Hyperkalaemia in the age of aldosterone antagonism

A. CHAPAGAIN and N. ASHMAN

From the Department of Renal Medicine and Transplantation, St Bartholomew’s and the Royal London Hospital, London E1 1BB, UK

Address correspondence to Dr A. Chapagain, Department of Renal Medicine and Transplantation, St Bartholomew’s and the Royal London Hospital, London E1 1BB, UK. email: ananda.chapagain@bartshealth.nhs.uk

Received 03 January 2012 and in revised form 15 May 2012

Summary

Hyperkalaemia is well recognized as a medical emergency. However, with the publication of trials showing benefit with renin-aldosterone axis suppression in heart failure, the epidemiology of patients presenting with hyperkalaemia has changed. The reported incidence of rate of serious hyperkalaemia (>6.0 mEq/l of potassium) ranges from 6 to 12% in patients on spironolactone with congestive cardiac failure (CCF). A rational choice of therapy based on present evidence is different from the traditionally used algorithm, given our understanding of the physiology relevant to this patient group. This article discusses the changing face of hyperkalaemia and the present evidence and discusses options in treatment of hyperkalaemia.

Introduction

An increased serum potassium (K+) concentration has long been recognized as a medical emergency, which is often silent, could occur suddenly and leads to cardiac arrhythmias, ventricular standstill and death, the treatment algorithm for hyperkalaemia being a familiar one. Hyperkalaemia was seen, usually in hospital, in patients with advanced renal failure, hormone deficiencies (aldosterone, cortisol or insulin)12 or chronic acidosis, often exacerbated by prescribed medication (Table 1). However, the publication of landmark studies demonstrating benefit of Renin Angiotensin aldosterone system (RAAS) blockade in cardiovascular outcomes over the last decade has seen an increase in patients presenting to general practice and hospital care with hyperkalaemia, with cardiovascular, renal and metabolic comorbidities. Aspects of the patient management strategy deserve critical review.

In this study, we discuss the evidence over the past decade regarding RAAS blockade and cardiovascular outcomes especially in heart failure and then discuss management of hyperkalaemia in this patient sub-group.

Randomized Aldactone Evaluation Study and Eplerenone Post–Acute Myocardial Infarction Heart Failure Efficacy and Survival Study: randomized controlled trials (RCTs) vs. clinical practice

In 1999, the Randomized Aldactone Evaluation Study (RALES)3 described a 30% reduction in risk of death in patients with symptomatic heart failure treated with the aldosterone antagonist, spironolactone (aldactone in the USA). Those on spironolactone had a reduced number of hospitalizations and better symptom relief. This landmark trial was soon...
followed by the Eplerenone Post–Acute Myocardial Infarction Heart Failure Efficacy and Survival Study (EPHESUS) trial in 2003, reporting a 15% reduction in death from cardiovascular causes in those treated with eplerenone, an aldosterone antagonist with a more optimal side-effect profile. After these trials, the use of aldosterone antagonists was recommended wherever possible in addition to renin-angiotensin system blockade and β-blockers. The benefits of preventing the action of aldosterone has little to do with its effect on the distal tubule. Aldosterone binds to tissue-expressed receptors to promote local injury and fibrosis. Prevention of local effects of aldosterone has been demonstrated to improve outcomes in other organs and tissues as well in preliminary studies. Resistant hypertension is increasingly linked to hyperaldosteronism, and progressive proteinuric chronic kidney disease (CKD) responds to aldosterone antagonism, with a decline in glomerular filtration rate (GFR) in those treated with spironolactone. It seems that drugs used to block aldosterone’s effect are likely to see wider use in the coming years. Prevalent enthusiasm about potential benefit of aldosterone blockade (especially in patients with CKD, diabetes and/or an increased serum potassium at baseline) should be tempered with a respect for risk of hyperkalaemia, especially in view of the fact that all trials on RALES blockade have excluded patients with advanced renal failure. Theoretically, the significant clinical benefits seen in RALES and EPHESUS should have included and weighed in any adverse events caused by spironolactone or eplerenone. However, in both studies, patients with renal impairment (>221 μmol/l) or high-normal potassium (>5.0 mmol/l) were excluded at randomization. Patients were also relatively young (mean age of 64 years in EPHESUS), likely to have a better GFR than older subjects. A minor increase in serum K⁺ of 0.3 mmol/l was observed in the treatment arm, though ‘serious’ hyperkalaemia was uncommon (2–5.5%). Importantly, declining GFR was an independent predictor of the likelihood of serious hyperkalaemia, with those with a GFR < 50 ml/min/m² having a 10% incidence of serious hyperkalaemia. In applying the trials to clinical practice, the cautions and exclusions of these trials have not always been borne in mind.

