



A STUDY ON PRE AND POST OPERATIVE SERUM ELECTROLYTES IN PATIENTS UNDERGOING CARDIAC SURGERY- A PROSPECTIVE OBSERVATIONAL STUDY

Biochemistry

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ABSTRACT

Background: The incidence of post operative arrhythmias are 34% in coronary artery bypass surgery. The incidence is higher in patients who are both Diabetic and Hypertensives.

Aim & Objectives: The aim of the present study was designed to assess the incidence of Arrhythmias and changes in serum potassium, magnesium, calcium and sodium concentrations after coronary artery bypass surgery.

Methodology: It is prospective observational study, conducted in the department of Biochemistry, Gandhi Medical College & general Hospital, Hyderabad, and Care hospital, Banjara hills, Hyderabad.

Results: Serum Potassium and Magnesium values are significantly decreased and serum Sodium values are significantly increased in post operative period. Serum Calcium values are not significantly altered. Except for serum Potassium levels which decreased post operatively no significant changes observed in other electrolytes studied in patients who remained normothymic perioperatively. Serum Potassium and Magnesium are significantly decreased and serum Sodium significantly increased post operatively in patients who developed arrhythmias perioperatively. Serum Potassium and Magnesium are significantly decreased in Diabetes, hypertensives, and age more than 65 years. Decreases in serum Potassium and Magnesium are observed in Diabetics compared to non diabetics, nonhypertensives with hypertensives, and nondiabetic and nonhypertensives with both diabetic and hypertensives. These decreases in post operative values serum Potassium and Magnesium in these groups are correlating with high incidence of Arrhythmias.

Conclusion: There are no significant alterations of all parameters observed in preoperative values of non diabetics with diabetics, non hypertensives with hypertensives with diabetics with hypertensives. The post operative increases in serum Sodium value is not correlating with incidence of arrhythmias and did not found supporting evidence for relation of Sodium and arrhythmias. Total Calcium values do not represent the Calcium homeostasis.

KEYWORDS

Sodium, Potassium, Diabetes, arrhythmias, Bypass surgery, Hypertensive

INTRODUCTION

Electrolyte disorders are an important cause of Arrhythmias as well as various other complications perioperatively in patients with Coronary artery bypass graft surgery. Patients undergoing cardiac surgery are at risk for development of arrhythmias, especially in the period during and immediately after surgical intervention. The incidence, predictors, morbidity, and mortality associated with postoperative Arrhythmias and its impact on intensive care unit (ICU) and postoperative hospital stay in patients undergoing cardiac surgery has to be studied. Postoperative Arrhythmias after open cardiac surgery is rather common. The etiology of these arrhythmia and factors responsible for its genesis are unclear, and its impact on postoperative surgical outcomes remains controversial. The causes to be elucidated for incidence of postoperative Arrhythmias and the factors associated with its development, as well as the impact of Arrhythmias on surgical outcome. Early identification and pharmacological treatment for selected patients may reduce the incidence of postoperative atrial fibrillation.¹⁻³

The electrophysiological mechanisms of postoperative Arrhythmias are believed to be reentry that results from dispersion of atrial refractoriness. When adjacent atrial areas have dissimilar or non uniform refractoriness, a depolarizing wave front becomes fragmented as it encounters both refractory and excitable myocardium.

Electrolytes such as potassium, magnesium, calcium, and sodium play important roles in cellular metabolism and energy transformation and regulation of cellular membrane potentials, especially those of muscle and nerve cells. Depletion of these electrolytes can induce a wide range of clinical disorders including neuromuscular dysfunction and severe arrhythmias. The risk of these disorders increases significantly when more than one electrolyte is deficient increases still further in the presence of ischemic heart disease.⁴⁻⁸

Electrolyte balance disorders after cardiac surgery are not widely investigated. There are very few studies that show the depletion of

serum electrolyte concentration changes after cardiac surgery. Present study was designed to assess the incidence of Arrhythmias and changes in serum potassium, magnesium, calcium and sodium concentrations after coronary artery bypass surgery.

MATERIALS AND METHODS

STUDY DESIGN

The study was conducted in the department of Biochemistry, Osmania general Hospital and Medical College, Hyderabad, and Care hospital, Banjara hills, Hyderabad.

The study was designed to assess the incidence of atrial fibrillation with changes of serum electrolyte concentrations following coronary artery bypass graft.

