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STUDY OF SERUM MAGNESIUM LEVELS AND ITS CORRELATION WITH IMPORTANT NUTRIENTS

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ABSTRACT

Background: Magnesium (Mg) is essential to the basic nucleic acid chemistry of life and thus is essential to all known living organisms. Mg is important for maintaining of DNA. Magnesium is extremely necessary for proper ATP synthesis (Buchachenkoa et al. 2009). Magnesium (Mg2) is the second most abundant intracellular cation after potassium and the fourth most abundant cation of the body after calcium, potassium, and sodium. Mg2 is involved in hundreds of enzymatic reactions and is essential for life. Mg2 is an important co-factor for many biologic processes, most of which use ATP. Mg2 is an essential mineral that is important for bone mineralization, muscular relaxation, neurotransmission, and other cell functions (Rude et al. 2000). Extracellular Mg2 concentration is tightly regulated by the extent of intestinal absorption and renal excretion. **Objective**: In this study our main goal is to measure serum magnesium levels and its correlation with important nutrients. **Method:** This Observational cross-sectional study was done at Department of Haematology, BSMMU, Dhaka from September 2016 to August 2017. During the study period of total 85 patients were enrolled for the study. **Result:** Investigation of the population, it was that mean serum sodium was 136.00±4.54 mmol/L, serum potassium was 3.77±0.49 mmol/L, serum chloride was 101.85±11.05 mmol/L, serum magnesium was 1.80±0.54 mg/dL, serum albumin was 34.56±6.47 g/L, serum calcium was 1.80±0.54 mg/dL, serum creatinine was 0.78±0.18 mg/dl, RBS was 5.98±1.22 mmol/l. Positive correlation (r= 0.15; p=0.16) between serum chloride (g/l) and magnesium (mg/dl) but not statistically significant. Positive correlation (r= 0.04; p=0.67) between serum potassium (mmol/l) and magnesium (mg/dl) but not statistically significant. Positive correlation (r= 0.05; p=0.62) between serum magnesium (mg/dl) level with serum sodium (mmol/L) level but not statistically significant. Positive correlation (r= 0.451; p=<0.001) between serum magnesium (mg/dl) level with serum calcium (mg/dl) level that was statistically significant. Mean serum magnesium was found 1.56±0.60 mg/dl in ALL patients and 1.89±0.49 mg/dl in AML patients which was significantly lower in ALL patient than AML patients (p =0.009). serum magnesium level majority 44(51.8%) was found hypomagnesaemia followed by 38(44.7%) were normal magnesium and 03(3.5%) were hypermagnesaemia. **Conclusion:** From our result we can conclude that, there were no significant differences in the incidence of serum Sodium, Potassium and Chloride between patients with AML and ALL, which was more frequently observed in AML patients.

KEYWORDS: Acute leukemia, hypocalcemia, serum magnesium, hypomagnesaemia.

INTRODUCTION

Magnesium (Mg) is essential to the basic nucleic acid chemistry of life and thus is essential to all known living organisms. Mg is important for maintaining of DNA. Magnesium is extremely necessary for proper ATP synthesis.[1] Magnesium (Mg2) is the second most abundant intracellular cation after potassium and the fourth most abundant cation of the body after calcium, potassium, and sodium. Mg2 is involved in hundreds of enzymatic reactions and is essential for life. Mg2 is an important co-factor for many biologic processes, most of which use ATP. Mg2 is an essential mineral that is important for bone mineralization, muscularrelaxation, neurotransmission, and other cell functions.[2] Extracellular Mg2 concentration is tightly regulated by the extent of intestinal absorption and renal excretion.

Hypomagnesemia is a relatively common electrolyte abnormality in leukemic patients. It has been reported that low serum magnesium levels may b3e detected in as many as 30% of AL patients.[3] Several studies has shown an increase cancer rate in regions with low magnesium levels in soil & drinking water. Magnesium is actually the key to the body's proper assimilation and use of calcium as well as other important nutrients. Patients with hypomagnesaemia consume too much[4] calcium without sufficient magnesium the excess calcium is not utilized correctly & may actually become toxic, causing painful conditions in the body. Hypocalcemia is a prominent manifestation of magnesium deficiency in humans.[2] Magnesium protects cells from aluminum, mercury, lead, cadmium, beryllium & nickel. Magnesium in general is essential for the survival of our cells. Glutathione requires magnesium for its synthesis. Glutathione is one of the antioxidant molecules known to neutralize mercury. Without the cleaning & chelating work of glutathione (magnesium), cells begin to decay as cellular filth &heavy metals accumulate; excellent environments to attract deadly infection/cancer. It has been suggested that Mg deficiency may trigger carcinogenesis by increasing membrane permeability. Magnesium deficient cell membranes seem to have a smoother surface than normal, and decreased membrane viscosity, analogous to changes in human leukemia cells. Magnesium has an effect on a variety of cell membranes through a process involving calcium & channels & ion transport mechanisms. Magnesium is responbile for the maintenance of the trans-membrane gradients of sodium & potassium.

