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Role Of Serum Magnesium Levels In Diagnosing Patients Of CAD

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Abstract

Ischemic heart disease (IHD) is the most common form of heart disease and despite major breakthroughs in its management, it still remains the single most important cause of premature deaths worldwide. IHD often reflects a degree of damage to the coronary arteries by atherosclerosis, plaque rupture, thrombosis and inflammation. IHD is seen to develop through the prism of several novel risk factors along with the major conventional cardiovascular risk factors along with the major conventional cardiovascular risk factors like hypertension, diabetes mellitus, smoking and hypercholesterolemia. Deficiency of trace elements, like magnesium has emerged as a premier cardiovascular cation. Magnesium (Mg) is being considered as one of the fast-emerging risk factors for cardiovascular disease. Magnesium homeostasis is regulated by several hormones including parathyroid (most important), antidiuretic hormone (ADH), calcitonin, glucagon and insulin. Aldosterone also has an influence on magnesium metabolism. Secondary hyperaldosteronism induced by diuretic treatment in patients of congestive heart failure accelerates potassium and magnesium ions excretion in the urine. Also, magnesium has a strong role in CVD prevention.[1] This includes cardiac depression of cardiovascular conduction system, peripheral vasodilation leading to decrease in afterload, reduced infarct size and intra as well as extracellular concentration of ions, an improved energy generation in myocardium and an inhibitory effect on platelet aggregation. All the above factors contribute towards protective role of magnesium in reducing adverse cardiovascular events.

Keywords: VASODILATION, PLATELET AGGREGATION, CVD, HYPERALDOSTERONISM, MAGNESIUM, IHD

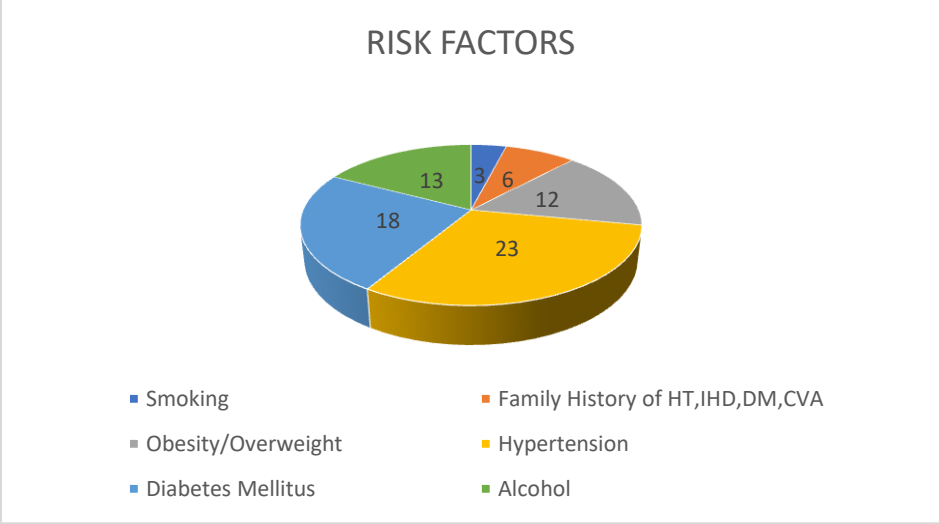
Introduction

Ischemic heart disease (IHD) is the most common form of heart disease and despite major breakthroughs in its management, it still remains the single most important cause of premature deaths worldwide. IHD often reflects a degree of damage to the coronary arteries by atherosclerosis, plaque rupture, thrombosis and inflammation. IHD is seen to develop through the prism of several novel risk factors along with the major conventional cardiovascular risk factors along with the major conventional cardiovascular risk factors like hypertension, diabetes mellitus, smoking and hypercholesterolemia. Deficiency of trace elements, like magnesium has emerged as a premier cardiovascular cation. Magnesium (Mg) is being considered as one of the fast-emerging risk factors for cardiovascular disease. Magnesium homeostasis is regulated by several hormones including parathyroid (most important), antidiuretic hormone (ADH), calcitonin, glucagon and insulin. Aldosterone also has an influence on magnesium metabolism. Secondary hyperaldosteronism induced by diuretic treatment in patients of congestive heart failure

accelerates potassium and magnesium ions excretion in the urine. Also, magnesium has a strong role in CVD prevention.[1] This includes cardiac depression of cardiovascular conduction system, peripheral vasodilation leading to decrease in afterload, reduced infarct size and intra as well as extracellular concentration of ions, an improved energy generation in myocardium and an inhibitory effect on platelet aggregation. All the above factors contribute towards protective role of magnesium in reducing adverse cardiovascular events.

