Effect of Phosphate Level on the Outcome of Critically Ill Patients in the Intensive Care Unit

Ahmed Sakhawey[1], Samir Alawady[1] and Assem Abdel Razek[2]

[1.] Department of Critical Care Medicine, University of Alexandria, Egypt.
[2.] Department of Anesthesia and Surgical Intensive Care, University of Alexandria, Egypt.
drsakhawey@yahoo.com

Abstract: Background: Electrolyte disorders frequently develop in critically ill patients during course of stay in the intensive care unit (ICU). Hypophosphatemia is commonly encountered electrolyte disorder, for which many causative factors are present in critically ill patients. Therefore, routine detection and correction of hypophosphatemia in the intensive care unit is commonplace. Hypophosphatemia has been associated with a multitude of clinical effects and there are many associations between correction of hypophosphatemia and improvement in outcome. However, there is no evidence at present to support the rapid correction of hypophosphatemia in critically ill patients. **Aim of the work:** To evaluate the prognostic effect of the serum phosphorus level on the outcome in terms of duration of mechanical ventilation, need for inotropes, length of ICU stay, other morbidity and mortality in critically ill patients during their stay in the intensive care unit. **Methods:** This study was conducted on critically ill adult patients admitted to the Critical Care Medicine Department in the Alexandria Main University Hospital, to the Intensive Care Unit in Alexandria Armed Force Hospital and to the Intensive Care Unit in Karmuz Health Insurance Hospital in Alexandria for six months from June 2014 till November 2014, divided into two stages: Stage I: All included patients admitted from June 2014 till August 2014 were categorized into two groups according to serum phosphate level: patients with normal serum phosphate level (2.5 – 4.5 mg/dL) and patients with low serum phosphate level (<2.5 mg/dL) then were followed and compared regarding the primary outcome (discharge from ICU or death) and the secondary outcome (duration of mechanical ventilation, need for inotropes and length of ICU stay). Stage II: All included patients admitted from September 2014 till November 2014 having low serum phosphate level (<2.5 mg/dL) were included and subjected to phosphate regimen then were followed and compared with the previous groups of hypophosphatemia and normophosphatemia according to the primary outcome (discharge from ICU or death) and the secondary outcome (duration of mechanical ventilation, need for inotropes and length of ICU stay). **Results:** we found the worst parameters among the hypophosphatemia group of stage I as following: A mean length ICU stay was 8.675 days in hypophosphatemia group compared to 5.811 days in normophosphatemia group and to 6.551 days in hypophosphatemia after regimen group.Need for inotropes was 51.9% in hypophosphatemia group compared to 26.1% in normophosphatemia group and to 30.5% in hypophosphatemia after regimen group. Use of mechanical ventilation was 56.2% in hypophosphatemia group compared to 46.8% in normophosphatemia group and to 50.8% in hypophosphatemia after regimen group. A mean duration of mechanical ventilation was 4.401 days in hypophosphatemia group compared to 2.550 days in normophosphatemia group and to 3.814 days in hypophosphatemia after regimen group. Mortality rate was 44.9% in hypophosphatemia group compared to 23.5% in normophosphatemia group and to 33.1% in hypophosphatemia after regimen group. **Conclusion**: Hypophosphatemia is considered a common co-morbidity in critically ill patients in I.C.U. Maintain of normal serum phosphate level is considered an important parameter in measuring the outcome of critically ill patients in I.C.U. Hypophosphatemia can be asymptomatic and passes unnoticed but may be accompanied by fatal complications. Hypophosphatemia can affect the outcome by showing increased mortality, need for inotropes, duration of mechanical ventilation, and length of ICU stay. If Hypophosphatemia is developed, it should be diagnosed early and corrected as rapid as possible to prevent all its harmful effects.

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Keywords: hypophosphatemia, length of ICU stay, need for inotropes, duration of mechanical ventilation, morbidity, mortality.

