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Level of Vitamin D assessment in the serum of acute myocardial infarction (AMI) patients in tertiary care hospital

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Vitamin D has a distinguished role in the homeostasis of minerals. In addition to this, it has many important functions that include anti-inflammatory activity, vascular smooth muscles cell relaxation, and an important role in down-regulating renal renin production. Coronary artery diseases are caused by vitamin D deficiency which can be treated easily. This study was piloted to determine vitamin D levels in acute myocardial infarction (AMI) patients. The study was conducted at the Cardiology department of Hayat Abad Medical Complex Peshawar from January to July 2019. In this research work, 150 patients of acute myocardial infarction of different age groups and both genders were evaluated for estimation of the level of vitamin D. The AMI patients were selected based on clinical presentation, ECG, and enzymes like troponin for myocardial necrosis. Our study assessed vitamin D levels in 150 healthy individuals of matched age and sex as a control group. These healthy individuals were selected by random sampling with no history of Ischemic heart disease and normal ECG. The criteria for vitamin D status determination was as follow; patient having vitamin D level of ≥ 30 ng/ml were categorized as sufficient, and patients with a vitamin D level of more than 15 ng/ml and less than 30ng/ml were classified as insufficient. Patients with levels of vitamin D of ≤ 15ng/ml were considered deficient. The data of our study was collected, and suitable statistical methods were used for our data analysis. Vitamin D level of ≤ 15ng/ml was recognized in 70% of the AMI cases. In 26% of the AMI cases, vitamin D insufficiency was recorded, while vitamin D level of ≥ 30 ng/ml was recognized in 4% of the AMI cases. Our study showed a considerably low level of vitamin D in the serum of AMI patients. Further study is needed to find out the effect of vitamin D supplementation on AMI patients.

Keywords: Vitamin D deficiency; acute myocardial infarction; vitamin D supplementation

INTRODUCTION

Despite the availability of preventive strategies, acute myocardial infarction remains the leading cause of morbidity and mortality in the western world (Nichols, et al. 2014). The association between low vitamin D levels and cardiac diseases has been known for quite some time. The effect of Vitamin D in retaining cardiac diseases health has been supported by clinical research studies (Aggarwal et al. 2010). The active form Vitamin D applies its act in several tissues by using Vitamin D receptors that include endothelium, vascular smooth muscle, and cardiomyocytes (Holick, 2007). Along with many risk factors such as hypertension, type -2 diabetes mellitus, and metabolic syndrome,vitamin D association with cardiac diseases has been documented in many latest studies (Forman, et al. 2005). Many epidemiological studies have shown an independent association between low vitamin D levels and myocardial infarction incidence of twice risk (Thomas MK, et al. 1998 and Castelli et al. 1995). In cardiac diseases, there is Vitamin D involvement that reduces the risk of cardiac diseases by playing many important roles. In many cells, it might regulate the expression of genes by using vitamin D receptors. It might have a role in maintaining blood pressure by using RAS and might have a role in vascular smooth muscle cells and cardiomyocytes proliferation and modulation of cell growth (Garcia and Martini 2014). A study conducted in the United Kingdom revealed the protective role of vitamin D in cardiac diseases that have an inverse relation with the exposure time to the sun (Heikkinen et al. 1997). 1-α, 25-dihydroxy vitamin D is the active metabolites of Vitamin D have a connection with the receptors of vitamin D. This active metabolite have a regulatory role in the expression of various genes that have involvement in many important processes in cardiac diseases that includes differentiation and cell proliferation, program cell death, transport across membrane and adhesion in cells (Norman PE, Powell JT 2014). A study

