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Short-Term Prognosis of Patients with Hyperpotassemia in the Emergency Department

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Abstract

Aim: Although hyperkalemia is a common encountered electrolyte disorder in the emergency room, there is little information in the literature regarding its clinical results. In this study, the short-term prognoses of patients who applied to the emergency department for any reason and were found to have hyperkalemia were investigated.

Materials and Methods: This retrospective cohort study was carried out in a tertiary care university hospital emergency department by using the data provided by a hospital information management system (HIMS) in a year period. The 1st week and 28th day survivals of the patients who applied to the emergency department for any reason and were found to have hyperpotassemia (K >5.11 mg/dL) were evaluated. The relationship between potassium values at the first admission of patients with hyperkalemia and hospitalization or intensive care admissions, age, gender, hemodialysis needs, chronic kidney disease (CKD) and acute kidney injury (AKI), and survival were investigated.

Results: In the study, the results of 18,582 serum potassium samples were evaluated. Among the 2,715 hyperkalemia samples, 532 (19.5%) false potassium elevations and 363 (9%) repeat patients were measured. These samples were excluded from evaluation. Information of seven patients could not be reached and they were excluded from the study. Hyperpotassemia results of 1934 patients were included in the final analysis. It was found that 130 (6.7%) of the patients died within seven days, and 245 (12.7%) died within 28 days. In the study, 7-day and 28-day day mortality of patients who developed AKI, needed hemodialysis, who were hospitalized or located in intensive care unit were found to be significantly higher ($p<0.001$ for each). There was no statistical difference at 7th and 28th days between patients with CKD and those without CKD. It was found that AKI for patients, hyperpotassemia was associated with hospitalization, death and hemodialysis.

Conclusion: Patients with hyperkalemia accompanying AKI carry a risk in terms of mortality and other adverse prognoses. This risk has been found to be weaker in CKD. Hyperkalemia creates a serious risk even in hyperpotassemia close to normal value.

Keywords: Hyperpotassemia, hyperkalemia, emergency department

Introduction

Potassium abnormalities (hypopotassemia-hyperkalemia) can be seen in many patients admitted to the emergency department with various complaints and symptoms (1). Potassium is an electrolyte that is vital for cell functions. Potassium must be present in the blood at a certain concentration (3.5-5.0 mEq/L). Serum potassium values other than these values are defined as "serum potassium abnormality" (2). In the studies conducted in the related literature, potassium blood level abnormality was found in 13-15% of the patients who were hospitalized and followed up (3). As is known, potassium abnormality may not always be due to a clinical pathology (4). Causes such as laboratory measurement errors, analyzer and kit problems, and inappropriate blood sampling may be the cause of potassium abnormalities (5). Potassium abnormality may be asymptomatic in patients, but it may also lead to various conditions ranging from nausea-vomiting, paresthesia, heartbeat abnormalities to cardiac blocks due to conduction disturbances and sudden cardiac death (6). Therefore, patients with potassium abnormalities presenting to the emergency department should be diagnosed quickly and

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treatment should be initiated as soon as possible (7). Limited data are available on the prevalence, etiology and clinical outcomes of these patients with high severity (8,9). Most of these data are about patients who are hospitalized and followed up, and the epidemiology and clinical results of emergency room admissions are limited (10). This observational study was planned to analyze information about the prevalence, mortality, demographic characteristics, hospitalization, intensive care admission, hemodialysis numbers and rates of patients who were admitted to a tertiary emergency service in a one-year period and were found to have high potassium level.

Materials and Methods

Study Population

This observational study was carried out by using the data provided by a hospital information management system (HIMS) of a tertiary care university hospital emergency department in a year period (2016). Samples with high serum potassium level (K >5.11 mEq/L) were determined and included in the study. No kit and autoanalyzer changes were made in the central biochemistry laboratory within a year where the study data were analyzed. Since the upper limit of the normal value range of the serum potassium measurement device used by the Biochemistry Laboratory was 5.10 mEq/L, values of 5.11 mEq/L and above were evaluated as hyperkalemia and were included in the study. The files of the patients were scanned via HIMS.

Exclusion criteria of the study:

1. Serum potassium values in blood samples taken repeatedly from the same patient on the same day,

2. Patients with pseudo-potassium abnormalities in the control samples because the results of the patients with serum potassium abnormalities are not compatible with the clinical findings.

Data Collection

The seven-day and 28-day mortality information was investigated and detected from "Death Notification System". Seven-day and 28-day mortality data were determined separately. This questioning covers a period of 28 days from the date the patient admitted to the hospital with serum potassium abnormality. The data of the patients included in the study regarding hospitalization, admission to the intensive care unit and whether they underwent hemodialysis were determined by HIMS scanning. If CKD patients developed AKI, they were excluded from the CKD group and included in the AKI group.

