EFFECTS OF SERUM VITAMIN D3 DEFICIENCY ON HEART RATE, SYSTOLIC BLOOD PRESSURE AND RATE PRESSURE PRODUCT (RPP)

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Objective: There were scarcy of local data regarding the association of deficiency of vitamin D3 on cardiac function. This study was conducted to assess the effects of vit –D3 deficiency on cardiac function.

Design: Prospective , descriptive study.

Place and duration of study: Study was carried out at Cardiology Department, Civil Hospital, Karachi, from May 2011 to June 2012.

Methods: Total of 70 patients, 30-60 years age, suspected of vit D deficiency were included in study. Blood samples collected during examination were sent for level of serum vit D3.

Results: Total of 70 patients, 46% were female and 24 % male; the mean age of patients was 38 years, with range from 30 to 60 years. 90% patients presented with palpitation, 80% with chest pain, weakness and 70%% with leg cramps and burning sensation of feets (table-1). In comparision to reference patient (Vit. D3 level >30 ng / ml) heart rate was significantly (p<0.001) higher, by 4.1+0.2 beats / minute, in patients with vit D3 < 10.0 ng /ml, while mean systolic B.P was 3.1+0.3 mmHg higher (P<0.001) for patients with Vit D3<10.0 ng / ml. Mean RPP was 848+27 beats / min. mmHg higher (P <0.001) in patients with vit-D3 less than10.0 ng/ml in comparision to patients with vit D3 level more than 30 ng/ml (Table 2).

Conclusion: Results suggest that low vit- D3 status increase cardiac work by increasing heart rate and systolic blood pressure. Clinicians should advise serum vit. D3 level in suspected patients in order to prevent adverse cardiac effects by correcting reversible cause.

Key words: Heart rate, Systolic BP, vit.- D3 deficiency.

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INTRODUCTION

Vitamin D is an important pro-harmone for optimal intestinal calcium absorption for mineralization of bone. Since the vitamin D receptor is present in multiple tissues, there has been interest in evaluating other potential functions of vitamin D, particularly in cardiovascular diseases. Mechanism regarding an inverse association between vitamin D status and risk for cardiovascular disease is still unclear.[1-2] Recent epidemiologic studies have shown that low baseline blood levels of vit. D3 predict increased risk for cardiovascular disease[3-4] and confirmed earlier case control studies reporting an inverse association between serum vit. D3 and myocardial infarction and stroke.[5-6] Hypertension also may be involved, as inverse associations have been observed between 25(OH)D levels and blood pressure.[7-8] Receptors to 1,25-dihydroxyvitamin D have been identified in cardiac and vascular smooth muscle, and animal studies have shown that vitamin D deficiency results in cardiac hypertrophy.[9-11] Vitamin D reduces heart rate

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because it may have a direct effect on the heart, possibly through a negative correlation between vitamin D signaling in cardiomyocytes and sympathetic system regulation of heart rate. This is supported by evidence that 1,25-dihydroxyvitamin D^3 regulated the production of tyrosine hydroxylase, the rate-limiting enzyme in the catecholamine biosynthetic pathway, and raises the possibility that the vitamin D hormonal system may modulate functions of the peripheral and central catecholaminergic system.[12] A direct effect of vitamin D on cardiac function is supported by echocardiographic studies in humans showing that vitamin D increases diastolic and end-systolic diameter and increase fractional fiber shortening[13,14] and by animal evidence showing that vitamin D deficiency alters heart morphology and adversely affects cardiac function.[15] Furthermore, the inverse association between vitamin D status and systolic blood pressure, seen in NHANES III,08 suggests that vitamin D also affects vascular function and is consistent with clinical research showing that vitamin D beneficially influences vascular resistance and endothelial function.[16] Because vit.D3 affects cardiac and vascular functions, we decided to asses affects on heart rate, systolic blood pressure and rate pressure product.

METHODS

Prospective, descriptive study, was carried out at Cardiology Department, Civil Hospital, Karachi, from May 2011 to June 2012.Total of 70 patients, 30-60 years age, suspected of vit. D3 deficiency were included in study. Blood samples collected during examination were sent for level of serum vit D3. Proforma filled with demographic variables, lab. results and data was analyzed by SPSS.8.