Materials And Methods

A total number of 40 patients of acute myocardial infarction (AMI) were enrolled in this study. Data collection was done for two years of Dec. 2019 to Dec. 2021. Diagnosis was made on basis of clinical symptoms, cardiac biomarkers levels and /or ECG findings. Vernacular language was used to conduct the study explaining the patients about procedure & written approval was taken. Patents were taken attending the OPD/IPD in Medicine departments. Control group comprise was selected matching the case having no such infirmity, family history and accompanying the patients. It was from same socioeconomic status to rule out any disparity of surroundings. The inclusion criteria were patients with AMI both, both ST-Elevation MI (STEM) and Non-ST-Elevation MI (NSTEMI) proven by cardiac enzymes, ECG and symptoms suggestive of AMI. On the other hand, exclusion list was of cirrhosis, chronic renal failure, protracted vomiting, chronic diarrhea, magnesium compound antacids, anti-cancer drugs, pregnancy[2]. Diagnosis of AMI was made from any of two out of three criteria viz: 1. Chest pain with radiation to retrosternal area, burning, heaviness, radiation to neck, jaw, epigastrium, left shoulder and arm 2: ECG manifestation of AMI in the form of STEMI and NSTEMI. 3: Serum cardiac biomarkers as rise in Troponin-T/ Troponin-I/ CPK-MB levels. In addition, all the tests imperative to AMI diagnosis were done[3]. Magnesium level in serum was done with kit method with NV as 1.9-2.5 mg/dl.



Observations And Results

The present study was caried out in a study population of 40 patients of acute myocardial infarction (AMI). Both sex with different age groups were included in the study of two years from 2019-2021. Table 1shows that majority of patients (34%) belonged to the age group of 61-70 years while very few patients (2.5%) belonged 31-40 years.

Table-2 shows that out of total 40 cases, 21 (51%) patients were males and 19 (49%) were females. The study clarifies were females. This study had near equal sex distribution with slight predominance of males.

Volume 5, Issue 4; July-August 2022; Page No 654-664

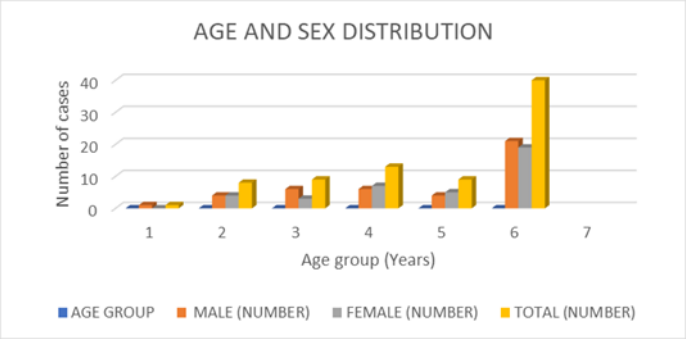


Table-3

Shows that maximum number of patients of males were of 51-60 years as well as 61-70 years of age group with ratio of 1:1 while females of were maximum of age group 61-70 years. The mean age of males was 59.66±64.15 while mean distribution of females was age group was 65±21±19.09. The comparison of age with gender was not significant with p value of >0.05.

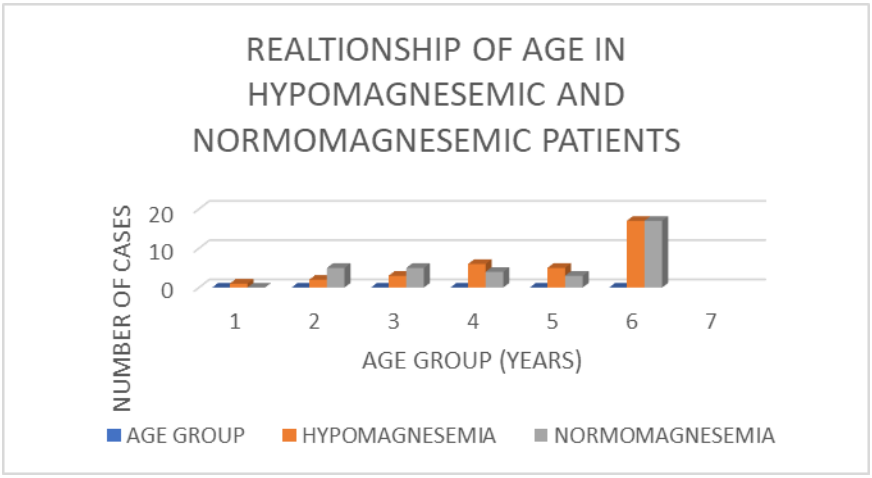
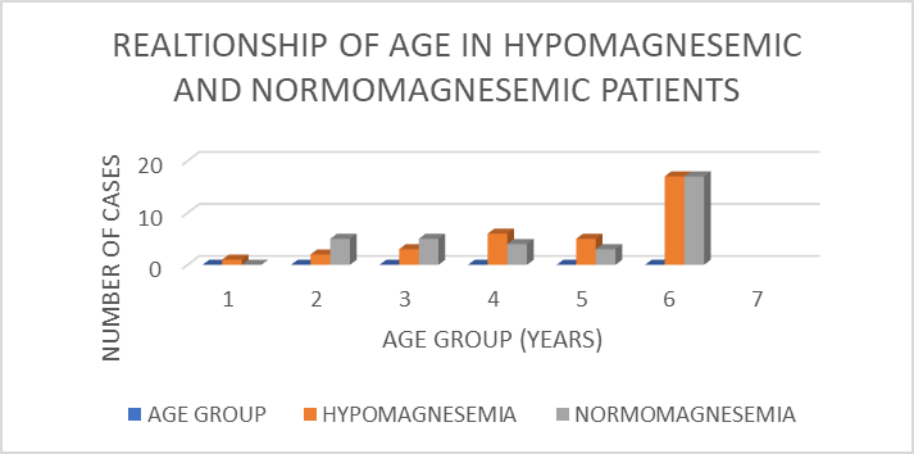