It was determined that serum potassium values were studied from 18,582 samples between 01/01/2016 and 31/12/2016. Hyperpotassemia was detected in 2,715 (14.6%) of 18,582 samples. Two hundred and forty-two (8.9%) serum potassium samples from 2,715 hyperkalemia samples were excluded from the study because they were duplicate samples taken from the same patient on the same application. Five hundred and thirty-two (19.5%) (2.8% of all samples) measurements in which the control serum potassium level was studied before medical treatment were considered to be incompatible with the patient's clinical findings were not considered as true hyperpotassemia and were not included in the data set. Seven (0.2%) serum potassium samples were excluded from the study because the patients' information could not be obtained (foreign patients). As a result, the data of 1934 (10.4% of all samples) confirmed hyperkalemia patients were evaluated in the study (Figure 1).

Demographic characteristics, potassium levels, AKI, CKD, Hemodialysis, 7-day mortality, 28-day mortality, numbers and percentages of hospital and intensive care admissions of hyperkalemia patients (Table 1).

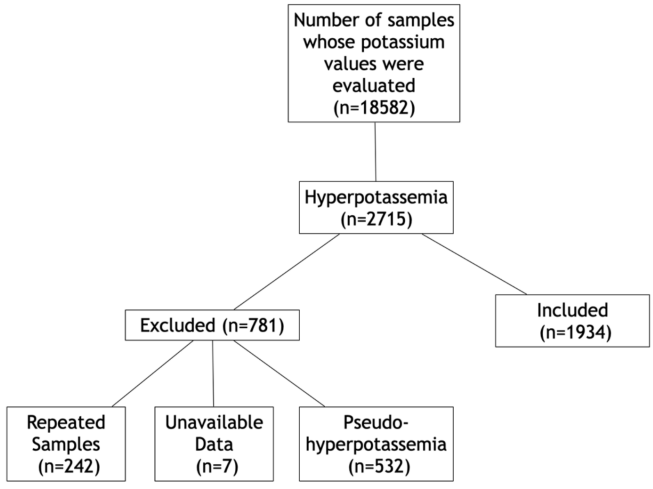

Figure 1. Scheme of emergency admissions with hyperkalemia

Table 1. Demographic characteristics	
Patients Included	**(n=1,934)**
Female/male	863/1,071 (44.6%)
Average age	61.6 (SD: 18.94)
Serum K levels	5.4 mEq/L (IQR: 0.56)
Acute kidney injury	297 (15.4%)
Chronic kidney disease	386 (20%)
Hemodialysis	218 (11.3%)
7-day mortality	130 (6.7%)
28 days of morality	245 (12.7%)
Hospital admission	820 (42.4%)
Intensive care admission	228 (11.8%)
SD: Standard deviation, IQR: Interquartile range, n: Number	

Gender distribution of hyperkalemia patients (1934 patients in total); 863 (44.6%) were female, 1,071 (55.4%) were male. In hyperkalemia patients, the lowest age was 1, the highest age was 115, and the mean age was 61.6 [standard deviation (SD): 18.94]. In the hyperpotassemia patient group, the mean age was 62.6 (SD: 19.14) in female group, and 60.7 (SD: 18.74) in male group.

The graph showing the distribution of serum potassium values of patients with hyperkalemia (It is seen that serum potassium values are not normally distributed and there is a density between 5.1 mEq/L and 5.5 mEq/L) (Figure 2).

When the serum potassium values in our study were examined, it is seen that the lowest serum potassium value was 5.11 mEq/L, the highest serum potassium value was 9.52 mEq/L, and the median serum potassium value was 5.40 mEq/L [interquartile range (IQR): 0.56].

Of the 1,934 patients included in the study, 297 (15.4%) had AKI, 386 (20.0%) had CKD, and 218 (11.3%) were admitted to hemodialysis. Moreover, it was found that 130 (6.7%) of the patients with hyperpotassemia died within seven days, and 245 (12.7%) died within 28 days. In addition, it was determined that 820 (42.4%) of the patients included in the study were hospitalized and treated, and 228 (11.8%) of these patients were admitted to intensive care.