After informed consent was obtained from all the study participants, patients undergoing elective coronary artery bypass surgery, in the department of cardiac surgery, during the period of March 2007 -April 2008, were analyzed for serum sodium potassium, calcium, and magnesium. They were measured before 24 hours of surgery and within 24 hours of Coronary artery bypass surgery. Cardiac rhythm was monitored throughout the study. Changes in cardiac rhythm were noted in all the study participants.

Study population

Total 100 participants are included in the study after informed consent. Study participants were selected as and when they are admitted for elective coronary artery bypass surgery.

Sample Collection

5ml of venous blood was collected in from all study participants. Serum was separated within one hour after collection. Care was taken to avoid hemolysis. Samples are stored at -20 degree Celsius.

Elimination criteria: Renal disease, and Patients who are on diuretics.

Estimation procedures for analytes: Estimation of serum Sodium and Potassium by flame photometry.^{9,10,11} Estimation of serum magnesium by calmagite method by Tietz

The present study was undertaken in the Department of Biochemistry, General Hospital, Gandhi medical College, and Care Hospital, Hyderabad.

The numbers of blood samples collected are two for each patients that is five operative before 24 hours and post operative within 24 hours after consent. The patients admitted for elective Coronary artery bypass surgery are included in the study.

EXCLUSION CRITERIA: patients with renal insufficiency and patients who are on diuretics.

All these parameters are estimated both pre and post operatively. The results are represented in the form of tables and bar diagrams.

STATISTICAL ANALYSIS

The data has been statistically analyzed by using Microsoft Excel Software, and Graphpad prism. Mean, Standard deviation and study *T* test was used to assess the significance of differences *In the Mean values* of different parameters.

RESULTS

Table 1: The neumeiucal representation of the case distribution among participants selected

Type of cases	n	Arrhythmia +ve	% arrhythmia
Diabetics	31	22	70.96
Non Diabetics	69	12	17.39
Hypertensives	31	21	67.74
Non Hypertensives	69	13	18.84
Diabetes with Hypertension	21	16	76.19
Non HTN, non DM	60	7	11.66
Age <5 years	74	18	24.32
Age >65 years	26	16	61.53
Total no of cases	100	34	34

Table 2: Mean, SD, t and P values of analytes pre operative data compared with post operative data (n=100)

Parameter	Mean	SD	T	p
Sodium pre op (mEq/L)	145.54	3.26	3.7	<0.001
Sodium post op(mEq/L)	146.98	2.31		
Potassium pre op(mEq/L)	4.24	0.52	4.5	<0.001
Potassium post op(mEq/L)	3.88	0.54		
Calcium pre op(mg/dl)	9.7	0.49	1.6	Not significant
Calcium post op(mg/dl)	9.65	0.50		
Magnesium pre op (mg/dl)	2.12	0.11	2.15	<0.02
Magnesium post op (mg/dl)	2.0	0.12		

The mean values of serum potassium, Magnesium and calcium are decreased post operatively when compared to preoperative values. This decrease is statistically significant for serum Potassium and Magnesium levels. The serum sodium value is increased postoperatively and it is statistically significant.

Table 3: Mean, SD,t and P values of analytes: who were in normal rhythm (n=66)

Parameter	Mean	SD	T	p
Sodium pre op (mEq/L)	146.63	3.07	0.714	Not significant
Sodium post op(mEq/L)	146.98	2.6		
Potassium pre op(mEq/L)	4.3	0.50	2.21	<0.001
Potassium post op(mEq/L)	4.11	0.49		
Calcium pre op(mg/dl)	9.73	0.59	1	Not significant
Calcium post op(mg/dl)	9.64	0.48		
Magnesium pre op (mg/dl)	2.11	0.105	1.1	Not significant
Magnesium post op (mg/dl)	2.05	0.11		

The mean values of serum potassium, calcium, and magnesium are decreased post operatively than pre operatively than pre-operative values. These decreases in serum potassium are significant statistically in participants who were in normal rhythm pre operatively. The serum values of sodium, calcium and magnesium are not significant.

Table 4: Mean, SD, t and P values of analytes: who experienced arrhythmias (n=34).