Table-4 shows that 45% of patients were vegetarians 55% consumed mixed diet. Non-vegetarian patients were dominating as is their cholesterol content is high.

Table-5 shows that in Punjab Sikhs are following the non-veg most of the times. Here 70% were Sikhs and 30% Hindus.



Volume 5, Issue 4; July-August 2022; Page No 654-664

Table-6 shows that most common symptoms was chest pain (90%) followed by sweating dyspnea (50%). Other symptoms observed were (35%) and palpitations (18%).

Table-6 shows that 55% presented 0-12 hrs.,14% presented with 12-24 hours and remaining 10% presented 24-48% of the onset of symptoms. 57.98% had hypertension, 18% had Diabetes making it the 2nd most common symptoms after hypertension.

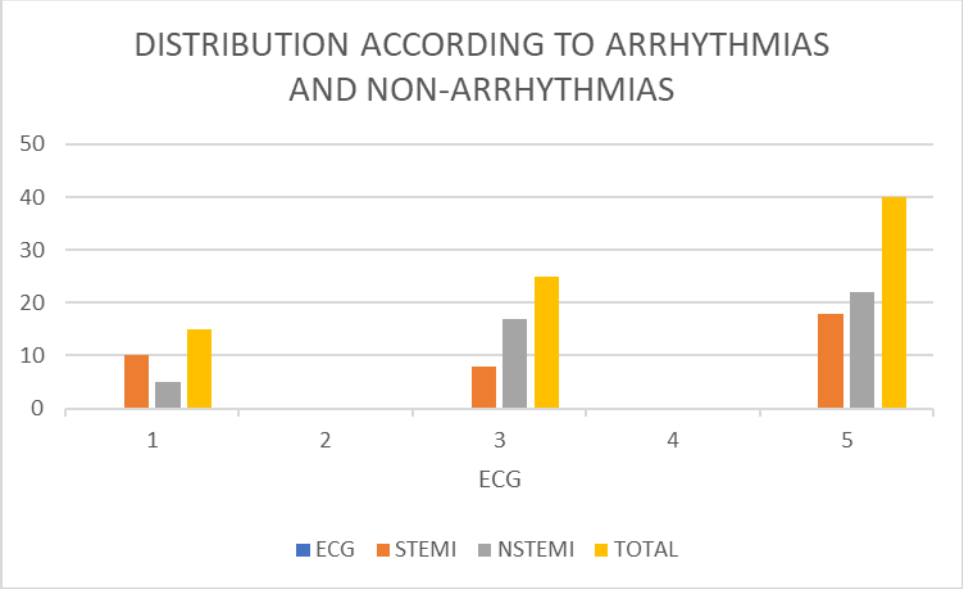


Table-7 showed18 patients of STEMI, 10% had arrythmias, whereas out of 22 patients of NSTEMI, only 5% had arrythmia. Since the p value was <0.05, this was statistically significant.

Table-8 showed 43% had post MI complications. Out of these 15% had ventricular premature complex AF, out of these 10% had AF, 6.7% had VT, 5%. Out of complications 5% had cardiogenic shock and death.

