

A Case of Pseudohyperkalaemia and Thrombocytosis

T G Seah,**MBBS, M Med (Anaes)*, T W K Lew,***FAMS, M Med (Anaes), EDIC*, N M Chin,****FAMS, MBBS, M Med (Anaes)*

Abstract

An unusual cause of 'hyperkalaemia' was observed in a neurosurgical patient admitted to our intensive care unit. The cause of the hyperkalaemia was not known initially and treatment with cation ion exchange resin was initiated to lower the elevated serum potassium level. The concurrent occurrence of thrombocytosis and hyperkalaemia raised the possibility of pseudohyperkalaemia associated with thrombocytosis. Simultaneous measurement of plasma and serum potassium with the Hitachi 917 Analyzer (indirect ion selective electrode, coefficient of variation = 1% to 2%) confirmed the diagnosis. Correlation between thrombocytosis and pseudohyperkalaemia was found to be highly significant ($r = 0.54$; $P = 0.014$). It is estimated that for every $100 \times 10^9/L$ of platelets, an increase of 0.07 to 0.15 mmol/L of potassium is expected. In thrombocytosis, plasma rather than serum potassium should be measured.

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Key words: Nosocomial pneumonia, Plasma, Reactive thrombocytosis, Serum potassium

Introduction

Hyperkalaemia is a common biochemical derangement in the intensive care unit reflecting a diversity of systemic perturbations such as acute renal failure, rhabdomyolysis, extracellular ionic shift from acid-base anomalies and tissue trauma. We report a rare and erstwhile unencountered cause of serum hyperkalaemia in our intensive care unit (ICU), which was determined to be due to pseudohyperkalaemia from reactive thrombocytosis.

Case Report

A 45-year-old previously healthy man was admitted to our ICU after acute non-traumatic coma due to intracerebral haemorrhage. On the second week of hospitalisation, he developed nosocomial pneumonia. During this period, there was progressive increase in platelet count from day 7 ($220 \times 10^9/L$) to day 16 ($1100 \times 10^9/L$). Thrombocytosis was attributed as reactive to pulmonary sepsis. Concurrently, there was elevation in the patient's serum potassium level, which peaked on day 16 (6.2 mmol/L). This was the only biochemical abnormality in the patient's daily electrolyte panel. Systemic review was negative for acidemia, acute tubular necrosis, rhabdomyolysis or extraneous potassium administration. Random serum cortisol level was elevated and consistent with a normal adrenal response to stress. Oral cation exchange resin (Resonium A, Pharma Science,

Montreal, Canada) therapy was initiated on day 16. A literature search for possible causes of hyperkalaemia in this patient was initiated. This revealed the possibility of thrombocytosis associated pseudohyperkalaemia. On day 20, simultaneous measurements of plasma and serum potassium were conducted on blood samples collected in a heparinised syringe and plain tube respectively. Both were measured by Hitachi 917 Analyzer (indirect ion selective electrode, coefficient of variation = 1% to 2%). Serum potassium was 5.4 mmol/L while plasma potassium was 4.2 mmol/L. The difference of 1.2 mmol/L was consistent with the diagnosis of pseudohyperkalaemia. Cation ion exchange resin was stopped. An analysis of the patient's daily serial platelet count and serum potassium level revealed a close correlation between the two investigations (correlation coefficient, $r = 0.543$; $P = 0.014$) (Fig. 1). Subsequent platelet count and serum potassium levels normalised on resolution of sepsis.

Discussion

Pseudohyperkalaemia, defined as serum to plasma potassium difference greater than 0.4 mmol/L, occurs when platelets, leukocytes or erythrocytes release intracellular potassium *in vitro* leading to falsely elevated serum values.¹ It has also been described following the practice of repeated clenching and unclenching of fist during venipuncture.² The association of pseudohyper-

* Registrar

** Consultant and Co-Director Neurological Intensive Care Unit

*** Consultant

Department of Anaesthesia

Tan Tock Seng Hospital

Address for Reprints: Dr T G Seah, Department of Anaesthesia, Tan Tock Seng Hospital, Moulmein Road, Singapore 308433.