Parameter	Mean	SD	T	p
Sodium pre op (mEq/L)	145.2	3.59	2.4	<0.05
Sodium post op(mEq/L)	146.98	1.6		
Potassium pre op(mEq/L)	4.15	0.54	2.24	<0.05
Potassium post op(mEq/L)	4.11	0.30		
Calcium pre op(mg/dl)	9.73	0.46	1.54	Not significant
Calcium post op(mg/dl)	9.64	0.48		
Magnesium pre op (mg/dl)	2.11	0.11	4.5	<0.0001
Magnesium post op (mg/dl)	2.05	0.08		

The mean values of serum potassium, calcium, and magnesium are decreased post operatively when compared to pre-operative values. These decreases in serum potassium are significant statistically in participants who were in ARRHYTHMIAS pre operatively. The serum values of sodium, calcium and magnesium are statistically significant.

Table 5: Mean, SD, t and P values of analytes: in known diabetes(n=31)

Parameter	Mean	SD	T	p
Sodium pre op (mEq/L)	145.74	3.78	2.0	NOT significant
Sodium post op(mEq/L)	147.45	2.61		
Potassium pre op(mEq/L)	4.16	0.47	4.24	<0.001
Potassium post op(mEq/L)	3.65	0.43		
Calcium pre op(mg/dl)	9.72	0.53	1.15	Not significant
Calcium post op(mg/dl)	9.57	0.50		
Magnesium pre op (mg/dl)	2.13	0.10	3.27	<0.0001
Magnesium post op (mg/dl)	1.95	0.13		

The mean values of serum potassium, calcium, and magnesium are decreased post operatively when compared to pre-operative values. In known diabetics. These decrease in serum potassium is significant statistically in known diabetics patients. The serum values of sodium, calcium and magnesium is increased post operatively and this increase is not significant.

Table 6: Mean, SD, t and P values of analytes: in non diabetes(n=31)

Parameter	Mean	SD	T	p
Sodium pre op (mEq/L)	145.4	3.06	3.1	<0.01
Sodium post op(mEq/L)	146.8	2.20		
Potassium pre op(mEq/L)	4.29	0.52	4.24	<0.001
Potassium post op(mEq/L)	3.97	0.55		
Calcium pre op(mg/dl)	9.79	0.48	1.15	Not significant
Calcium post op(mg/dl)	9.67	0.47		
Magnesium pre op (mg/dl)	2.10	0.11	3.27	Not significant
Magnesium post op (mg/dl)	2.01	0.12		

The mean values of serum potassium, calcium, and magnesium are decreased post operatively when compared to pre-operative values. In non diabetics patients. The decreased post operative value of serum potassium is statistically significant. The mean value of serum sodium is increased post operatively when compared to pre operative values and this increase is significant.

Table 7: Mean, SD,t and P values of analytes: in known hypertensives(n=31)

Parameter	Mean	SD	T	p
Sodium pre op (mEq/L)	145.2	3.78	1.2	not significant
Sodium post op(mEq/L)	146.23	2.61		
Potassium pre op(mEq/L)	4.21	0.47	4.34	<0.001
Potassium post op(mEq/L)	3.71	0.43		
Calcium pre op(mg/dl)	9.74	0.48	0.698	Not significant
Calcium post op(mg/dl)	9.65	0.53		
Magnesium pre op (mg/dl)	2.13	0.11	3.5	<0.001
Magnesium post op (mg/dl)	1.96	0.14		

The mean values of serum potassium, calcium, and magnesium are decreased post operatively when compared to pre-operative values. In known hypertensives. The decreased post operative value of serum potassium is statistically significant. The mean value of serum sodium is increased post operatively when compared to pre operative values and this increase is not significant in known hypertensive patients.

Table 8: Mean, SD, t and P values of analytes: in non hypertensives (n=31)

Parameter	Mean	SD	T	p
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Sodium pre op (mEq/L)	145.69	3.07	2.5	<0.01
Sodium post op(mEq/L)	146.88	2.21		
Potassium pre op(mEq/L)	4.25	0.52	2.9	<0.01
Potassium post op(mEq/L)	3.97	0.55		
Calcium pre op(mg/dl)	9.79	0.48	1.4	Not significant
Calcium post op(mg/dl)	9.66	0.47		
Magnesium pre op (mg/dl)	2.11	0.11	1.8	Not significant
Magnesium post op (mg/dl)	2.02	0.13		

The mean values of serum potassium, calcium, and magnesium are decreased post operatively when compared to pre-operative values. In non hypertensives. The decreased post operative value of serum potassium is statistically significant. The mean value of serum sodium is increased post operatively when compared to pre operative values and this increase is significant in non hypertensive patients.