In 2004, a Canadian population-based study of people older than 66 years described spironolactone prescriptions at 34/1000 patients before the publication of RALES. This more than quadrupled to 149/1000 in the years following the study being made public. Admissions for hyperkalaemia increased sharply, and deaths attributed to hyperkalaemia increased significantly from 0.3/1000 patients to 2.0/1000 patients in the aftermath of the trial. This translated into an estimated 1485 excess admissions and 171 excess hyperkalaemia-associated deaths among their 1.3-million cohort for the use of spironolactone. No change in heart failure-related admissions or deaths was observed. Since then, reports of hyperkalaemia in patients on aldosterone antagonists have become more frequent in clinical literature.

A recent (retrospective) study analysed data from 15 803 patients with CVD treated with antihypertensive drugs (defined as patients with heart failure and hypertension treated with antihypertensive drugs that impair potassium homeostasis) and found that hyperkalaemia was independently predicted by CKD stage (odds ratio [OR]: 2.14, 95% confidence interval [CI]: 2.02–2.28), diabetes mellitus (OR: 1.59, 95% CI: 1.47–1.72), coronary artery disease (OR: 1.32, 95% CI: 1.21–1.43) and peripheral vascular disease (OR: 1.55, 95% CI: 1.36–1.77). At the same time, predictors of all-cause mortality were CKD stage (OR: 1.26, 95% CI: 1.12–1.43), hyperkaemic event (OR: 1.56, 95% CI: 1.30–1.88), age (OR: 1.04, 95% CI: 1.03–1.05) and hospitalization (OR: 1.04, 95% CI: 1.04–1.05).

A recent prospective study by Muzzarelli et al. of 566 patients, aged 60 years or older, randomized to a standard vs. an intensified N-terminal brain natriuretic peptide-guided haemofiltration treatment during an 18-month follow-up found that 76 patients (13.4%) had hyperkalaemia (≥5.5 mmol/l) and 28 (4.9%) had severe hyperkalaemia (≥6.0 mmol/l). The independent predictors of hyperkalaemia were CKD (OR: 1.11 per 10 μmol/l), higher baseline serum potassium (OR: 2.92 per mmol/l), gout (OR: 2.56), New York Heart Association (NYHA) class (compared with NYHA class II and class IV; OR: 3.08), higher dosage of spironolactone at baseline (OR: 1.20/12.5 mg/day) and higher dose changes of spironolactone (compared with no dose change: 12.5 mg, OR: 1.45; 25 mg, OR: 2.52 and >25 mg, OR: 3.24).

It is likely that physicians may have applied the information gained from RALES and EPHESUS in a broader population, which tended to be older, more likely to have a serum K⁺ above 5.0 and to have

Table 1 Major causes of drug-induced hyperkalaemia

<table>
<thead>
<tr>
<th>ACE inhibitors and angiotensin-receptor antagonists</th>
<th>Potassium-sparing diuretics (spironolactone, eplerenone and amiloride)</th>
<th>β-blockers</th>
<th>Non-steroidal anti-inflammatory drugs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unfractionated and low-molecular-weight heparins</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Downloaded from https://academic.oup.com/qjmed/article-abstract/105/11/1049/1513381 by guest on 23 February 2019
renal impairment. Many patients with heart failure have renal impairment, with a GFR of <50 ml/min/m². More importantly, those with pre-existing minor renal impairment are more vulnerable to sudden changes in blood pressure or renal blood flow. A patient with a stable GFR of 55 ml/min/m² may see an abrupt fall from 20 to 30 ml/min/m² with an acute intercurrent illness that leads to volume depletion (the new addition of a diuretic, intercurrent diarrhoea or vomiting) or a transient fall in cardiac output (ischaemia or an arrhythmia). The associated fall in potassium excretion may see a sudden and dangerous increase in serum K⁺. Indeed, a recent in-depth review of the role of RAAS inhibition and potassium homeostasis concluded that there was no potential harm from RAAS inhibition in CKD and CCF, with reported incidence of hyperkalaemia ~2%, but with the important caveat that these patients should be monitored more frequently, up to every few weeks after changes in medications.¹⁹