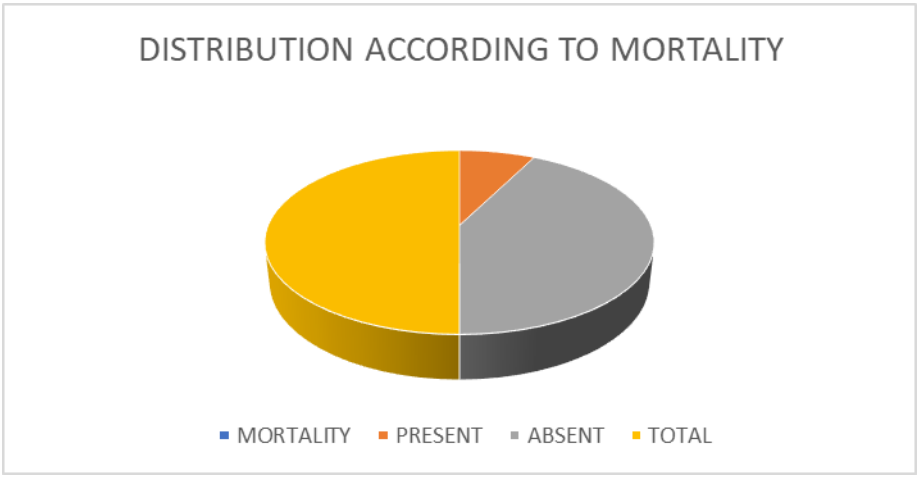


Table-9 12.5% died with arrythmias as a result of cardiogenic shock. With p value of <0.05 mortality was significantly high

Volume 5, Issue 4; July-August 2022; Page No 654-664

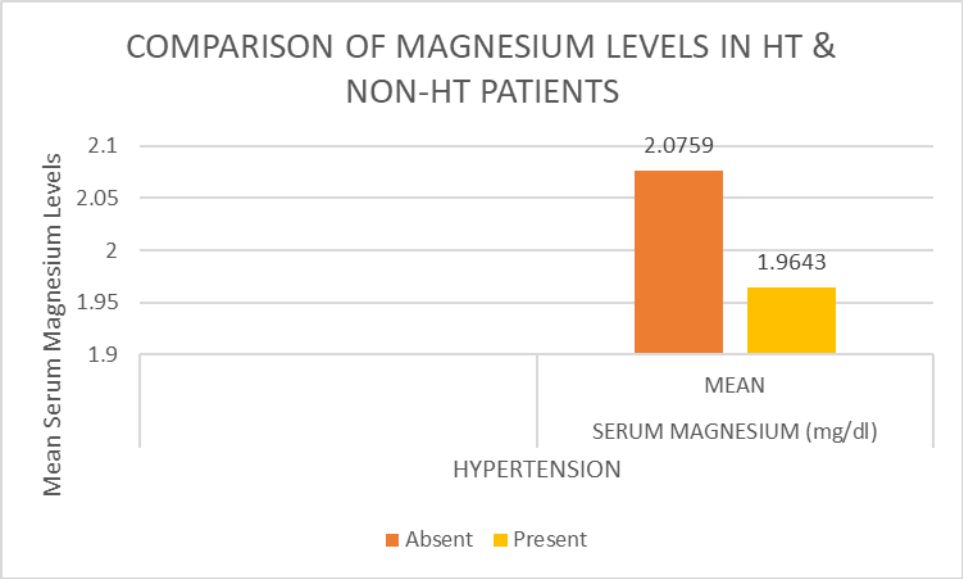


Table-10 17 Out of 40 patients had low level of serum magnesium, 17 showed normal, 6 patients had high serum magnesium level. By day 7,6 patients expired and out of remaining 34, 1 patient had low, 28 patients had normal and 5 patients had high Magnesium levels.

