
- Activation of the renin–angiotensin–aldosterone axis.

The syndrome of 'heart failure' can result from either systolic dysfunction as a result of impaired left ventricular contractility, or diastolic dysfunction secondary to impaired left ventricular filling. The pathophysiological processes initiating cardiac failure are different in these two settings, but both result in the activation of these neurohormonal mechanisms (Ledingham, 1987). The consequent sodium and fluid retention leads to the clinical picture of elevated jugular venous pressure, peripheral and pulmonary oedema, pleural effusion and ascites (Wagner and Cohn, 1977). Effective renal blood flow is reduced, glomerular filtration rate declines and urine volume and natriuresis are reduced. This situation is commonly referred to as 'pre-renal' renal failure and occurs in one third or more of patients with cardiac failure (Dzau, 1987; Anand et al, 1989; Fliser et al, 1996).

Progressive loss of functioning renal tissue is also characterized by sodium and water retention, as the excretion of sodium falls below that required to maintain a neutral sodium balance (Gabow, 1992). The degree of sodium retention is not well correlated with the severity of renal impairment, clinical evidence of fluid 'overload' occurring earlier in the course of renal failure in some cases than in others. The resulting clinical picture may be identical to that of congestive heart failure.

CASE REPORT

A 42-year-old man with a 26-year history of insulin-dependent diabetes mellitus, complicated by proliferative retinopathy, presented with dyspnoea at rest and peripheral oedema. Congestive cardiac failure had been diagnosed 6 months previously, when a chest radiograph demonstrated cardiomegaly with bilateral pleural effusions. A transthoracic echocardiogram had revealed left ventricular dilatation with severe impairment of left ventricular contraction and functional mitral regurgitation.

On examination, jugular venous pressure was elevated and a third heart sound, pulmonary crepitations, and peripheral oedema were present. A clinical diagnosis of congestive cardiac failure was made. Serum creatinine was 388 μmol/litre (creatinine clearance 19 ml/min estimated by Cockcroft-Gault formula). Treatment with intravenous inotropes and high dose diuretics resulted in a 10 kg weight loss with relief of symptoms. Serum creatinine at 'dry weight' was 572 μmol/litre (estimated creatinine clearance 13 ml/min) and continuous ambulatory peritoneal dialysis was introduced. Six months later ejection fraction was 16% on multiple gated acquisition (MUGA) scan performed as part of assessment for renal transplant. The left ventricle was globally hypokinetic and the inferior wall and septum akinetic. The patient was asymptomatic. Repeat MUGA scans at 8 and 16 months showed ejection fractions of 28 and 24% respectively. In view of the discrepancy between MUGA scan findings and the patient's clinical condition, coronary and left ventricular angiography were performed. Severe, diffuse, distal coronary artery disease was present and the left ventricle was globally dilated and dyskinetic.

This patient had severe intrinsic (ischaemic) cardiac and intrinsic (diabetic) renal disease. Recognition of the severity of renal failure led to the introduction of dialysis therapy. With appropriate control of salt and water balance, cardiac function improved and symptoms disappeared, although ejection fraction remained low.

THE CLINICAL SYNDROMES

The majority of cases of cardiac failure are the result of systolic dysfunction. However, isolated diastolic dysfunction may account for up to 40% of cases, and is particularly prevalent in elderly patients with left ventricular hypertrophy secondary to hypertension (Topol et al, 1985). The distinction is important as diastolic dysfunction may be associated with a normal heart size, both on clinical examination and radiological investigation.

Refractory cardiac failure may be defined as New York Heart Association class IV cardiac failure that is unresponsive to medical therapy, including maximal dose diuretics (loop diuretic

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plus metolazone), angiotensin-converting enzyme (ACE) inhibitors, digoxin and intravenous inotropes and/or vasodilators (Canaud et al, 1991). Pre-renal failure, characterized by intense renal sodium retention (urinary sodium <20 mmol/litre), is often present at this stage.

Severe fluid overload caused by progressive renal failure will also be resistant to conventional doses of diuretics, as diuretic responsiveness declines with decreasing glomerular filtration rate. The presence of primary renal failure in the patient with cardiac dysfunction may thus lead to diuretic resistance that is not related to the severity of heart failure.

DETERMINATION OF DISEASE SEVERITY

Examination

There are no universally agreed criteria for diagnosing heart failure (Cowie et al, 1997). Clinical detection of heart failure is unreliable (Remes et al, 1991), the examination findings of distension of the neck veins, pulmonary crepitations, and a third heart sound having a low sensitivity for the diagnosis (Harlan et al, 1977). All these features may be present in fluid overload resulting from renal failure. Blood pressure may help discrimination, hypotension being usual in cardiac failure and hypertension in fluid retention. However, when both pathologies are present blood pressure and pulse volume are less indicative. In addition, diastolic dysfunction is often characterized by hypertension (Badgett et al, 1997) and then resembles fluid overload closely.