1. Introduction

Electrolyte disorders frequently develop in critically ill patients during course of stay in the intensive care unit (ICU). Therefore, ICU patients are routinely monitored for electrolyte disorders, and it is common practice to correct them.[(1)] Hypophosphatemia is one of those frequently encountered electrolyte disorders, for which many causative factors are present in critically ill patients. It is uncertain when and how to correct

hypophosphatemia, and whether correction affects outcome in critically ill patients. [2]

Normal values of the total serum phosphate level are 0.80-1.45 mmol/L (2.5-4.5 mg/dL). Hypophosphatemia is defined as: serum phosphorus level below 2.5 mg/dL in adult and below 4 mg/dL in children.[3] Hypophosphatemia is usually subdivided into two categories: moderate hypophosphatemia defined as 0.32-0.65 mmol/L and severe hypophosphatemia as less than 0.32 mmol/L (<1 mg/dL).[4] The incidence of hypophosphatemia is high in critically ill patients, having been reported to be as high as 28%,[5] and is frequently noted in patients with severe trauma.[6]

Hypophosphatemiacan be caused by 3 different mechanisms:decreased intestinal absorption, increased renal excretion or internal redistribution of inorganic phosphate.[7] A common mechanism in hypophosphatemia – caused complications is impaired energy metabolism; leading to cellular dysfunction in multiple organ systems.[8] Hypophosphatemia may be associated with respiratory muscle dysfunction; resulting in acute respiratory failure and weaning problems[9] and also it can lead to myocardial dysfunction and arrhythmias.[10] Other effects include hematologic dysfunction,[11] insulin resistance,[12] number of neuromuscular symptoms, rhabdomyolysis and central pontinemyelinolysis.[13,14]

With the high prevalence of hypophosphatemia in critically ill patients, as well as their susceptibility to life threatening symptoms, frequent laboratory monitoring is recommended, especially in previously mentioned high risk groups. It is generally recommended to correct hypophosphatemia in hypophosphatemic patients with associated symptoms. [15]

2. Subjects

This study was conducted on critically ill adult patients admitted to the Critical Care Medicine Department in the Alexandria Main University Hospital, to the Intensive Care Unit in Alexandria Armed Force Hospital and to the Intensive Care Unit in Karmuz Health Insurance Hospital in Alexandria for six months from June 2014 till November 2014.

Inclusion criteria:

Critically ill patients ≥18 years old, with respiratory failure (due to chronic obstructive pulmonary disease, pneumonia and other causes), with diabetic ketoacidosis, with shock state, with cardiac cause (acute coronary syndrome, myocardial infarction, severe heart failure and others), with sepsis, with cerebrovascular strokes (either infarction or hemorrhage), with surgical cause (upper or lower gastrointestinal bleeding), with trauma, or postoperative critically ill patients.

Exclusion criteria:

Critically ill patients <18 years old, with chronic renal failure, on renal replacement therapy and regular haemodialysis, with malignancy, with advanced liver disease, with neuromuscular diseases, or received phosphate agents prior to study entry.

3. Methods

All patients were followed up and evaluated by:

1. Detailed history taking including age, sex, date of ICU admission, cause of admission and preexisting chronic disease.
2. Full clinical examination.
3. Severity of illness was assessed by using Acute physiology and chronic health evaluation II (APACHE II) score and Glasgow Coma Scale (GCS) on admission, and daily for one week to assess the severity of illness.[16]
4. Laboratory investigations included the followings:

- Liver function tests: Alanine amino transfers (ALT), Aspartame amino transferees (AST), serum bilirubin (total and direct), Prothrombin time, International normalization ratio (INR), and serum albumin (gm./dl).[17]
- Renal function tests: blood urea nitrogen (mg/dl) and serum creatinine (mg/dl).[18]
- Random blood sugar (in mg/dl).[19]
- Complete blood count (total and differential).[20]

5. ABG including pH, partial pressure of arterial CO_2 ($PaCO_2$ mmHg), partial pressure of arterial oxygen (PaO_2 mmHg) and bicarbonate level (HCO_3mmol/L).[21]
6. Serum electrolytes: Sodium (Na) mEq/L, potassium (K) mEq/L, Calcium (Ca) mg/dL and magnesium (Mg) mg/dL.[22]
7. Serum phosphorus level (mg/dL) (mmol/L): It was measured during the first 24 hours of admission. Serum phosphorus level was measured by using the phosphorus (PHOS) method on the Dimension® clinical chemistry system.[23]

