ORIGINAL ARTICLES

CHANGES IN SERUM ELECTROLYTES IN BLOOD TRANSFUSED AND NON-TRANSFUSED POST-OPERATIVE PATIENTS AT A NATIONAL REFERRAL HOSPITAL IN GHANA

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Abstract

Background: Red blood cell transfusion among patients is an essential part of medical care, and can be life-saving. This study therefore determined changes in serum electrolyte in blood transfused and non-transfused post-operative patients at the Korle-Bu Teaching Hospital (KBTH) in Ghana.

Methodology: This was a hospital-based longitudinal study involving 160 female patients aged 18- 70 years admitted to the KBTH and screened pre-operatively. In all 92 general surgical and gynaecological adult patients who met the inclusion criteria were studied post-post operatively. Data abstraction form was used for data collection on demographic, weight and serum electrolytes. Categorical data were analysed using chi-square. Independent t-test was used to compare the means for the two groups, while the paired t-test was used to compare the means for the immediate post-operative and 24 hours post-operative period, using SPSS version 23.0 software.

Results: In the transfused patients, serum levels of sodium ($p= 0.297$), Chloride ($p= 0.143$), and calcium ($p= 0.368$) increased, while potassium ($p= 0.383$) and magnesium ($p= 0.147$) levels decreased after transfusion; although not statistically significant. However, there was a significant decrease in serum levels of sodium ($p= 0.040$), potassium ($p= 0.001$), and magnesium ($p= 0.026$) in non-transfused patients 24 hours post operatively. Hypomagnesemia was observed among the transfused patients in this study (pre-transfusion, 0.66±0.05 vs. post transfusion, 0.57±0.04, $p= 0.147$)

Conclusion: Blood transfusion corrected serum electrolyte levels in patients after surgery. Serum electrolytes monitoring is clinically useful in post-operative patients in this large referral hospital.

Key Words: *serum electrolytes, blood transfusion, adult surgical patients, post-operative period, Sub-Saharan Africa.*

Background

Blood transfusion and conservation techniques are increasingly becoming an essential part of the holistic management of the surgical patients. The national requirement for blood in Ghana is estimated to be 1% of the total population of 25 million, amounting to about 250,000 units, based on the 2010 National Population and Housing Census[1].

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Red blood cell transfusion is an essential part of medical care, can be life-saving among patients[2]. Medically appropriate use of blood transfusions means using red blood cells only for the prevention of mortality in patients who cannot be saved with other methods other than with blood transfusion[2]. Globally, it is estimated that 85 million red blood cell units are transfused yearly[3]. Red blood cell (RBC) transfusion is commonly required in critically ill and post-operative patients. Due to the frequency of use of this intervention, it is essential for health providers at the intensive care and post-operative units and wards of health facilities to be abreast with current developments in this evolving field of transfusion medicine and the clinical consequences for patients[4].

When deciding to transfuse, it is essential to consider that despite the advances made in blood transfusion practices, complications still exist. Potential risks of RBC transfusions include infection, metabolic and cardiovascular complications, hypothermia, iron overload, and graft-versus-host disease[5]. Massive transfusion in adults, is the replacement of more than a litre of blood volume in 24 hours or greater than 50% of blood volume in four hours (adult blood volume is approximately 70 mL/kg)[5].

Overall, the metabolic complications or consequences of blood transfusion include citrate toxicity, hyperkalemia, and hypothermia. These complications are most commonly observed during large-volume infusions[6]. In addition, during storage, RBCs leak potassium into the plasma or additive solution. This relatively little amounts of potassium load rarely causes problems in small volume transfusions. This is mainly due to post-transfusion rapid dilution and redistribution into cells of the body. On the other hand, rapid infusion of RBCs (> 1 litre) into patients with cardiac, hepatic, or renal dysfunction absolutely requires close monitoring and observation[7,8].

The safety of transfusing whole blood and red blood cells (RBCs) after longer durations of refrigerated storage has been identified as “the most critical issue facing transfusion medicine”[9]. A large observational study of post-operative cardiac surgery patients found an increased risk of postoperative complications and reduced survival in those who received RBCs stored for more than 14 days[10]. Clinical consequences have been reported in some epidemiologic studies of transfusions of RBCs stored for longer durations[11,12].