Imaging

Both heart failure and fluid overload complicating renal failure result in chest radiographic appearances of cardiomegaly, pleural effusions and interstitial shadowing that are indistinguishable (Rocker et al, 1989). Without sufficient clinical information the radiologist may mis-report such appearances as those of 'left ventricular failure', even though this diagnosis cannot be made on radiological appearances alone.

Transthoracic echocardiography is now widely available. However, echocardiographic findings do not always correlate well with the clinical picture. The fluid overloaded heart may be abnormal on echocardiography and a severely disordered ventricle may be associated with either gross or minor clinical abnormalities (Franciosa et al, 1981). The ejection fraction at rest does not correlate well with the functional ability of the patient (Franciosa et al, 1981). The finding of a dilated left ventricle in the presence of fluid overload gives no information about the potential left ventricular function unless any renal component to fluid retention has been corrected.

Laboratory investigation

Serum creatinine is not an adequate guide to severity of renal failure, particularly in elderly patients with marked loss of muscle mass, who may have severe renal failure with only modest elevation of serum creatinine (Denham et al, 1975). The more widespread use of the modified Cockcroft-Gault (Cockcroft and Gault, 1976) or other formulae when reporting serum creatinine would highlight the severity of renal failure, even though they do not measure glomerular filtration rate precisely.

There may be other evidence to suggest significant intrinsic renal disease on simple non-invasive investigation. An abnormal urinary sediment, marked proteinuria (>2 g/litre), or an unexplained normochromic, normocytic anaemia should draw attention to the severity of renal disease. Renal ultrasonography may demonstrate the bilateral small kidneys and loss of cortico-medullary differentiation typical of advanced renal disease. An inequality of renal size raises the possibility of renal arterial disease.

MANAGEMENT OF COMBINED RENAL AND HEART FAILURE

The approach to managing combined cardiac and renal failure should be similar to that of heart failure alone, including the use of diuretics, ACE inhibitors and digitalis. Each of these measures requires increased caution and surveillance when renal impairment is present. Combinations of high dose diuretics may lead to worsening uraemia. The differentiation between volume depletion, with exacerbation of pre-renal uraemia, from the unveiling of the serum creatinine at dry weight is difficult.

The successful use of dialysis techniques to treat refractory cardiac failure has been well described (Mailloux et al, 1967; Rubin and Ball, 1986; Canaud et al, 1991; Konig et al, 1991; Tormey et al, 1996). These patients have had predominant cardiac failure with only modest elevation of serum creatinine, and dialysis has been introduced with the objective of short-term control of salt and water balance. In the patient with both intrinsic renal and cardiac disease, it may be impossible to determine the relative contribution of the renal and cardiac components to the clinical picture without a trial of dialysis.

The relief of sodium retention in predominant cardiac disease typically reveals a low cardiac output state associated with hypotension, particularly when secondary pulmonary hypertension is present. If significant renal disease exists then a clinical improvement would be expected. Any dialysis technique can be used to achieve salt and water balance. Continuous venovenous/arteriovenous haemofiltration, slow continuous ultrafiltration (Canaud et al, 1991) and peritoneal dialysis (Mailloux et al, 1967; Rubin and Ball, 1986; Konig et al, 1991; Tormey et al, 1996) are probably the best tolerated.

DISCUSSION

The coexistence of cardiac and renal failure is common. If the importance of the renal disease component of salt and water retention is not appreciated, then the cardiac diagnosis may be overemphasized. 'End stage' heart disease is difficult to define, is often implicit, and is less used than the terms 'refractory' or 'intractable' for cardiac failure or pulmonary oedema (Seller, 1966). Congestion from primary renal disease is easily mis-attributed to heart failure (Dzau, 1987) and 'end stage heart disease' inappropriately diagnosed. This can prejudice attitudes towards further management, including the decision to consider renal replacement therapy. This may partly explain the documented shortfall in the number of elderly and diabetic patients referred for dialysis (Department of Health, 1994).

Recognition of the severity of renal failure leads to more aggressive treatment to reverse salt and water retention and the acceptance of the need to introduce dialysis to achieve this if necessary. This is distinct from the use of dialysis to 'reset' the circulation in 'refractory' heart failure. In the latter case, the neurohumeral mechanisms causing inappropriate salt and water retention are circumvented. In the former the dialytic treatment of renal failure avoids the complication of secondary fluid overload and its adverse effects on cardiac function. In the accompanying case history, death from 'heart failure' would have occurred had dialysis not been considered.

Explicit terms to describe the combination of cardiac and renal failure would increase awareness of this potential clinical pitfall and could prevent the unnecessary death in refractory congestive states of patients with intrinsic renal disease. 'Refractory' cardiac failure may be explained by significant but underestimated renal impairment and an early trial of dialysis is the correct treatment for such patients. **HM**

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