All included critically ill adult patients were divided into two stages:

- Stage I: All included patients admitted from June 2014 till August 2014 were categorized into two groups according to serum phosphate level: patients with normal serum phosphate level (2.5 – 4.5 mg/dL)[3] and patients with low serum phosphate level (<2.5 mg/dL)[4] then were followed and compared regarding the primary outcome (discharge from ICU or death) and the secondary outcome (duration of mechanical ventilation, need for inotropes and length of ICU stay).
- Stage II: All included patients admitted from September 2014 till November 2014 having low

serum phosphate level (<2.5 mg/dL)[4] were included and subjected to phosphate regimen[3] then were followed and compared with the previous groups of hypophosphatemia and normophosphatemia according to the primary outcome (discharge from ICU or death) and the secondary outcome (duration of mechanical ventilation, need for inotropes and length of ICU stay).

4. Results

As regarding age, in the Hypophosphatemia in stage (I) group it ranged between 18-96 years with mean±S.D. 59.56±16.015 years, in the Normophosphatemia in stage (I) group it ranged between 18-91 years with mean±S.D. 60.85±15.781 years and in the Hypophosphatemia in stage (II) (after regimen) group it ranged between 18-89 with mean±S.D. 62.398±16.046 years. There was no statistically significant differences between Hypophosphatemia in stage (I) and Normophosphatemia in stage (I) groups where *P* =0.124 and there was no statistically significant differences between Hypophosphatemia in stage (I) and Hypophosphatemia in stage (II) (after regimen) groups where *P* =0.171 (P significant level at *P* less than 0.05).table (1).

As regarding sex, in the Hypophosphatemia in stage (I) group 128(69.2%) out of the patients was male while 57(30.8%) out of the patients was female, in the Normophosphatemia in stage (I) group it ranged between 151(68%) out of the patients was male while 71(32%) out of the patients was female and in the Hypophosphatemia in stage (II) (after regimen) group 73(61.9%) out of the patients was male while 45(38.1%) out of the patients was female. There was no statistically significant differences between Hypophosphatemia in stage (I) and Normophosphatemia in stage (I) groups where *P* =0.213 and there was no statistically significant differences between Hypophosphatemia in stage (I) and Hypophosphatemia in stage (II) (after regimen) groups where *P* =0.280 (*P* significant level at *P* less than 0.05). Table (1).

Table (1):- Comparison between the serum phosphate level groups as regarding demographic criteria.

	Serum phosphate level					
	Stage (I) Hypo-phosphatemia		**Stage (I) Normo-phosphatemia**		**Stage (II) Hypo-phosphatemia after regimen**	
Age						
Min.	18		18		18	
Max.	96		91		89	
Mean	59.56		60.85		62.398	
±S.D.	16.015		15.781		16.046	
***P*1**	0.124					
***P*2**	0.171					
Sex	**No.**	**%**	**No.**	**%**	**No.**	**%**
Male	128	69.2	151	68	73	61.9
Female	57	30.8	71	32	45	38.1
Total	185	100	222	100	118	100
***P*1**	0.213					
***P*2**	0.280					

P1 test of significant between Hypophosphatemia in stage (I) and Normophosph in stage (I),
P2 test of significant between Hypophosphatemia in stage (I) and Hypophosphatemia in stage (II) (after regimen)

As regarding APACHE II score, in the Hypophosphatemia in stage (I) group it ranged between 0-24 with mean±S.D. 15±8.245, in the Normophosphatemia in stage (I) group it ranged between 0-24 with mean±S.D. 12.126±7.919 and in the Hypophosphatemia in stage (II) (after regimen) group it ranged between 0-24 with mean±S.D. 13.87±6.876. There was statistically significant differences between Hypophosphatemia in stage (I) and Normophosphatemia in stage (I) groups where P=0.001 and there was statistically significant differences between Hypophosphatemia in stage (I) and Hypophosphatemia in stage (II) (after regimen) groups where *P* =0.04 (*P* significant level at *P* less than 0.05).table (2).