Mechanisms of hyperkalaemia in RAAS blockade

Hyperkalaemia results if normal intake exceeds failing excretion (impaired kidney function), abnormal intake (by diet or infusion) exceeds normal excretion or potassium moves into the wrong body compartment (extracellular fluid). Approximately 98% of total body potassium is within cells, maintained in this compartment by the sodium- and potassium-activated adenosine triphosphatase (Na⁺/K⁺-ATPase) pump. The ratio of intracellular:extracellular potassium is important in determining cellular membrane potential, a key component of excitable tissues. Small changes in extracellular potassium can thus have profound effects on cardiovascular and neuromuscular function. The acute and life-threatening effects of hyperkalaemia are due to cardiac dysrhythmias. Heart failure and its treatment can be a ‘perfect storm’ of K⁺ retention. Patients with heart failure are often elderly, with vascular disease and under-diagnosed CKD.²,¹¹,¹² Treatment for heart failure may limit the kidney’s normal capacity to excrete K⁺. Angiotensin converting enzyme (ACE) inhibitors and angiotensin-receptor blockers drop efferent arterial tone, leading to a fall in GFR, limiting K⁺ excretion. β-blockers block cellular Na⁺:K⁺-ATPase activity, restricting the inward K⁺ pump that maintains K⁺ as the principal intracellular cation. Also, aldosterone antagonists act as diuretics by competitively inhibiting the mineralocorticoid receptor in the principal cells of the distal tubule. Aldosterone (released in response to a rising serum potassium) activates epithelial sodium channels to promote sodium reabsorption and leads to enhanced potassium loss through increased Na⁺/K⁺-ATPase activity (an antiporter exchanging tubular luminal sodium for intracellular potassium). Aldosterone antagonism leads to increased urinary sodium loss and potassium retention. In this setting, an acute deterioration in cardiac performance may lead to a reduction in effective arterial blood volume, with the kidney (appropriately) responding with oliguria in an attempt to retain salt and water. Oliguria, renal impairment and a fixed and reduced capacity to excrete K⁺ can lead to sudden and dangerous hyperkalaemia.

Management of hyperkalaemia

Initial assessment of the patient

Generally, a serum K⁺ of >6.0 mmol/l is thought of as hyperkalaemia, but absolute values are often not as important as the speed of change in the K⁺ concentration. A patient with diabetes and a GFR of 40 ml/min/m² with a longstanding K⁺ of 6.3 mmol/l is at significantly less risk than a previously fit and well man with rhabdomyolysis who experiences an increase in K⁺ from 3.9 to 6.2 mmol/l inside 24 h. As a rule, hyperkalaemia of >7.0 mmol/l is always an emergency. Chronic hyperkalaemia of 6.0–6.5 mmol/l can often be treated on an outpatient basis, whereas 6.5–7.0 mmol/l usually requires supervised treatment. It is always worth erring on the side of caution.

Demonstrating true hyperkalaemia

Sampling should immediately be repeated, as false hyperkalaemia occurs with mechanical blood cell lysis at traumatic venepuncture or with markedly elevated white blood cell and platelet counts.¹⁴,¹⁵ The volume status of the patient needs to be accurately assessed and the likely urine output predicted. A drug history should be obtained (with all contributing drugs withdrawn), and the systemic pH, urea and electrolytes are requested. Good intravenous access should be established and cardiac monitoring instituted. Oxygen should be administered.

Twelve-lead electrocardiogram

It has been traditional to get a baseline electrocardiogram (ECG) to assess cardiac rhythm and predict the risk of arrhythmia by the presence or absence of characteristic changes (Table 2). Importantly, a normal ECG in the face of hyperkalaemia should not reassure clinicians. In a retrospective review of 90 patients,²² 80% of whom had a serum K⁺ of >7.2,
ECG changes did not help in the management of hyperkalaemia. No diagnostic threshold for T-wave amplitude in predicting actual for hyperkalaemia was found. The authors concluded that there is no role for the ECG in guiding the treatment of hemodynamically stable patients. If changes are present, these may serve to alert clinicians to the need for prompt action and if not, be guided by the degree of hyperkalaemia rather than the ECG findings.

Protect myocardium
Regardless of the degree of hyperkalaemia, rapid electrolyte shifts are theoretically more likely to induce arrhythmias. The myocardium should, therefore, always be protected with intravenous calcium as mentioned below before specific potassium-lowering therapy is initiated.