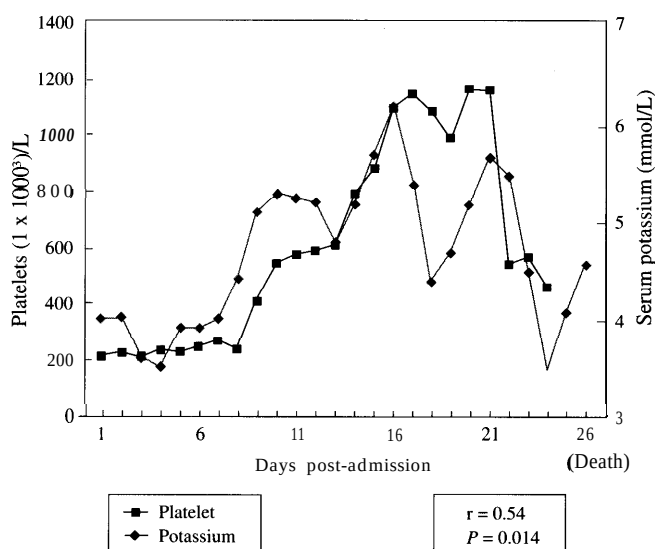


Fig. 1. Platelet and serum potassium.

kalaemia with thrombocytosis was first described by Hartmann et al in 1957.³ They described patients with myeloproliferative diseases and platelet counts as high as $2000 \times 10^9/L$ with serum potassium level exceeding 10 mmol/L with no electrocardiographic changes. Plasma potassium was normal in these patients.

In vitro elevated serum potassium level in the presence of thrombocytosis is attributed to the release of potassium by platelets during *in vitro* clotting of blood specimen prior to measurement. Nijsten et al⁴ demonstrated that the increase in serum potassium can be totally accounted for by release of intracellular potassium in platelets measured by atomic absorption spectroscopy by Makino et al.⁵ It was also demonstrated that the release of potassium occurs during the clot retraction phase and not the aggregation phase of platelets during blood clotting.⁶

The difference between serum and plasma potassium levels in a blood sample is affected by the amount of potassium released by the platelets and the volume of distribution of the released potassium.⁷ It has been estimated that for every 100×10^9 platelets per litre, an increase of 0.07 mmol/L to 0.15 mmol/L can be measured.^{4,8} Larger platelets are associated with greater release of intracellular potassium. Hartmann et al³ reported a patient with megakaryocytic leukaemia and pseudohyperkalaemia (serum potassium 10 mmol/L) associated with a platelet count of only $642 \times 10^9/L$. However, in most instances, the size of platelets does not seem to vary much significantly between individuals. The amount of potassium released from platelets during *in vitro* clotting and the rapidity of release may also

depend on the cause of thrombocytosis. It has been suggested that potassium release occurs more readily in patients with myeloproliferative disorders than in normal patients. Whether the observed difference in the degree of pseudohyperkalaemia with different types of thrombocytosis is due to difference in the speed of degranulation or absolute difference in the fractional potassium release is not known. In the former case, the extent of pseudohyperkalaemia will depend on standing benchtime of the sample before the serum is separated and measured. The volume of distribution of the released potassium is inversely proportional to the haematocrit. Thus, for the same level of platelets, a higher haematocrit will result in a higher increment of potassium in the serum sample due to a small volume of distribution.

The clinical implications of interpreting serum potassium levels in patients with thrombocytosis are significant if **unrecognised** in the ICU. Pseudohyperkalaemia may be erroneously treated, resulting in iatrogenic hypokalaemia with its attendant complications. Conversely, genuine hypokalaemia may be **unrecognised**. Differences will also exist between plasma potassium measured by point-of-care analysers using heparinised blood samples, compared with serum potassium using clotted blood measured in the main laboratory. This may pose difficulties in analysing trends or be wrongly interpreted as a quality assurance issue in point-of-care analysers. When in doubt, we recommend the measure of plasma potassium in this group of patients.

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