OBJECTIVES

General objective

To measure the status of serum magnesium level in patients with newly diagnosed acute leukemia.

Specific objectives:

- To correlate magnesium level with sodium, potassium, chloride
- To correlate magnesium level with calcium and albumin

METHODOLOGY

Study type

This was an Observational cross-sectional study.

Place and period of the study

This study was conducted in department of Haematology, BSMMU, Dhaka from September 2016 to August 2017.

Study Population

All newly diagnosed acute leukemia patients attending department of Haematology.

Sampling method

Purposive sampling.

Sample size

Purposive sampling of the acute leukemia patients attending Dept. of Haematology of BSMMU.

The Sample size was determined by using following formula,

$$n = \frac{Z^2 pq}{d^2}$$

Z = given Cl (Z = 1.96 for 95% Cl)
P = 0.42 (Demir et al. 2011)
q = 1-p = 1-0.42 = 0.58
d = 0.1 (where allowable error is 5%)

$$\frac{(1.96)^2 \times 0.42 \times 0.58}{(0.10)^2}$$

= 93.58%
= ≥94 (approx); that mean sample size should be ≥94.

Data and sample collection procedure

A pre-designed structured data collection sheet was used. For each and every subject separate data collection sheet was prepared. After selection of study subjects data was collected by details history taking and clinical examination. Written consent was taken from those who was agree to participate in the study. The patients were chosen according to purposive sampling as diagnosed case of acute leukemia attending department of Haematology. The diagnosis was confirmed by bone marrow study. All patients' data including demographical, clinical and laboratory data was collected to evaluate basic hemogram and trace elements status specially magnesium. The study subjects were briefed about the purpose of the study, and written consent was taken from each of them. Ethical approval was obtained from the Institutional Review Board (IRB).

Venous blood sample (5 ml) was collected from the antecubital vein of each of the acute leukemia patients in a metal-free sterile tube, in the morning. Samples with signs of hemolysis were discarded. The blood was then allowed to clot and centrifuged for 15 minutes at 3000 rpm to extract the serum. The serum was aliquoted into deionised polyethylene tubes and stored at -80°C in a deepfreeze (without thawing) until the day of study serum magnesium level was done in the Department of Biochemistry & Molecular Biology, BSMMU. Serum sodium, potassium, chloride, calcium and albumin were done in Department of heamatology, BSMMU.

Biochemical Analysis

Serum concentrations of Magnesium, Sodium, Potassium, Chloride, Calcium & albumin in patients were determined.

Data analysis

All data were processed by utilizing SPSS program (Version 23.0) and expressed as frequencies or percentages as well as mean (SD/SEM) as applicable. Unpaired t-test was used for continuous variables.

Pearson's correlation coefficients was used between serum magnesium level with other sodium, potassium, chloride, calcium and albumin. The level of significance was determined as <0.05. p value <0.05 was declared as statistically significant.

RESULT

This observational cross-sectional study was carried out with the aim to determine the status of serum magnesium level in patients with newly diagnosed acute leukemia in the department of Haematology, BSMMU, Dhaka between September 2016 to August 2017. During the study period of total 85 patients were enrolled for the study.

Age distribution of the study population

Table showed mean age was found 36.17(±19.15) years, majority age group was found 10-40 years of age which was (62.4%).

Table I: Age distribution of the study population (n=85).

Age in years	Number	Percentage
10-20 years	27	31.8
21-30 years	13	15.3
31-40 years	13	15.3
41-50 years	15	17.6
51-60 years	06	07.1
> 60 years	11	12.9
Total	85	100.0
Mean ±SD	36.17(±19.15)	Range (10-78)

Sex distribution of the study population

Regarding gender 55% were found male and 45% were found female.