It has been reported that complications such as hyperkalaemia, hyponatraemia and citrate toxicity may follow blood transfusion of stored blood[13]. When blood is stored in the blood banks or refrigerators on the wards, there is slow but constant leakage of potassium from the red blood cells into the surrounding plasma milieu along a concentration gradient due to the failure of the sodium potassium ATPase pump[13]. The plasma level of potassium may increase by 0.5-1 mmol/L per day of refrigerated or stored blood. Thus the longer the duration of storage the higher the level of extracellular potassium levels. Upon transfusion, the extracellular potassium is also infused which creates a transient increase in plasma potassium in the recipient.

Massive blood transfusion (especially with blood stored for longer periods) may thus cause hyperkalaemia and hyponatraemia in the patient[14]. Plasma potassium level is linked to plasma levels of electrolytes such as sodium, magnesium, calcium and others, and thus derangement in potassium level affects the levels of these electrolytes during massive transfusion.

The need for blood transfusion for both surgical and non-surgical patients in hospitals is steadily increasing whereas the availability of allogeneic blood is lagging far behind[1]. Some of the major operations conducted in this large tertiary hospital (KBTH) require large volume transfusions. However, little has been published on the effect of large volume transfusion on electrolyte changes of post-operative patients in Sub-Saharan Africa, especially in Ghana.

The aim of this study was to investigate the effect of large volume transfusion on electrolyte changes of post-operative patients in a national referral centre in Ghana. The goal is to potentially provide a guide to electrolyte management in the post-operative period in surgical patients in this large referral hospital in Ghana.

Methodology

Study Design and Study Site

This is a hospital-based longitudinal study comparing transfused and non-transfused female patients, conducted at the main Surgical Theatre and the Gynaecological Theatre of the Korle-Bu Teaching Hospital (KBTH), over a three months period in 2017. Korle-Bu Teaching Hospital is a tertiary referral centre located in the National capital of Ghana, Accra. With 2000 bed capacity and twelve different departments. The general surgical out-patient clinic attends to a high number of patients, (over 15,512 out-patients, constituting 43% of the total hospital out-patients in 2013). The most common surgical diagnoses for admission are hernia, appendicitis and breast cancer, while myomectomies and Total abdominal Hysterectomy are the most common Gynaecological operations[15]. In addition, the Department of Anaesthesia of KBTH delivers over 12000 anaesthetics annually.

Study Population and sampling

We recruited adult females aged 18-70 years at the general surgical and gynaecological departments booked for laparotomy (including myomectomy and total abdominal hysterectomy) admitted to the KBTH. Female patients were selected due to the type of surgical interventions. Patients admitted for emergency surgeries, those with known chronic kidney and chronic liver disease were excluded. In this study, a transfused patient was one who received at least a litre of whole blood or one blood volume loss in 24 hours, and a general surgical patient is one who had laparotomy.

The study compared two populations, transfused and non-transfused surgical (general and gynaecological). Hyponatremia is one of the most common electrolyte disorder in transfused patients, and been reported to occur in about 30–40% of hospitalized patients [16]. Using the difference in proportions sample size determination, based on 40% rate of hyponatremia in transfused patients, and assuming a hyponatremia rate of 10% in non-transfused, at 95% confidence interval and power of 95%, a final sample of 46 transfused and 46 non-transfused patients were recruited in each category for the study (i.e. total sample size of 92). A total of 160 female patients aged 18- 70 years admitted to the KBTH were screened pre-operatively and 92 patients who met the inclusion criteria were studied post- operatively.

Patients were recruited by simple random sampling technique from the main surgical and gynaecological wards of the hospital, after informed consent. A maximum number of six (3 general surgical and 3 gynaecological) subjects were selected daily by balloting and comparable number of non-transfused patients were selected accordingly. These numbers gave enough time for the abstraction of information and increased the time period over which patients were selected aimed at increasing variability in patients' characteristics. The study tried to limit the influences of intra-operative events (type of surgery, type of anaesthesia used etc) by taking the baseline serum electrolyte for both groups in the immediate post-operative period.