As regarding GCS score, in the Hypophosphatemia in stage (I) group it ranged between 1-15 with mean±S.D. 8.195±5.398, in the Normophosphatemia in stage (I) group it ranged between 1-15 with mean±S.D. 10.432±4.953 and in the Hypophosphatemia in stage (II) (after regimen) group it ranged between 1-15 with mean±S.D. 9.29±4.970. There was statistically significant differences between Hypophosphatemia in stage (I) and Normophosphatemia in stage (I) groups where *P* =0.011 and there was statistically significant differences between Hypophosphatemia in stage (I) and Hypophosphatemia in stage (II) (after regimen) groups where *P* =0.003 (*P* significant level at *P* less than 0.05). Table (2).

Table (2):- Comparison between the serum phosphate level groups on admission and after regimen as regarding clinical scores

		Stage (I) Hypo-phosphatemia	Stage (I) Normo-phosphatemia	Stage (II)Hypo-phosphatemia after regimen
APACHE II score	**Range**	0 – 24	0 – 24	0 – 24
	Mean±S.D.	15±8.245	12.126±7.919	13.87±6.876
	***P* value**	P1=0.001* P2=0.04*		
GCS score	**Range**	1 – 15	1 – 15	1 – 15
	Mean±S.D.	8.195±5.398	10.432±4.953	9.29±4.970
	***P* value**	*P*1=0.011* *P*2=0.003*		

P1 test of significant between Hypophosphatemia in stage (I) and Normophosphatemia in stage (I) .
P2 test of significant between Hypophosphatemia in stage (I) and Hypophosphatemia in stage (II) (after regimen)

As regarding length of ICU stay, in the Hypophosphatemia in stage (I) group it ranged between 0.25-40 days with mean±S.D. 8.675±7.032 days, in the Normophosphatemia in stage (I) group it ranged between 1-15 days with mean±S.D. 5.811±3.739 days and in the Hypophosphatemia in stage (II) (after regimen) group it ranged between 2-15 days with mean±S.D. 6.551±3.373 days. table (3).

As regarding need for intotropes, in the Hypophosphatemia in stage (I) group 89(48.1%) out of the patients was negative while 96(51.9%) out of the patients was positive, in the Normophosphatemia in stage (I) group it ranged between 164(73.9%) out of the patients was negative while 58(26.1%) out of the patients was positive and in the Hypophosphatemia in stage (II) (after regimen) group 82 (69.5%) out of the patients was negative while 36 (30.5%) out of the patients was positive. table (3).

As regarding use of mechanical ventilation, in the Hypophosphatemia in stage (I) group 81(43.8%) out of the patients was negative while 104(56.2%) out of the patients was positive, in the Normophosphatemia in stage (I) group it ranged between 118(53.2%) out of the patients was negative while 104(46.8%) out of the patients was positive and in the Hypophosphatemia in stage (II) (after regimen) group 58(49.2%) out of the patients was negative while 60(50.8%) out of the patients was positive. table (3).

As regarding duration of mechanical ventilation, in the Hypophosphatemia in stage (I) group it ranged between 0-36 with mean±S.D. 4.401±5.858, in the Normophosphatemia in stage (I) group it ranged between 0-14 with mean±S.D. 2.55±3.355 and in the Hypophosphatemia in stage (II) (after regimen) group it ranged between 1-9 with mean±S.D. 3.814±2.302. table (3).

As regarding mortality, in the Hypophosphatemia in stage (I) group 102(55.1%) out of the patients was negative while 83(44.9%) out of the patients was positive, in the Normophosphatemia in stage (I) group it ranged between 169(76.5%) out of the patients was negative while 52(23.5%) out of the patients was positive and in the Hypophosphatemia in stage (II) (after regimen) group 79(66.9%) out of the patients was negative while 39(33.1%) out of the patients was positive. table (3).

Table (3):- Comparison between the three groups as regard to patient's outcome.