Intravenous calcium
Physiology. Myocyte depolarization occurs after overcoming the difference between the resting membrane potential (usually −90 mV) and the threshold potential (for depolarization, usually −75 mV), normally −15 mV. Hyperkalaemia leads to the normal resting membrane potential becoming less negative (and closer to the threshold potential of −75 mV, so increasing myocardial excitability). Calcium shifts the threshold potential to being less negative (closer to −70 mV), so restoring the normal gradient between threshold potential and resting membrane potential. Calcium also restores maximal velocity of myocyte depolarization and reverses depressed myocyte impulse propagation.

Intervention. Ten millilitres of 10% calcium gluconate contains 2.2 mmol calcium (compared with 3.4 mmol in 5 ml of 10% calcium chloride). Calcium protects from cardiac dysrhythmias within 5 min of injection and acts for 30–60 min. Doses are administered over 2–5 min and can be repeated every 10 min to a total dose of 10 mmol of calcium and titrated against ECG changes if present. Hypercalcemia can cause induction of digitalis toxicity in patients on digoxin, and it is preferable to give calcium gluconate more slowly (up to over 30 min) in this patient group. Severely hyperkalaemic patients with digitalis-associated arrhythmias should be treated with either dialysis (ideally) or digoxin-binding Fab antibodies.

Evidence. There have been no clinical trials of the efficacy of calcium infusion in hyperkalaemia.

Increase total body potassium wasting
More importantly, and less well appreciated, is to take steps to begin total body potassium wasting as soon as is possible (Figure 1). If patients pass urine, encouraging a diuresis will enhance urinary K+ losses and lower total body K+. Hypovolaemic patients should be rapidly resuscitated with 0.9% NaCl to restore a good urine output. Even in patients known to have heart failure, if clinical assessment suggests intravascular depletion (postural hypotension is a useful sign), a challenge with 250 ml of 0.9% NaCl is usually safe and often helpful. Euvolaemic and uric patients may benefit from intravenous furosemide with or without 0.9% NaCl replacement, and overloaded patients may begin to diurese under the influence of a loop diuretic. It is usually worth challenging oliguric patients with reasonable renal function (GFR > 30 ml/min/m²) with furosemide as well.

Specific K+-lowering interventions
It must be emphasized that very few clinical trials have examined the benefit of treatment of hyperkalaemia and that very little clinical data exist from day-to-day clinical practice. The algorithms and agents used to lower K+ have been evaluated in studies using healthy animals, healthy human volunteers or patients with end stage renal disease (ESRD), all of which may not share co-morbidities with the typical hyperkalaemic patient seen in Accident and Emergency (A&E) in 2012. In clinical practice, often elderly and with abnormal renal function; our patients now have treated heart failure, an intercurrent illness and often occult or actual coronary artery disease. Table 3 summarizes chief interventions in hyperkalaemic patients.

Insulin/dextrose
Physiology. Insulin (with or without dextrose) was shown to lower potassium in patients with ESRD. Insulin binds to its membrane receptor and stimulates glucose uptake by membrane-bound glucose transporters. This is associated with activation of the membrane Na+/K+-ATPase pump, enhancing inward shift of serum K+ into cells.

Intervention. Ten to 15 units of short-acting insulin with infused glucose causes the plasma K+ to fall

Table 2 ECG changes in hyperkalaemia

<table>
<thead>
<tr>
<th>ECG Changes</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tall, tented T waves</td>
<td>Prolongation of the PR interval</td>
</tr>
<tr>
<td>Widening of the QRS</td>
<td>Sinusoidal pattern preceding ventricular standstill</td>
</tr>
</tbody>
</table>

Downloaded from https://academic.oup.com/qjmed/article-abstract/105/11/1049/1513381 by guest on 23 February 2019
within 15 min by 0.6–1 mmol/l. This fall is maintained for 2–3 h and can be repeated with good effect if needed (for example, 15 units of actrapid with 50 g dextrose infused over 20–30 min). Blood glucose monitoring for up to 6 h after administration is essential to avoid symptomatic hypoglycaemia.