Data Collection Methods

An abstraction form was used for record of data collected and solicited information on the demographic characteristics and weight of patients. Determination of serum electrolytes was done among transfused patients, pre-transfusion and 24 hour post-transfusion, while in the non-transfused patients, serum electrolytes were determined immediate post –operatively and 24 hour post operatively. The rational was to enable comparability in serum electrolytes at these periods post-operatively for transfused and non-transfused patients.

All transfused patients received whole blood. To control for or avoid the influence of other fluids given to the patients and how much did each patient get of what type of fluid intra-operatively, the baseline serum electrolytes were measured immediate post Operatively and was then compared with the measurements 24-hour post operatively.

Samples for serum electrolyte determination were taken under strict aseptic conditions. Three (3) millilitres of blood was obtained each time from the brachial vein using a vacutainous needle into gel separator tubes. Shaking or agitation of the tubes was avoided to prevent haemolysis of the sample. Samples obtained were kept in an ice-chest and within two (2) hours of collection, were sent to the laboratory for separation and analysis of serum concentrations of sodium, potassium, chloride, calcium and magnessium.

Measurements

All electrolyte determinations were done at Korle-Bu Polyclinic Laboratory, of the KBTH. Blood samples were centrifuged and serum separated into cryotubes (at -20 degree). Analysis of electrolytes were done using an automated Mindray chemistry analyzer. Serum electrolyte levels were determined using atomic absorption methods and analysed within 24 hours of sample collection. Each unit of blood was transfused slowly to patients over a four hour period. Among the transfused patients, no pre-medications were administered.

In this study, massive transfusion in adults is the replacement of more than a litre of blood volume in 24 hours or greater than 50% of blood volume in four hours in a patient; hyperkalaemia was defined as a serum potassium level greater than 5.0 mmol/L; hypokalaemia was defined as less than 3.5 mmol/L; hyponatraemia was defined as below 135mmol/L; and hypomagnesemia and was defined as less than 1.7 mg/dL (0.7 mmol/L).

Data Handling and Analysis

Strict confidentiality was maintained during and after the study. To anonymise and protect the data, respondents were represented with codes and data was kept in locked cabinets and computer files on personal laptop computer which was password protected.

Data were captured using Microsoft Excel 2013 Database and analysed using SPSS statistical software version 23.0. Categorical variables were summarized as frequencies and percentages, and continuous variables were summarized as means and standard deviations. Chi square was used to test for associations between categorical variables. Independent t-test was used to determine significant differences in serum electrolytes levels in transfused and non-transfused patients. Paired t-test was used to test significant differences in serum electrolytes at the initial time period and at 24 hours within each group. Significance level was set at 95% (p-value < 0.05).

Ethical Issues

Ethical approval was obtained from the Ethical and Protocol Review Committee of the College of Health Sciences, University of Ghana (protocol approval number: CHS. Et/M.8-P3.1/2016-2017) as well as the Institutional Review Board of the Korle-Bu Teaching Hospital (protocol approval number: KBTH-IRB/00017/2017). All adult patients admitted for surgery to the surgical and gynaecological theatres in KBTH were informed about the study and consent sought for data abstraction for the study on the wards. Patients provided written informed consent duly administered and witnessed before data abstraction from patients' medical records.

Results

Demographic and clinical characteristics of patients

In all, 92 participants (patients) were involved in the study (46 were patients who received blood transfusion within 24 hours after surgery, and 46 were patients who did not receive blood transfusion after surgery). The mean age of the transfused patients was 42.9 ± 15.1 year and that of non- transfused patients (41.4 ± 9.2 years). Age of patients ranged from 22- 70 years in transfused patients and 22- 62years in the non-transfused.

The mean weight in transfused patients was 73.8 ± 22.1kg and that of non- transfused patients (71.5 ± 17.9kg). The weight of patients ranged from 47- 134kg in transfused patients and 39- 120kg in non-transfused patients.

