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VITAMIN C STATUS IN AN ELDERLY POPULATION HOSPITALIZED IN A GERIATRIC REHABILITATION UNIT

C. Chen[1], O. Chermak[2], V. Has[2], H. Belhadj-Tahar[3], N. Sadeg[1]

Abstract: *Background:* Malnutrition and vitamin deficiencies are frequent in the elderly, especially after occurrence of deterioration in their health status. The aim of this study is to determine the vitamin C status as well and it relation with biological markers of inflammatory and nutritional status in patients hospitalized in a geriatric rehabilitation unit of a general hospital. *Methods:* This prospective study covers a population of 36 elderly admitted in the rehabilitation unit during one month. At admission, the blood concentrations of Vitamin C, CRP, Albumin and prealbumin were measured. Statistic studies were performed to assess the vitamin C status in this population and to determine the relation of vitamin C with the biological markers. *Results:* Most patients (94%) have biological criteria for malnutrition (serum albumin concentration <35g/L). Only four patients (11%) have levels of vitamin C over 5mg/L and these patients have also biological criteria for mild malnutrition. The AA levels observed in this study (the mean serum AA concentration in this study was 2.7 mg/L and the median is 1.95 mg/L) were compatible with vitamin C deficiency. Vitamin C deficiency was slightly correlated with biological criteria of inflammatory and malnutrition syndromes; with correlation index R^2 of (vitamin C vs CRP) 0.20; R^2 of (vitamin C vs albumin) = 0.38 and R^2 of (vitamin C vs prealbumin) 0.32. Therefore CRP, albumin and prealbumin are not reliable predictive biological criteria for vitamin C deficiency. These results suggest that a systematic higher intake of vitamin C in the elderly may be particularly interesting after acute health status deterioration. Finally, screening for vitamin C status should be included in the assessment of the general health status of the elderly population.

Key words: Elderly, vitamin C, malnutrition, ascorbic acid, scurvy.

Introduction

Vitamin C (ascorbic acid or AA) is an essential nutriment for humans; therefore it requires a daily intake. In addition, this vitamin is fragile and often hydrolyzed in aerobic conditions and notably during cooking. Furthermore, in elderly there is an important individual variation in bioavailability of the vitamin C. Lack of AA dietary leads to scurvy which is characterized by various symptoms such weakness, perifollicular hemorrhages and bleeding gums and even death in serious cases. The fragile elderly patients have increased needs for AA and are more likely to be deficient in it. In fact, it is shown that some diseases increase the need for vitamin C, especially in diabetes (1), common disease in elderly. Our team has recently proposed an original dosage method of AA in plasma by a chromatographic technique (2). The aim of this work is to perform the status of vitamin C in the elderly admitted in a rehabilitation unit.

Materials and methods

The study covers a population of 36 persons including 28 women and 8 men aged between 73 and 99 years (83.68 ± 7.67). All patients were admitted during month of June 2011 in a geriatric rehabilitation unit of a general hospital. Patients treated with medecines containing salicylates or corticoides are excluded from this study. Patients with fever or in dialysis are also excluded.

To assay plasma vitamin C in our population, we have developed a simple and rapid method UHPLC-UV, a procedure that allows us to process blood samples upon receipt and analysis after precipitation with metaphosphoric acid and analyzed by liquid chromatography coupled with UV detection (2). Briefly, we used a new simple and rapid method for vitamin C determination in plasma by UHPLC with UV detection. Plasma was deproteinized by precipitation in a 10 % metaphosphoric acid solution before analysis by UV-UHPLC. The UHPLC separation involve a BEH C18 Acquity™ column (Waters Lab), 1.7 micron particle size, dimensions of 2.1 x 100 mm. UV detection was acquired

1. Biology Laboratory, CH René Dubos F-95301 Pontoise, France; 2. Geriatric Department, CH René Dubos F-95301 Pontoise, France; 3. French Association for Medical Research Advancement (AFPreMed), 31100 Toulouse, France, http://www.afpremed.org

Corresponding Author: Dr N. Sadeg, Praticien Hospitalier, Laboratoire Biochimie-Toxicologie, Hôpital de Pontoise, 6 av ile-de france 95300 Pontoise, Tel 0130754254 Fax 0130755369, Email : nouredine.sadeg@ch-pontoise.fr

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at a wavelength of 243 nm. The oven temperature of the column was set at 50 ° C.