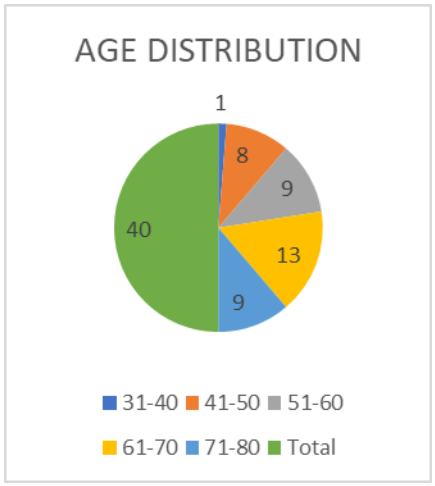
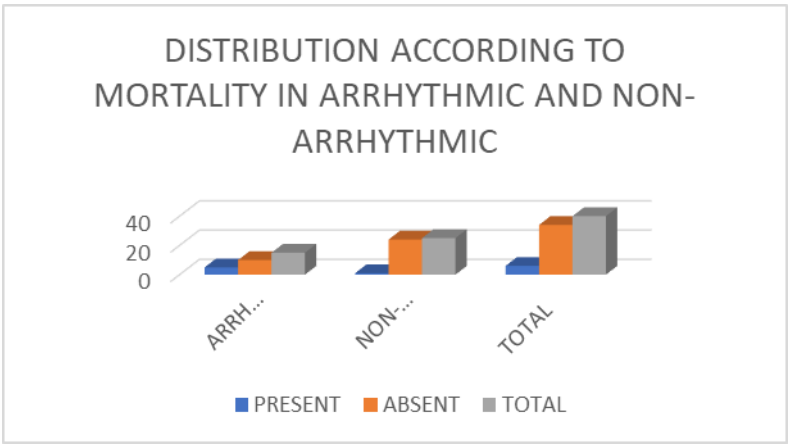
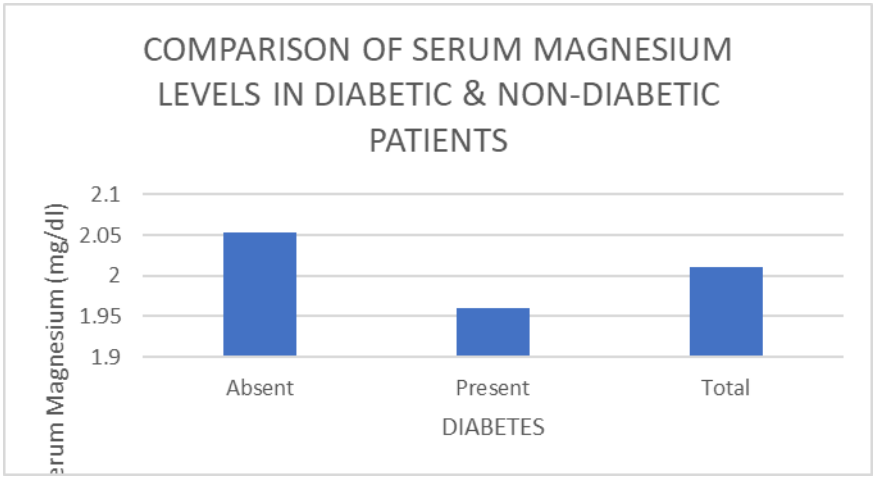
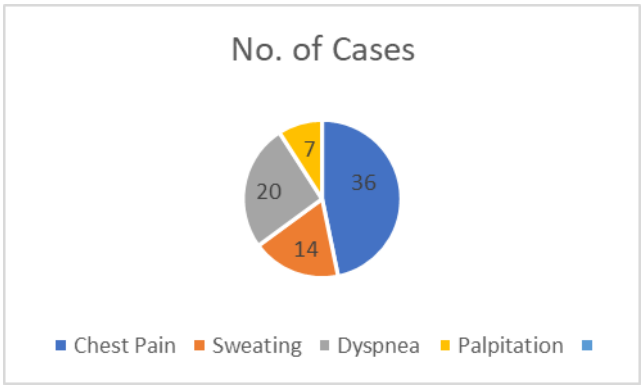


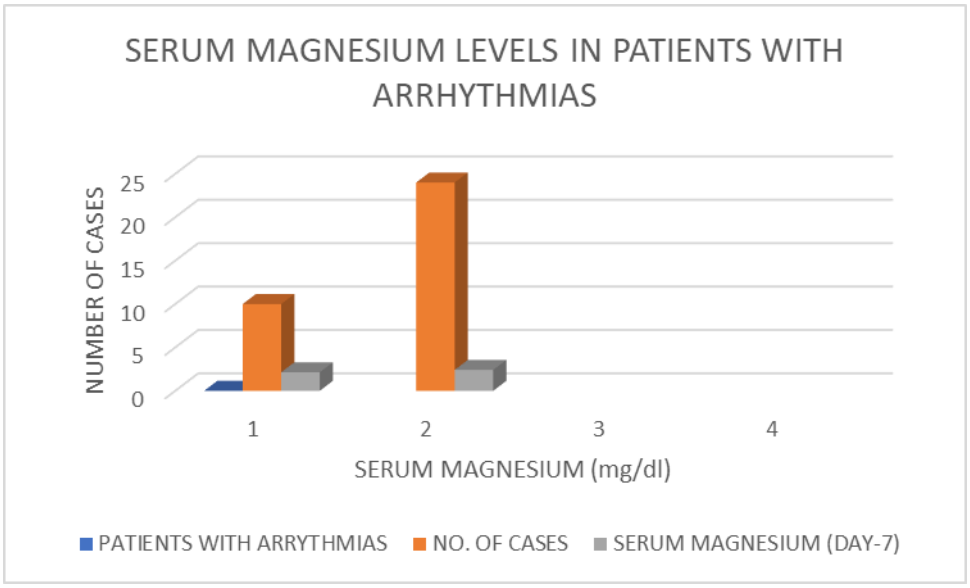
Table-11 shows that mean age in patients with hypomagnesemia 63.294±13.961 as compared to mean age group of 59.824±10.768 in patients with normomagnesemia. Although, mean age was more in patients with hypomagnesemia but statistically not significant (p>0.05)



