ORIGINAL ARTICLE

# HYPOMAGNESEMIA CAUSING VENTRICULAR TACHYCARDIA IN PATIENTS PRESENTING TO A CORONARY CARE UNIT

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## ABSTRACT

**Objective:** To determine the frequency of hypomagnesemia in patients with ventricular tachycardia.

**Materials and Methods:** It is a descriptive Cross-Sectional study conducted in the Department of Cardiology, MTI-HMC, Peshawar from 20 Sept 2020 to 20 Mar 2021 after approval from the Institutional Ethical Committee. Patients were managed according to the guidelines and hospital protocol. After stabilization, the data was collected. Age, sex, address, patient's history of diabetes, and hypertension were noted. Patients` serum was sent for serum electrolytes level and also serum magnesium level. Patients were labeled as hypomagnesemia and Hypokalemia as per operational definitions.

**Results:** The Mean and SDs for age were 57.52+9.155. The Mean and SDs for the serum level of potassium were 4.93+0.806. The Mean and SDs for the serum level of magnesium were 1.22+0.423. Thirty-four (18.4%) patients were recorded in the 35-50 years age group while 151 (81.6%) patients were recorded in the 51-72 years age group. 144 (77.8%) male patients and 41 (22.2%) female patients were recorded. Diabetes mellitus was present in 42 (22.7%). Hypertension was present in 37 (20.0%) patients. 9 (26.5%) patients had past five days' history of diuretics usage. 18 (9.7%) patients were recorded with Hypokalemia. Ninety-eight (53.0%) patients were found to have hyperkalemia. A total of 185 patients admitted to the CCU of our hospital having ventricular tachycardia were included in this study, out of which 70 (37.8%) patients having ventricular tachycardia were recorded with hypomagnesemia. 19 (38.8%) patients with diuretics induced Ventricular Tachycardia had hypomagnesemia and while remaining 51 (37.5%) patients with ischemic Ventricular Tachycardia and VT-RVOT respectively were recorded with hypomagnesemia (P Value = 0.875)

**Conclusion:** The data suggest that magnesium deficiency does occur in ventricular tachycardia with an increased incidence of cardiac arrhythmias.

**Keywords:** Cardiovascular Disease, Ventricular Tachycardia, Hypomagnesemia

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## INTRODUCTION

Cardiovascular diseases are the most common cause of mortality in almost all countries around the world. In developed nations, one-third of all deaths are caused by cardiovascular disease[1]. In a country like Norway, 79.9% of all admitted cases were cardiovascular-related. [2] According to epidemiology of the non-communicable disease in Pakistan19% of all death are from cardiovascular cause[3].

Electrolyte imbalance increases the risk of mortality in cardiovascular disease. Although magnesium balance is strictly controlled by the kidneys, hypomagnesemia is fairly common, especially in people with comorbid conditions[4]. Increased renal magnesium secretions, sometimes increased by drugs, are a common finding in conditions such as diabetes mellitus[4]. Hypomagnesemia may lead to secondary hypokalemia and hypocalcemia, and severe neuromuscular and cardiovascular clinical manifestations.[5] Also, marked cardiac and neurological signs and symptoms can be developed as a result of severe hypomagnesemia[6]. Also, the most commonly prescribed medication to the general population is proton pump inhibitors which have been shown to cause severe hypomagnesemia (70%)[7]. Furthermore, the patient with torsade de pointe promptly responded to magnesium replacement even if the pre-existing magnesium level is normal[4,6] The prevalence of extreme hypomagnesemia in anadmitted patient is 0.3%[8]. It further becomes common in patients with ventricular arrhythmia. In one study, hypomagnesemia has been found in 38% of patients with ventricular arrhythmias. [9] The patients with complex ventricular arrhythmias had lower serum magnesium levels than those with undisturbed sinus rhythm or unifocal ventricular ectopic beats, both on admission and on day 8 (0.68+0.13 vs. 0.77+0.14mmol/L, P=0.01, and 0.69+0.12 vs 0.79+0.14mmol/L, P=0.003, respectively).

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The rationale of my study is to find out the frequency of hypomagnesemia in patients with ventricular arrhythmia. Very few studies have been conducted in our setup to look for hypomagnesemia in this particular group of patients. The results can be added to the existing body of knowledge and owing to local evidence practitioners may improve their practices.

## MATERIAL AND METHODS

After approval from the hospital ethical committee, those patients with ventricular tachycardia, both genders aged 35-72 years were included in this study. Ventricular Tachycardia was considered in all those patients in whom there was new onset broad complex regular tachycardia (>120 bpm) with positive or negative concordance and AV dissociation.

