

Acute renal failure in patients with type 1 diabetes mellitus

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Summary: Acute renal failure (ARF) is a serious condition which still carries a mortality of around 50%. People with diabetes may be at increased risk of developing ARF, either as a complication of diabetic ketoacidosis or hyperosmolar coma, increased incidence of cardiovascular disease, or due to increased susceptibility of the kidney to adverse effects in the presence of underlying diabetic renal disease. During the period 1956–1992, 1,661 cases of ARF have been treated at Leeds General Infirmary. Of these, we have identified 26 patients also having type 1 diabetes. ARF due to diabetic ketoacidosis is surprisingly uncommon (14 cases out of 23 patients whose notes were reviewed). All cases of ARF complicating ketoacidosis in the last decade have been associated with particularly severe illness requiring intensive care unit support, rather than otherwise ‘uncomplicated’ ketoacidosis.

We discuss the conditions that may result in ARF in patients with diabetes and the particular difficulties that may be encountered in management.

Introduction

People with diabetes may be at increased risk of developing acute renal failure (ARF). Acute pre-renal failure may occur as a result of the severe fluid depletion associated with diabetic ketoacidosis and non-ketotic hyperosmolar coma. The presence of underlying diabetic nephropathy may predispose to ARF resulting from adverse effects such as hypotension, sepsis or exposure to nephrotoxic agents. The increased incidence of cardiovascular disease may also lead to renal impairment as a result of complications of ischaemic heart disease or renal artery atherosclerosis. We describe our experience of treating patients with type 1 diabetes and ARF over the period 1956–1992 and discuss the aetiology of renal failure and management of these patients.

Methods

Between 1956 and 1992 a total of 1,661 patients with ARF (sudden deterioration of renal function to a creatinine of over 500 $\mu\text{mol/l}$ or requiring dialysis in patients without previously known chronic renal impairment) were treated by the Renal Unit at Leeds General Infirmary. We have identified 26 patients from Renal Unit records who also had type 1 diabetes mellitus without previous evidence of chronic renal impairment. We were able to obtain adequate records for 23 of these patients for review of clinical details.

Results

Of 23 patients with type 1 diabetes complicated by ARF, diabetic ketoacidosis was the main underlying factor in 14 cases, non-ketotic hyperosmolar coma was present in one and the remaining eight cases were due to causes other than acute metabolic complications of diabetes.

In the group of patients with ARF secondary to ketoacidosis there was a 50% mortality. Compared with the 10 earlier patients, the four patients treated since 1980 had more severe and complicated illnesses. All required mechanical ventilation, with three having hypotension unresponsive to fluid replacement, requiring inotropic support. Cardiovascular depression would have been a major factor in the development of ARF in these patients. Two patients with ketoacidosis and ARF died of severe metabolic derangement before dialysis could be instituted, two died from septicaemia, one from multiple organ failure, one from pulmonary aspiration and the other from non-recovery of renal function due to cortical necrosis.

The patient with non-ketotic hyperosmolar coma had not previously been diagnosed as diabetic. She was comatose on admission, with a blood glucose of 73.8 mmol/l, renal failure and Gram-negative septicaemia of urinary tract origin. After a complicated illness requiring ventilation inotropic support for hypotension and dialysis, she died without recovery of renal or cerebral function.

Eight patients had ARF not caused by acute disturbance of diabetic control. Three had severe sepsis (renal abscess, empyema and biliary disease)

and all of these died. Three had cardiac causes of ARF (myocardial infarction, cardiac failure and cardiac surgery) and only one of these survived. Of the remaining two patients, one had pre-renal ARF due to Addison's disease presenting as fluid depletion and uraemia, and the other occurred in a patient with a fractured femur and pre-existing cardiac failure. Both of these recovered without the need for dialysis.

Discussion

Acute renal failure is a serious illness with a mortality still around 50% in most series.¹ Patients with diabetes may be predisposed to the development of ARF due to a variety of reasons. Although diabetic ketoacidosis can result in severe fluid depletion accompanied by marked metabolic disturbance, it is surprisingly rare for it to be complicated by ARF. In a study of deaths in people with diabetes under the age of 50 years, 74 out of 448 deaths were due to ketoacidosis, yet only two of these also developed ARF.² It is our impression that ARF due to 'uncomplicated' ketoacidosis may be becoming even more rare, as our most recent cases were complicated by cardiorespiratory failure. The rarity of ARF complicating ketoacidosis may reflect the standard of current management of this condition. It is also possible that the osmotic effect of hyperglycaemia tends to preserve the intravascular volume and that the associated diuresis protects against development of ARF.

Non-ketotic hyperosmolar coma is characterized by profound dehydration and may be accompanied by hypotension and uraemia. Presentation is often late due to lack of ketotic symptoms and there are often associated problems such as neurological dysfunction and sepsis. Mortality is high with death often due to serious underlying illness.³

Other causes of ARF which are more likely to occur in patients with diabetes include radiocontrast nephropathy, which is more likely to occur in the presence of diabetic nephropathy,⁴ especially with chronic renal impairment,⁵ papillary necrosis

complicating urinary tract infection,⁶ and atherosclerotic renal artery disease complicated by either administration of angiotensin converting enzyme inhibitors or renal artery occlusion.⁷ One study has shown diabetes to increase the risk of ARF developing from hypovolaemia,⁸ though two other studies did not show diabetes to be an independent risk factor for development of ARF in patients admitted to hospital or intensive care.^{9,10} It is important to remember that unexplained ARF in a patient with diabetes may be due to unrelated causes and exclusion of urinary tract obstruction or intrinsic renal parenchymal disease is mandatory.

The presence of diabetes poses certain particular problems in the management of ARF. Prompt institution of dialysis is important as the diabetic patient may tolerate uraemia less well. Diabetes must be well controlled as uncontrolled ketosis may worsen hyperkalaemia and metabolic acidosis. Insulin requirements are often altered, either being increased due to insulin resistance or decreased due to impaired clearance of circulating insulin.¹¹

Although the majority of patients requiring dialysis will receive intermittent haemodialysis, this may be poorly tolerated in patients with cardiac dysfunction or autonomic neuropathy, with development of hypotension during treatment. Anticoagulation with heparin on dialysis may increase the risk of haemorrhage from proliferative retinopathy and prostacyclin may be used as a safer alternative.¹² Although peritoneal dialysis causes less cardiovascular disturbance, it may be complicated by peritonitis and chest infections (due to confinement in bed and splinting of the diaphragm), and may provide inadequate control of uraemia in the hypercatabolic patient. Continuous arteriovenous or venovenous haemofiltration (or haemodialysis) are the best tolerated forms of treatment in patients with cardiovascular instability, allowing greater fluid removal and so more freedom for the administration of drugs and nutrition.

Patients with diabetes may be at increased risk of developing ARF. This condition carries a high mortality and management may be more complicated by the presence of diabetes. Some cases may be avoidable by reducing exposure of the diabetic patient to nephrotoxic agents.

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