Results

When we examine 130 patients who died in seven days, it was observed that 64 (49.2%) patients had AKI (21.5% of 297 patients with AKI) (Table 2). It was also observed that 4.0% (66 patients) of patients without AKI died within seven days. The frequency of AKI in patients with hyperkalemia who died within a week was statistically significant, which was higher than those who did not die ($p<0.001$). It was seen that 36 (27.6%) of 130 patients who died within a week were taken on hemodialysis (16.5% of 218 patients who received hemodialysis). It was found that 5.5% of the patients (94 patients) who were not treated with hemodialysis died within seven days. The frequency of hemodialysis was statistically significant, which was higher in patients who had hyperkalemia and died within a week than those who did not die ($p<0.001$).

It was found that 23 (17.6%) of 130 patients who died within a week had CKD (6.0% of 386 patients with CKD), 6.9% of patients without CKD (107 patients) died within seven days. There was no statistical difference between those with CKD and those without CKD in patients with hyperkalemia who died within a week ($p=0.503$).

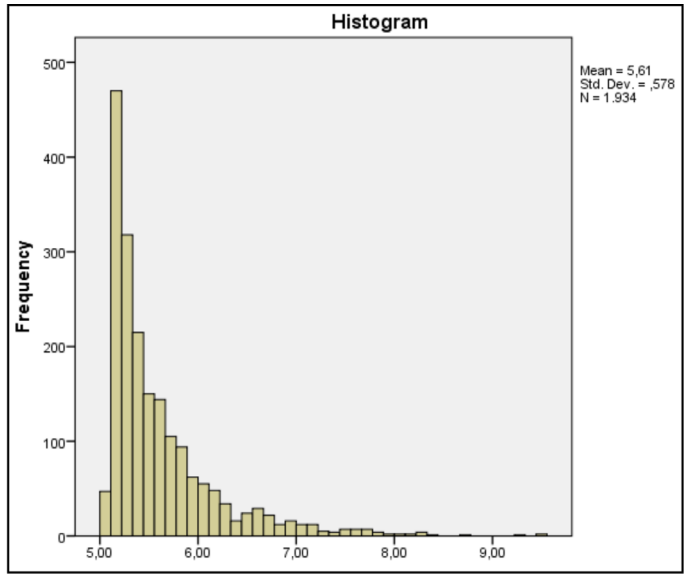

Figure 2. Distribution of serum potassium values of patients
Std. Dev.: Standard deviation

Table 2. AKI, hemodialysis, CKD, hospitalization, intensive care admission and gender comparisons of patients with hyperkalemia who died within 7 days

		7-day mortality in the hyperpotassemia group				
		Death		Survival		p value
		n	%	n	%	
AKI		64	21.5	233	78.5	<0.001
Hemodialysis		36	16.5	182	83.5	<0.001
CKD		23	6.0	363	94.0	0.503
Hospital admission		89	10.9	731	89.1	<0.001
ICU admission		73	32.0	155	68.0	<0.001
Gender	Male	62	7.2	801	92.8	0.466
	Female	68	6.3	1003	93.7	

AKI: Acute kidney injury, CKD: Chronic kidney disease, ICU: Intensive care unit

It was seen that 89 (68.4%) of 130 patients who died within a week were hospitalized (10.9% of 820 hospitalized patients). It was found that 3.7% of the patients who were not hospitalized (41 patients) died within seven days. The frequency of hospitalization in patients with hyperpotassemia who died within a week was statistically significant, which was higher than those who did not die (p<0.001).

It was observed that 73 of 130 patients (56.1%) who died within a week were treated by hospitalization in intensive care (32.0% of 228 patients hospitalized in intensive care). It was found that 3.3% (57 patients) of the patients who were not hospitalized in intensive care died within seven days. Patients with hyperkalemia who died within a week were more frequently hospitalized in intensive care than those who did not die (p<0.001).

When the gender analysis of 130 patients who died in a week was done, it was seen that 62 female patients (7.2% of female patients), 68 male patients (6.3% of male patients) died within seven days, and there was no statistical difference between sexes in terms of death within seven days (p=0.466).

When 245 patients who died within 28 days in patients with hyperpotassemia were examined (Table 3), it was seen that patients with AKI compared to those who were not (p<0.001), patients who received hemodialysis compared to those who did not (p<0.001), patients who were hospitalized due to the indication for hospitalization (p<0.001), and patients who were admitted to the ICU due to the ICU indication compared to those who were not (p<0.001) died within 28 days in a greater ratio, which was statistically significant. In the patient group, it was found that there was no statistically significant difference (p=0.818) in the 28 days mortality rate of female patients with hyperkalemia compared to male patients.

