Response of Hyperkalemia to Medical Treatment in End Stage Renal Disease

Ghulam Abbas Tahir, Zaheer Ahmed, Rashid Hanif

ABSTRACT

End stage renal disease patients commonly encounter metabolic complications of their renal disease or dialysis related complications. The most common cause of sudden death in patients with ESRD is hyperkalemia, which is often encountered in patients after missed dialysis or dietary indiscretion. Metabolic acidosis in renal failure causes an increase in serum potassium. The rise in serum potassium is a very important cause of ventricular arrhythmias and cardiac death. Medical therapy for hyperkalemia can be lifesaving while patient is waiting for dialysis which is not readily available because of meagre resources of the hospitals. **Objective:** Our objective was to determine the mean decrease in serum potassium 1 hour after medical treatment (inj.10% Calcium Gluconate, nebulization with Salbutamol and 25% Dextrose water 100 ml plus 12 units regular insulin) in patients of hyperkalemia due to ESRD. **Study Design:** This study was a cross sectional study. **Settings:** Medicine Inpatient Department, Allied Hospital, Faisalabad. **Period:** Duration of study was six months from 06-08-2015 to 05-02-2016. **Methods:** Fifty patients including males and females with age ranges from 14-70 years having end stage renal disease with serum Potassium more than 5.5 mEq/L at presentation were taken according to inclusion criteria. **Results:** 50 patients were enrolled in study. Mean age of study population was 47.68 ± 12.14. 29 (58%) were male and 21 (42%) were female. Serum potassium at start of study was 6.024 ± 0.30 and 1 hour after medical therapy it was 5.15 ± 0.35. Mean decrease in serum potassium was 0.874 ± 0.24. Paired sample t test was applied (P-value 0.0001). **Conclusions:** It has been concluded from this study that medical therapy in hyperkalemia decreases serum potassium significantly and is an effective way to bridge interval to dialysis in patients with significant hyperkalemia.

Keywords: Serum Potassium, End Stage Renal Disease, Hyperkalemia

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INTRODUCTION

Chronic renal failure (CRF) with estimated GFR less than 15ml/minute requiring renal replacement therapy i.e., dialysis or transplantation, is known as end stage renal disease (ESRD)[1]. End Stage Renal Disease poses a variety of threatening complications like encephalopathy, metabolic acidosis, refractory pulmonary oedema, uraemic pericarditis, uraemic gastritis and hyperkalemia.[2,3] End stage renal disease (ESRD) patients commonly encounter metabolic complications of their renal disease or dialysis related complications. The most common cause of sudden death in patients with end stage renal disease [ESRD] is hyperkalemia, which is often encountered in patients after missed dialysis or dietary indiscretion.[4] Metabolic acidosis in renal failure causes an increase in serum potassium. The rise in serum potassium is a very important cause of ventricular arrhythmias and cardiac death.[5]

Hyperkalemia is defined as a potassium level greater than 5.5 mmol/L.[6] Patients may be asymptomatic or report vague symptoms like weakness, paraesthesias, paralysis, palpitations and generalized fatigue.[7] Emergency dialysis is a treatment for patients who are experiencing potentially lethal hyperkalemia that is unresponsive to more conservative measures or for patients who have complete renal failure.[8] Initiation of dialysis often can take some time, therefore, even if dialysis is contemplated, it is recommended to initiate first the other modalities of therapy in emergency department to buy time.[9] Medical therapy for hyperkalemia can be lifesaving while patient is waiting for dialysis which is not readily available because of meagre resources of

our hospitals. We designed this study to determine the mean decrease in serum potassium levels after medical therapy which is not very well established before.

OBJECTIVE
Our objective was to determine the mean decrease in serum potassium 1 hour after medical treatment (inj.10% Calcium Gluconate, nebulization with Salbutamol and 25% Dextrose water 100 ml plus 12 units regular insulin) in patients of hyperkalemia due to end stage renal disease.

OPERATIONAL DEFINITIONS
End Stage Renal Disease: Patients who are in stage V (estimated GFR <15ml/minute) chronic renal failure as calculated by Cockcroft and Gault equation as given under:

$CrCl = (140 - age(years)) * weight(kg)$/serum creatinine (mg/dl)*72 (Multiplied by factor 0.85 for female gender).