Table 9: Mean, SD, t and P values of analytes: in non hypertensives and non diabetics (n=60)

Parameter	Mean	SD	T	p
Sodium pre op (mEq/L)	145.36	3.19	2.82	<0.01
Sodium post op(mEq/L)	146.77	2.24		
Potassium pre op(mEq/L)	4.27	0.53	2.78	<0.01
Potassium post op(mEq/L)	4.02	0.52		
Calcium pre op(mg/dl)	9.78	0.49	1.2	Not significant
Calcium post op(mg/dl)	9.67	0.48		
Magnesium pre op (mg/dl)	2.11	0.09	1.4	Not significant
Magnesium post op (mg/dl)	2.04	0.117		

The mean values of serum potassium, calcium, and magnesium are decreased post operatively when compared to pre-operative values. In non hypertensives non diabetic. The decreased post operative value of serum potassium is statistically significant. The mean value of serum sodium is increased post operatively when compared to pre operative values and this increase is statistically significant in non hypertensive non diabetic patients.

Table 10: Mean, SD, t and P values of analytes: in with hypertensives and diabetics (n=21)

Parameter	Mean	SD	T	p
Sodium pre op (mEq/L)	144.86	3.87	2.14	<0.001
Sodium post op(mEq/L)	147.42	3.01		
Potassium pre op(mEq/L)	4.19	0.54	4.17	<0.001
Potassium post op(mEq/L)	3.66	0.51		
Calcium pre op(mg/dl)	9.66	0.55	0.5	Not significant
Calcium post op(mg/dl)	9.57	0.52		
Magnesium pre op (mg/dl)	2.14	0.14	3.0	<0.001
Magnesium post op (mg/dl)	1.96	0.11		

The mean values of serum potassium, calcium, and magnesium are decreased post operatively when compared to pre-operative values. In with hypertensives diabetic. The decreased post operative value of serum potassium is statistically significant. The mean value of serum sodium is increased post operatively when compared to pre operative values and this increase is statistically significant in with hypertensive diabetic patients.

Table 11: Mean, SD, t and P values of analytes: in diabetics with hypertension & non diabetics with no hypertension (pre op data compared)

Parameter	Mean	SD	T	p
Sodium post op (mEq/L)	145.36	3.19	0.6	Not significant
Sodium pre op(mEq/L)	144.85	3.87		
Potassium post op(mEq/L)	4.27	0.53	0.6	Not significant
Potassium pre op(mEq/L)	4.19	0.54		
Calcium post op(mg/dl)	9.78	0.48	0.5	Not significant
Calcium pre op(mg/dl)	9.68	0.55		
Magnesium post op (mg/dl)	2.13	0.09	0.2	Not significant
Magnesium pre op (mg/dl)	2.10	0.12		

The mean values of serum potassium, calcium and magnesium are decreased in patients who are known diabetes and hyper tension, and these decreases are not statistically significant. The mean sodium value is increased and it is not significant

Table 12: Mean, SD, t and P values of analytes: in with hypertensives and diabetics and non diabetics with no hypertension (post operative values compared)

Parameter	Mean	SD	T	p
Sodium post op (mEq/L)	146.76	2.24	1.1	Not significant
Sodium pre op(mEq/L)	147.72	3.02		
Potassium post op(mEq/L)	4.03	0.50	2.8	<0.001
Potassium pre op(mEq/L)	3.66	0.54		
Calcium post op(mg/dl)	9.67	0.48	0.83	Not significant
Calcium pre op(mg/dl)	9.57	0.52		
Magnesium post op (mg/dl)	2.03	0.12	2.6	<0.001
Magnesium pre op (mg/dl)	1.95	0.11		

The mean values of serum potassium, calcium, and magnesium are decreased in participants who are known diabetic and hypertensives when compared to non diabetic non hypertensives and these decreases is significant for potassium and magnesium values when post operative values are compared. The differences in mean values of serum sodium and calcium are not significant.