Serum albumin and serum prealbumin were measured by immunoturbidimetry Modular analyzer (Modular™, Roche Lab). CRP was dosed by turbidimetric method (Modular™, Roche Lab).

Results

The results of AA assays showed that 89% of these patients were vitamin C deficient (vitamin C rate observed was 2.80 ± 2.01 mg/L). Normal rates of vitamin C ranged from 5 to 20 mg/L (2).

Physiological rates of albumin and prealbumin in serum are 35 to 52g/L and 0.2 to 0.4g/L respectively. We classified the AA levels obtained in relation with the nutritional status: low serum albumin concentration (<30g/L, table 1), intermediate rate of serum albumin concentration (range 30 to 35 g/L, table 2) and the normal rate of serum albumin concentration (> 35g/L, table 3).

Table 1
Patients with low serum albumin level (albumin <30g/L)

Patient	Sex	Age	Alb (g/L)	Prealb (g/L)	CRP (mg/L)	Vitamin C (mg/L)
1	M	79 years	21.5	ND	183	1.23
2	W	83 years	24.2	0.19	<3	0.50
3	W	72 years	27.4	0.12	<3	4.52
4	W	85 years	18.4	0.09	114	0.50
5	W	99 years	27.6	0.22	11	1.21
6	M	92 years	29.3	0.25	31	0.58
7	W	71 years	29.6	0.23	<3	0.65
8	W	84 years	24.4	0.15	142	3.12
9	W	71 years	18.7	0.08	61	0.50
10	M	79 years	25.9	0.15	97	1.36
11	W	94 years	25.6	0.15	11	4.73
12	M	89 years	28	0.08	29	0.50
13	W	88 years	18.6	0.07	<3	0.50

ND: not determined

Discussion

Malnutrition is common in geriatric medicine. It is often detected in hospitalized patients.

Vitamin deficiencies are less studied and therefore less tested in geriatric practice.

Recently cases of scurvy are increasingly reported in the literature and it is often forgotten that a deficiency in vitamin C may be at the origin of bleeding and/or spontaneous bruising (3-7). Vitamin C contributes to the stability of collagen in the vessel wall and in the repair process of damaged tissue; it participates in various physiological reactions, such as the synthesis of L-carnitin in collagen, the synthesis of catecholamines, the neutralization of free radicals and facilitates the absorption of non-heme iron (8). It also contributes to the chemotaxis of neutrophils and transformation of lymphocytes, thereby increasing the resistance to infection (9). The maintenance of an acceptable rate of AA depends on the turnover and the oxidative pressure of the environment. During aging, there is an accumulation of damages associated with ROS (reactive oxygen species) which may partly explain the increased need for this vitamin in our population. We developed a model for evaluating the defense to free radical attacks (ROS entities) in an adult population in order to predict the overall health (10).

A group of experts reported that a hypovitaminosis C may be due to an increase in the capture and storage by white blood cells circulating following a trauma or infection (8). In fact, some European studies show that circulating levels of vitamin C and CRP levels were inversely correlated (11-12).

Table 2
Patient with a serum albumin concentration level comprised between 30 and 35g/L

Patient	Sex	Age	Alb (g/L)	Préalb (g/L)	CRP (mg/L)	Vit C (mg/L)
14	W	90 years	31	0.17	6	0.50
15	W	79 years	32.6	0.23	<3	2.67
16	W	78 years	30.8	0.21	56	8.15
17	W	95 years	33.9	0.23	<3	8,67
18	W	87 years	31.6	0.24	38	2.26
19	W	76 years	32.3	0.16	17	0,50
20	W	90 years	31.4	0.27	4	2.77
21	W	85 years	31.1	0.19	4	4.58
22	W	84 years	31.9	0.17	4	1.94
23	M	85 years	30.6	0.21	4	1.95
24	M	62 years	30.6	0.21	41	0.98
25	W	90 years	30.8	0.13	29	0.66
26	W	78 years	33.2	0.18	135	0.50
27	W	88 years	30.2	0.24	17	4.19
28	W	88 years	32.1	0.20	<3	3.60
29	W	88 years	31.9	0.18	35	2.65
30	M	86 years	33.5	0.25	48	2.45
31	W	85 years	32.8	0.25	6	1.04
32	W	79 years	31.9	0.21	<3	2.52
33	W	80 years	32	0.25	12	14.32
34	W	86 years	30.6	0.29	7	5.76