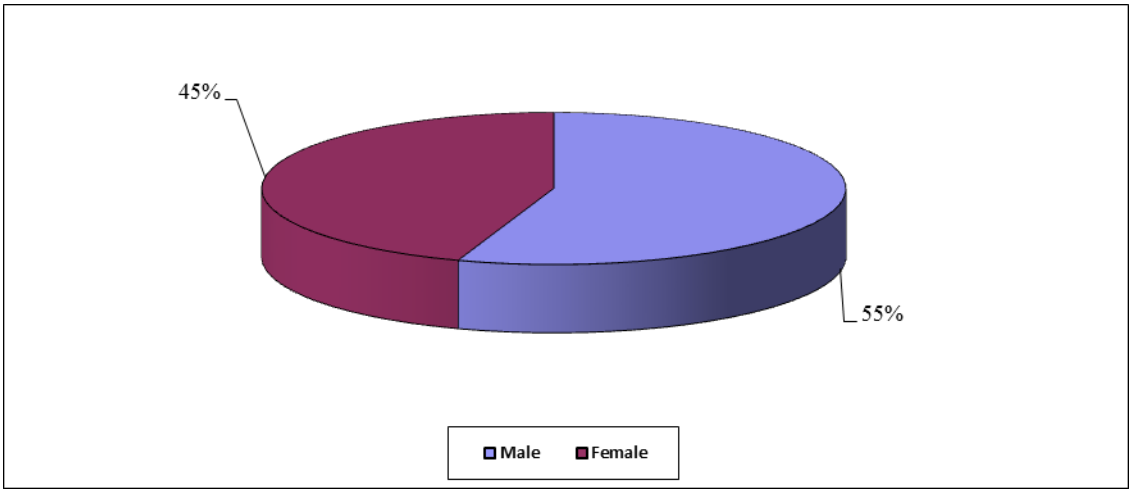

Figure I: Sex distribution of the study population (n=85)

Nutritional status of the study population

Regarding nutritional status 25(29.4%) was well nourished, 50(58.8%) was moderately nourished and 10(11.8%) was malnourished.

Table II: Nutritional status of the study population (n=85).

	Number	Percentage
Well nourished	25	29.4
Moderately nourished	50	58.8
Malnourished	10	11.8
Total	85	100.0

Distribution of the study population by investigation

Table III shows investigation of the population, it was that mean serum sodium was 136.00±4.54 mmol/L, serum potassium was 3.77±0.49 mmol/L, serum chloride was 101.85±11.05 mmol/L, serum magnesium was 1.80±0.54 mg/dL, serum albumin was 34.56±6.47 g/L, serum calcium was 1.80±0.54 mg/dL, serum creatinine was 0.78±0.18 mg/dl, RBS was 5.98±1.22 mmol/l. Mean serum Hb% was 8.75±1.97 gm/dl, ESR was 73.93±34.24 mm/1st hour, platelets count was 77.86±87.28 $\times 10^9$/L, TWBC was 50.07±70.17 $\times 10^9$/L and blast was 62.38±22.53 %.

Table IIIa: Distribution of the study population by biochemical investigation (n=85).

Investigation	Mean ±SD	Range (Min-max)
Serum Sodium (mmol/L)	136.00(±4.54)	124-145.70
Serum Potassim (mmol/L)	3.77(±0.49)	2.61-4.98
Serum Chloride (mmol/L)	101.85(±11.05)	87.80-180.0
Serum Magnesium (mg/dL)	1.80(±0.54)	0.80-3.88
Serum Albumin (g/L)	34.56(±6.47)	8.20-50.00
Serum Calcium (mg/dL)	8.16(±1.14)	0.62-10.61
Serum Creatinine(gm/dl)	0.78(±0.18)	0.55-1.50
RBS (mmol/l)	5.98 (±1.22)	3.52-8.90

Table IIIb: Distribution of the study population by haemogram (n=85).

Investigation	Mean ±SD	Range (Min-max)
Hb% (gm/dl)	8.75 (±1.97)	4.80-13.58
ESR (mm/1st hour)	73.93(±34.24)	10-120
Platelets count (×10^9/L)	77.86(±87.28)	10-500
TWBC (×10^9/L)	50.07(±70.17)	1-370
Blast (%)	62.38(±22.53)	20-95

Correlation between serum magnesium level with serum albumin level

Figure II Scatter diagram showing negative correlation (r=-0.023; p=0.83) between serum albumin (g/l) and magnesium (mg/dl) but not statistically significant.