Table 13: Mean, SD, t and P values of analytes: in participants <= 65 years (n=74)

Parameter	Mean	SD	T	p
Sodium pre op (mEq/L)	145.4	3.07	2.78	<0.01
Sodium post op(mEq/L)	146.82	2.2		
Potassium pre op(mEq/L)	4.29	0.52	3.59	<0.001
Potassium post op(mEq/L)	3.96	0.55		
Calcium pre op(mg/dl)	9.78	0.48	1.2	Not significant
Calcium post op(mg/dl)	9.67	0.47		
Magnesium pre op (mg/dl)	2.1	0.1	1.8	Not significant
Magnesium post op (mg/dl)	2.01	0.12		

The serum potassium is decreased post operatively when compared to pre operative values in participants who are < 65 years and this decrease is significant statistically. The serum sodium is increased post operatively when compared to pre operative values and this difference in value is significant statistically.

Table 14: Mean, SD, t and P values of analytes: in participants >= 65 years

Parameter	Mean	SD	T	p
Sodium pre op (mEq/L)	145.9	3.78	1.66	Not significant
Sodium post op(mEq/L)	147.4	2.66		
Potassium pre op(mEq/L)	4.07	0.47	3.25	<0.001
Potassium post op(mEq/L)	3.67	0.43		
Calcium pre op(mg/dl)	9.73	0.53	1.0	Not significant
Calcium post op(mg/dl)	9.6	0.50		
Magnesium pre op (mg/dl)	2.15	0.11	3.6	<0.001
Magnesium post op (mg/dl)	1.97	0.14		

The mean values are decreased in serum potassium, calcium and magnesium post operatively when compared to pre operatively in patients who are > 65 years. These decreases in serum potassium and magnesium are statistically significant. The increase in serum sodium and decrease in serum calcium post operatively when compared to pre operatively were not significant.

Table 15: Mean, SD, t and P values of analytes: in hypertensive and non hypertensive participants (pre operative values compared)

Parameter	Mean	SD	T	p
Sodium pre op (mEq/L)	145.69	3.1	0.5	Not significant
Sodium pre op(mEq/L)	145.2	3.62		
Potassium pre op(mEq/L)	4.25	0.51	0.44	Not significant
Potassium pre op(mEq/L)	4.2	0.54		
Calcium pre op(mg/dl)	9.79	0.48	0.14	Not significant
Calcium pre op(mg/dl)	9.74	0.53		
Magnesium pre op (mg/dl)	2.11	0.1	0.1	Not significant
Magnesium pre op (mg/dl)	2.13	0.13		

The differences between means of pre operative values of serum sodium, potassium, calcium and magnesium in hypertensives and non hypertensives are not statistically significant.

Table 16: Mean, SD, t and P values of analytes: in hypertensive and non hypertensive participants (post operative values compared)

Parameter	Mean	SD	T	p
Sodium post op no htn(mEq/L)	146.87	2.11	0.8	Not significant
Sodium post op htn (mEq/L)	147.2	2.76		

Potassium post op no htn (mEq/L)	3.97	0.52	1.9	<0.05
Potassium post op htn (mEq/L)	3.72	0.53		
Calcium post op no htn (mg/dl)	9.66	0.46	0.9	Not significant
Calcium post op htn(mg/dl)	9.65	0.52		
Magnesium postop no htn (mg/dl)	2.02	0.12	2.4	<0.02
Magnesium post op htn (mg/dl)	1.9	0.16		

The mean values of post operative serum potassium, calcium and magnesium are decreased in hypertensive participants compared to non hypertensive participants. these decreases in serum potassium and magnesium are statistically significant. the decrease in serum calcium is not significant. there is increase in serum sodium value in hypertensive participants and this increase is not significant

Table 17: Mean, SD, t and P values of analytes: diabetics and non diabetics participants (pre operative values compared)

Parameter	Mean	SD	T	p
Sodium pre op no dm (mEq/L)	145.69	3.1	0.5	Not significant
Sodium pre op dm(mEq/L)	145.2	3.62		
Potassium pre op no dm(mEq/L)	4.25	0.51	0.44	Not significant
Potassium pre op dm(mEq/L)	4.2	0.54		
Calcium pre op no dm(mg/dl)	9.79	0.48	0.14	Not significant
Calcium pre op dm(mg/dl)	9.74	0.53		
Magnesium pre op no dm(mg/dl)	2.11	0.1	0.1	Not significant
Magnesium pre op dm (mg/dl)	2.13	0.13		

The differences between means of pre operative values of serum sodium, potassium, calcium and magnesium are decreased in diabetics compared to non diabetics but are not statistically significant.