showed that the deficiency of vitamin D is an independent risk factor for cardiac disease. People spending day time inside their homes like women who are pregnant, mothers who lactate their babies, infants, infants on breastfeeding with not vitamin D supplementation, people having more weight, chronic or infectious disease patients, and aged people are high-risk groups for vitamin D deficiency was shown by a study convened in Central Europe (Pludowski P, et al. 2014). The antiatherogenic influence of vitamin D regulates the immune system and the inflammatory response. (Kassi E, et al. 2013). Endothelium-dependent vasoconstriction is inhibited by Vitamin D by preventing the production and expression of Cox1 enzyme and reactive oxygen species. Besides these functions, vitamin D can change the expression of gene and function of macrophages that is important in the foam cell formation and inflammatory vascular response that stimulate atherosclerosis process (Riek AE, et al. 2012). Vitamin D deficiency appears to affect in-hospital and periodic hostile cardiac actions, as it has an association with the affected coronary artery, AMI complications associated with the AMI, and AMI patient cardiac remodeling (De Metrio M, et al. 2015 and Ng LL, et al. 2017). In conducting epidemiological studies, the main problem is that there is no accord on the definition of vitamin D deficiency (Aleksova A 2015). United States Endocrine Society instruction are the most acceptable guidelines that show that serum vitamin D level of ≥ 30 ng/mL is considered as sufficient, serum vitamin D level between 21-29 ng/mL is considered as insufficient, and serum vitamin D level of ≤ 20 ng/mL as deficient (IOM (Institute of Medicine) Dietary Reference, 2011). Both in adults and children, the common nutritional deficiency globally is vitamin D deficiency (Holick MF, et al. 2011). More than 40% of people from Europe and the United States have low vitamin D levels (Hossein-nezhad A, Holick MF, 2013). Many epidemiological studies have revealed that coronary artery disease, diabetes mellitus, hypertension, and vitamin D deficiency increase with the increase of distance from the equator (Yao T,et al. 2015). It has been reported that in the winter season, in which there is less exposure to sunlight, the mortality due to cardiac problems and deficiency of vitamin D reaches their peak (Fabsitz R, Feinleib M., 1980). An early study suggested that many cardiovascular risk factors are developed by vitamin D deficiency (Zipes DP, 1999, Forman JP, et al. 2007, Forman JP et al. 2008, Hyppönen E et al. 2008, Chonchol M 2007, Mattila C 2007). In 1978, a study by Danish et al. evaluated the vitamin D status of 75 patients with angina pectoris, 53 patients with acute myocardial infarction, and 409 healthy control groups. They observed a low vitamin D level in angina and AMI patients compared to control (Go AS et al. 2004). In the 1739 Framingham Children Study on healthy subjects, a higher rate of a cardiovascular event of 50% and 80% was observed in participants with vitamin D insufficiency and deficiency, respectively (Lund B, et al. 1978). In health professionals' follow-up studies, men with vitamin D deficiency are at a higher risk for acute myocardial infarction. This follow-up study also observed that normal participants with no vitamin D deficiency have half the risk for acute myocardial infarction. In agreement with these epidemiological studies, many reports have shown that hospitalized AMI patients have a high vitamin D deficiency prevalence (Wang TJ, et al. 2008, Giovannucci E et al. 2008, Wang L, et al. 2008 and Lee JH, et al. 2011). The adversarial health consequence of a curable Vitamin D deficiency and the relative absence of local data encouraged us to conduct the present research. The objective of the study was to evaluate Vitamin D levels in patients with acute myocardial infarction.

MATERIALS AND METHODS

After authorization from the institutional ethical committee, this study was conducted in the Department of cardiology, Hayatabad Medical Complex, Peshawar Khyber Pakhtunkhwa. The study duration for our study was six months, from January 2019 to July 2019. Data was collected from all the patients fulfilling the inclusion criteria. Written informed consent was obtained from all the participants. In this research work, AMI patients of both genders admitted to the Department of cardiology, Hayatabad Medical Complex, Peshawar Khyber Pakhtunkhwa, were evaluated for the level of vitamin D. The AMI patients were selected based on clinical presentation, ECG, and enzymes like troponin for myocardial necrosis. Our study assessed vitamin D levels in 150 healthy individuals of matched age and sex for control purposes. These healthy individuals were selected by random sampling with no history of Ischemic heart disease and with normal ECG. A significance level of 5%, error of margin 5%, and confidence interval of 95% were taken. The consecutive sampling technique was used in this study. AMI patients diagnosed on ECG, biochemical tests, and clinical presentation were included in our study. While the exclusion criteria for our study was patients receiving vitamin D supplementation, patients with hepatic, renal, and other chronic illnesses. The criteria for vitamin D status of participants was as follow; patients with vitamin D level of ≥ 30 ng/ml were categorized as sufficient, and patients with levels of vitamin D between >15ng/ml and <30ng/ml were measured as insufficient while patients having levels of vitamin D of ≤ 15ng/ml were considered as deficient. Blood was collected from all the patients and sent to the diagnostic laboratory of the hospital for the evaluation of vitamin D levels. Table 1 shows the status of vitamin D consideration