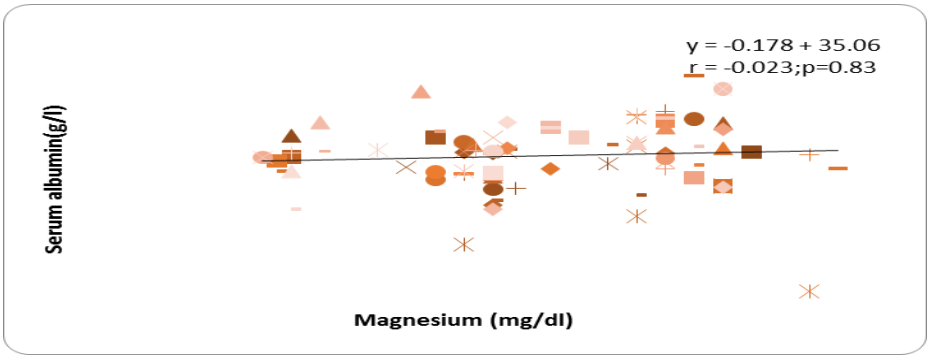

Figure II: Correlation between serum magnesium level with serum albumin level.

Correlation between serum magnesium level with serum choloride level

Figure III Scatter diagram showing positive correlation (r= 0.15; p=0.16) between serum chloride (g/l) and magnesium (mg/dl) but not statistically significant.

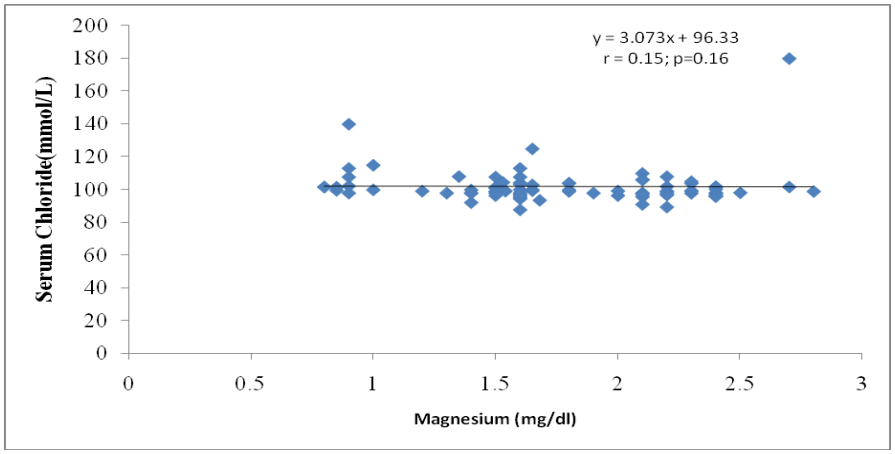

Figure III: Correlation between serum magnesium level with serum choloride level.

Correlation between serum magnesium level with serum potassium level

Figure IV Scatter diagram showing positive correlation (r= 0.04; p=0.67) between serum potassium (mmol/l) and magnesium (mg/dl) but not statistically significant.

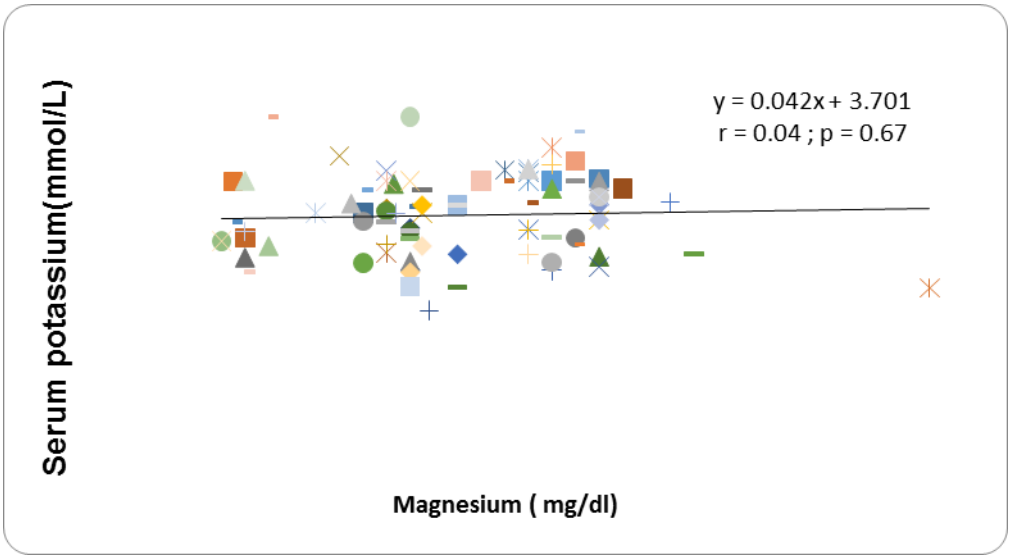

Figure IV: Correlation between serum magnesium (mg/dl) level with serum potassium (mmol/L) level.

