*Lesson of the week***In vitro and in vivo haemolysis and potassium measurement**

Abbas Ismail, Wendy Shingler, Jeff Seneviratne, Gillian Burrows

Serum or plasma potassium concentration is one of the most commonly requested biochemical tests. Haemolysis is common, occurring in vitro in most cases—that is, during or after taking the sample. In such cases, reported potassium concentrations are clinically inaccurate, greater roughly in proportion to the degree of haemolysis.^{1–3} The World Health Organization recommends that laboratories do not report potassium concentrations for haemolysed samples because of this.⁴

By not reporting a result, laboratories may imply to the clinical team that potassium concentration cannot be measured analytically. But in cases of in vivo haemolysis, a result may be of clinical use. We report a case of a patient with renal failure and in vivo haemolysis who subsequently died, which highlights the problems of not reporting potassium concentrations for haemolysed samples.

Case report

A 40 year old Afro-Caribbean woman with recently diagnosed systemic lupus erythematosus was admitted to hospital as an emergency, with a five day history of vomiting, diarrhoea, and increasing weakness. Laboratory results on admission were haemoglobin 8.9 g/dl, white cell count $6.1 \times 10^9/l$, platelets $70 \times 10^9/l$, C reactive protein 36.6 mg/l, urea 31.2 mmol/l, and creatinine 423 $\mu\text{mol/l}$. Potassium concentration was not reported because the sample was grossly haemolysed. Coagulation was normal. A blood film showed diffuse fragmented cells consistent with microangiopathic haemolytic anaemia. An electrocardiogram on admission was normal.

She became increasingly drowsy, and we diagnosed her as having haemolytic uraemic syndrome with acute renal failure. In the next 12 hours we treated her aggressively with intravenous methylprednisolone, fresh frozen plasma, and intravenous fluids. We planned to transfer her to a dialysis unit the next day. In the interim period we requested biochemical investigations, including urea and electrolytes, on several occasions to assess the metabolic and electrolytic disturbances known to occur in these patients. Potassium was not reported because of our laboratory's policy of not reporting potassium in haemolysed samples.

Unfortunately, about a day after her admission she had an electromechanical dissociation cardiac arrest and died. Subsequent postmortem examination showed evidence of diffuse proliferative glomerulonephritis (WHO class IV) and diffusely congested appearance, with petechial haemorrhages on the cortical surfaces, consistent with haemolytic uraemic syndrome.

Discussion

Moderate or even mild haemolysis may not only cause pseudohyperkalaemia but could also mask clinically important hypokalaemia, if the potassium concentration is within the reference range. Because of this, many laboratories regard potassium concentrations in

haemolysed samples to be clinically invalid and unreliable and do not report them. Such a policy may be considered prudent because the cause of haemolysis in most cases is in vitro.

Potassium concentrations are reported inconsistently in UK hospital laboratories: results may not be issued by some or released with specific provisos by others (for example, "sample haemolysed suggest repeat"). Such provisos are useful but vague. Three repeats in our case did not yield any further information. Some clinicians may be unaware that potassium concentration can be measured with analytical accuracy in haemolysed samples. Results from in vivo haemolysis, however, may be treated in the same way as in vitro haemolysis and therefore suppressed by the laboratory analyser or computer. Point of care testing analysers may also suppress potassium in haemolysed samples, reinforcing the perception that potassium in such conditions is analytically unobtainable, hence the assumption by the clinical team that communication with the laboratory was unwarranted. In the context of our case, availability of potassium, which had probably risen acutely in a relatively short period of time, could have led to earlier treatment with dialysis.

Repeating analyses taking all necessary precautions to avoid in vitro haemolysis is important. This can be achieved by taking blood in a lithium heparin container, transporting it to the laboratory without mechanical agitation (for example, avoiding air tube transport), and immediate separation of plasma from cells. When haemolysis occurs in vitro, repeats will usually not be haemolysed. However, if haemolysis persists and in vivo haemolysis is suspected or known, as in our case, then clinicians must liaise with laboratory staff about the need for potassium measurement in these haemolysed samples. In such cases, good liaison between clinicians and laboratory staff is paramount and would ensure availability and best clinical use of potassium results that could be of crucial importance. Laboratories may also play an important part by formulating appropriate procedures (for example, automatic computer prompts or provisos) to over-ride the suppression of potassium results in carefully taken but persistently haemolysed repeat samples and alert clinicians to the possibility of in vivo haemolysis in such cases.

We thank Adel AA Ismail, now retired consultant in clinical chemistry and chemical endocrinology.

Contributors: AI had the original idea. AI and WS wrote the paper. WS searched for references. JS and GB revised the manuscript on numerous occasions. AI is guarantor.

Funding: None.

Competing interests: None declared.

1 Mather A, Mackie NR. Effect of haemolysis on serum electrolyte values. *Clin Chem* 1960;6:227–33.

2 Frank JJ, Bermes EW, Bickel MJ, Watkins BF. Effect of in vitro haemolysis on chemical values for serum. *Clin Chem* 1978;11:1966–70.

3 Kerr DJ, McAlpine Dagg LJ. Pseudohyperkalaemia. *BMJ* 1985;291:890–1.

4 World Health Organization. *Use of anticoagulants in diagnostic laboratory: stability of blood, plasma and serum samples*. Geneva: WHO, 2002. (WHO/DIL/LAB 99.)

(Accepted 24 November)

Potassium measurements should be requested and reported in cases of in vivo haemolysis

Rheumatology Department, Stepping Hill Hospital, Stockport SK2 7JE

Abbas Ismail
consultant
rheumatologist
Wendy Shingler
specialist registrar in
rheumatology

Jeff Seneviratne
consultant clinical
scientist

Gillian Burrows
consultant chemical
pathologist

Correspondence to:
A Ismail
abbas.ismail@
stockport-tr.nwest.
nhs.uk

BMJ 2005;330:949