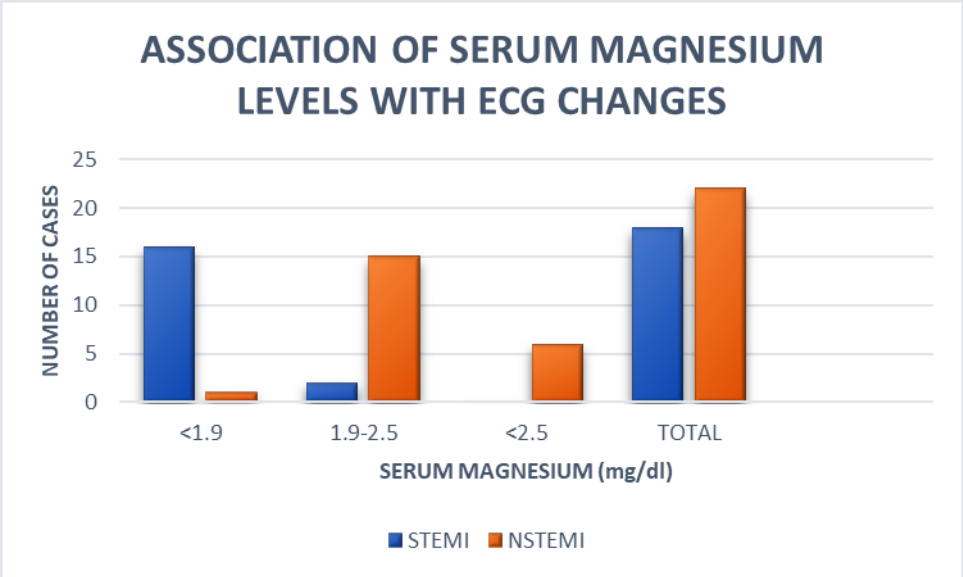
Volume 5, Issue 4; July-August 2022; Page No 654-664