Table 18: Mean, SD, t and P values of analytes: in hypertensive and non hypertensive participants (post operative values compared)

Parameter	Mean	SD	T	p
Sodium post op no DM(mEq/L)	146.76	2.54	4.2	Not significant
Sodium post op DM (mEq/L)	147.45	2.45		
Potassium post op no DM (mEq/L)	3.99	0.52	3.7	<0.001
Potassium post op DM (mEq/L)	3.65	0.48		
Calcium post op no DM (mg/dl)	9.69	0.48	1.3	Not significant
Calcium post op DM(mg/dl)	9.57	0.47		
Magnesium postop no DM (mg/dl)	2.02	0.13	3.34	<0.001
Magnesium post op DM (mg/dl)	2.19	0.12		

The post operative Serum Potassium and Magnesium and Calcium are decreased in diabetics when compared to non diabetics. And this decrease in serum Potassium and Magnesium are statistically significant. The increase in serum Sodium and decrease in serum Calcium are not significant. In order to assess the discriminative capacity of different markers used in the present study, the data is analyzed by Receiver Operator Characteristic curves. The best cut off Values and the area under the curve values presented along with the sensitivity and specificities in the following table

Table 19: Receiver operator characteristic curves in arrhythmic participants

S.NO	Parameter	Best cut off	Sensitivity	specificity
1	Sodium	148.5(mEq/l)	52.9%	70.59%
2	Potassium	3.85(mEq/l)	91%	71%
3	Calcium	9.3(mEq/l)	67%	73%
4	magnesium	1.91(mEq/l)	74%	100%

Table 20: Area under curve for various analytes in arrhythmic participants

S.NO	Parameter	Area Under Curve	Standard error	95% confidence interval	
				Upper limit	Lower limit
1	Sodium	0.6107	0.0688	0.7456	0.4759
2	Potassium	0.8569	0.0439	0.9520	0.7799
3	Calcium	0.7180	0.8659	0.8400	0.5960
4	magnesium	0.9550	0.0209	0.9960	0.9140

The serum Magnesium exhibited better discrimination in differentiation between the patients who developed arrhythmias and those who do not.

DISCUSSION

Ischemic heart disease is one of the major causes of morbidity and mortality throughout the world. One of permanent mode of treatment Coronary artery bypass surgery. Cardiac arrhythmias are a common complication after coronary artery bypass surgery. This complication remained the subject of considerable interest predominantly because the arrhythmias are associated with a number of adverse clinics and financial outcomes. Electrolyte balance disorders after cardiac surgery are not widely investigated. Hence the present study is undertaken to assess the incidence of arrhythmias and the effect of advanced age, diabetes mellitus and hypertension on electrolyte changes and arrhythmias after coronary artery bypass surgery.

The incidence of post coronary bypass surgery arrhythmias are reported to be occurring in 20-40% of the patients.¹² In the present study we also found this to be 34% in the total study group. The incidence of arrhythmias are highest in the patients who are both Diabetic and hypertensive, followed patients who are diabetic or hypertensive. High incidence also observed in patients who are above 65 years of age.

Serum electrolyte alterations are reported in patients perioperatively especially after coronary artery bypass surgery.¹³ In the present study we found significant decreases in serum potassium and magnesium post operative period compared to pre operative period. Significantly higher serum sodium values were observed post operatively in these patients. However no significant changes in serum calcium levels were observed. These observations are especially significant in case of potassium and magnesium as all these patients were supplemented with cardioplegic solution containing potassium and magnesium. This also has been reported by others.¹⁴ The probable mechanism is a combination of increase urinary excretion: intracellular shift induced by combination of extra corporeal circulation and decreased body temperature during surgery.

Decreased in post operative serum sodium levels are reported in patients who are received large amount of fluids other than sodium chloride are given.¹⁵ However we could not explain and relate increased sodium values to post operative Arrhythmias.