Hyperkalemia: It was defined as serum potassium more than 5.5mEq/L at presentation in medical emergency department.

Decrease in serum Potassium: It was defined as pre-treatment serum potassium minus serum potassium 1 hour after medical treatment.

METHODOLOGY
Study design: Cross sectional study
Settings: Medicine Inpatient Department, Allied Hospital, Faisalabad.
Duration of study: 06-08-2015 to 05-02-2016
Sample size: Sample size was calculated using WHO sample size calculator for one mean
Anticipated population mean =0.69[9]
Standard deviation= 0.13[6]
Confidence Interval = 95%
d = 0.05
Sample size = 50
Sampling Technique: Non-Probability Consecutive Sampling.
Sample Selection
Inclusion Criteria:
- Both Male and Female.
- Age ranges from 14-70 years.
- Patients with end stage renal disease with serum potassium more than 5.5mEq/L at presentation.

Exclusion Criteria:
- Patients with acute renal failure (sudden decrease in urine output <0.5ml/kg/hour or abrupt rise in creatinine more than 1.5 fold from baseline.
- Hemodynamically unstable patients (Blood Pressure <90mmHg systolic or <60mmHg diastolic).

- Serum Potassium more than 7.0mEq/L or Electrocardiographic changes suggestive of hyperkalemia (Tall tented T waves, widening of QRS complex, PR prolongation, Sinus bradycardia and conduction blocks).

DATA COLLECTION PROCEDURE
Approval from hospital ethical review committee was taken after formulation of synopsis. Informed consent was taken from each participant of the study. Patients fulfilling inclusion criteria were enrolled from indoor patient presenting in emergency department of medicine, Allied Hospital Faisalabad. Information collected by researcher and comprised of age, sex, address, and contact number serum potassium at baseline and 1 hour after medical treatment. Patients with serum potassium more than 5.5mEq/L were given medical treatment which comprised of Injection Calcium Gluconate (10%) 10ml over 10 minutes, nebulization with Salbutamol 1ml in 2ml normal saline 0.9% for 10 minutes, 25% Dextrose Water 100 ml with 12 units regular insulin over 20 minutes. Serum potassium measured at presentation and 1 hour after medical treatment by drawing 2ml of blood from patient's vein with a 5cc disposable syringe after aseptic measures were taken and sent to laboratory to be reported by pathologist.

DATA ANALYSIS PROCEDURE
All the collected information transferred to SPSS version 20 and analyzed accordingly. Mean and standard deviation were calculated for all quantitative variables like age and serum potassium at presentation, serum potassium 1 hour after medical treatment and decrease in serum potassium 1 hour after medical treatment. Frequency and percentage were calculated for all qualitative variables like gender.
Paired sample t-test was applied to compare pre and post treatment serum potassium.
Effect modifiers like age and gender were controlled by stratification. Post stratification independent sample t-test was applied. P-value <0.05 was taken as significant.

RESULTS
50 patients were enrolled in study. Mean age of study population was 47.68 ± 12.14. 29 (58%) were male and 21 (42%) were female (Fig.I). Serum potassium at start of study was 6.024 ± 0.30 and after 1 hour of medical therapy it was 5.15 ± 0.35. Mean decrease in serum potassium was 0.874 ± 0.24. Paired sample t test was applied (P-value 0.0001).(Table I).
Age and gender stratification was done and ANOVA test was applied to age stratification and

independent sample t test was applied to gender stratification for mean decrease in serum potassium level. The p-value was 0.108 and 0.696 respectively for age and gender. (Table II and III).
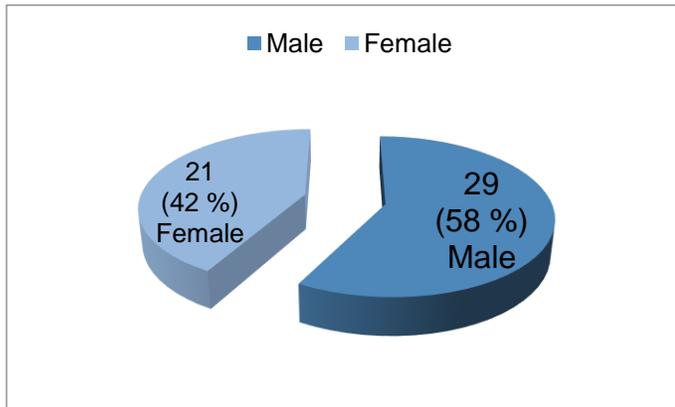