The most common surgical operation was Laparotomy, 21 (46.7%), followed by Hysterectomy 6 (13.3%) in the transfused patients, while Total Abdominal Hysterectomy, 19 (41.3%) and Myomectomy, 18 (39.1%) were the common surgical operation in the non-transfused patients.

Serum Electrolyte changes in the Transfused patients

Table 1 shows the pre-transfusion and 24 hour post transfusion mean serum levels of the sodium, potassium, chloride, calcium and magnesium. Compared to pre-transfusion levels, the 24 hour post transfusion serum levels of sodium, chloride and calcium increased by 2.88± 2.66 mmol/L, 5.77± 3.87 mmol/L and 0.04± 0.04 mmol/L respectively. While the 24 hour post transfusion serum levels of potassium and magnesium decreased compared to pre-transfusion levels by 0.18± 0.20 mmol/L and 0.08± 0.06 mmol/L respectively. These differences were however, not statistically significant as shown in table 1.

Table 1: Serum Electrolyte changes before and after transfusion in post-operative patients at the Korle-Bu Teaching Hospital (N= 46)

Serum Electrolyte (mmol/L)	Mean	Standard Error	Paired t-test	P-value	Confidence Interval
Serum Sodium (Na^+)					
Na^+ level pre-transfusion	138.64	2.46	-1.056	0.297	133.685 - 143.597
Na^+ level 24 hours post-transfusion	141.44	0.77			139.886 - 143.004
Difference (means)	-2.80	2.66			-8.156 - 2.547
Serum Potassium (K^+)					
K^+ level pre-transfusion	3.88	0.16	0.880	0.383	3.547 - 4.211
K^+ level 24 hours post-transfusion	3.70	0. 12			3.452 - 3.943
Difference (means)	0.18	0.20			-0.234 - 0 .598
Serum Chloride (Cl^-)					
Cl^- level pre-transfusion	104.17	4.18	-1.490	0.143	95.760 - 112.583
Cl^- level 24 hours post-transfusion	109.94	0.96			108.013 - 111.875
Difference (means)	-5.77	3.87			-13.576 - 2.032
Serum Calcium (Ca^{2+})					
Ca^{2+} level pre-transfusion	1.57	0.02	-0.910	0.368	1.540 - 1.607
Ca^{2+} level 24 hours post-transfusion	1.61	0.03			1.545 - 1.675
Difference (means)	-0.04	0.04			-0.117 - 0 .044
Serum Magnesium (Mg^{2+})					
Mg^{2+}level pre-transfusion	0.66	0.05	1.475	0.147	0.547 - 0.763
Mg^{2+}level 24 hours post-transfusion	0.57	0.04			0.485 - 0.657
Difference (means)	0.08	0.06			-0.031 - 0.199

Electrolyte changes in the Non- Transfused patients

Among the non-transfused, mean levels of all the serum electrolytes decreased when measured at the 24 hour post operatively compared to the baseline values i.e. the immediate post-operative period. These decreases in levels were statistically significant for sodium, potassium, and magnesium.

As depicted in Table 2, the mean level of Na decreased from 140.27 mmol/L baseline to 137.72 mmol/L (24 hours post-operation) , (*P*< *0.040*), serum level of Chloride decreased minimally from 107.99 mmol/L to 107.43 mmol/L, (*P*< *0.600*) and mean serum level of Calcium decreased from 1.68 mmol/L to 1.64 mmol/L (*P*< 0.133)

Similarly, mean level of serum potassium decreassed from 3.88 mmol/L to 3.57 mmol/L (*P*< *0.001*) and mean serum level of Magnessium decreased 0.82 mmol/L to 0.71 mmol/L (*P*< *0.026*).

