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Role of serum magnesium in atrial fibrillation: A study from North Eastern India

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Abstract

Background: Low levels of serum magnesium have been associated in development of post operative atrial fibrillation (AF) in patients undergoing coronary artery bypass grafting. However, the role of magnesium in the development of AF in ambulatory patients is limited.
Aim: To evaluate the relation between serum magnesium levels and presence of atrial fibrillation either paroxysmal or permanent.
Material and Methods: Hospital-based prospective observational study, between May 2015 and November 2016 in 100 patients (50 cases and controls each) aged ≥ 18years. Admitted patients who had detectable AF on electrocardiography constituted the cases. Patients with any other irregular rhythm, valvular heart disease, history of electrolyte disorder, alcoholism and potassium sparing diuretic use were excluded. Chi-square test, Fisher's exact test and Pearson's correlation analysis was used to examine the possible relations between serum magnesium level and other parameters. A p value of <0.05 was considered for statistical significance.
Results: The mean age 65.39 ± 11.4 years and 67.18 ±10.6 in the AF and control group respectively. In the AF group 36% had paroxysmal AF and 64% had permanent AF. The serum magnesium levels were significantly lower in the patients with atrial fibrillation (p <0.01) than in controls. The mean serum magnesium levels in paroxysmal AF were 1.49 ± 0.29 while the mean magnesium levels in permanent AF: 1.66 ± 0.36. (p=0.07).
Conclusion: Serum magnesium levels were significantly lower in the patients with atrial fibrillation. Correction of magnesium deficiency may be a potential target for the prevention of development of atrial fibrillation.
Keywords: Cardiac arrhythmia, dyselectrolytemia, prevention.

1. Introduction

The role of magnesium in the development of cardiac arrhythmias in both humans and animal models has been previously postulated in few studies. [1,2] In humans, low levels of serum magnesium has been previously associated in development of post operative atrial fibrillation (AF) in patients undergoing coronary artery bypass grafting.[3] Furthermore, there is evidence in literature that supplementation of magnesium reduces the incidence of postoperative AF.[4]

With respect to the development of AF in ambulatory patients particularly those without existing cardiovascular disease a previous study found that low serum magnesium is has a moderate association with the development of AF in individuals without cardiovascular disease. [5] An establishment of such an association could have potential public health implications because prevalence of low magnesium levels in the body is relatively common and is a potentially correctable therapeutic target.[5]

However, there is a lack of data from India with respect to the establishment of any such association between atrial fibrillation and serum magnesium. In this background this study was carried out in patients admitted to the department of cardiology of a tertiary care centre in north eastern India to evaluate the relation between serum magnesium and atrial fibrillation.

2. Materials and Methods

The present study was a hospital-based prospective observational study, carried out between May 2015 and November 2016 with 100 patients (50 case and control each) who had been admitted in the department of cardiology of a tertiary care hospital in north eastern state of Meghalaya. Patients aged ≥18 years who were admitted and had detected AF on electrocardiography constituted the study group. Admitted age sex matched patients not diagnosed with AF constituted the control group.

2.1 Inclusion criteria

- All patients with atrial fibrillation (persistent and paroxysmal)
- Sinus rhythm patients as control.

2.2 Exclusion criteria

- Patients with any other irregular rhythm
  - Atrial flutter
  - Ventricular arrhythmias
  - Multifocal atrial tachycardia
- Valvular heart disease
- History of electrolyte disorder,
- Alcoholism
- Pottasium sparing diuretic use

The demographic characteristics, history, drug intake and current AF type (paroxysmal: 7 days, short-lived, terminating in spontaneous, permanent: lasting longer than 7 days, does not convert to sinus rhythm) were recorded in pre structured proforma. All the routine blood investigation including electrocardiography, serum magnesium and other electrolytes were done. Echocardiography (VIVID S-5 General Electric Medica System 3.6 MHz) was performed according to the American Society of Echocardiography guidelines, and LVEF was evaluated using the visual assessment.

Ethical clearance was taken from the Institutional Ethical Committee and written informed consent was taken from all the patients included in the study.

2.3 Statistical Analyses

Statistical Analyses were done using Statistical Package for Social Survey (SPSS) and STATA Data analysis and Statistical software for Windows version 17.0. The results were tabulated and graphically represented using Microsoft Office for Windows 2008. Categorical data between treatment groups were compared by the chi-square test or Fisher's exact test. Pearson's correlation analysis was used to examine the possible relations between serum magnesium level and other parameters A p value of <0.05 was considered for statistical significance.

