Outcome Of Critically Ill Patients With Hypokalemia

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Abstract: Background:Hypokalemia is a common clinical problem. Potassium homeostasis is frequently disturbed in critically ill patients. Underlying diseases or treatments in intensive care unit (ICU) patients often affect homeostasis of potassium level in body. Hypokalemia can lead to lethal arrhythmia. Derangements in serum potassium levels in ICU patients should therefore be avoided and monitoring of potassium is mandatory. This study identifies various factors responsible for hypokalemia in critically ill patients in ICU.Material And Methods:Retrospective evaluation of data of 80 patients from march 2018 to february 2019 who were admitted in ICU and developed hypokalemia, was done. Various factors responsible for development of hypokalemia were identified. Treatment response and outcome was evaluated.Result:Incidence of hypokalemia in critically ill patients was more in males. Diabetes mellitus (40%) and hypertension (37.5%) were common comorbidities associated with hypokalemia. Majority patients (70%) had mild hypokalemia. Insulin (37.5%), antibiotics (25%), b2 agonist (22.5%) and steroid (22.5%) were commonly responsible for development of hypokalemia. 62.5% patients were cured and discharged while 37.5% patients were died due to various complications.Conclusion:Multiple factors play an important role in development of hypokalemia in critically ill patients. Frequent monitoring of serum potassium is required in them. Severity of hypokalemia is associated with increased mortality in critically ill patients. Early detection and correction of hypokalemia reduce the overall mortality and improve outcome in critically ill patient.[Makwana D Natl J Integr Res Med, 2021; 12(6): 64-67]

Key Words: Critically Ill, Hypokalemia, Intensive Care Unit

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Introduction: Potassium (K^+) is an important electrolyte that has been proven essential for normal functioning of the cardiovascular system, skeletal muscles, internal organs and nervous system. The intracellular proportion of K^+, which represents more than 98% of the total body K^+, controls cell metabolism and the resting membrane potential. Intracellular K^+ is essential for excitability and automaticity of myocardial cells and for the normal functioning of other cells.

The normal serum K^+ level is 3.5 to 4.5 mEq/L. An abnormal K^+ level predisposes a patient to serious complications, especially cardiac arrhythmia and muscle weakness, which may provoke sudden cardiac arrest and/or respiratory failure. Critically ill patients are at risk for alterations in their serum K^+ level[1] . Hypokalemia is defined as serum potassium less than 3.5meq per litre.Underlying diseases or treatments in intensive care unit (ICU) patients often affect the Na^+/K^+ ATPase pump.

This pump maintains the potassium gradient and can be influenced by many factors, such as Various factors responsible for development of insulin, catecholamine and acid–base status. The long-term potassium balance is regulated mainly by the kidney. Thus, hypokalemia is often the result of renal impairment[2]. Both hypo- and hyperkalemia are known to induce potentially lethal arrhythmias and cardiac dysfunction, as well as other complications[3,4]. Derangements in serum potassium levels in ICU patients should therefore be avoided, and monitoring of potassium is mandatory[5].

Material & Methods: Retrospective data of patients with hypokalemia was taken who were admitted between march 2018 to february 2019 at Shardaben Municipal Hospital, Ahmedabad. Ethical commitee permission was taken. 80 patients aged more than 18 year, who were suffering from various medical conditions admitted to ICU of our hospital, who needed advanced life support and developed hypokalemia were included in study. Patients admitted for any condition requiring surgical intervention were excluded. Hypokalemia was defined as serum potassium <3.5 mEq/litre. hypokalemia were identified. Changes in

potassium level, response to treatment and outcome were studied.

Results: Incidence of hypokalemia was higher in male (60%) than in females (40%). 4 patients (5%) were from 18-30 year age group, 8 patients (10%) were from 31-40 year age group, 13 patients (16.25%) were from 41-50 year age group, 16 patients (20%) from 51-60 year age group, 18 patients (22.5%) from 61-70 year age group and 21 patients (26.25%) were from more than 70 year age group. Diabetes Mellitus and Hypertension were most common associated comorbidities in patients who developed hypokalemia (40% and 37.5% respectively).

Other comorbidies were ischemic heart disease (20%), cerebrovascular accident (13.75%), chronic liver disease (11%), chronic obstructive pulmonary disease (15%), and chronic kidney disease (6.25%). Among 80 patients, 70% patients had mild hypokalemia, 20% patients had moderate hypokalemia and 10% patients had severe hypokalemia (Table 1).