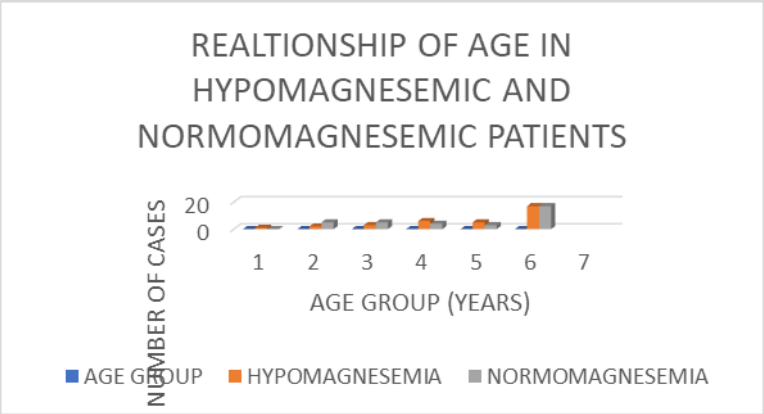


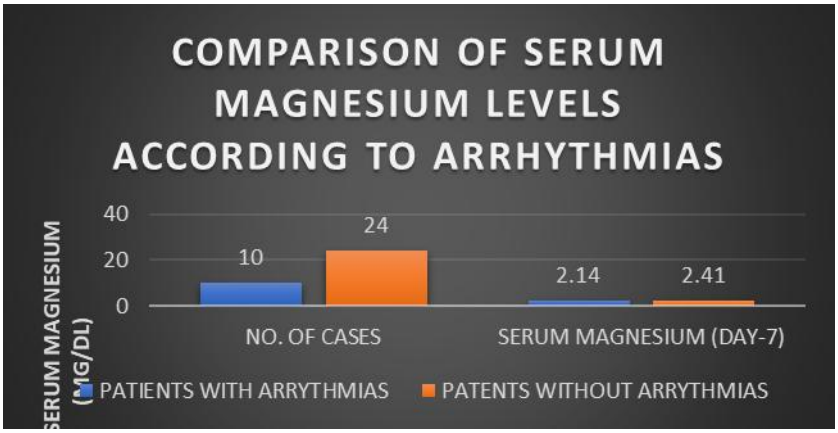




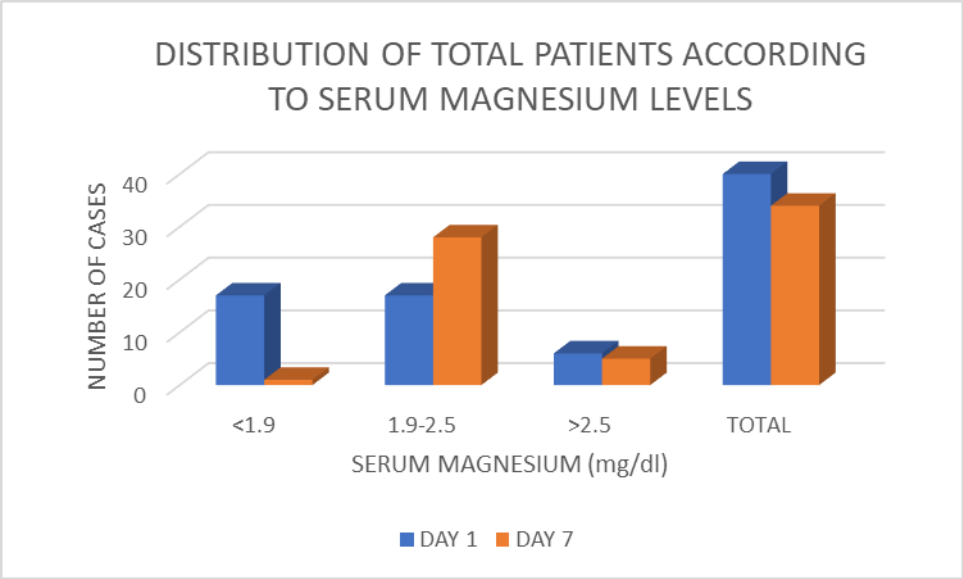
Volume 5, Issue 4; July-August 2022; Page No 654-664







Volume 5, Issue 4; July-August 2022; Page No 654-664



Discussion

Ischemic heart disease (IHD) is the most common form of heart disease and despite major breakthroughs in its management, it still remains the single most important cause of premature deaths worldwide. IHD often reflects a degree of damage to the coronary arteries by atherosclerosis, plague rupture, thrombosis, and inflammation. There are several novel risk factors like hypertension, diabetes mellitus, smoking and hypercholesterolemia. Deficiency of trace element is one of the recent factors. Magnesium has emerged as a premier cardiovascular cation[4]. It acts as a natural calcium antagonist and affects contractility and conduction of the myocardium. It also has direct electrophysiological effects. It has independent effects on blood pressure, glycemic parameters, lipid profile and affecting the major bulk of risk factors for MI[5]. Magnesium deficiency was seen to increase the pre deposition to development of arrhythmias after myocardial infarction. In the present study, a total of 40 MI patients were enrolled. For all the patients, cardiac enzymes and ECG were done along with serum magnesium levels on day 1 and day 7 and its correlation was observed with the clinical consequences. In our study, the mean age of patients with hypomagnesemia was 63.29$_{\pm}$ 13 years while mean age of patients with normal levels was 59.82±10 years[5]. Ambali A et al proposed that in AMI serum levels of magnesium decrease with increasing age and elderly (>60 years) are at high risk for hypomagnesemia due to decreased intake, stress and chronic medications[6]. S Kumar et al reported that magnesium deficiency in geriatric patients because of their low magnesium intake and diminished intestinal absorption.

This study had 52.50% males and 47.50% females. It had almost equal gender distribution with slight male predominance. Akila A et al (2017) enrolled 50 cases of which 42 were males and 8 were females[7]. The study had reported 80% male predominance.

In our study we found that majority of patients consumed mixed diet (vegetarian as well as non-vegetarian diet). In concordance with our study, Akila A et al also reported that most of the patients in the study population of MI patients consumed a mixed diet.

In our study the most common symptom was chest pain (90%), dyspnea (50%), sweating (35%) and palpitations (17.5%)[8]. Akila et al reported that all the patients had chest pain which is associated with sweating (26%), dyspnea (16%) and palpitations (2%). Studied by Ambali A et al found chest pain to be the commonest symptom. Baset et al had a study of population of 50% (100%) patients with chest pain[16].

It was seen that out of 40% MI patients, 57.50% were having a HT while 45.00% patients were diabetic; concluding that HT was the most common risk factor. Other risk factors were alcohol intake (32.5%), obesity (30%), family history (15%) and smoking

Volume 5, Issue 4; July-August 2022; Page No 654-664

(7.5%)[9]. Study by Akila A et al reported smoking 70%, DM (36%), HT (30%), obesity (24%), family history (20%) and hyperlipidemia (12%)[9]. Since 70% of the population were Sikhs and 30% Hindus, so smoking was not concluded.

It was observed that out of total study population 45% had STEMI whereas 50% had NSTEMI in the ECG. Ambali A et al had 69% with STEMI and 31% with NSTEMI. It was concluded that out of 18 patients of STEMI, 10 (55.55%) had arrhythmias whereas 22 patients of NSTEMI, only 5 (22.72%) patients had arrhythmias and this difference was considered as statistically significant[10]. Khatib Al et al reported that arrhythmias are less common in patients with NSTEMI compared to patients with STEMI. In the present study out of 18(45%) patients with STEMI, 16 (40%) patients had significantly low mean serum magnesium levels as compared to only 1 patient out of 20 patients with NSTEMI. Mean serum magnesium levels in patients with STEMI was 1.638± 0.19 while serum magnesium levels in patients with NSTEMI was 2.315± 0.321[11]. This was statistically significant; STEMI is usually due to transmural infarction whereas NSTEMI due to subendocardial ischemia. This was in concordance, Kumar et al (2013) reported that serum low magnesium level may have a larger area of infarction. Magnesium prevents the growth of thrombus and thus lower magnesium levels are associated with larger infarct area.