Table-1: Shows Demographic Variables

Level of vit "D3"	Pulse Rate (beats/Minute)	Systolic BP (mmHg)	RPP (beats/min.mmHg)
25 (OH) D (ng/ml)	Mean (±SE) Difference	Mean (±SE) Difference	Mean (±SE) Difference
<10	85.3±0.5 4.1±0.2	145.3±0.6 3.1±0.3	12394±91 848±2.7
10-29	8.3.6±0.3 1.7±0.0	143.4±0.5 1.2±0.2	11988±24 441±66
>30	81.2±0.3 0	142.2±0.3 0	11546±64 0

(>3O) Reference Group.
Data are expressed as means + SE.

Table-2: Measurement of pulse rate, systolic BP and rate-pressure product (RPP) according to level of vit D3 level.

RESULTS

Total of 70 patients, 46% were female and 54 % male; the mean age of patients was 38 years, with range from 30 to 60 years. Ninety percent were present with palpitation, 80% with chest pain, weakness and 70%% with leg cramps and burning sensation of feets (Table-1). In comparision to reference patient (Vit. D3 level >30 ng / ml) heart rate was significantly ($p<0.001$) higher ,by 4.1+0.2 beats / minute, in patients with vit D3<10.0 ng /ml, while mean systolic B.P was 3.1+0.3 mmHg higher ($P<0.001$) for patients with Vit D3<10.0 ng / ml. Mean RPP was 848+27 beats / min. mmHg higher ($P <0.001$) in patients with vit-D3 less than10.0 ng/ml in comparision to patients with vit D3 level more than 30 ng/ml (Table-2).

Symptoms Percentage	
Palpitation	90%
Generalized Weakness	80%
Chest Pain	80%
Pricking sensation	70%
Burning sensation	70%
Leg Cramps	70%
DM	20%
HTN	60%
Cardiovascular disease	30%
Colour Consciousness	40%
Religious Women	55%

Serum Level of Vit "D" Percentage	
< 10 ng / ml	18%
10-29 ng / ml	45%
> 30 ng / ml	37%

DISCUSSION

It is seen in litrature that low vitamin D status is associated with increased heart rate, systolic blood pressure, and RPP (a measures of cardiac work), adjusting for covariates, in large cross-sectional surveys representative of the US population. The inverse association between vitamin D status and RPP was observed in all age groups >20 years and in all 3 racial and ethnic group (Non-Hispanic whites, non-Hispanic blacks, and Mexican Americans).[17] Inverse association between vitamin D status and heart rate is seen in 2 clinical trials showing that vitamin D reduces heart rate because vitamin D may have a direct effect on the heart, possibly through a negative correlation between vitamin D signaling in cardiomyocytes and sympathetic system regulation of heart rate.[18-20]

In our study it was also seen significant inverse association between serum level of vitamin D3 and heart rate. The inverse association between vitamin D status and RPP, which described previously, suggests that vitamin D deficiency may increase cardiac work and cardiac oxygen demand, because studies in healthy human volunteers have shown that RPP is correlated with myocardial blood flow.[10-11] A previous cohort study of coronary patients in Italy, which found that RPP at rest is inversely associated with survival, may not be applicable to healthy subjects, because measurements in the Italian study were collected after myocardial infarction and before discharge, when patients were recuperating.[22] Another cohort study of patient referred for exercise testing found that RPP did not predict cardiovascular mortality.[23] However, in healthy subjects, because heart rate[24] and systolic blood pressure[18] predict cardiovascular mortality, it is probable that their product, the RPP measure, will also predict mortaliy. Thus, our findings are likely to have clinical and public health significance.

Our study had some limitations. The measurements of pulse rate, systolic blood pressure, and serum 25(OH)D were made on a single occasion for each participant. This is likely to have resulted in measured error, which, if random, is likely to have weakened observed association between cardiovascular function and vitamin D status. The RPP value is derived from heart rate and systolic blood pressure rather than a direct measure of cardiac work and myocardial blood flow. Another limitation was the cross-sectional study design, which could not separate cause and effect. It is small study needs more studies to asses affects of vitamin D3 on heart rate, systolic blood pressure and cardiac work.

CONCLUSION

Vitamin D insufficiency is very common in Pakistan and world-wide. Several recent epidemiologic studies have demonstrated a strong association between vitamin D insufficiency and risk of cardiovascular disease, risk of diabetes and metabolic syndrome. Several prospective studies have suggested that vitamin D deficiency predisposes individuals to increased risk of incident hypertension, ischemic heart disease, sudden cardiac death and heart failure. Our results also suggest that low vit- D3 status increase cardiac work by increasing heart rate and systolic

blood pressure. Clinicians should advise serum vit. D3 level in suspected patients in order to prevent adverse cardiac effects by correcting reversible cause.

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