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Leucocyte ascorbic acid concentration and plasma ascorbic acid levels in children with various infections

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Summary

In this study leucocyte ascorbic acid concentrations and plasma ascorbic acid levels were measured simultaneously and correlation between these two variables was sought in various bacterial and viral infections. A total of 258 patients were studied. The control group consisted of 21 healthy children in the same age group. Except for scarlet fever no significant differences were observed between the patients' leucocyte ascorbic acid levels during and after the infections and also no differences were observed in leucocyte ascorbic acid levels between control's and patient's. However plasma ascorbic acid values were significantly decreased during infection in all patients. During infection ascorbic acid is utilized rapidly, and our findings seem to indicate that there is transfer of ascorbic acid from plasma to leucocytes in order to keep the leucocyte ascorbic acid levels within normal limits.

Introduction

It has been shown during infections that plasma ascorbic acid level decreases, possibly due to the transfer of ascorbic acid from plasma to tissues [1, 2]. Although ascorbic acid is widely useid as a prophylactic and therapeutic agent against infection, there are no studies concerning leucocyte ascorbic acid concentration and plasma ascorbic acid levels during infections other than common cold [3].

Human peripheral polymorphonuclear leucocytes (PMN) contain relatively high concentrations of ascorbic acid [4] and 20 μg or more of ascorbic acid per 10^8 cells is needed for proper phagocytic activity and possibly for intracellular killing of bacteria [5, 6]. High doses of ascorbic acid are said to enchance leucocyte function [6, 7], wound healing and allergic reactions [8]. Therefore, in this study leucocyte ascorbic acid concentrations and plasma ascorbic acid levels were measured simultaneously and a correlation between these two variables was studied in various bacterial and viral infections.

Material and methods

A total of 258 patients were studied, 43 of them had bronchopneumonia, 18 scarlet fever, 22 meningitis, 30 tonsillitis. 40 mumps, 37 infectious hepatitis, 29 chicken pox, 29 measles, 10 common cold (Table I). The mean age of the patients was 5.8 years. The control group consisted of 21 healthy children in the same age group. In some patients leucocyte ascorbic acid concentration and plasma ascorbic acid levels were determined for the second time after treatment.

Ascorbic acid concentrations in both leucocytes and plasma were measured using the method described by Denson and Bowers [9] to permit easier separation of white blood cells. The leucocyte ascorbic acid levels are expressed per 10^8 white blood cells, plasma ascorbic acid levels are expressed as mg/dl.

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Results

In the control group the average leucocyte ascorbic acid concentration and plasma ascorbic acid levels were found to be 40.9 $\mu g/10^8 \pm 15.90$ and 0.68 mg/dl ± 0.25, respectively (Table 1).

The average plasma ascorbic acid levels of the patients with bronchopneumonia and meningitis were significantly lower than the control values. While there was no change in the leucocyte ascorbic acid concentration ($P < 0.005$, $P < 0.005$, Table).

In patients with bronchopneumonia that we examined after recovery (10 days later) plasma ascorbic acid levels were still lower than normal ($P < 0.001$, Table 2).

In patients with scarlet fever plasma as well as leucocyte ascorbic acid concentrations were found to be significantly decreased (Table 1), ($P < 0.005$, $P < 0.005$). In 10 of these patients after ten days of therapy plasma levels were still significantly lower, but leucocyte ascorbic acid concentration reached the control values ($P < 0.01$, Table 2).

Table 1

Leucocyte ascorbic acid and plasma ascorbic acid levels of controls and chikdren with various infections

Groups	Average n Leucocyte AA ug/10^8	SD	Average Plasma PA/mg	SD
Control	21 40.90	15.90	0.68	0.25
Broncho-pneumonia	43 35.21	16.68	0.37*	0.24
Scarlet Fever	18 23.40**	9.35	0.37*	0.15
Tonsillitis	30 42.22	17.61	0.59	0.23
Meningitis	22 42.29	20.27	0.50*	0.26
Mumps	40 37.92	16.46	0.51*	0.24
Chickenpox	29 43.76	21.27	0.47*	0.25
Measles	29 49.01	26.21	0.42*	0.28
Hepatitis	37 49.63	38.95	0.56	0.58
Common Cold	10 33.18	10.50	0.57	0.28

* When PA acid levels were compared with control, they were significantly low ($P < 0.05$, $P < 0.005$)

** When plasma and leucocyte AA levels were compared with control, they were significantly low ($P < 0.005$).

In viral infections such as mumps, measles and chickenpox, plasma ascorbic acid levels were found to be significantly below the normal value, while there was no change in the leucocyte ascorbic acid concentrations ($P < 0.005$, Table 1). Except for chickenpox plasma ascorbic acid values obtained on the third week after the first symptoms, were still lower than the control values ($P < 0.05$, Table 2).

Important differences were not observed in leucocyte and plasma ascorbic acid values in tonsillitis (Table 2).

Leucocytes and plasma ascorbic acid levels of the 37 patients with hepatitis were not different from those of the control group, the significant rise in the initial leucocyte ascorbic acid levels during the infection when compared to the concentrations at follow-up investigations in 11 patients need, however, some explanation ($P < 0.01$, Table 2).