Table 1: Classification of study participants based upon the serum Vitamin D level estimation

Vitamin D status of the study participants		
Deficient	**Insufficient**	**Sufficient**
≤15 ng/ml	>15 ng/ml and <30 ng/ml	≥30 ng/ml

RESULTS

A total of 150 patients of acute myocardial infarction belonging to all age groups and both genders admitted to the Department of cardiology, Hayatabad Medical Complex, Peshawar Khyber Pakhtunkhwa, were evaluated for the level of vitamin D. Corresponding 150 healthy control groups with no disease were also assessed for Vitamin D levels. Our results showed that 70% (n=105) of our study participants were deficient in Vitamin D, whereas 26% (n=39) of the AMI cases had vitamin D insufficiency. In contrast, only 4% (n=6) cases were shown to have sufficient levels of Vitamin D. (The results are shown in Table 2)

While in the case of control samples, Severe vitamin D deficiency of less than ≤ 15ng/ml was found in 20% (n=30) of the samples. Vitamin D insufficiency was found in 8% (12) of the samples, and sufficient vitamin D (25 (OH) vitamin D ≥ 30 ng/ml) was found in 72% (108) of the samples. (Table 2)

The mean vitamin D level was 12 ng /ml in the Vitamin D deficient group of AMI patients and 20 ng/ml in the insufficient group. In comparison, Vitamin D levels were 35 ng/ml in the Vitamin D sufficient group. (Table 2)

The mean vitamin D level of less than ≤ 15ng/ml in 20% of the control samples was 14ng/ml. The mean level of the vitamin D level between >15ng/ml and <30ng/ml in 8% of the control samples was 23ng/ml, while the mean level of vitamin D of ≥ 30 ng/ml in 72% of control samples was 37ng/ml. (Table 2)

Amongst 150 cases of AMI, 95 were male patients, and 55 AMI patients were female. Among 105 AMI patients, having severe vitamin D deficiency of less than ≤ 15ng/ml was found in 75 males (50%) and 30 females (20%). Among 39 AMI patients having vitamin D in between >15 ng/ml and <30 ng/ml, 18(12%) were male, and 21(14%) were female, while among 6 AMI patients, having vitamin D level of ≥ 30 ng/ml, 2 AMI patient (1.33%) were male and 4 (2.66%) were female. (Table 3

Table 2: Vitamin D levels in study cases and control groups

Vitamin D status	AMI patient			Control cases		
	Cases	Mean level	percentage	Cases	Mean level	percentage
Deficient	105	12 ng/ml	70%	30	14 ng/ml	20%
Insufficient	39	20 ng/ml	26%	12	23 ng/ml	8%
Sufficient	6	35 ng/ml	4%	108	37 ng/ml	72%
Total	**150**		**100**	**150**		**100**

Table 3: Gender wise status of vitamin D in AMI patient (n=150)

Vitamin D status	Total cases	Male cases n(%)	Female cases n(%)
Deficient	105	75 (50%)	30(20%)
Insufficient	39	18(12%)	21(14%)
Sufficient	6	2(1.33%)	4(2.66%)