**Evidence.** Data from haemodialysis (HD) patients show 20 units of short-acting insulin with infused glucose caused the plasma K⁺ to fall rapidly by 0.6–1 mmol/l in 60 min.²⁵ Although diabetic patients need external (supraphysiological) dosage of insulin for hyperkalaemia to be corrected, there are data to suggest that hyperglycaemia can cause hyperkalaemia due to osmotic effects.²⁷

**Beta-agonists**

**Physiology.** Inhaled β₂-agonists act by the same mechanism as insulin (activating the membrane Na⁺/K⁺-ATPase pump), and it remains uncertain whether any additive benefit accrues in using both in patients who do not have ESRD.²⁸,³⁰,³¹

**Intervention.** The dose of albuterol used is 4–8 times of that given for acute asthma, and 20–40% of patients had a fall < 0.5 mmol/l, with no factors identifiable in one-third of patients who received no benefit from beta-agonist therapy.³²

**Evidence.** Hyperkalaemic patients given 10–20 mg of nebulized albuterol showed a decrease within 15 min by 0.6–1 mmol/l. This fall is maintained for 2–3 h and can be repeated with good effect if needed (for example, 15 units of actrapid with 50 g dextrose infused over 20–30 min). Blood glucose monitoring for up to 6 h after administration is essential to avoid symptomatic hypoglycaemia. Generally, a supraphysiological dose of insulin is required to lower serum potassium, and dextrose given alone is not as effective as a hypokalaemic agent in non-diabetic patients.²⁶

**Table 3**  Acute medical management of hyperkalaemia

| Calcium gluconate 10%, 10 ml intravenous (IV) | 50 ml 50% dextrose containing actrapid insulin 10–15 IU IV |
| Encourage a diuresis through saline resuscitation or loop diuretic (or both) | Haemodialysis/CVVH |

...
in serum K⁺ of 0.6 mmol/l (10 mg)–1.0 mmol/l (20 mg) within 30 min, sustained for at least 2 h. However, although no serious adverse effects were reported in the studies, it is not certain whether this would remain true for potentially unstable patients with coronary artery disease and heart failure. If nothing else, the tachycardia seen with β₂-agonists is undesirable. There is no evidence of benefit in the use of β₂-agonists where insulin (and dextrose) can be safely administered.

**Sodium bicarbonate**

*Physiology.* Sodium bicarbonate has been advocated for the acute treatment of hyperkalaemia in both acidic and non-acidotic patients in the past. As a systemic acidosis is corrected, cellular Na⁺/H⁺ exchange promotes Na⁺ uptake into cells as H⁺ exits (towards the newly relatively alkalotic exterior). Increasing intracellular Na⁺ should activate the Na⁺/K⁺-ATPase pump, exporting Na⁺ in exchange for inwardly transported K⁺. This mechanism relies on a fully activated Na⁺/H⁺ exchanger, which may not be the case in hyperkalaemic patients.

*Intervention.* We would only recommend 150 mmol intravenous 1.26–1.4% NaHCO₃ in addition to insulin and dextrose in those with a systemic pH of <7.2. The potential hazards of its use include sudden salt loading and volume expansion, and abrupt hypocalcaemia, potentially undesirable in those with significant cardiac disease.

*Evidence.* HD patients given 200–250 mmol NaHCO₃ had a drop in serum K⁺ after 4 h, despite not being significantly acidotic. In acidic and hyperkalaemic patients, a small study suggests synergistic K⁺-lowering effects with insulin/dextrose infusions and with β₂-agonists. It is not known whether sodium bicarbonate offers benefits in patients not on dialysis.

**Exchange resins**

*Physiology.* Cation-exchange resins are cross-linked polymers with negatively charged structural units, commercially available in the UK as calcium resonium (others include the sodium-based Kayexelate™). Both exchange bound calcium or sodium for potassium in the gut. Their efficacy depends on the ambient K⁺ concentration and rapid excretion in the stool of the K⁺: polymer compound.

*Intervention.* Exchange resins with or without laxative agents should not be used exclusively to treat acute hyperkalaemia because of their slow onset of action and variability in efficacy. Usual dose of calcium resonium is 15 g 3–4 times a day in water. Use may be limited to patients with chronic hyperkalaemia who are not candidates for renal replacement therapy (supportive care) in combination with laxatives.