Correlation between serum magnesium level with serum sodium level

Figure V Scatter diagram showing positive correlation (r= 0.05; p=0.62) between serum magnesium (mg/dl) level with serum sodium (mmol/L) level but not statistically significant.

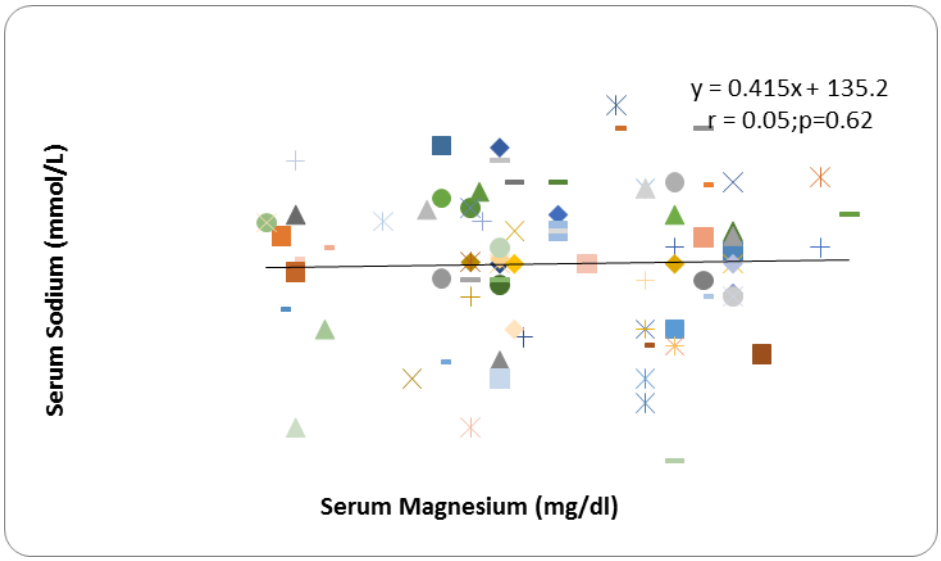

Figure V: Correlation between serum magnesium (mg/dl) level with serum sodium (mmol/L) level.

Correlation between serum magnesium level with serum calcium level

Figure VI Scatter diagram showing positive correlation (r= 0.451; p=<0.001) between serum magnesium (mg/dl) level with serum calcium (mg/dl) level that was statistically significant.

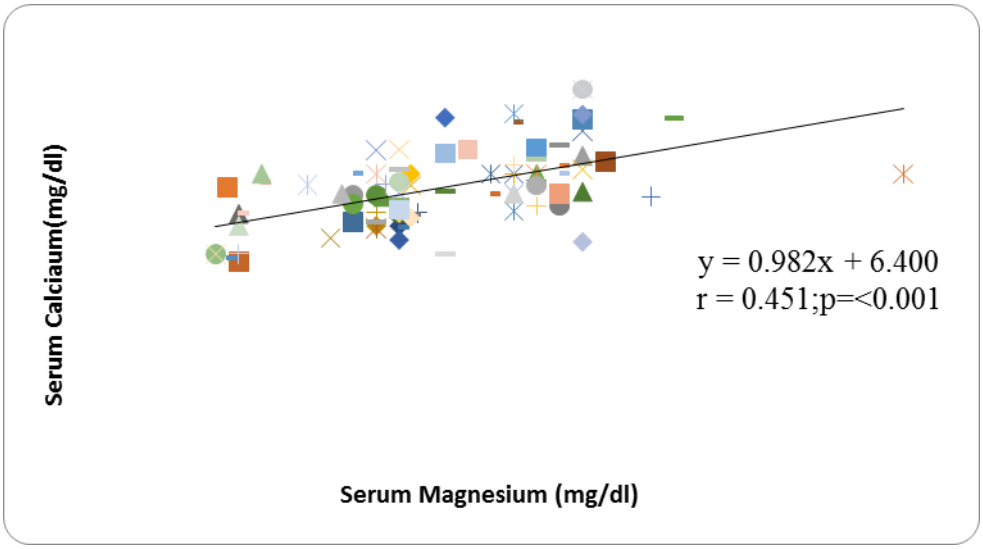

Figure VI: Correlation between serum magnesium (mg/dl) level with serum calcium (mg/dl) level.