Table 2: Serum Electrolyte changes in the immediate and 24 hours post-operative period in non-transfused surgical patients at the Korle-Bu Teaching Hospital (N= 46)

Serum Electrolyte (mmol/L)	Mean	Standard Error	Paired t-test	P-value	Confidence Interval
Serum Sodium (Na^+)					
Na^+ immediate post-operation	140.27	1.07	2.117	**0.040**	138.117 - 142.422
Na^+ level 24 hours post-operation	137.72	1.22			135.263 - 140.176
Difference (means)	2.55	1.21			0.124 - 4.979
Serum Potassium (K^+)					
K^+ immediate post-operation	3.88	0.08	3.783	**0.001**	3.727 - 4.038
K^+ level 24 hours post-operation 24 hours post-operation	3.57	0.07			3.429 - 3.700
Difference (means)	0.32	.08			0.148 - 0.486
Serum Chloride (Cl^-)					
Cl^- immediate post-operation	107.99	0.95	0.528	0.600	106.076 - 109.901
Cl^- level 24 hours post-operation	107.43	1.06			105.291 - 109.578
Difference (means)	0.55	1.05			-1.561 - 2.669
Serum Calcium (Ca^{2+})					
Ca^{2+} immediate post-operation	1.68	0.02	1.529	0.133	1.643 - 1.725
Ca^{2+} 24 hours post-operation	1.64	0.02			1.600 - 1.686
Difference (means)	0.04	0.03			-0.013 - 0.094
Serum Magnesium (Mg^{2+})					
Mg^{2+}immediate post-operation	0.82	0.06	2.294	**0.026**	0.693 - 0.955
Mg^{2+} 24 hours post-operation	0.71	0.05			0.604 - 0.808
Difference (means)	0.12	0.05			0.014 - 0.221

Baseline (immediate post-operative period) serum electrolyte levels in blood transfused and non-transfused patients

Table 3 demonstrates that the baseline serum levels of all the five measured electrolytes (sodium, potassium, chloride, calcium and magnesium) were relatively higher in the non-transfused compared to those who later got transfused. The baseline serum calcium levels was (1.68 mmol/L) in the non-transfused compared to (1.57 mmol/L) in the transfused patients, (*P*< *0.001*). Similarly, the baseline serum magnesium levels was (0.82 mmol/L) in the non-transfused compared to (0.17mmol/L) in the transfused (*P*< *0.048*).

The 24-hour post transfusion and 24-hour post-operative serum electrolyte levels in transfused and non-transfused patients

The levels of all measured serum electrolytes with the exception of magnessium were higher in the transfused group compared to the non-transfused. The serum level of sodium was 141.44 mmol/L in the transfused patients compared to 137.72 mmol/L in the non-transfused, ($P < 0.012$), serum levels of Potassium was 3.69 mmol/L in transfused patients compared to 3.56 mmol/L in the non-transfused, ($P < 0.345$). The levels of Chloride and calcium were both higher in the transfused patients compared to the non-transfused, though not significant. The serum level of magnesium was however, significantly lower in the transfused patients (0.66 mmol/L), compared to the non-transfused patients, (0.82 mmol/L ($P < 0.045$) as shown in Table 4.

Table 3: Baseline (immediate post-operative period) serum electrolyte levels in blood transfused and non-transfused patients in the Korle-Bu Teaching Hospital

Serum Electrolyte (mmol/L)	Mean	Standard Error	Two-sample t-test	P-value	Confidence Interval
Serum Sodium (Na^+)					
Transfused	138.64	2.46	-0.607	0.545	133.685 - 143.597
Non-transfused	140.27	1.07			138.117 - 142.422
Combined (N= 92)	139.45	1.34			136.800 - 142.110
Difference (means)	-1.63	2.68			-6.958 - 3.701
Serum Potassium (K^+)					
Transfused	3.87	0.16	-0.018	0.986	3.547 - 4.211
Non-transfused	3.88	0.08			3.727 - 4.038
Combined (N= 92)	3.88	0.09			3.701- 4.060
Difference (means)	-0.01	0.18			-0.365 - 0.359
Serum Chloride (Cl^-)					
Transfused	104.17	4.18	-0.891	0.375	95.760 - 112.583
Non-transfused	107.99	0.95			106.076 - 109.901
Combined (N= 92)	106.08	2.14			101.831 - 110.329
Difference (means)	-3.82	4.28			-12.325 - 4.692
Serum Calcium (Ca^{2+})					
Transfused	1.57	0.02	-4.237	**0.001**	1.539 - 1.607
Non-transfused	1.68	0.02			1.643 - 1.725
Combined (N= 92)	1.63	0.01			1.600 - 1.657
Difference (means)	-0.11	0.03			-0.163 - -0.059
Serum Magnesium (Mg^{2+})					
Transfused	0.65	0.05	-2.003	**0.048**	0.547 - 0.763
Non-transfused	0.82	0.06			0.693 - 0.955
Combined (N= 92)	0.74	0.04			0.65 - 0.825
Difference (means)	-0.17	0.08			-0.336 - -0.001

