The incidence, severity, timing and circadian variation of hypophosphataemia in Glasgow Royal Infirmary Intensive Care Unit

CJ Gilhooly*, S Mackie*,M. Shaw*, D O'Reilly†, J Kinsella*
*Section of Anaesthesia, Pain & Critical Care Medicine, Division of Developmental Medicine, Faculty of Medicine - University of Glasgow, Level 2, QEB, Glasgow Royal Infirmary,10 Alexandra Parade, Glasgow G31 2ER
†Glasgow Royal Infirmary, 84 Castle St, Glasgow, G4 0SF

Background

Hypophosphataemia is a common treatable problem in the Intensive Care Unit (ICU), and can be indicative of many pathophysiological processes that occur in critical illness. Many processes that occur in critical illness will have an effect on phosphate concentrations in ICU admissions. In normal patients there is a well defined circadian effect on phosphate concentrations that is secondary to the Parathyroid hormone axis[1].

Aims

The objectives of this audit were to quantify the incidence, severity and timing of hypophosphataemia in Glasgow Royal Infirmary Intensive Care Unit. Namely the incidence of hypophosphataemia on admission to ICU and the incidence of hypophosphataemia that develops following admission. In addition, we aimed to examine the effect of timing of blood samples and see if this could potentially influence the diagnosis of hypophosphataemia.

Methods

A retrospective audit of data entered in computerised medical record database (CareVue) from of all admissions between 27/04/2006 (when the electronic record was initiated) and 07/07/2008. The time, date and value of all serum phosphate concentrations were analysed. The phosphate concentrations of all patients were then analysed by time of day of sampling and day after admission. Abnormal phosphate concentrations in mmol/l were subsequently categorised as the following: critically low (< 0.3), low (<0.7), high (>1.5).

Results

689 of 795 patients admitted during this period had a serum phosphate recorded. The table below shows that the incidence of hypophosphataemia on admission to GRI ICU is 10% of which less than 1% is at a critical concentration. However, the incidence of hypophosphataemia during the whole of the ICU stay rises to 42% of admissions. 5% of ICU admissions get critical hypophosphataemia at some point during their ICU stay. 69% of these patients have a normal or high concentration of phosphate on admission, 19% have a low admission phosphate and 13% are admitted with a critically low phosphate concentration.

Phosphate Level	Admission N (%)	Minimum (at any time) N (%)
All	689	689
Critically low	4 (0.4%)	32 (5%)
Low	69 (10%)	289 (42%)
Normal	364 (53%)	311 (45%)
High	256 (37%)	89 (13%)

Results

Table: Diurnal variation of phosphate concentrations

Phosphate Sample Time	n	Minimum Mmol/l	Maximum Mmol/l	Mean Mmol/l	Standard Error of Mean
Midnight to 04:00	257	0.29	4.15	1.36	.039
04:00 to 08:00	4936	0.21	4.3	1.62	.006
08:00 to 12:00	3124	0.21	4.3	1.17	.008
12:00 to 16:00	1946	0.21	4.01	1.86	.010
16:00 to 20:00	381	0.21	4.87	1.34	.030
20:00 to Midnight	343	0.25	4.87	1.34	.035

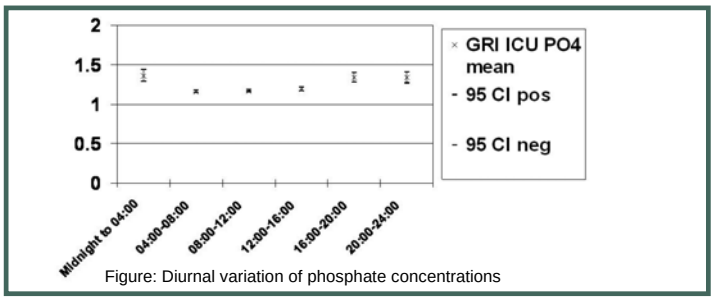

Figure: Diurnal variation of phosphate concentrations

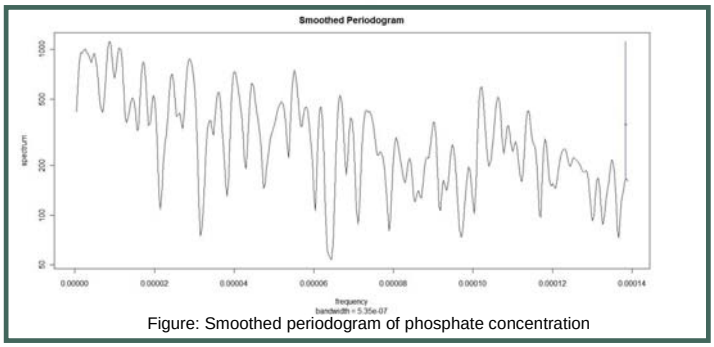

Figure: Smoothed periodogram of phosphate concentration

A total of 10,987 samples were analysed. Frequency (Fourier) analysis on all data showed two peaks. The predominant (fundamental frequency) showed a periodicity of 25 hours, a second lesser fundamental frequency showed a periodicity of 2.5 hours.

Conclusion

Hypophosphatemia is common in ICU admissions. Most commonly it develops subsequent to admission to ICU and reaches critical levels in 5% of ICU admissions. The timing of this fall in phosphate may indicate specific pathophysiological processes and merits further investigation. There continues to be a circadian variation in phosphate concentrations in ICU. This shows different characteristics to the normal rhythms but sample time can still influence phosphate concentrations, and subsequent diagnosis of abnormal phosphate concentrations.

References
1. Fraser, WD et al.: Clinical Endocrinology 1994; 40: 523-528