Many biochemical processes depend on intracellular calcium including cardiac contractility. It has been reported that serum calcium decreases significantly after coronary artery bypass surgery.¹² However in the present study we did not observe any significant changes in serum calcium levels in pre and post operative values either in total patients or in any other study groups. This may be due to some to some extent of the fact that calcium is estimated and not ionised calcium which is a better indicators homeostasis.¹⁶

It is well established that ischemic heart disease patients with low blood levels of potassium are more prone to develop serious arrhythmias than are patients with normal levels. Although etiology of atrial fibrillation after cardiac surgery is incompletely understood. Stimuli and triggers are thought to play a role in pathogenesis. among them hypokalaemia causes cellular hyper polarity, increase resting potential, hastens depolarization increases automaticity and excitability. Several authors reported association of increase incidence of arrhythmias and electrolyte alterations perioperative period. It has also been shown that acute and chronic hypokalaemia sensitizes the isolated heart in hypoxic injury.¹⁷ The serum potassium its shown to influence myocardial cell excitability by increasing the membrane potential, diastolic depolarization, duration of refractory period and action potential and decrease conduction velocity. In the present study we found significant decreases in post operative serum Potassium levels in total patients both with normal rhythm and arrhythmias, and in all study groups. However two reports have shown no relation between Hypokalemia and incidence of Arrhythmias.^{87,25} Larger studies later established clear association of hypokalaemia and perioperative arrhythmias,^{69,70} and Potassium recommended supplementation.

Several reports have shown that Hypomagnesemia is associated with adverse outcome.¹⁴⁻¹⁶ Hypomagnesemia can cause arrhythmias, neuromuscular irritability, hypertension and vasoconstriction. In the present study we found significant post operative decreased Magnesium levels. We did not found any significant changes in serum Magnesium concentrations in patients who remained in normal rhythm. There is a large body of evidence suggesting that magnesium plays an important role in preventing injury to ischemic heart, and perhaps also brain. The effects of Magnesium depletion can be greatly

enhanced in the presence of other electrolyte disorders especially Hypokalaemia.¹⁵ In addition hypomagnesaemia can induce Hypokalemia through increase in renal Potassium excretion and Hypokalemia in turn causes Hypomagnesaemia. The potentiating effect of Hypomagnesaemia on Hypokalemia is supported by our findings of no significant differences in Magnesium concentrations in patients who remained normorhythmic in the presence of decreased Potassium concentrations. And by presence of significantly decreased Magnesium and Potassium in post operative period in patients who developed arrhythmias.

Diabetes mellitus is shown to be associated with Magnesium deficiency, and Magnesium deficiency of Diabetics is implicated in diabetic complications.¹⁸ In the present study we also found increased incidence of arrhythmias in Diabetic patients 71% compared to 17% in non diabetics. In present study we found significant decreases in serum Potassium, and Magnesium values in post operative period compared to the significant decreases of only serum potassium values in non Diabetics. Magnesium decreases along with Potassium decreases in the post operative period of Diabetics explain the increased incidence of arrhythmias in Diabetics differences in pre operative concentrations of Potassium and Magnesium in Diabetics and nondiabetics. The post operative values are significantly different.

Hypertension is also shown to be associated with increased incidence of arrhythmias.¹⁹ In the present study 31% are Hypertensives. 68% of patients developed arrhythmias. As with Diabetics there are no significant differences in preoperative Potassium and Magnesium concentrations in Hypertensives and non Hypertensives. And as the post operative values are significantly different.

The highest incidence of arrhythmias occurred in patients who are both diabetic and Hypertensives. And this fact is explained by the combination of significant decreases of Potassium and Magnesium in our study. We did not find any report studying patients who are suffering from both diabetes and Hypertension.

Several authors reported increased incidence of cardiac arrhythmias in aged in post operative period of Coronary artery bypass surgery.²⁰ However others have shown no relation between age and incidence of arrhythmias.²¹ In the present study we also found higher incidence of arrhythmias after Coronary artery bypass surgery in patients who are more than 65 years (61%). This organs may be attribute to structural changes in and combined significant decreases in Potassium and Magnesium in these patients compared to lesser age patients.

In the present study, we calculated best cutoff values by using ROC analysis. By using best cutoff values are not shown that, at best cutoff values serum Magnesium exhibited highest specificity with good sensitivity and Potassium with good sensitivity and good specificity. Hence the present study also support the view that decreases in Magnesium and Potassium can be used as markers for predicting Arrhythmias in post operative period of Coronary artery bypass surgery.

CONCLUSION

We conclude that, significant decreases observed in serum electrolytes due to a combination of increased urinary excretion, intracellular shift induced by a combination of extra corporeal circulation and decreased body temperature during surgery. This signifies the importance administration of Potassium and magnesium. Diabetes, Hypertension and advanced age are associated with increased incidence of post operative arrhythmias. Combined deficiency of potassium and magnesium are responsible for this predisposition. Magnesium and Potassium deficiencies potentiate each other.

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Conflict of Interest

None

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