		Stage (I) Hypo-phosphatemia	Stage (I) Normo-phosphatemia	Stage (II)Hypo-phosphatemia after regimen
ICU stay	**Range**	0.25 – 40	1 – 15	2 – 15
	Mean±S.D.	8.675±7.032	5.811±3.739	6.551±3.373
	***P* value**	P1=0.001* P2=0.013*		
Need intotropes	**Negative**	89(48.1%)	164(73.9%)	82(69.5%)
	Positive	96(51.9%)	58(26.1%)	36(30.5%)
	***P* value**	P1=0.000* P2=0.004*		
Use Mechanincal ventilation	**Negative**	81(43.8%)	118(53.2%)	58(49.2%)
	Positive	104(56.2%)	104(46.8%)	60(50.8%)
	***P* value**	P1=0.018* P2=0.023*		
Duration of mechanical ventilation	**Range**	0-36	0-14	1-9
	Mean±S.D.	4.401±5.858	2.550±3.355	3.814±2.302
	***P* value**	P1=0.015* P2=0.011*		
Mortality	**Negative**	102(55.1%)	169(76.5%)	79(66.9%)
	Positive	83(44.9%)	52(23.5%)	39(33.1%)
	***P* value**	P1=0.002* P2=0.001*		
		Stage (I) Hypo-phosphatemia	**Stage (I) Normo-phosphatemia**	**Stage (II)Hypo-phosphatemia after regimen**

P1 test of significant between Hypophosphatemia in stage (I) and Normophosphatemia in stage (I) .
P2 test of significant between Hypophosphatemia in stage (I) and Hypophosphatemia in stage (II) (after regimen)

5. Discussion

With the progress of hypophosphatemia and its fatal complications, many issues have been conflicted between its clinical effects and the indication of its correction; mainly due to the more understanding of its complications; so most ICUs should focus on protocol that can help the staff for taking the right decision for correction of hypophosphatemia. Presence of clear protocols for managing patients In ICUs may prevent many hazards which may affect critically ill patients during their stay in ICU.

In our study, we conducted it in two stages with time interval, we included patients admitted from June 2014 till November 2014 in Critical Care Medicine Department in the Alexandria Main University Hospital and to Intensive Care Unit in Alexandria Armed Force Hospital and to Intensive Care Unit in Karmuz Health Insurance Hospital.

In (stage I):-407 included patients were categorized into two groups: one group with normophosphatemia-(2.5-4.5mg/dl), another group with hypophosphatemia (<2.5mg/dl), and then the two groups were followed and compared regarding the primary and secondary outcomes as mentioned above.

In (stage II):-118 included patients with hypophosphatemia (<2.5mg/dl) were subjected to phosphate regimen depended on dose calculation using rapid intravenous correction and then were followed and compared with the previous groups in stage I regarding the primary and secondary outcomes as mentioned above.

Concerning the second stage in our research we had a total of 118 patients who are hypophosphatemic and showed a mean serum phosphate level on admission of 2.044 mg/dl then subjected to rapid phosphate correction according to the phosphate regimen(based on dose calculation) which included the following:- [15,24]

1) moderate depletion:- (1-2mg/dl were corrected by giving 0.16-0.32mmol/kg IV infusion over 6-8 hours)(received 30mmol potassium phosphate in 100 ml saline over 6hours).

2) mild depletion:- (2.1-2.4mg/dl were corrected by giving 0.08-0.16mmol/kg IV infusion over 4-6 hours) (received 15mmol potassium phosphate in 100ml saline over 4hours).

3) severe depletion:- (<1mg/dl corrected by giving 0.32-0.64mmol/kg IV infusion over 8-12hours) (received 45mmol potassium phosphate in 100ml saline over 8hours).

As mentioned above; we had 3 groups:- Hypophosphatemia,Normophosphatemia,Hypophosp-hatemia after regimen. After that, we compared the different parameters measured between each of the different three groups.

As regarding age in our study: In normophosphatemia group ranged 18-91 years with mean value 60.85±15.781 years, hypophosphatemia group ranged 18-96 years with mean value 59.56±16.015 years, hypophosphatemia after regimen group ranged 18-89 years with mean value 62.398±16.046 years.

