Effect of smoking cessation on plasma ascorbic acid concentration

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Numerous studies have shown that cigarette smokers have a lower plasma concentration of ascorbic acid than non-smokers, but only a few have considered the antioxidant status of ex-smokers.[1] We report the first controlled study monitoring the early effect of smoking cessation on the concentration of ascorbic acid in plasma.

Subjects, methods, and results

The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the local ethics committee. Two hundred volunteers were recruited through local advertisement and gave signed informed consent. Eligible subjects of both sexes (aged 35 to 65 years) had smoked at least 15 cigarettes a day for one year and declared motivation to stop. Exclusion criteria were known presence of disease; daily intake of drugs, including hormonal contraceptives; antioxidant supplements within the last month; and pregnancy or breastfeeding.

Subjects (n = 182) were assigned by a computer generated random number list either to stop smoking immediately (quitters group, n = 100) or to continue smoking for four weeks (smokers group, n = 82). After four weeks, those in the smokers group left the study and were offered a smoking cessation programme. During the 26 weeks of the study, subjects in the quitters group visited the clinic seven times. Smoking cessation was aided by nicotine patches releasing 15 mg nicotine daily (16 hours; Nicorette, Pharmacia AB, Helsingborg, Sweden).[2] After 12 weeks, dosage was reduced during a four week period. None of the subjects used nicotine patches after 26 weeks.

After four weeks, the quitters group consisted of 62 subjects and the smokers of 72. The remaining 48 subjects did not succeed in stopping smoking, suffered from acute illness, used intercurrent antioxidant supplements, or withdrew their consent. After 26 weeks, 41 subjects in the quitters group were still not smoking; 28 of these fulfilled the remaining criteria.

At the entry and four week visits, fasting blood samples were collected from both groups. The quitter status of the subjects was confirmed at each visit by measurements of end-expiratory carbon monoxide and plasma cotinine.

Total ascorbic acid was measured using high performance liquid chromatography with coulometric detection as previously described.[3] T tests were used to analyse differences within groups; analysis of covariance with baseline adjustment was used for differences between groups; and intention to treat analysis was used for confirmation.

Four weeks after the start of the study, the plasma concentration of ascorbic acid had increased by an average of 23.3% (P<0.001) in the quitters group and 9.8% (P<0.05) in the smokers group (difference 13.5%, P<0.05). Intention to treat analysis showed similar results for the quitters group (21.2%, P<0.001; n = 90) and the smokers group (10.2%, P<0.05; n = 77) (difference 10%, P = 0.06).

After 26 weeks, the ascorbic acid concentration had increased by 21.2 % (P<0.005) from baseline in the quitters group as compared with baseline. There was no significant difference in ascorbic acid concentration at baseline in successful and unsuccessful quitters.

Table 1—*Results from a controlled smoking cessation study with randomisation to immediate smoking cessation or continued smoking for four weeks. Values are given as mean (SD)*

	Quitters group	Smokers group
Baseline characteristics		
No	100	82
Men/women	59/41	47/35
Age (years)	44.6 (7.8)	44.4 (7.6)
Cigarette consumption (No/day)	22.2 (5.1)	24.2 (6.5)
Cumulative cigarette consumption (pack years)	24.7 (8.6)	26.9 (11.1)
Weight (kg)	75.2 (13.7)	75.2 (12.3)
Body mass index (kg/m^2)	24.7 (3.6)	24.3 (3.1)
After four weeks		
No of subjects	62	72
Ascorbic acid concentration (μmol/l)		
Before smoking cessation	45.4 (20.2)*	44.7 (16.7)
After four weeks	56.0 (24.2)	49.1 (26.2)
Mean change (95% confidence interval)	10.6 (5.8 to 15.4)	4.4 (0.4 to 8.5)
Significance	P< 0.001	P< 0.05
Difference between groups	6.18 (0.1 to 12.3)	
Significance	P< 0.05	
After 26 weeks		
No of subjects	28	
Ascorbic acid concentration (μmol/l)		
Before smoking cessation	51.3 (18.7)	
After 26 weeks	62.2 (18.1)	
Mean change (95% confidence interval)	10.9 (4.3 to 17.5)	
Significance	P< 0.005	

*Intention to treat analysis (subjects whose blood was sampled at four weeks) confirmed the significant difference for the quitters group (P<0.001, n = 90) as well as for the smokers group (P<0.05, n = 77). The difference between the two groups did not reach statistical significance (P=0.06).

Comment

Several studies have shown that smokers have a lower dietary intake of ascorbic acid than non-smokers,[4,5] and a previous cross sectional population study suggested that more than one year without smoking is necessary to attain plasma concentrations similar to those of people who have never smoked.[1] Our results show that there is considerable recovery within four weeks. Such a change in ascorbic acid concentration must originate from a sudden change in demand rather than from a changed dietary intake since an increase of 25% would require supplementation with 200 mg ascorbic acid.[1] These results thus strongly suggest that the low ascorbic acid concentrations in plasma relate to smoking per se.

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