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Study of vitamin C levels in relationship to stress hormone response and acute phase reaction in patients with newly diagnosed pulmonary tuberculosis

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ABSTRACT

A study of vitamin C levels in relationship to stress hormone response and acute phase reaction in patients with newly diagnosed pulmonary tuberculosis.

INTRODUCTION

Tuberculosis remains a major public health threat globally and the Human Immunodeficiency Virus (HIV) pandemic afflicting developing and developed countries has resulted in enormous increases in tuberculosis infections worldwide. Researchers have previously documented very low plasma vitamin C levels in patients with active pulmonary tuberculosis. This was attributed to a number of factors including: accelerated turnover of vitamin C, shifts in plasma concentrations, increased collagen formation and tissue repair and decreased vitamin C intake. Vitamin C appears to have a role in steroid-genesis and catecholamine synthesis. Decreased plasma vitamin C levels may therefore impact on the stress hormone response and acute phase reaction of patients with active tuberculosis.

AIM

The primary aims of the study were to measure plasma vitamin C levels, as well as stress hormone levels and acute phase reaction in patients with newly diagnosed active pulmonary tuberculosis and control patients (without

tuberculosis), to determine if there was any relationship between vitamin C levels and the levels of these other variables.

METHODS AND MATERIALS

This was a prospective study of seventy one (71) consecutive patients admitted to Helen Joseph Hospital (between March and October 2002) with newly diagnosed active pulmonary tuberculosis and eighty nine (89) control patients with medical conditions other than tuberculosis. Demographic, clinical and laboratory data were captured and analyzed using SPSS 7.5 soft-ware. Continuous variables were analyzed using students t-test. Categorical data were analyzed by non parametric analysis and Pearsons linear regression model was used to determine the correlation between vitamin C and the other variables in the two groups.

RESULTS

There were no differences in race, gender, age, suburb of residence and occupational distributions in the study group with tuberculosis compared to the control group. There were more smokers and consumers of alcohol in the control group (54 and 62 patients respectively) than in the study group (28 and 31 patients respectively). The study patients had lower blood pressure (average $^{90}/_{40}$ mmHg versus $^{100}/_{60}$ mmHg of controls), higher mean pulse rate (101.87 ± 15.14 beats/minute versus 82.92 ± 8.88 beats/minute, $p < 0.01$), higher mean

temperature (38.66 ± 0.67^{o}C versus 37.14 ± 0.44^{o}C, p< 0.01), and lower body mass index (18.29 ± 3.80 Kg/ M^{2} versus 23.20 ± 5.35 Kg/ M^{2}, p< 0.01). Laboratory data comparing study group and controls also showed marked differences as follows: White cell count (WCC) 8.68×10^{6} / L ± 5.44 versus 11.00×10^{6} / L ± 4.94, p = 0.01; Haemoglobin 9.56gm / dl ± 1.93 versus 12.92gm / dl ± 2.34, p < 0.01 and platelet count 369.21× 10^{6}/L ± 190.71 versus 295.94×10^{6} / L ± 94.64, p = 0.01. White cell vitamin C levels (normal range – 20-40 μg/10^{8} leucocytes) were low in half of the patients in both groups (study patients mean 29.85 ± 28.70μg/10^{8} leucocytes versus controls 31.39 ± 30.24μg/10^{8} leucocytes, p = NS). Plasma vitamin C levels were reduced (normal range 10-20 mg/ml) in both groups but more so in the controls (mean 3.87 ± 2.82 mg/ml versus 4.81 ± 3.21 mg / ml in study patients, p= 0.053). Mean cortisol levels were slightly higher in the study patients (448.11 ± 197.41ηmol/L) than controls (392.70 ± 191.25ηmol/L, p = NS). Norepinephrine levels were slightly higher in the study patients than controls (study patients mean 2531.61 ± 2043.60 ρmol/L versus 2178.98 ± 1719.98 ρmol/L of controls, p = NS). Dopamine levels were higher in the study patients than in the controls (468.42 ± 377.57 ρmol/L in study patients versus 293.37 ± 355.84 ρmol/L in controls, p = 0.01). Epinephrine levels were higher in the controls (control patients mean 680.64 ± 743.78 ρmol/L versus 449.41 ± 380.04 ρmol/L of the study patients, p = 0.03). Ferritin levels were much higher in the study patients compared with controls (study patients mean 3005.87 ± 5023.26 μg/L versus 466.51 ± 1774.76 μg/L of the controls, p<0.01) as were

CRP levels (125.91 ± 54.77 mg/L in the study patients versus 77.22 ± 81.17 mg/L in the controls, p=0.01). Mean urine cotinine levels were 16.42 ± 24.26μM/L for controls and 9.28 ± 11.59 μM / L for the study patients (p=0.027). Correlation studies did not show any significant differences between the different variables. There was an inverse correlation between CRP levels and urine cotinine levels in the control group (R squared=0.058 and p= 0.024).

DISCUSSION

There were no differences in the demographic profile of the two groups. Smoking and alcohol consumption were more common in the control group than in the study patients. Over 90 % of patients in both groups had low plasma vitamin C levels, while half of the patients in each group had low white cell vitamin C levels. The low levels of vitamin C could be due to some of the reasons given above or possibly due to the fact that generally there are low levels in Africans for reasons that are not apparent. The control group had increased mean urine cotinine levels suggesting a possible influence of cigarette smoking on vitamin C homeostasis in these patients. In both groups, the majority of patients had normal cortisol levels as well as normal to high catecholamine levels. Also, Ferritin and CRP levels were much higher in the study group than in the controls. The low levels of vitamin C did not, however, have any relationship with stress hormone levels and acute phase reactants.

CONCLUSION

This study has reaffirmed low plasma and white cell vitamin C levels in patients with new onset pulmonary tuberculosis but has also found low levels in control patients with diseases other than pulmonary tuberculosis. The study demonstrates adequate stress hormone responses in tuberculosis patients, which was not different from non- tuberculosis patients. Acute phase responses were found to be of higher magnitude in tuberculosis patients than in the controls. There were, however, no correlations between plasma vitamin C and stress hormones or acute phase reactants.