As regarding sex in our study: In normophosphatemia group, males were 151(68%) and females were 71(32%). Hypophosphatemia group, males were 128(69.2%) and females were 57(30.8%). Hypophosphatemia after regimen group, males were 73(61.9%) and females were 45(38.1%).

As regarding APACHE II score in our study: In the Hypophosphatemia in stage (I) group it ranged between 0-24 with mean±S.D. 15±8.245, in the Normophosphatemia in stage (I) group it ranged between 0-24 with mean±S.D. 12.126±7.919 and in the Hypophosphatemia in stage (II) (after regimen) group it ranged between 0-24 with mean±S.D. 13.87±6.876, also Fu, zang *et al.* [25] showed that APACHE II score was higher in hypophosphatemia patients compared to normophosphatemia(21.4+/-7.6 compared to 18.9+/-8.8) which is more or less close to our study.

As regarding GCS score in our study: In the Hypophosphatemia in stage (I) group it ranged between 1-15 with mean±S.D. 8.195±5.398, in the Normophosphatemia in stage (I) group it ranged between 1-15 with mean±S.D. 10.432±4.953 and in the Hypophosphatemia in stage (II) (after regimen) group it ranged between 1-15 with mean±S.D. 9.29±4.970.

As regarding length of ICU stay in our study: In the Hypophosphatemia in stage (I) group it ranged between 0.25-40 days with mean±S.D. 8.675±7.032 days, in the Normophosphatemia in stage (I) group it ranged between 1-15 days with mean±S.D. 5.811±3.739 days and in the Hypophosphatemia in stage (II) (after regimen) group it ranged between 2-15 days with mean±S.D. 6.551±3.373 days, also Kilic *et al.* [26] discussed the clinical implications of hypophosphatemia in critically ill children in the pediatric ICU, it was a mean of 2.9+/-1.9days in normophosphatemia compared to a mean of 4.4+/-2.8days in hypophosphatemia which is more or less close to our study.

As regarding need for intotropes in our study: In the Hypophosphatemia in stage (I) group 89(48.1%) out of the patients was negative while 96(51.9%) out of the patients was positive, in the Normophosphatemia in stage (I) group it ranged between 164(73.9%) out of the patients was negative while 58(26.1%) out of the patients was positive and in the Hypophosphatemia in stage (II) (after regimen) group 82(69.5%) out of the patients was negative

while 36(30.5%) out of the patients was positive, also Bollaertpe *et al.* [27] found that patients having normal phosphate levels showed a lower degree of cardiac enzymes elevation and had about 70% normal ECG and 20% only needed for inotropes compared to hypophosphatemia group which had more elevation of cardiac enzymes, only 50% normal ECG and 60% needed for inotropes; which proved also importance for normal serum phosphate level for normal cardiac functions which is more or less close to our study.

As regarding use of mechanical ventilation in our study: In the Hypophosphatemia in stage (I) group 81(43.8%) out of the patients was negative while 104(56.2%) out of the patients was positive, in the Normophosphatemia in stage (I) group it ranged between 118(53.2%) out of the patients was negative while 104(46.8%) out of the patients was positive and in the Hypophosphatemia in stage (II) (after regimen) group 58(49.2%) out of the patients was negative while 60(50.8%) out of the patients was positive, also at Farah et al[28] conducted on 255 critically ill patients, 100% of hypophosphatemic patients(<2.0mg/dl) compared to 62.5% of hypophosphatemic patients(2 to <2.5mg/dl) compared to only 16.9% of normophosphatemic patients needed mechanical ventilation which is more or less close to our study with the big difference between the two studies.

As regarding duration of mechanical ventilation in our study: In the Hypophosphatemia in stage (I) group it ranged between 0-36 with mean±S.D. 4.401±5.858, in the Normophosphatemia in stage (I) group it ranged between 0-14 with mean±S.D. 2.55±3.355 and in the Hypophosphatemia in stage (II) (after regimen) group it ranged between 1-9 with mean±S.D. 3.814±2.302, also Alsumarain *et al.* [29] The study was conducted on 193 mechanically ventilated patients, that study associated hypophosphatemia with prolonged duration of mechanical ventilation and failure to wean patients from mechanical ventilation which is more or less close to our study.