**Evidence.** If used orally, the stomach K⁺ concentration (5–9 mmol/l) is low and as such not favourable for exchange. If used rectally, the higher colonic K⁺ concentration (90 mmol/l) and lower Na⁺ concentration (50 mmol/l) favour exchange. Even assuming an adaptive increase in colonic K⁺ excretion in ESRD, total K⁺ excretion from the colon has been calculated to be 4 mmol/day (modest in the face of hyperkalaemia). Importantly, it is not known whether exchange resins actually bind enough K⁺ to lower serum potassium on their own. This is particularly true for calcium resonium, which is constipating when given orally. Any agent that reduces stool K⁺ losses may exacerbate rather than improve hyperkalaemia. In fact, laxatives have been shown to be as effective as cation exchange resins in enabling faecal K⁺ excretion. A new exchange resin has been evaluated in the recently published ‘PEARL-HF’ study, which has tested the combined use of RLY5016, a novel non-absorbed K⁺-binding polymer, with spironolactone in heart failure patients receiving standard care but with previous documented hyperkalaemia or CKD. RLY5016 significantly lowered serum K⁺ levels from baseline relative to placebo, lowered the incidence of hyperkalaemia (defined as >5.5 mEq/l) and allowed a higher proportion of heart failure patients to receive spironolactone at a dose of 50 mg/day. However, this resin has not yet been approved for clinical use.

**Dialysis and continuous veno-venous haemofiltration**

*Physiology.* Diffusion and convection will lead to substantial potassium removal. Conventional HD lowers serum potassium by the mechanism of diffusion, whereas various other modalities use a combination of diffusion and convection in potassium removal.

*Intervention.* Conventional HD or continuous veno-venous haemofiltration (CVVHF) is effective at reducing total body potassium. CVVHF offers a less efficient alternative to HD but may have (theoretical) advantages in haemodynamically unstable patients.

*Evidence.* HD rapidly lowers total body potassium. As blood is circulated at 250–300 ml/min
through the extracorporeal circuit, over 2 h ~30 l of blood (at high serum K+) will be exposed to a dialysate K+ of 1–2.0 mmol/l. Significant potassium rebound will be seen after dialysis, as K+ moves from the intracellular to the extracellular compartment.35 Under ideal conditions, the serum potassium level can decrease by 1.0–1.5 mEq/l for each hour of dialysis.36,37 Table 4 summarizes indications for HD in patients with hyperkalaemia with renal failure.

Dose reduction of RAAS inhibitors in CKD and heart failure

There have been numerous studies linking hyperkalaemia and spironolactone-prescription rate for patients treated with ACE inhibitors who had been hospitalized for heart failure.12 A recent review,38 however, highlights the appropriate point that a large proportion of patients being treated with RAS blockade do not fulfil trial criteria for inclusion.

Furthermore, studies in patients with CKD treated with spironolactone 25 mg once a day (OD) or eplerenone (50–100 mg OD)39 in addition to other RAS blocking agents38,40 improved blood pressure and preserved renal function while demonstrating no adverse impact of hyperkalaemia or worsening renal function.

The currently available data regarding use of low-dose spironolactone (principally) in CKD suggest that the risk for developing hyperkalaemia is significantly less than previously thought, and patients with CKD should have a dose adjustment of RAAS inhibitors and/or spironolactone with frequent (up to twice weekly) serum potassium measurements. The only article describing the frequency of monitoring in patients with CKD and diabetes (not necessarily heart failure)40 has used fortnightly serum monitoring after baseline. In view of the fact that patients with CKD are known to have a higher cardiovascular mortality and morbidity, and should benefit from RAAS blockade, we would recommend cautious dosing, frequent monitoring (every 2 weeks) at initiation and titration of therapy and early dose reduction if a tendency to hyperkalaemia is observed.

Conclusion

Hyperkalaemia in an era of aldosterone antagonism is now a common and life-threatening condition with reported incidence of rate of serious hyperkalaemia (>6.0 mEq/l of potassium) ranging from 6 to 12% in patients with congestive heart failure (CHF) on spironolactone post-RALES. Indications for the use of spironolactone or eplerenone are ever widening, and an appreciation for the risks these drugs pose is growing. Many of the traditional treatments for hyperkalaemia lack an evidence base and were intended for use in patients in different clinical circumstances. We advocate that contemporary management should revolve around first and foremost protecting the heart from dysrhythmia. However, a rational choice of therapy should differ from the conventional algorithm, given our understanding of the physiology relevant to patients with heart failure and coronary artery disease. Encouraging renal K+ wasting through rehydration or diuresis wherever possible is an important and under-utilized early intervention. Treating intercurrent illness and titrating rather than stopping offending drugs completely will usually allow safe discharge with acceptable serum potassium.

Conflict of interest: None declared.

References