Table: 1 Severity Of Hypokalemia

Degree Of Severity	Range Of Hypokalemia	No Of Patients
Mild Hypokalemia	3.0-3.49.	56
Moderate Hypokalemia	2.5-2.99	16
Severe Hypokalemia	<2.5	8

Most common etiology among all hypokalemic patients was insulin, which was present in 30 (37.5%) patients. Others were use of antibiotics, beta 2 agonists, vomiting, steroids, diuretics, loose stools, respiratory alkalosis, metabolic alkalosis and osmotic diuresis (22.5 %, 25% , 20%, 22.5%, 11.25%,16.25%,15%, 10%, 10% respectively),(Table2). Majority of patients had more than one factors responsible for development of hypokalemia.

Table 2: Possible Underlying Causes For Hypokalemia

Possible Underlying etiology	No Of Patients
Osmotic Diuresis	8
Metabolic Alkalosis	8
Respiratory Alkalosis	12
Steroids	18
Antibiotics	20
Insulin	30
Beta 2 Agonists	18
Diuretics	9
Vomiting	16
Loose Stools	13

Common reasons for ICU admission were septic shock (33.75%), followed by respiratory failure (31.25%), hypovolemic shock (13.75%), cardiogenic shock (16.25%) and others (4%). Electrocardiogram(ECG) changes were present in 17(30.35%) patients out of 56 mild hypokalemic patients, 10(62.5%) out of 16 moderate hypokalemic patients and 6(75%) out of 8 severe hypokalemic patients (Table3). ECG changes varies from decreased T-wave amplitude, ST-interval depression, T-wave inversions, PR-interval prolongation, U wave, sinus bradycardia, ventricular tachycardia or ventricular fibrillation to torsade de pointes in different patients. 65% patients developed hypokalemia within 0-5 days, 20% patients developed hypokalemia from 6-10 days and 15% patients developed hypokalemia after 10 days of hospitalisation (Table 4).

Table 3: ECG Changes With Severity Of Hypokalemia

Severity Of Hypokalemia	ECG Changes Seen (No Of Pt.)	Percentage	ECG Changes Not Seen (No Of Pt.)	Total
Mild Hypokalemia	17	30.35%	39	56
Moderate Hypokalemia	10	62.5%	6	16
Severe Hypokalemia	6	75%	2	8

Table 4: Day Of Development Of Hypokalemia

Day Of Development Of Hypokalemia	Total No Of Patients
0-5 Days	52
6-10 Days	16
>10 Days	12

Average duration required for correction of hypokalemia was 1.35 days for mild hypokalemia, 2.1 days for moderate hypokalemia and 3.98 days for severe hypokalemia.

Table 5: Outcome According To Severity Of Hypokalemia

	Death (No Of Patients)	Discharge (No Of Patients)
Mild Hypokalemia	18(32.14%)	38(67.85%)
Moderate Hypokalemia	6(37.5%)	10(62.5%)
Severe Hypokalemia	6 (75%)	2(25%)
Total	30	50

Out of 56 patients with mild hypokalemia 18(32.14%) patients expired and 38(67.85%) patients were discharged, out of 16 patients with moderate hypokalemia, 6(37.5%) patients were expired and 10(62.5%) were discharged, while out of 8 patients with severe hypokalemia, 6(75%) were expired and 2(25%) were discharged (table 5). Overall37.5% mortality was there.

There is significant increase in mortality with increased severity of hypokalemia. Mortality was due to reasons like cardiac arrhythmias, septicemic shock, cardiogenic shock and respiratory failure in which hypokalemia played major contributory role.

Discussion: In this study of 80 patients, number of males was higher (60%) than number of females (40%).Other study also has similar observation[6]. Majority of the patients were of more than 70 year age (26.25%) followed by 61-70 year age group (22.5%). The mean age of the patients is 53 year. Amongst the hypokalemic patients, the proportion of patients with mild, moderate and severe hypokalemia were 70%, 20% and 10% respectively.

Diabetes Mellitus was most common observed comorbidity similar to Jacopo Burrello et al[6] followed hypertension, ischemic heart disease, CVA, chronic liver disease and chronic kidney disease. This is because these patients are might suffering from diagnosed or undiagnosed underlying kidney disease and also they are on multiple drugs might causing hypokalemia.