3. Results

A total of 50 patients in the AF group and 50 patients in the control group were included in the present study. The mean age was 65.39 ± 11.4 years in the AF group and 67.18 ±10.6 in the control group. In the AF group, 63 % of the patients were male, whereas 37% of the patients were female. Age, gender, SBP- DBP, history of CAD, DM, COPD, CHF and CRF were similar between the AF and control groups In the AF group, 18 of 50 patients (36%) had paroxysmal AF and 32 of 50 patients (64%) had permanent AF. The baseline characteristics between patients with AF and Control Group are shown in Table 1.

The serum magnesium levels were significantly lower in the patients with atrial fibrillation when compared to the control group (Table 2). The mean serum magnesium levels in paroxysmal AF were 1.49 ± 0.29 while the mean magnesium levels in permanent AF: 1.66 ± 0.36. On comparison between the groups the mean serum magnesium levels were found to be higher in permanent AF than in paroxysmal AF but not significant different (p=0.07) (Table 3). Furthermore, in our study we did not find a significant difference in the levels of serum magnesium in patients with congestive heart failure and chronic renal failure. However, there was a weak relationship between these conditions and serum magnesium with comparatively higher values in patients with CRF and lower values in CHF. The association between serum magnesium and various factors in study population is shown in Table 4.

Table 1: Comparison between baseline characteristics of the Patient and Control Groups

Variable	AF Group	Control Group	t value	p value
Age	65.39	67.18	0	0.5
BMI	27.10	25.5	2.50855	0.006
Sex (M/F)	33/17	30/20	-	0.53
CHF	35	31	-	0.39844
CRF	11	10	-	0.80
DM	17	20	-	0.53
HTN	36	34	-	0.66

Table 2: Comparison of Serum Mg levels AF group and Control Group

	AF group	Control Group	P value
Mean Serum Mg	1.68	2.10	< 0.00001

Table 3: Comparison of Serum Mg levels in paroxysmal AF and permanent AF

	Paroxysmal AF	Permanent AF	P value
Mean Serum Mg	1.49±0.29	1.66±0.36	0.07

Table 4: Association between serum magnesium and various factors in study population

Variable	R score	p value
CHF	0.0736	0.79
CRF	-0.4553	0.18

4. Discussion

Magnesium has multiple effects on the conducting system of the heart serving as an essential cofactor for the Na-K ATP pump the integral component for maintaining transcellualr electrical balance. [5] Previous studies have shown that restriction of dietary magnesium to less than one-half of the recommended daily allowance is associated with increased incidence of supraventricular arrhythmia and atrial fibrillation.[6,7] Another study has also shown an inverse relation between sudden cardiac death and hypomagnesimia thus further providing evidence between decreased magnesium levels and cardiac arrhythmias.[8]

In our study we found that the serum magnesium levels were significantly lower in the patients with atrial fibrillation. Furthermore, on comparison between the groups the mean serum magnesium levels were found to be higher in permanent AF than in paroxysmal AF though the results did not attain statistical significance. A majority of the previous studies that have reported the association of serum magnesium with development of atrial fibrillation have been on post surgical patients. [5] With regard to medical patients without structural heart disease a previous study has shown similar results as our study suggesting association between serum magnesium and AF in a manner that the maximum risk of AF appears primarily in those in the lowest quartile of serum magnesium. [5] Previous studies have also shown that therapy with intravenous magnesium can facilitate rate control in AF and aid in the maintenance of sinus rhythm. [9]

Establishment of causality is difficult to infer from the data accrued during our study. However, if further validated with supportive evidence the results may have potential public health importance because magnesium deficiency is common and potentially modifiable as has been suggested by previous studies. [10]

Limitations of our study do include the fact that serum magnesium levels may not fully corroborate with overall body magnesium stores, although it has been seen serum magnesium correlates well with intracellular magnesium levels. [11]

5. Conclusion

Serum magnesium levels were significantly lower in the patients with atrial fibrillation. Furthermore, on comparison between the groups the mean serum magnesium levels were found to be higher in permanent AF than in paroxysmal AF. Correction of magnesium deficiency may be a potential target for the prevention of development of atrial fibrillation.

Key Messages:

Targeted approach towards early recognition and treatment of magnesium deficiency can be of paramount importance in prevention of atrial fibrillation.

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