Post Mi Complications

In our study 17 (42.5%) patients out of the total 40 cases had in-hospital complications after AMI. Out of these 17 patients with complications, 6(15%) had ventricular premature complex (VPC), 4 (10%) had AF, 3 (7.55) had VT, 2(5%) had heart blocks and 2 (5%) patients had cardiogenic shock. 6 (15%) out of these 17 patients died due to complications. Baset et al studied 50 patients out of which 6 died in their 5-day hospital stay. 4 patients died of ventricular tachycardia and ventricular fibrillation. Study also shows that VPC''s were the most common arrhythmias among 26 AMI patients with arrhythmias out of these 50 patients[12]. A study on 100 patients of MI by Ambali et al reported post MI complications in 20 patients, the complications were ventricular ectopic in 1 patient, CCF in 2 patients, sinus bradycardia in 3 patients, tachyarrhythmias (VI and AF) in 7 patients and bundle brunch blocks in 7 patients.

Mortality

In our study mortality was seen in 6 (15%) patients by day 7[13]. Out of these 6 patients 5 expired due to arrythmias and one without arrhythmias as a result of cardiogenic shock.

Our study resembled Akila A et al who reported mortality of 7(14%) patients by day 5. Serum magnesium levels in these patients was significantly low. In concordance, Mohan G et al concluded the cases dying due to major arrhythmias or cardiogenic shock. These patients had low serum magnesium levels.

Realtionship Of Serum Magnesium With Ht And Dm

Mean serum magnesium levels in patients with HT were low then normotensive patients but this difference was considered statically non-significant. Resnick et al reported an inverse relation of serum magnesium with plasma renin activity, concluding that HT patients with more renin will have low magnesium levels.

Wulansari et al (2019) stated that a vicious circle of hypomagnesemia and DM exists. Poorly regulated DM can cause hypomagnesemia which in turn triggers insulin resistance leading to DM. Both of these factors increase the risk of mortality.

Serum Magnesium Levels In A Relation To Arrhythmias

In our study 15 patients develop arrhythmias within 7 days. 10 (66.67%) had serum magnesium levels less than 1.9 mg/dl on day 1. In comparison to this, only 7 (28%) patients out of 25 without arrhythmias low serum magnesium level on day 1. On day 1 mean serum magnesium level were significantly low in patients with Arrhythmias as compared to total patients. Mean serum Mg levels improved in all the patients by day 7 but when compared to total patients' improvement was non-significant in patients with arrhythmias and significant in patients without arrhythmias[14]. On day 1, mean serum magnesium levels in patients with and without arrhythmias were 1.73%±0.358 and 2.17± 0.36. On day 7 the level of magnesium in patients with arrhythmias was 2.14± 0.250 and without arrhythmias was 2.41± 0.238.

Volume 5, Issue 4; July-August 2022; Page No 654-664

There was a significant difference in mean serum magnesium levels in patients with and without arrhythmias on day 1 and 7.

Abraham et al reviewed magnesium levels of 65 consecutive patients with diagnosis of AMI. Serum magnesium on day 1 was low in patients of AMI (mean 1.70 mg/dl, p< 0.001) and acute coronary insufficiency (mean 1.61 mg/dl, p< 0.01). Bogdan et al reported lowest serum magnesium level on day 1 and day 3. Singh et al and Sachdeva et al also concluded that levels of magnesium to be low on day 1 of MI with progressive rise days after. Mohan G et al (1994) reported low serum magnesium within first 12hr in all cases. Levels increased slowly to near normal value by the 14th day[15]. Serum magnesium levels were apparently lower in patients with complications as compared to cases who had uneventful recovery. Dyckner T et al also concluded that incidence of serious ventricular arrhythmias was significantly higher in hypomagnesemia patients with AMI. Subramanyam NT et al found serum magnesium levels were lower in AMI cases at presentation. Serum magnesium levels were lower in AMI patients with complications and raised towards normal by day 7.

Conclusion

Magnesium is an under estimated cation, it has been implicated in the pathogenesis of AMI and its complications. Estimation of serum magnesium levels is simple and cost effective, and thereby should be done in MI patients along with routine hematological investigations. It was inferred from this study that patients with AMI with low serum magnesium levels are prone to develop complications like arrythmias as compared to patients of AMI with normal magnesium levels. Hence, it can be concluded that measurements of magnesium level is of prognostic significance in AMI. Magnesium replacement therapy in patients with acute myocardial infarction with low serum magnesium lev

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Volume 5, Issue 4; July-August 2022; Page No 654-664

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Volume 5, Issue 4; July-August 2022; Page No 654-664