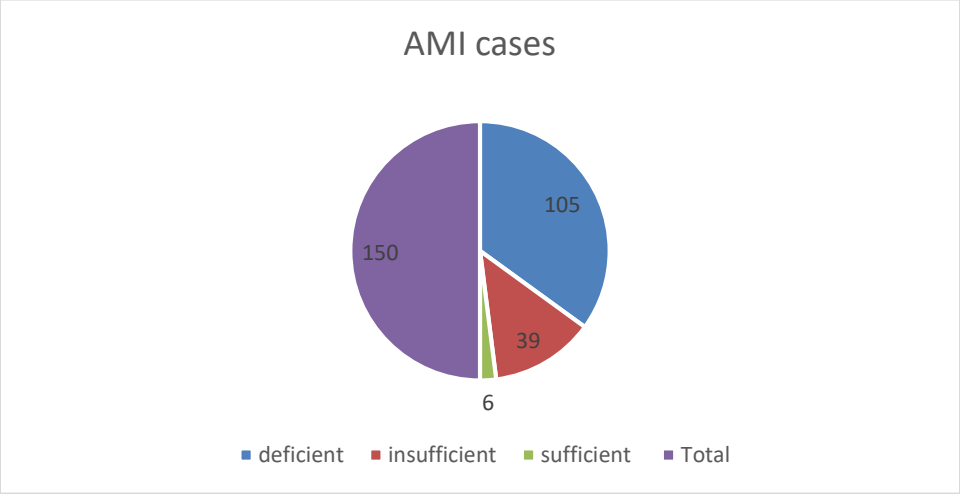

Figure 1: AMI Cases showing the status of Vitamin D

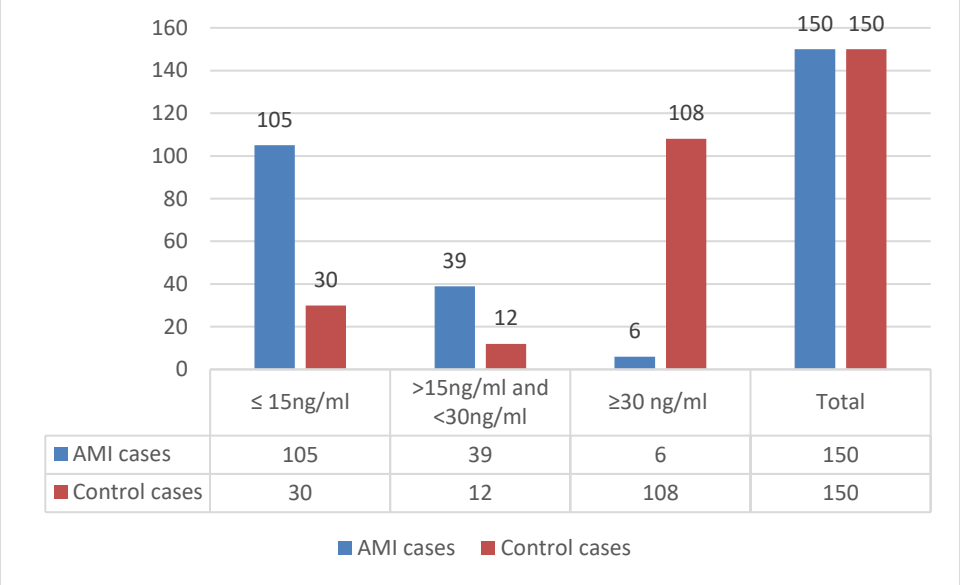

Figure 2: Comparative status of Vitamin D in AMI cases and control cases

DISCUSSION

In cardiovascular disease, the important role of vitamin D is currently an interesting field for research. A well-known research study has shown in a definite way that vitamin D has a major role in connection to various risk factors for cardiovascular diseases like hypertension and type II diabetes, and they also correlate vitamin D deficiency with the incidence and prevalence of cardiovascular risk factors (Brandenbug VM, et al. 2012).

Vitamin D level of ≤ 15ng/ml was recognized in 70% (n=105) of the AMI cases. In 26% (n=39) of the AMI cases, vitamin D insufficiency was recorded, while vitamin D level of ≥ 30 ng/ml was recognized in 4% (n=6) of the AMI cases.