Patients with a previously known case of chronic kidney disease or chronic liver failure and who used antiarrhythmic drugs like amiodarone were excluded from the study. The sample size was calculated by taking the frequency of hypomagnesemia in ventricular tachycardia patients of 38% with a margin of error of 7% and a confidence level of 95%, the sample size was n= 185 patients of ventricular tachycardia

Patients admitted in the CCU section of the cardiology department of the Hayatabad medical complex were included. Written Informed consent was from each participant and all the benefits were explained. Before starting to fill out the proforma, the patient was managed according to the guidelines and hospital protocol. After stabilization, the data was collected. Age, sex, address, patient's history of diabetes, and hypertension were noted. Patient serum was sent for serum electrolytes level and also serum magnesium level. The patient was labeled hypomagnesemia and hypokalemia as per operational definitions. All the data was collected by the doctor himself and was noted in a designated proforma.

Data were analyzed by using the SPSS version 23. Descriptive statistics were used to determine the Mean with SD for quantitative variables like age, serum level of potassium, and serum level of magnesium. Frequencies and percentages were calculated and presented for qualitative variables like gender, history of diabetics, history of hypertension, any type of diuretic usage in the previous 5 days, presence of hypokalemia, hyperkalemia, and presence of hypomagnesemia. Effect modifiers like age, gender, presence of diabetes, presence of hypertension, any type of diuretic usage in the last 5 days, and potassium level were stratified against the presence of hypomagnesemia. Post-stratification Chi-square test was applied, and the significance level was set at $< 0.05$. All the data were presented using tables and charts.

## RESULTS

This study was carried out on 185 patients at the Department of Cardiology, MTI-HMC, Peshawar.

Table 1 shows the mean ages and serum levels of potassium and magnesium. Thirty-four (18.4%) patients were recorded in the 35-50 years age group while 151 (81.6%) patients were recorded in the 51-72 years age group. 144 (77.8%) male patients and 41 (22.2%) female patients were recorded.

Diabetes Mellitus was present in 42 (22.7%) and hypertension was present in 37 (20.0%) patients. Diuretic usage was present in 49 (26.5%) patients. Hypokalemia was present in 18 (9.7%) patients. Hyperkalemia was present in 98 (53.0%). As per frequencies and percentages for hypomagnesemia in patients presented with ventricular tachycardia, 70 (37.8%) patients with ventricular tachycardia were recorded with hypomagnesemia.

Thirteen (38.2%) patients with Ventricular Tachycardia in the 35-50 years age group were recorded with hypomagnesemia and 57 (37.7%) patients with Ventricular Tachycardia in the 51-72 years age group were recorded with hypomagnesemia. P Value = 0.958. 57 (39.6%) male patients with Ventricular Tachycardia were recorded with hypomagnesemia and 13 (31.7%) female patients with Ventricular Tachycardia were recorded with hypomagnesemia.

P Value = 0.359. 16 (38.1%) diabetic patients having Ventricular Tachycardia were recorded with hypomagnesemia and 54 (37.8%) nondiabetic patients having Ventricular Tachycardia were recorded with hypomagnesemia. P Value = 0.969. 12 (32.4%) hypertensive patients having Ventricular Tachycardia were recorded with hypomagnesemia and 58 (39.2%) normotensive patients having Ventricular Tachycardia were recorded with hypomagnesemia. P Value = 0.448. (Table No. 2). 19 (38.8%) patients with the use of diuretics having Ventricular Tachycardia were recorded with hypomagnesemia and 51 (37.5%) with no use of diuretics patients having Ventricular Tachycardia were recorded with hypomagnesemia. P Value = 0.875. (Table No. 3).

**Table 1: Descriptive Statistics of Study**

| Numerical Variables | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|
| Age | 35 | 70 | 57.52 | 9.155 |
| Serum Level of Potassium | 2.1 | 5.3 | 4.932 | .8066 |
| Serum Level of Magnesium | .7 | 1.6 | 1.221 | .4231 |

**Table 2: Stratification of Hypomagnesemia with History of Hypertension**

| | | History of HTN | | Total | P Value |
|---|---|---|---|---|---|
| | | 12 | No | | |
| Hypomagnesemia | Yes | 32.4% | 58 | 70 | 0.448 |
| | | 25 | 39.2% | 37.8% | |
| | No | 67.6% | 90 | 115 | |
| | | 37 | 60.8% | 62.2% | |
| Total | | 100.0% | 148 | 185 | |
| | | 100.0% | 100.0% | 100.0% | |

**Table 3: Stratification of Hypomagnesemia with Past Five Days Diuretics Usage**

| | | Past Five Days Diuretics Usage | | Total | P Value |
|---|---|---|---|---|---|
| | | Yes | No | | |
| Hypomagnesemia | Yes | 19 | 51 | 70 | 0.875 |
| | | 38.8% | 37.5% | 37.8% | |
| | No | 30 | 85 | 115 | |
| | | 61.2% | 62.5% | 62.2% | |
| Total | | 49 | 136 | 185 | |
| | | 100.0% | 100.0% | 100.0% | |

