ABSTRACT

TITLE: The Effects of Cessation of Smoking on Blood Lipids:
         Its Significance on Risk Factors for Coronary Artery
         Disease

AUTHOR: Commander Paul F. Quinn, USN

PURPOSE: To investigate the effects of the cessation of
           smoking on blood lipid chemistry

INTENDED READERSHIP: Students, faculty and staff of the
                       National Defense University and
                       professionals in the medical field

BRIEF SUMMARY: Eleven long term heavy smokers participated in
a study to test the effects of the cessation of smoking on
lipoprotein levels in the blood. Blood samples were analyzed
before and after 16/20 weeks of cessation of smoking. A
significant   increase   (10%)   in   high-density   lipoprotein
cholesterol (HDL-C) accompanied by a significant decrease (12%)
in low-density lipoprotein cholesterol (LDL-C) and in the ratio
of total cholesterol to high-density lipoprotein cholesterol
(15.9%) was noted in these subjects. The implications of this
study are that stopping smoking significantly reduces the
chance of coronary heart disease.

AUTHOR'S BIOGRAPHY

Commander Paul F. Quinn, USN is a restricted line oceanographer. He graduated from Holy Cross College in 1972 with a bachelor's degree in biology. His early assignments included: Hydrographic Survey Officer, Oceanographic Unit FOUR, USNS Chauvenet (T AGS 29) and Oceanographic Operations Analyst, Navy Field Operational Intelligence Office, Fort Meade, MD. In 1978 he received a masters degree in meteorology and oceanography from the Naval Postgraduate School, Monterey, California. He then served as Executive Officer, U.S. Naval Oceanography Command Facility, Yokosuka, Japan. From 1982 to 1985 he served as a member of the faculty of the Oceanography Department of the U.S. Naval Academy. From 1985 to 1987 he served as Meteorologist aboard USS AMERICA (CV 66) where he participated in combat operations against Libya. He graduated from the Industrial College of the Armed Forces in 1988.

Commander Quinn is married to the former Carolyn J. Wilde of Summersville, West Virginia. They have two sons, Matthew and Christopher.

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EXECUTIVE SUMMARY

Cholesterol is a known risk factor associated with coronary heart disease. Cigarette smokers have been shown to have higher levels of "bad" cholesterol and lower levels of "good" cholesterol in their blood. The purpose of this study was to compare the concentration of these factors in the blood of smokers before and after stopping smoking for an extended period of time.

Blood samples taken before and after 16-20 weeks of non-smoking were analyzed in 11 participants. Statistically significant increases in "good" cholesterol (10% increase in HDL-C) and decreases in "bad" cholesterol (12% decrease in LDL-C) were noted. This implies that stopping smoking can help decrease the risk of coronary heart disease.

DISCLAIMER - ABSTAINER

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INTRODUCTION

Cigarette smoking is a well established risk factor for coronary heart disease (1-3). It is, in fact, the single most preventable cause of cardiovascular related death in the United States (4). Several means by which smoking increases the risk of cardiovascular disease have been postulated. First, the formation of carboxyhemoglobin in the blood is thought to result in anoxemia in the myocardium, thereby weakening it. Second, smoking is known to increase vasoconstriction, platelet aggregation and adhesion, in effect, increasing the blood's clotting ability. Third, nicotine may chemically induce various cardiac arrhythmias (5). The above mechanisms have been directly related to the occurrence of several cardiovascular conditions including unstable angina, acute myocardial infarction, ventricular fibrillation, transient ischemic attacks and acute thrombotic stroke (6). Additionally, it has been shown that cessation of smoking reverses the risk of the above conditions (7).

Another means that has been suggested is that smoking adversely affects the concentration of lipoproteins in the bloodstream (8). Arterosclerotic lesions throughout the vascular system are more prevalent in smokers than in non-smokers (9). Cigarette smokers have also been shown to have significantly lower levels of high-density lipoprotein cholesterol (HDL-C) and higher low-density lipoprotein cholesterol (LDL-C) levels in their blood than non-smokers (10).

