ORIGINAL ARTICLE

Association Between Rheology and Lipoproteins in Menopausal Women

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Abstract

Lipid profile, haematocrit, fibrinogen, and blood viscosity were studied in 26 healthy volunteers (15 premenopausal, 11 post menopausal). Menopausal women had significantly higher total cholesterol, fibrinogen, hematocrit and blood viscosity levels as compared to premenopausal women. Also, triglyceride, LDL-cholesterol and HDL-cholesterol levels were higher in menopausal women, but the difference was statistically insignificant. Since these parameters are considered to be risk factor for the development of coronary artery disease (CAD), menopausal women are at an increased risk of developing CAD.

Keywords

Cholesterol, fibrinogen, hematocrit, viscosity, menopause

Introduction

Epidemiological studies have shown that certain hemostatic and rheological factors (e.g. fibrinogen, viscosity, hematocrit, vWF, tPA, fibrin D-dimer) are associated with incident cardiovascular events(1,2). Possible causal mechanisms include effects on thrombogenesis and ischaemia(3). However, these factors could also be important in promoting endothelial damage and diffuse intimal thickening that constitute the prolonged, asymptomatic phase of the atherosclerotic process(3). Low levels of HDL cholesterol have been associated with elevations in the viscosity of blood and plasma, however, this observation has been ascribed to concomitant hypertriglyceridemia(3). This study evaluated distribution of blood viscosity, fibrinogen, hematocrit, and plasma lipids in healthy pre- and post-manopusal women.

Materials and Methods

The present study was carried out in 26 healthy volunteers (15 premenopausal and 11 post menopausal women). All volunteers were queried regarding current or pre-existent illness, known metabolic disorders including dyslipidemia and current or recent medications. After overnight fasting venous samples were drawn. Lipids profile was estimated enzymatically. Hematocrit, plasma fibrinogen were also estimated(5,6) and blood viscosity was calculated using Merill formula(7).

Yield Shear Stress = 13.5x10-6 x (fibrinogen concentration in g%)2 x (Hematocrit-6)3

The data was analyzed statistically using student's t – test and regression analysis.

Results: The demographic and biochemical data for all subjects are described in Table I.

Table 1: Rheological parameters and lipoproteins in premenopausal and post menopausal women (mean ± SD)

	Premenopausal (n=15)	Menopausal (n=11)
Age (years)	44.21 ± 1.98	46.62 ± 2.40
BMI (kg/m^2)	20.60 ± 3.75	21.10 ± 2.50
Cholesterol (mmol/L)		
Total	2.78 ± 0.45	4.03 ± 0.26*
LDL	2.24 ± 0.18	2.35 ± 0.10**
HDL	1.22 ± 0.23	1.19 ± 0.12**
Triglycerides (mmol/L)	1.42 ± 0.8	1.63 ± 0.42**
Fibrinogen (g/L)	2.59 ± 0.27	3.09 ± 0.76[a]
Hematocrit (%)	31.82 ± 2.83	36.3 ± 6.2[a]
Blood viscosity (Dynes/cm^2)	0.0199 ± 0.0151	0.0261 ± 0.0752*

p<0.001, **pNS, [a]p<0.01

Monopausal women had significantly higher total cholesterol as compared to premenopausal women ($p<0.001$). Also, fibrinogen and hematocrit levels were higher in menopausal women as compared to postmenopausal women ($p<0.01$). Blood viscosity was significantly higher in menopausal women. Triglyceride, LDL-cholesterol and HDL-cholesterol levels were higher in menopausal women, but they were statistically

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insignificant. Regression analysis was performed with total cholesterol, triglyceride, HDL cholesterol, LDL cholesterol, fibrinogen concentrations as shown in Table II.

Table 2: Regression analysis with cholesterol with rheological variables in menopausal women

	Cholesterol r-value	p-value
Blood viscosity	0.96	0.001
Fibrinogen	0.98	0.001
Hematocrit	0.97	0.001

Discussion

Incidence of ischaemic heart disease mortality is higher in men than in women, reason for which have not been clearly demonstrated. Currently there is no evidence to suggest that menopause perse increases the risk of cardiovascular diseases (CVD)(8). Although few studies have suggested that early menopause may increase the risk of CVD(9). A considerable body of evidence has accumulated which linked blood lipids with accelerated atherogenesis. In the present study, significantly higher levels of serum total cholesterol, LDL cholesterol and triglycerides were observed in menopausal women as compared to premenopausal women.

Plasma fibrinogen an important determinant of blood viscosity is a well-established cardiovascular risk factor(10). Significantly higher levels of fibrinogen were observed in menopausal women as compared to control ($p<0.1$). These findings are consistent with those reported in literature. Fibrinogen may promote atherosclerosis through various mechanisms, including increases in platelet aggregation, fibrin formation and blood viscosity and decreased fibrinolysis(3). Pathological studies have suggested that fibrinogen may be particularly important in early atherosclerotic development(12). The primary determinant of blood viscosity is the hematocrit concentration. In the present study, menopausal women had higher hematocrit values (Table I). Also, hematrocrit correlated positively with total cholesterol levels in menopausal women (Table II). A positive correlation between hematocrit and viscosity levels was observed in menopausal women ($r=0.32$, $p<0.001$).

We could not come across any study in literature correlating the effect of menopausal on hematocrit. Studies have shown that elevated hematocrit might promote atherogenesis by promoting erythrocyte aggregation leading to increased viscosity(3). We observed significantly higher levels of viscosity in menopausal women as compared to premenopausal women. Also, blood viscosity positively correlated with cholesterol levels in menopausal women ($r=0.96$, $p<0.01$). Elevated blood viscosity may promote atherosclerotic development by increasing platelet adhesion to the subendothelium, by increasing protein infiltration into the arterial wall and by altering local shear forces, at sites of atherogenesis(3,13). Menopausal effects on plasma viscosity are not well documented in literature. The MONICA Augsburg Study reported a significant inverse correlation between plasma viscosity and HDL cholesterol(14). This study did not obtain fasting samples or measure triglyceride concentrations, but, the authors attributed this to influence of triglyceride enriched lipoproteins.

Association of changes in hemorheological profile in menopausal women is not clearly understood, however, age, smoking, obesity, menopausal status could be the possible mechanism. Results from the present study provide evidence to suggest that blood viscosity and its major determinants may be important risk factors for the development of early atherosclerosis in menopausal women. Since these parameters are considered to be risk factor for the development of coronary artery disease (CAD) menopausal women are at risk of development of CAD. Viscosity determination may improve identification and risk stratification of patients at high risk for atherosclerotic vascular disease and its complications.

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