Table 3
Patients with normal levels of serum albumin concentration (albumin >35g/L)

Patient	Sex	Age	Alb (g/L)	Préalb (g/L)	CRP (mg/L)	Vit C (mg/L)
35	M	81 years	36.7	0.21	24	4.59
36	W	77 years	38.1	0.26	9	3.62

The table 4 shows negative correlation between vitamin C rate and inflammatory and malnutrition syndromes.

Table 4
Correlation between Vitamin C and CRP, Albumin, Prealbumin concentrations

	CRP	Albumin	Prealbumin
Vitamin C	R^2= 0.20 (n=36)	R^2= 0.38 (n=36)	R^2= 0.32 (n=35)

In our series, only six of 36 patients (17%) had a CRP <3mg/L. Our results are comparable to a French study of 84 subjects aged over 75 years where the presence of an inflammatory syndrome was significantly associated with deficient circulating vitamin C (13). Daily needs of AA were estimated at 45mg per day, but it is noted that the needs are increasing in some circumstances: inflammation, infection, diabetes (8).

In our study the average vitamin C circulating is 2.7mg/L and the median is 1.95mg/L. In addition, 19 subjects had a rate of AA lower than 2 mg/L, which represents 53% of the studied population. These levels of AA were near the scurvy biological state (2). This result suggests that it may be necessary to consider standards for the elderly and to review the daily needs for routine supplementation, especially after an acute phase of disease. However, dosage over 1g per day leads to digestive and kidney effects with the formation of urinary calcium oxalate calculi, catabolite of the AA (8).

In 677 elderly population (40% aged 70-79 years and 23% aged ≥80 years), Jacob et al (14) showed that nonusers of vitamin C supplement had levels of plasma AA below standard with a significant difference compared to those having a daily supplementation.

In our study only two patients (5.5%) do not respond to biological criteria of malnutrition (albumin <35g/L). Four patients (11%) with circulating levels of vitamin C higher than 5mg/L had a serum albumin between 30g/L and 35 g/L, and prealbumin above 0.20g/L. This implies a mild recent malnutrition or malnutrition with an adapted nutritional program. As for the nine subjects (25%) with circulating AA levels ≤ 0.5mg/L, their serum albumin concentrations varied between 18.4 and 33.2g/L: 3 values below 20 g/L, 3 values over 30 g/L and 3 values between 20 and 30g/L. In all cases prealbumin levels are less than 0.20g/L. Even those who have more than 35g/L of serum albumin concentration are under 5 mg/L of AA levels. Besides, there is absence of correlation between Vitamin C concentration and biological criteria related to inflammatory and malnutrition syndromes; with correlation index R^2 of (vitamin C vs CRP) 0.20, R^2 of (vitamin C vs albumin) 0.38 and R^2 of (vitamin C vs prealbumin) 0.32. Therefore CRP, albumin or prealbumin rates are not reliable predictive biological criteria for vitamin C deficiency detection (with R^2 of each biological criterion above 40%).

Conclusion

Most patients (89%) admitted in geriatric department were vitamin C deficient. The AA levels observed in our study (the average of AA circulating is 2.7 mg/L and the median is 1.95 mg/L) are compatible with scurvy. This underlines the importance of searching for malnutrition and vitamin C deficiency tied to an acute medical episode and the need to consider a systematic supplementation in this population. The supplementation of vitamin C may be particularly interesting after an acute episode. The number of subjects in the cohort is too small and not suitable representative of the general elderly population: this study should be confirmed by other larger studies (eg multicenter studies).

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