Distribution of serum magnesium level of the study population

Regarding serum magnesium level majority 44(51.8%) was found hypomagnesaemia followed by 38(44.7%) were normal magnesium and 03(3.5%) were hypermagnesaemia.

Table IV: Distribution of serum magnesium level of the study population (n=85).

Serum magnesium	Normal	Percentage
Hypomagnesaemia	44	51.8
Normal	38	44.7
Hypermagnesaemia	3	3.5
Total	85	100.0

DISCUSSION

In present study observed that the mean age was found 36.17(±19.15) years, majority age group was found 10-40 years of age which was (62.4%).

In present study regarding gender 55% were found male and 45% were found female. In study of Demir et al. (2011) observed that out of 42 cases 14(33.3%) of them were females and the other 28(66.7%) person were males. In study of Merza et al. observed acute leukemia group composed of 42 person (AML: 38; ALL: 4), 14(33.3%) of them were females and the other 28(66.7%) person were males.

In present study investigation of the population, it was reported that mean serum sodium was 136.00±4.54 mmol/L, serum potassium was 3.77±0.49 mmol/L, serum chloride was 101.85±11.05 mmol/L, serum magnesium was 1.80±0.54 mg/dL, serum albumin was 34.56±6.47 g/L, serum calcium was 8.16±1.14 mg/dL, serum creatinine was 0.78±0.18 mg/dl, RBS was 5.98±1.22 mmol/l, Hb% was 8.75±1.97 gm/dl, ESR was 73.93±34.24 mm/1st hour, platelets count was 77.86±87.28 ×10^{9}/L, TWBC was 50.07±70.17 ×10^{9}/L and blast was 62.38±22.53%.

In current study observed that positive correlation (r= 0.451; p=<0.001) between serum magnesium (mg/dl) level with serum calcium (mg/dl) level that was statistically significant. Milionis et al. (1999) study revealed that Serum Ca2+ levels were well correlated with serum Mg^{2+} levels (R= 0.57, P=0.001). Udristioiu et al. (2012) the lower ratio of calcium to magnesium was also associated with high-grade cancer, suggesting the interaction between magnesium and calcium plays a role in the pathogenesis and progression of this disease to a more clinically relevant phase. High Ca/Mg ratio was also significantly associated with high-grade cancer.[7]

In present study observed that the mean serum magnesium was found 1.56±0.60 mg/dl in ALL patients and 1.89±0.49 mg/dl in AML patients which was significantly lower in ALL patient than AML patients (p =0.009). Mean serum Sodium, Potassium and Chloride were not significantly associated with ALL and AML patients. Merza et al. (2009) study observed that the mean concentration of serum magnesium (S.Mg) (mg/dl) in All 1.623(±0.453) (mg/dl), AML were 1.737 (±0.385) (mg/dl).[8] Milionis et al. (1999) study reported that there were no significant differences in the incidence of serum Sodium, Potassium and Chloride between patients with AML and ALL, which was more frequently observed in AML patients.[3]

In present study regarding serum magnesium level majority 44(51.8%) was found hypomagnesaemia followed by 38(44.7%) were normal magnesium and 03(3.5%) were hypermagnesaemia. In study of Demir et al. (2011) observed that the serum levels of Mg were significantly lower in with acute leukemia patients than in the controls (p<0.001).[9] The decreased S[Mg] in ALL patients (65.7%) can be explained in accordance with the findings of Sahin et al. (2000) and Orhun et al. (1994).[4,5] A high prevalence of chronic magnesium deficiency in T-cell lymphoblastic leukemia in children with ALL and lymphoma was recorded (Sahin et al. 2000).[4]

The normal S[Mg] indicated by (38.2%) of total patients is in accordance with the observation made by Sahin et al. (2000).[4] Other workers had also reported similar findings on the normal and decreased S[Mg] in patients with malignant disorders showed a controversial results that may have been related to the fact that S[Mg] are not always stable and may be affected by variable factors.[6,3]

CONCLUSION

There were no significant differences in the incidence of serum Sodium, Potassium and Chloride between patients with AML and ALL, which was more frequently observed in AML patients. Serum magnesium level majority was found hypomagnesaemia. Serum levels of Mg were significantly lower in with acute leukemia patients.

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