While in the case of control samples, Severe vitamin D deficiency of less than ≤ 15ng/ml was found in 20% (n=30) of the samples. Vitamin D insufficiency was found in 8% (n=12) of the samples, and sufficient vitamin D (25(OH) vitamin D ≥ 30 ng/ml) was found in 72% (108) of the samples.

Our results are consistent with the study done in India, in which they also showed a high prevalence of vitamin D deficiency in AMI patients. A study done in northern India showed that vitamin D deficiency in rural people is high than in urban people in which the vitamin D level was high by 70% (Goswami R, et al. 2008). A study done in Delhi showed the serum level of vitamin D in healthy individuals observed that 91.2% of the individual have a deficiency of vitamin D < 20 ng/ml that include severe deficiency of < 10 ng/ml in 62% and observed insufficient vitamin D 20e<30

ng/ml in 6.8% individuals (Marwaha RK, et al. 2011). Likewise, high vitamin D deficiency prevalence was shown by a study done in Andhra Pradesh (Harinarayan CV et al. 2008). Brøndum-Jacobsen et al. did their study on a large population that included participants of serum vitamin D at first to the fourth percentile to the participant with a serum vitamin D level at the 50th to 100th percentile. They observed that in individuals with vitamin D deficiency, the risk for ischemic heart disease increases by 40%, myocardial infarction increases by 64%, and early death and fatal ischemic heart diseases increased by 57% and 81%, respectively (Brøndum-Jacobsen P, et al. 2018).

A case-control study from Trivandrum in South Indians has done a study to associate vitamin D with chronic heart diseases. They observed that patients with a vitamin D level of >89 ng/ml have increased odds of ischemic disease than patients having lower levels (. Rajasree S.et al. 2001).

In our study, among 150 cases of AMI, 95 were male patients, and 55 AMI patients were female. Among 105 AMI patients, having severe vitamin D deficiency of less than ≤ 15ng/ml was found in 75male (50%) and 30 females (20%). Among 39 AMI patients having vitamin D in between >15ng/ml and <30ng/ml, 18(12%) were male, and 21(14%) were female, while among 6 AMI patients, having vitamin D level of ≥ 30 ng/ml, 2 AMI patient (1.33%) were male and 4 (2.66%) were female. In follow-up studies by health professionals, men having vitamin D deficiency are at high risk for acute myocardial infarction. This follow-up study also observed that normal participants with no vitamin D deficiency have half the risk for acute myocardial infarction (Giovannucci E et al. 2008). A case-control study done in the United States on AMI showed that risk for AMI is inversely proportional to the level of vitamin D (Scragg R, et al. 1990). In Pakistan recently, a study shows that individuals with a normal level of vitamin D have a low risk for acute myocardial infarction compared to individuals with a low level of vitamin D, which have a high risk for acute myocardial infarction (Iqbal MP, et al. 2013). From North India, a study was done by Syal et al. on 100 patients suffering coronary angiography. They observed that patients with low vitamin D levels have more severity of coronary artery disease and more endothelial dysfunction (Syal SK, et al.2012). This study was small, and a larger study should be conducted with a large number of people from different parts of Pakistan. People should be educated about the importance of vitamin D, and they should be encouraged to take a daily sunbath and take a diet rich in vitamin D.

CONCLUSION

Our study concludes that AMI patients have a high prevalence of vitamin D deficiency as compared to control. People should be educated about the importance of vitamin D. They should be encouraged to take daily sunbath and take a diet rich in vitamin D. Further study is needed to find out the effect of vitamin D supplementation on AMI patients.

CONFLICT OF INTEREST

The present study has no any conflict of interest.

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AUTHOR CONTRIBUTIONS

ST designed and performleed the experiments and also wrote the manuscript. ST, IM, A performed experiments, and data analysis. ST and KA designed experiments and reviewed the manuscript. All authors read and approved the final version.

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