Common drugs were insulin (37.5%) followed by use of antibiotics(25%), beta 2 agonists (22.5%), steroids(22.5%), diuretics(11.5%) which have known side effect of hypokalemia. Vomiting (20%) and loose stools(16.25%) also cause electrolyte imbalance due to loss from body. Respiratory alkalosis(15%), metabolic alkalosis(10%) and osmotic diuresis(10%) also known to cause hypokalemia. Paice BJ study[7] where the most common likely underlying cause was found to be drugs (38%) with diuretics accounting for 62% cases, insulin 17%, steroids 9 %,Gastrointestinal losses occurred only in 16.8% of cases. This is because major comorbid condition in our study was diabetes mellitus who were critically ill and were kept on insulin. Few patients were given steroids during their management or already taking steroids for some reason. Majority patients were given beta 2 agonist for their respiratory condition. Few patients were also on diuretics which contributed in development of hypokalemia during their critical illness.

Most common reasons for ICU admission are contrasting from Surat T et al[1] study. In which septic shock was most common reason (65%) followed by respiratory failure (20%). Out of 80 patients 41.25% patients had ECG changes associated with hypokalemia. Frequency of ECG changes were increased with severity of hypokalemia. This is also observed by other studies[8,9].

Initial few days were being the most commonly associated with the decrease in serum potassium levels. Average duration required for correction of hypokalemia was 1.35 days for mild hypokalemia, 2.1 days for moderate hypokalemia and 3.98 days for severe hypokalemia. This is

because majority patients were diagnosed having hypokalemia when it was mild as patients were monitored frequently in ICU and managed well. There is 37.5% mortality which is consistent with Surat T et al[1] which has 39.5% ICU mortality. There is significant increase in mortality with increased severity of hypokalemia as there is highest mortality in patients with severe hypokalemia[10,11,12].

Conclusion: There are multiple factors that play an important role in development of hypokalemia in critically ill patients. Important etiological factors among those are insulin, diuretics, beta 2 agonists, steroids and antibiotics. Judicious use of these drugs with frequent monitoring of serum potassium is required. Severity of hypokalemia is associated with increased mortality in critically ill patients. Early detection and correction of hypokalemia can reduce the overall mortality and improve outcome in critically ill patients.

References:

1. Surat T, Tanuwong V, Chairat P. Serum potassium levels and outcomes in critically ill patients in the medical intensive care unit. Journal of International Medical Research. 2018 Mar; 46(3): 1254–1262.
2. Kraft MD, Btaiche IF, Sacks GS et al. Treatment of electrolyte disorders in adult patients in the intensive care unit. American Journal of Health Sysemt Pharmacy, 2005; 62(16):1663–1682.
3. Halperin ML, Kamel KS. Potassium. Lancet. 1998;352:135-140.
4. GennariFJ.Hypokalemia. New England Journal of Medicine. 1998; 339:451–458.
5. Gennari FJ. Disorders of potassium homeostasis- hypokalemia and hyperkalemia. Crit Care Clin. 2002; 18:273-288.
6. Jacopo B, Silvia M, Isabel L. Prevalence of Hypokalemia and Primary Aldosteronism in 5100 Patients Referred to a Tertiary Hypertension Unit. Hypertension. 2020; 75:1025-1033.
7. Paice BJ, Peterson KR, Anyang OF. Record linkage study of hypokalemia in hospitalised patients. Postgrad Med J. 1986; 62:187-191.
8. Diercks DB, ShumaikGM,Harrigan RA et al. Electrocardiographic manifestations: Electrolyte abnormalities. Journal of Emergency Medicine. 2004; 27(2): 153-160.
9. Nabil ES, Gioia T. Electrolyte disorders and arrythmogenesis. Cardiol J. 2011; 18(3):233-245.
10. Collins AJ, Pitt B, Reaven N, Funk S et al. Association of Serum Potassium with All-Cause Mortality in Patients with and without Heart Failure, Chronic Kidney Disease, and/or Diabetes. Am J Nephrol. 2017; 46:213-221.
11. Mette A, Anne CJ, Line Davidsen et al. Associations of serum potassium levels with mortality in chronic heart failure patients. European Heart Journal. 2017; 38(38): 2890–2896.
12. Hessels L, Hoekstra M, Mijzen LJ et al. The relationship between serum potassium, potassium variability and in-hospital mortality in critically ill patients and a before-after analysis on the impact of computer-assisted potassium control. Crit Care. 2015; 19:4. Available on https://doi.org/10.1186/s13054-014-0720-9

Conflict of interest: None
Funding: None
Cite this Article as: Makwana D, Chauhan H, Ganvit A. Outcome Of Critically Ill Patients With Hypokalemia. Natl J Integr Res Med 2021; Vol.12(6): 64-67