Table 4: The 24-hour post transfusion and 24-hour post-operative serum electrolyte levels in transfused and non-transfused patients

Serum Electrolyte (mmol/L)	Mean	Standard Error	Two-sample t-test	P-value	Confidence Interval
Serum Sodium (Na^+)					
Transfused	141.44	0.77	2.579	**0.012**	139.887 - 143.004
Non-transfused	137.72	1.22			135.263 - 140.176
Combined (N= 92)	139.58	0.74			138.104 - 141.061
Difference (means)	3.726	1.44			0.856 - 6.596
Serum Potassium (K^+)					
Transfused	3.69	0.12	0.949	0.345	3.452 - 3.943
Non-transfused	3.56	0.07			3.429 - 3.701
Combined (N= 92)	3.63	0.06			3.493 - 3.769
Difference (means)	0.13	0.14			-0.144 - 0.409
Serum Chloride (Cl^-)					
Transfused	109.94	0.96	1.7519	0.083	108.013 - 111.875
Non-transfused	107.43	1.06			105.291- 109.578
Combined (N= 92)	108.69	0.72			107.251 - 110.128
Difference (means)	2.51	1.43			-0.336 - 5.355
Serum Calcium (Ca^{2+})					
Transfused	1.61	0.03	-0.879	0.382	1.544 - 1.675
Non-transfused	1.64	0.02			1.601 - 1.686
Combined (N= 92)	1.63	0.01			1.588 - 1.665
Difference (means)	-0.03	0.04			-0.111- 0.043
Serum Magnesium (Mg^{2+})					
Transfused	0.63	0.05	-2.003	**0.045**	0.547 - 0.763
Non-transfused	0.82	0.06			0.693 - 0 .9548
Combined (N= 92)	0.74	0.04			0.654 - 0.824
Difference (means)	-0.19	0.08			-0.336 - -0.001

Discussion

There were more females in the study which is expected as it corresponds to pattern of utilisation of health services in general and in the Korle-Bu Teaching Hospital. Females in general tend to utilise health services more[15]. In addition, the two main study sites were the general surgical and gynaecological theatres. Those patients who required transfusion post operatively were slightly older than those who did not require transfusion. This result was expected, as older patients may tend to require correction for blood loses due to presence of some chronic conditions and dietary factors[8].

In general, serum levels of sodium, chloride and calcium increased after transfusion, while potassium and magnesium levels decreased after transfusion. It is known that hyponatremia is the most common electrolyte disorder and the prevalence of this complication following blood transfusion is estimated to be in the range of 30–40% of hospitalized patients[17]. However, hyponatremia usually develops when certain factors or underlying condition impairs the kidney's ability to excrete water. This clinical risk has been shown to be more pronounced in the postoperative period when non-osmotic stimuli such as nausea, pain, stress, and volume depletion lead to higher Adenosidetriphosphate (ADH) levels when compared to preoperative values[18].

The changes in serum potassium levels in this study is supported by a previous study conducted by Murthy which indicated that in blood transfusion, the relatively small potassium which leaks from the red blood cells into the plasma or additive solution rarely causes any clinical problems. The study observed that an extensive literature particularly in paediatrics which have reported deaths form hyperkalemia. Minor changes in the other serum electrolytes have also not been shown to cause any clinical problems. This is because of post-transfusion rapid dilution and redistribution into cells[8]. This post-transfusion rapid dilution and redistribution into cells may be the potential explanation for the results of the current study which measured post-transfusion potassium 24 hours after the transfusion. Murphy, and Carvalho however cautioned that rapid infusion of large volumes of RBCs into patients with cardiac, hepatic, or renal dysfunction mandates close monitoring[7,8].