The purpose of this study was to test the reversibility of the above cardiovascular risk factor upon cessation of smoking. The concentrations of blood lipoproteins of smokers were measured prior to and after quitting smoking. The hypothesis was that the concentration of total cholesterol, LDL-C and triglycerides in the former smoker's bloodstreams would decrease while the concentration of high-density lipoprotein cholesterol and the ratio of HDL-C to total cholesterol would increase.

SUBJECTS AND METHODS

The subjects were members of the faculty, staff and student body of the National Defense University. The volunteers, all of whom smoked at least one pack of cigarettes a day for 10 to 30 years (mean 20.1 years), agreed to stop smoking. Of the 27 volunteers who started the test, 11 succeeded in not smoking for the entire test period. Ten of the successful participants were male and one was female. Their ages ranged from 38 to 48 years (mean 41.3).

Approximately 10 ml of blood was drawn from an antecubital vein following 12-14 hours of an overnight fast. Blood was tested before cessation of smoking and after 16 and/or 20 weeks of non-smoking. Total cholesterol (TC) and triglycerides (TG) were measured directly. High-density lipoprotein cholesterol (HDL-C) was measured directly after precipitation of very low-density lipoprotein cholesterol (VLDL-C) and low-density lipoprotein cholesterol (LDL-C) by dextran sulfate (4). Low-density lipoprotein cholesterol level was calculated using the following formula:

$$LDL\text{-}C = TC - (HDL\text{-}C - TG/5) \qquad (11)$$

Subjects diets were monitored and no significant changes in cholesterol or fat intake were noted.

A t-test for matched pairs was run to compare the two samples using the following formula:

$$t(n-1) = \bar{D}/(SD/SQRT(n)) \qquad (12)$$

RESULTS AND DISCUSSION

The results are presented in Table 1. Total cholesterol and triglyceride levels showed no statistically significant change. A significant decrease in LDL-C (12%) and an increase in HDL-C (10%) was achieved by smokers who quit smoking. Furthermore, the total cholesterol to HDL cholesterol ratio showed a significant (15.9%) decrease after cessation of smoking. Although not statistically significant, average total cholesterol decreased by nearly 4%. Triglycerides did not decrease as hypothesized. Conflicting relationships in triglyceride levels between smokers and non-smokers have been cited in other studies (13-15). Modest elevations of plasma triglycerides do not necessarily increase the risk of cardiovascular disease (16). When triglycerides are below 250 mg/dl risk generally does not exceed that of other Americans (17). The slight elevation of triglycerides in this sample population is, therefore, considered to be of little or no significance in determining overall risk of cardiovascular disease.

Table 1. Comparison of Blood Lipoprotein Levels in Smokers Prior to and After Cessation of Smoking

Lipoprotein	Before Smoking Cessation		After Smoking Cessation		t	Prob.
	Mean	SD	Mean	SD		
TC (mg/dl)	193.18	29.14	186.00	36.50	1.11	.146
TG (mg/dl)	81.55	26.51	94.91	32.37	-1.19	.131
HDL-C (mg/dl)	43.64	11.03	48.09	11.23	-3.06	.006 +
LDL-C (mg/dl)	133.09	26.41	119.00	31.43	2.43	.018 *
TC/HDL-C	4.61	1.04	3.96	.83	3.84	.002 +

* Indicates Statistically Significant to P<.05
+ Indicates Statistically Significant to P<.01

The small sample size is of concern. Approximately half of the smokers who enrolled in the study did not succeed in stopping smoking for the entire time period. Their data was excluded.

CONCLUSION

The results are consistent with the established theory that cigarette smoking is associated with an elevation of plasma liproproteins, a known risk factor of coronary heart disease. Furthermore, they demonstrate that this risk factor is reversible upon cessation of smoking. In a relatively short period of time following cessation of smoking, plasma lipoprotein levels showed a significant beneficial change. The implications are simple: stopping smoking can help reduce the risk of coronary heart disease by reducing LDL cholesterol and increasing HDL cholesterol.

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