During common cold plasma and leucocyte ascorbic acid values did not change significantly. However on the tenth day of the infection the average leucocyte ascorbic acid values of all 10 patients were significantly higher than the first values ($P < 0.05$, Table 2).

Significant positive correlations between leucocyte ascorbic acid concentrations and plasma ascorbic acid levels were obtained only in the recovery period of bronchopneumonia and scarlet fever ($P < 0.001$, $P < 0.05$, 0.70, 0.63 respectively in Table 2).

Discussion

Ascorbic acid has repeatedly recommended as a prophylactic and therapeutic agent for common cold, and a large number of studies of its efficiency in this use have been carried out [10-19].

We found significantly decreased leucocyte ascorbic acid concentrations in 10 cases with common cold ($P < 0.005$, Table 1). This is consistent with the findings of Hume and Wayers [3]. They suggested that this finding was due to excessive utilization of vitamin C in leucocytes and transfer of ascorbic from leucocytes to plasma [20]. Plasma ascorbic acid levels were significantly decreased in the patients suffering from bronchopneumonia scarlet fever, meningitis, mumps and chicken pox when compared with control. Chakraborty et al [2], demonstrated that plasma ascorbic acid levels dropped in meningitis and in pulmonary infections while dehydroascorbic acid levels rose. The method we have applied determined total ascorbic acid (reduced as well as non-reduced ascorbic acid), therefore, we would think that not only reduced ascorbic acid, but dehydroascorbic acid as well might be utilized in these conditions.

It has been shown that ACTH administration decreases plasma ascorbic acid levels [21-24]. Decreased plasma ascorbic acid levels during the above mentioned infections may results from stimulation of adrenal cortex by cyclic AMP which produces increased amount of ACTH.

When assessment in 16 bronchopneumonia cases was done 10 days after the initiation of the therapy and in mumps, chickenpox and measles three weeks after, the plasma ascorbic acid levels were still significantly lower than in controls, except in chickenpox cases. If the determinations were re-

The mean values of leucocyte and plasma ascorbic acid levels and correlation and regresion coefficient between these two variables in each group and after infections

Table 2

The Average Ascorbic Acid Levels													
	During Infection							After Infection					
Groups	Cases n	Leucocyte mg/10^8	SD	Plasma mg/dl	SD	Correlation	Regresion	Leucocyte mg/10^8	SD	Plasma mg/dl	SD	Correlation	Regresion
Control	21	40.90	15.90	0.68	0.25	0.852	10.33						
Bronchopneumonia	16	37.01	14.32	0.40*	0.171	1.157	13.063	31.34	–9.9	0.37*	0.22	0.70	30.98
Scarlet Fever	10	25.97	11.72	0.39**	0.160	0.24	17.56	47.12***	28.85	0.38**	0.21	0.63	77.46
Tonsillitis	13	45.36	19.3	0.67	0.177	0.34	38.67	52.31	21.19	0.73	0.21	0.28	28.36
Meninigitis	10	43.99	19.5	0.43*	0.25	–0.80	–63.04	33.16	15.99	0.52	0.22	–0.46	–32.82
Mumps	12	37.49	20.35	0.49*	0.22	0.62	57.13	42.21	20.49	047	0.25	0.09	0.02
Chicken Pox	17	39.24	16.73	0.49*	0.28	0.060	3.49	42.38	20.86	0.53	0.20	0.39	40.97
Measles	10	48.65	27	0.54	0.27	0.46	44.95	41.44	28.34	0.47	0.24	–0.22	–26.22
Hepatitis	11	71.66****	35.95	0.58	0.29	0.085	10.24	46.19	20.21	0.52	0.20	0.04	40.60
Common Cold	10	33.18	10.50	0.57	0.28	0.871	0.47	48.62***	19.97	0.61	0.21	0.79	0.146

* When compared with control, they were significantly low ($P < 0.05$).
** When compared with control, they were significantly low ($P < 0.05$ and $P < 0.01$).
*** There was a significant difference between leucocyte ascorbic acid valuesduring and after infection ($P < 0.01$).
**** When leucocyte ascorbic acid levels were compared with control, they were significantly high ($P < 0.01$).

peated after a longer period, it might have been demonstrated that plasma vitamin C levels returned to the normal values.

It is concluded that plasma ascorbic acid levels give an indication of the transfer of ascorbic acid between tissues at a specific time and particular circumstances [25]. In this study in all infections plasma ascorbic acid levels were decreased while leucocyte ascorbic acid levels were normal or about normal, except in scarlet fever. This seems to indicate that there is a transfer of ascorbic acid from plasma to the leucocyte ascorbic acid pool within normal limits in these clinical conditions.

In scarlet fever the leucocyte ascorbic acid concentration is also decreased as well as plasma levels. This would suggest that the transfer of vitamin C from plasma to leucocytes would not be enough because of highly increased utilization of ascorbic acid in this infection [26].

It may be concluded that since, at least, plasma ascorbic acid levels are decreased significantly for some time in many infections. Vitamin C supplementation or foods rich in vitamin C would be advisable in these clinical conditions.

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