Physiologically, the extracellular potassium concentration is determined by multiple factors (catecholamines, the renin–angiotensin–aldosterone system, glucose and insulin metabolism, as well as direct release from exercising or injured muscle). Catecholamine-associated intracellular potassium shifting is amply demonstrated when hyperkalaemia induced by hypothermia occurs[8].

One key observation is on the 24 hours post-transfusion level of magnesium (0.63 mmol/L) observed among the transfused patients in this study. This indicates hypomagnesemia by definition (i.e. values less than 0.7 mmol/L defined as hypomagnesemia). This was not the case among the non-transfused patients. Hypomagnesemia is associated with a two to three-fold increased mortality in critically ill and postoperative patients[19,20]. It has been observed that, the occurrence of hypomagnesemia in patients is frequently associated with derangement in other electrolytes such as hypokalemia and hypocalcaemia[20,21]. This association of hypomagnesemia with hypokalemia was however, not observed in the current study.

This observation indeed calls for the need to determine the levels of these electrolytes in the post-operative patient to limit the risk of mortality associated with hypomagnesemia in critically ill and postoperative patients.

In general, among the non-transfused patients, the levels of all the serum electrolytes sodium, potassium, chloride, calcium and magnesium decreased from the immediate post-operation to the 24 hours post-operative period. Overall these decreases in levels were statistically significant for sodium, potassium, and magnesium but were generally not below the normal levels. These changes in the serum electrolytes are potentially due to the physiological redistribution into the cells as noted by Murthy[8].

There was a relative increase in the levels of the serum electrolytes upon blood transfusion among the transfused patients particularly regarding potassium level. This is in agreement with a study by Opoku-Okrah and colleagues[13]. When blood is stored in the blood banks or refrigerators on the wards, there is slow but constant leakage of potassium from the red blood cells into the surrounding plasma milieu along a concentration gradient due to the failure of the sodium potassium ATPase pump[13]. Thus the potassium concentration of RBCs in stored blood is higher than the normal human plasma potassium level. Upon transfusion, the extracellular potassium is also infused which creates a transient increase in plasma potassium in the recipient. This increase may be transient and the level would normalize through the normal physiological process of redistribution into cells.

Massive blood transfusion (especially with blood stored for longer periods) may thus cause hyperkalaemia and hyponatraemia in the patient[14]. These were however, not observed in the current study probably due firstly to the time period when the electrolytes were measured (only once after the transfusion); some studies conducted these at more regular intervals (at four-hourly intervals)[13]. Secondly, this may probably be due to the duration of storage (i.e. demand for blood in this large teaching hospital is very high and does not allow for prolonged storage of blood at the national blood transfusion service centre or the blood bank of the teaching hospital[1] . A third reason is probably due to the volumes transfused (all transfused patients in this study received a litre or more (i.e. fits the definition of massive blood transfusion), the largest volume transfused for a patient in this study was four units). Emergencies and other types of surgeries may require much larger volumes for transfusion.

It should also be noted that this current study used patients booked for elective surgery, a relatively more stable group of patients. Assessment of emergencies and critically ill patients may lead to different findings.

Study limitations: The study tried to limit the influences of intra-operative events (type of surgery, type of anaesthesia used etc) by taking the baseline serum electrolyte for both groups in the immediate post-operative period. However, the measurement of the serum electrolytes in the transfused group was done only after 24 hours. Other studies conducted this immediately after transfusion (i.e. within minutes to few hours to observe the immediate haemodynamic and serum electrolyte changes) [13, 22]. In addition, the study did not did not consider the type and amount of fluids given during the post-operative period.

Conclusion

There was no significant changes in the levels of serum electrolytes among transfused patients, 24 hours after transfusion. It is however, worthy to note that, baseline serum electrolyte levels were lower in patients who were eventually transfused compared to non-transfused patients. Twenty-four hours post transfusion, serum sodium level was significantly elevated and serum magnesium level was significantly decreased among transfused compared to non-transfused patients. These observations, could serve as a guide to the management haemodynamic and electrolyte changes in the many patients who undergo surgery in this large referral hospital in Ghana.

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