Fig 1: Gender Distribution of Study Population

Table 1: Paired sample t-test to determine efficacy of medical treatment of hyperkalemia

	Mean Serum Potassium
At start of study	6.024 ± 0.3000
At 1 hour after therapy	5.150 ± 0.3466
Mean change in potassium 1 hour after treatment	0.8740 ± 0.2380
Paired sample t-test (p value)	0.0001

Table 2: Stratification of age groups and mean decrease in potassium

Decrease in Potassium			
Age categories	Mean	Std. Deviation	p-value
>61	0.775	0.0957	
41- 60	0.863	0.2295	
21- 40	0.975	0.1893	0.108
20 or Less	0.975	0.4349	
Total	**0.874**	**0.2380**	

Table 3: Gender & mean decrease in potassium

Gender	Mean	Std. Deviation	p-value
Male	0.879	0.2381	
Female	0.867	0.2436	0.696

DISCUSSION

Chronic renal failure is a very common condition and end stage renal disease is labelled when estimated GFR falls below 15ml/minute. There are a variety of complications associated with this disease. Hyperkalemia is one of these complications which pose a significant mortality reason in these patients. Arrhythmias are the most common cause of death with this complication.

Initiation of dialysis often can take some time, therefore, even if dialysis is contemplated, it is recommended to initiate first the other modalities of therapy in emergency department to buy time.

Medical therapy for hyperkalaemia can be lifesaving while patient is waiting for dialysis which is not readily available because of meagre resources of our hospitals. We designed this study to determine the mean decrease in serum potassium levels after medical therapy which is not very well established before.

It was a small study in which medical therapy for hyperkalemia was evaluated. Mean Decrease in serum Potassium was 0.874 ± 0.278. There was also a significant decrease in serum potassium level after treatment.

In one study by Ahmad Z et al, y. The mean decrease in serum potassium after medical treatment in emergency department and after two hours of dialysis was 0.69±0.13 [p value <0.0001] and 2.93±0.12 mmol/L [p value <0.0001] respectively. These results support the findings in our study in which decrease in serum potassium was 0.874 ± 0.278 after 1 hour of medical therapy.[10]

In another study by Mushtaq et al, Base line serum potassium levels fell from 6.4±0.3mmol/L, 6.5±0.3 mmol/L and 6.5±0.2 mmol /L, to 5.5±0.2 mmol/L, 5.7±0.2mmol/L and 5.4±0.3 mmol /L for groups A, B, and C respectively at 60 minutes. These levels started to creep up again at 180 minutes to 5.7±0.1 mmol /L, 5.9±0.2 mmol /L and 5.5±0.4 mmol /L for groups A, B and C respectively. These results are very similar to our study as discussed above.[11]

Chothia MY et al., demonstrated decrease in serum potassium levels between insulin with dextrose versus dextrose alone. At 60 min, the glucose-only group had a fall in [K(+)] of 0.50 ± 0.31 mmol/l (p < 0.001). In the insulin group, there was a fall of 0.83 ± 0.53 mmol/l at 60 min (p < 0.001) and a lower serum [K(+)] at that time compared to the glucose-only group (5.18 ± 0.76 vs. 5.73 ± 1.12 mmol/l, respectively; p = 0.01). these values support the results of our study.[12]

Disadvantages:

Pitfalls of my study include:
- Small sample size

- Non randomized sampling

Advantages
Advantages of the study include:
- Medical therapy for hyperkalemia is easily administrable.
- It is available in far flung areas so it will be a useful in areas where no immediate facility for dialysis is available.

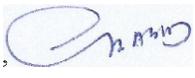Large randomized controlled trials are needed to further validate these results.

CONCLUSION
It has been concluded from this study that medical therapy in hyperkalemia decreases serum potassium significantly and it can be used as a bridging modality in treatment of hyperkalemia via dialysis.

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