## DISCUSSION

In the present study, a total of 185 patients with Ventricular Tachycardia were included from the CCU. In this study, 70 (37.8%) patients having Ventricular Tachycardia were recorded with hypomagnesemia. Marked cardiac and neurological signs and symptoms can be developed as a result of severe hypomagnesemia[6]. Also, the most commonly prescribed medication to the general population is proton pump inhibitors which have been shown to cause severe hypomagnesemia (70%)[7]. Furthermore, the patient with torsade de pointe promptly responds to magnesium replacement even if the pre-existing magnesium level is normal[4,6]

The prevalence of extreme hypomagnesemia in admitted patients is 0.3%[7]. In one study, hypomagnesemia has been found in 38% of patients with ventricular arrhythmias and in this study, diuretics were the main cause of Ventricular Tachycardia which is in agreement with the findings of this study where 19 (38.8%) patients with diuretics induced Ventricular Tachycardia had hypomagnesemia. [9] Patients with complex ventricular arrhythmias had lower serum magnesium levels than those with undisturbed sinus rhythm or unifocal ventricular ectopic beats, both on admission and on day 8 (0.68+0.13 vs. 0.77+0.14mmol/L, P=0.01, and 0.69+0.12 vs 0.79+0.14mmol/L, P=0.003, respectively) which as compared to the findings of our study mean for serum level of potassium was 4.93+0.806.

Magnesium is the second in abundance intracellular ion. The relationship between magnesium and the cardiovascular system, arterial hypertension, central nervous system, skeletal muscles, and pregnancy, is an already established knowledge. The main part of total body magnesium is concentrated in the bones, only 1% is in the serum while 31% is in the intracellular space diluted in the cytoplasm or conjunct to enzymes or ATP.

The usual daily magnesium consumption is 200-300 mg but only 1/3 of this quantity is absorbed through the small intestine. The magnesium renal excretion rate is approximately 100 mg per day. Normal values of serum magnesium are considered those between 0.75 and 1.5 mmol/L. Values below the threshold of 0.75 mmol/L are defined as hypomagnesemia which as compared to the findings of our study mean for serum level of potassium was 4.93+0.806.

A wide variety of methods have been used to measure magnesium in serum and intracellular space, but none was reliable. During the last decades by means of new techniques, the precise determination of magnesium concentration became possible. Magnesium depletion occurs when intracellular magnesium stores are depleted. Since there is no possibility to determine the levels of intracellular magnesium the physician is obliged to estimate the magnesium stores using the values of serum magnesium.

The main problem in the diagnosis of intracellular magnesium depletion is that it can coexist even with

normal serum values. This situation was confirmed with muscle biopsy in patients with normal serum magnesium values and evidence of magnesium stores depletion. However, the majority of patients with decreased total magnesium have low serum Mg as well. Thus, in clinical practice, patients with hypomagnesemia are considered as having intracellular magnesium depletion. The measurement of serum Mg is easy and considered the main method of estimation of the Mg stores. Another method for intracellular Mg estimation is the measurement of Mg concentration in red blood cells or in monocytes or the 24-hour Mg renal excretion. Approximately 1/3 of serum Mg is in conjunction with albumin and during hypoalbuminemia, false decreased values of Mg are encountered. Furthermore, although the serum Mg level is normal there could be intracellular depletion of Mg that can cause symptoms. Unfortunately, there is no quick and direct method of measuring the total Mg levels at the moment.

Hypomagnesemia as a side effect of diuretics is the most common cause of this disturbance. Loop diuretics and thiazides are involved in increased Mg excretion. Another common cause of hypomagnesemia is decreased Mg consumption in the elderly and patients with disturbances in intestinal absorption. In developing countries, Mg consumption is inadequate. Vegetables and fish are considered rich in Mg, while consumption of fatty food, salt, vitamin D, proteins and calcium increases the need for Mg. Patients with acute or chronic use of alcohol have Mg depletion due to osmotic diuresis by the alcohol. The same mechanism must be implicated in the development of Mg depletion in diabetic patients.

## CONCLUSION

In conclusion, the data suggest that magnesium deficiency does occur in ventricular tachycardia with an increased incidence of cardiac arrhythmias. Therefore, it is recommended to retain normal Mg2+ levels in order to prevent the onset of this disease.

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Following authors have made substantial contributions to the manuscript as under

**Khan ZA:** Main Idea, Research proposal

**Khan RD:** Data Collection and writing

**Hussain C:** Data Collection, Review and proofreading

**Nawaz T:** Data Collection

**Hakeem Y:** Data, Review and proofreading

**Ullah H:** Data Collection

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.