Although there was no difference between patients with CKD and patients without CKD in 7-day deaths, when the 28-day deaths of patients with hyperkalemia were evaluated, it was observed that patients without CKD died more than patients with CKD, which was statistically significant (p=0.042). It was concluded that the reason for this was the fact that there were AKI patients with a high mortality rate among patients without CKD (These patients were removed from the CKD group and included in the AKI group). For this reason, AKI patients were excluded from the study group and an additional statistical analysis was performed for CKD patients. We found that if AKI patients among patients without CKD were excluded, the 7-day and 28-day rate of CKD patients might be higher than those without CKD.

In the statistical analysis performed when AKI patients were excluded (1638 patients), the 1-week mortality rate was found to be significantly higher in patients with CKD (p=0.027). Although the 28-day mortality rate was high in patients with CKD, no statistically significant difference was found (p=0.188) (Table 4).

The rate of hospitalization and hemodialysis in hyperkalemia patients with AKI was found to be significantly higher than those without AKI (p<0.001).

In the ROC analysis performed on samples with hyperpotassemia, a relationship was observed between potassium values and 7 and 28-day mortality (p<0.001 AUC=0.762, p<0.001 AUC=0.696). However, it was determined that mortality was found even with potassium values close to normal (Figure 3).

When 460 patients with hyperkalemia who died within 1 year were examined, the median of potassium samples was 5.65 mEq/L (IQR25: 5.28-IQR75: 6.16). In addition, it was observed that almost 70% of hyperkalemia patients who died within a year had potassium values lower than 6 mEq/L. Significant mortality was observed in patients close to normal potassium levels.

Table 3. AKI, hemodialysis, CKD, hospitalization, intensive care admission and gender comparisons of patients with hyperpotassemia who died within 28 days

		28-day mortality in hyperpotassemia group				
		Death		Survival		p value
		N	%	N	%	
AKI		114	38.4	183	61.6	<0.001
Hemodialysis		68	31.2	150	68.8	<0.001
CKD		37	9.6	349	90.4	0.042
Hospital admission		186	22.7	634	77.3	<0.001
ICU admission		120	52.6	108	47.4	<0.001
Gender	Female	111	12.9	752	87.1	0.818
	Male	134	12.5	937	87.5	

AKI: Acute kidney injury, CKD: Chronic kidney disease, ICU: Intensive care unit

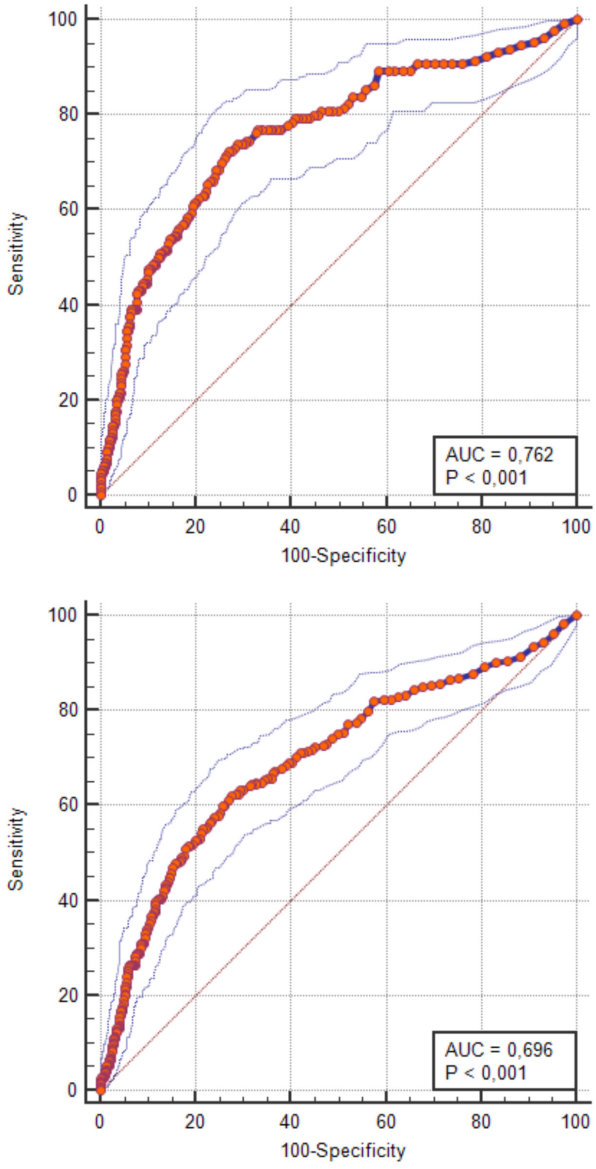

Figure 3. ROC analysis performed on samples with hyperpotassemia, a relationship was observed between potassium values and 7 and 28-day mortality