As regarding mortality in our study: In the Hypophosphatemia in stage (I) group 102(55.1%) out of the patients was negative while 83(44.9%) out of the patients was positive, in the Normophosphatemia in stage (I) group it ranged between 169(76.5%) out of the patients was negative while 52(23.5%) out of the patients was positive and in the Hypophosphatemia in stage (II) (after regimen) group 79(66.9%) out of the patients was negative while 39(33.1%) out of the patients was positive, also Zazzo *et al.* [30] mortality rate was 30% in hypophosphatemia compared to 15% in normophosphatemia, and at Sankaran *et al.* [31] was 31.9% in hypophosphatemia v 13.2% in normophosphatemia which are more or less close to our study, while at Yang *et al.* [32] and Suzuki *et al.* [33] there were no relationship between the incidence of hypophosphataemia and 28-day mortality rate was found, with a big difference between the two studies as regard mortality this high mortality at our study is mostly due to the pre-existing chronic diseases and their complications .

6. Conclusion

- Hypophosphatemia is considered a common co-morbidity in critically ill patients in I.C.U.
- Maintain of normal serum phosphate level is considered an important parameter in measuring the outcome of critically ill patients in I.C.U.
- Hypophosphatemia can be asymptomatic and passes unnoticed but may be accompanied by fatal complications.
- Hypophosphatemia can affect the outcome by showing increased mortality, need for inotropes, duration of mechanical ventilation, and length of ICU stay.
- If Hypophosphatemia is developed, it should be diagnosed early and corrected as rapid as possible to prevent all its harmful effects.

References

1. Luce J. Approach to the patient in a critical care setting. In: Goldman E (ed). Cecil textbook of Medicine. 21st ed. Philadelphia: W.B. Saunders, 2000. 484-5.
2. GeeerseDA, Bindels AJ, Kuiper MA, Roos AN, Spronk PE, Schultz MJ. Treatment of hypophosphatemia in the intensive care unit: a review. Crit Care 2010; 14: 147.
3. Lau K. Phosphate disorders, InKokko JP, Tannen RL (eds). Fluids and electrolytes. Philadilphia, Saunders 1986; 398-9.
4. Knochel JP. The pathophysiology and clinical characteristics of severe hypophosphatemia. Arch Intern Med., 1977; 137:203-20.
5. Fiaccadori E, Coffrini E, Ronda N, Vezzani A, Cacciani G, Fracchia C, *et al.* Hypophosphatemia in course of chronic obstructive pulmonary disease. Prevalence, mechanisms, and relationships with skeletal muscle phosphorus content. Chest, 1990; 97: 857-68.
6. Berger MM, Rothen C, Cavadini C, Chiolero L. Exudative mineral losses after serious burns: a clue to the alterations of magnesium and phosphate metabolism. Am J ClinNutr., 1997; 65: 1473-81.
7. Amanzadeh J, Reilly RF Jr. Hypophosphatemia: an evidence based approach to its clinical consequences and management. Nat ClinPractNephrol., 2006; 2:136-48.