ROC: Receiver operating characteristics, AUC: Area under the curve

Table 4. 7-day and 28-day mortality of CKD patients when AKI patients are removed

	AKI patients excluded, (n=1,638)				
	Death		Survival		p value
	n	%	n	%	
7-day mortality	23	6.0	363	94.0	0.027
28-day mortality	37	9.6	349	90.4	0.188

CKD: Chronic kidney disease, AKI: Acute kidney injury, n: Number

As a result, it was found that the frequency of AKI, hemodialysis, hospitalization and intensive care admission was higher in all patient groups who died in 7 days and 28 days in patients with hyperpotassemia and were statistically significant (Table 5). There was no statistical increase in 7-day and 28-day mortality in CKD patients without AKI.

Discussion

In our study, false potassium abnormality was detected in 532 (19.5%) (2.8% of all samples) measurement patients. In the study conducted by Singer et al. (11), false potassium abnormality was detected in 3.6% and the samples showing this abnormality were excluded. This result is also consistent with our study.

In our study, the gender distribution was 48.5% (1,502 patients) female and 51.5% (1,589 patients) male. In the study by Singler et al. (12), the gender distribution was found to be 54% female and 46% male. In our study, the mean age of patients with hyperkalemia was 61.6 (SD: 18.94). In the study conducted at Hacettepe University Hospital, the average age of hyperpotassemia patients was found to be 56.8 (SD: 17) (12). In a study conducted in the USA, the average age of all patients included in the study was found to be 49 (SD: 22) (11). It was observed that patients with hyperkalemia in the population in our study were older compared to other studies.

In our study, the median potassium level of hyperkalemia patients was 5.40 mEq/L (IQR: 0.56). In the study conducted in South Korea by An et al. (13), the mean serum potassium level of patients with hyperkalemia was found to be 5.7 mEq/L (SD: 1.5). Since there was no normal distribution in the distribution of potassium levels in our study, the median was used, and since in the study we compared our findings, the average value was used, sufficient comparison could not be made.

While AKI was detected in 297 (15.4%) patients with hyperkalemia, and CKD was found in 386 (20.0%) of the patients who were hospitalized in Hacettepe University Hospital, 27% renal dysfunction was reported, although no distinction was made between acute and chronic (12).

It has been reported that hemodialysis was performed in 218 (11.3%) of hyperkalemia patients, while hemodialysis was performed in 7.9% of the patients hospitalized in Hacettepe University Hospital (12). In our study, it was found that the frequency of hemodialysis was higher. It is thought that this difference may be related to the tendency of nephrologists working in related hospitals to perform early or late hemodialysis.

It was found that the frequency of AKI, hemodialysis, hospitalization and intensive care hospitalization was higher

Table 5. Comparison of hospitalization and hemodialysis rates in patients with and without AKI and with and without CKD with hyperpotassemia

	Hospital admission				p value	Hemodialysis				p value
	Yes		No			Yes		No		
	n	%	n	%		n	%	n	%	
AKI	254	85.5	43	14.5	<0.001	90	30.3	207	69.7	<0.001
CKD	167	43.3	219	56.7	0.427	124	32.1	262	67.9	<0.001

AKI: Acute kidney injury, CKD: Chronic kidney disease, n: Number

in all patient groups who had hyperkalemia and died within 7 days and 28 days, which was statistically significant. It was observed that there was no statistically significant difference between patients with CKD and those who did not die within 7 days and patients who died within 7 days. It was found that it was statistically significant that patients without CKD died within 28 days more than those with CKD. It was concluded that the reason for this was AKI patients with a high mortality rate among patients without CKD.

Conclusion

In this study, it was found that AKI patients with hyperkalemia were associated with increased hospitalization, intensive care hospitalization, hemodialysis and death, and mortality could be seen in patients with hyperpotassemia close to normal values. Therefore, we think that all patients with increased potassium should be followed up closely, especially if AKI developed.

Ethics

Ethics Committee Approval: This study was approved by Akdeniz University Ethics Committee [no: 2012-KAEK (490), date: 09.08.2017].

Informed Consent: Retrospective study.
Peer-review: Externally peer-reviewed.

Authorship Contributions

Surgical and/or Medical Practices: R.Y., O.E., Concept: R.Y., O.E., Design: R.Y., E.G., O.E., Data Collection and/or Processing: R.Y., E.G., O.E., Analysis and/or Interpretation: R.Y., E.G., O.E., Literature Search: R.Y., E.G., O.E., Writing: R.Y., E.G., O.E.

Conflict of Interest: No conflict of interest was declared by the authors.

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