8. Bugg NC, Jones JA.Hypophosphataemia. Pathophysiology, effects and management on the intensive care unit. Anaesthesia, 1998; 53:895-902.
9. Agusti AG, Torres A, Estopa R, Agustividal A. Hypophosphatemia as a cause of failed weaning: the importance of metabolic factors. Crit Care Med., 1984;12:142-3.
10. Brautbar N, Baczynski R, Carpenter C, Massry SG. Effects of phosphate depletion on the myocardium. AdvExp Med Biol., 1982; 151: 199-207.
11. Jacob HS, Amsden T. Acute hemolytic anemia with rigid red cells in hypophophatemia. N Engl J Med., 1971; 285:1446-50.
12. Ravenscroft AJ, Valentine JM, Knappett PA. Severe hypophosphataemia and insulin resistance in diabetic ketoacidosis. Anaesthesia 1999; 54:198.
13. Singhal PC, Kumar A, Desroches L, Gibbons N, Mattana J. Prevalence and predictors of rhabdomyolysis in patients with hypophosphatemia. Am J Med., 1992;92:458-64.
14. Michell AW, Burn DJ, Reading PJ. Central pontinemyelinolysis temporally related to hypophosphataemia. J Neurol Neurosurg Psychiatry 2003;74:820.
15. Kraft MD, Btaiche IF, Sacks GS, Kudsk KA. Treatment of electrolyte disorders in adult patients in the intensive care unit. Am J Health Syst Pharm., 2005; 62: 1663-82.
16. Knaus WA, Draper EA, Wagner DP, Zimmerman JE. APACHE II: a severity of disease classification system. Crit Care Med., 1985;13:818-29.
17. Balistreri WF, Rej R. liver function. In: Tietz NW (ed). Fundamentals of clinical chemistry. 4th ed. Philadelphia: WB Saunder's 2001; 543-54.
18. Whelton A, Waston AJ, Rock RC. Nitrogen metabolites and renal function. In: Tietz NW (ed). Fundamentals of clinical chemistry. 4th ed. Philadelphia: WB Saunder's 2001; 575-6.
19. David BS. Carbohydrates. In: Tietz NW (ed). Fundamentals of clinical chemistry. 4th ed. Philadelphia: WB Saunder's 2001;361-5.
20. Davice JV, Lewis SM. Practical haematology. 7th ed. London: Churchill Livingston, 1991; 37-63.
21. Pruden EL, Anderson OS, Tietz NW. Blood gases and ph. In: Tietz NW (ed). Fundamentals of clinical chemistry. 4thed. Philadelphia: WB Saunder's2001; 506-16.
22. Tietz NW, Pruden EL, Anderson OS. Electrolytes. In: Tietz NW (ed). Funcamentals of clinical chemistry. 4th ed. Philadelphia: WB Saunder's, 2001; 500-2.
23. Fiske CH, Subbarow U. The colorimetric determination of phosphorus. J BiolChem., 1925; 66:375.
24. Miller DW, Slovis CM. Hypophosphatemia in the emergency department therapeutics. Am J Emerg Med., 2000; 18:457-61.
25. Fu JH, Zang B. The Occurrence Of Hypophosphatemia and its prognostic value in intensive care unit patients. Chinese Crit Care Med., 2012; 24(1):29-32.
26. Kilic O, Demirkol D, Ucsel R, Citak A, Karabocuoglu M. Hypophosphatemia And Its Clinical Implications In Critically Ill Children: A Retrospective Study. J Crit Care 2012; 27:474-9.
27. Bollaertpe, Levyb. A Prospective Study On The Effect Of Phosphorous Level On Normal Cardiac Functions In Critically Ill Patients 2013; 107: 1698-701.
28. Farah R[1], Khamisy – Farah R, Arraf Z, Jacobson L, Makhoul N. Hypophosphatemia as a prognostic value in acute exacerbation of COPD. J ClinRespir 2013Oct; 7(4):407-15.
29. Alsumrain MH, Jawad SA, Imran NB, Riar S, De Bari VA, Adelman M. Association Of Hypophosphatemia with Failure –To- Wean from Mechanical Ventilation. Ann Clin Lab Sci 2010 Spring; 40(2):144-8.
30. Zazzo JF, Troche G, Ruel P, Maintenant J. High incidence of hypophosphatemia in surgical intensive care patients: efficacy of phosphorus therapy on myocardial function. Intensive Care Med 1995; 21: 826-31.
31. Sankaran RT, Mattana J, Pollack S, Bhat P, Ahuja T, Patel A, et al. Laboratory abnormalities in patients with bacterial pneumonia. Chest 1997; 111: 595-600.
32. Yang Y, Zhang P, Cui Y, Lang X, Yuan J, Jiang H, et al. Hypophosphatemia during continuous veno-venous hemofiltration is associated with mortality in critically ill patients with acute kidney injury. Crit Care 2013; 17: R205.
33. Suzuki S, Egi M, Schneider A, Bellomo R, Hart G, Hegarty C. Hypophosphatemia in critically ill patients. J Crit Care 2013 Aug; 28(4):536 e9-19.

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