Comparison of atherogenic index and lipid profiles in candidates for coronary artery bypass graft surgery versus normal people

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Abstract: Information on incidence and risk factors of cardiovascular disease (CVD) is rare in the Middle East. This study aims to compare Iranian candidates for coronary artery bypass graft (CABG) surgery and healthy controls in terms of lipid profile, atherogenic index of plasma (AIP), and atherosclerosis index (ASTI). The individuals recruited in this study were 135 CVD patients before CABG surgery and 135 healthy subjects matching in age with the cases. Lipid profiles of the two groups were analyzed with a commercial kit. The AIP and ASTI indexes were calculated with related formula. The TC, TG, LDL-C and HDL-c parameters were dramatically changed ($p<0.01$) between study groups. AIP and ASTI indexes were significantly higher in patients than in healthy people ($p=0.001$). In individuals with CVD, it is suggested to measure these indexes in order for effective diagnosis before CABG surgery.

Keywords: Lipid profile, Atherogenic index, Atherosclerosis index, Coronary artery bypass graft surgery.

INTRODUCTION

Cardiovascular disease (CVD) is the most leading cause of death and disability throughout the world (McCullough, 2007; Scarborough *et al*., 2010; Rashid *et al*., 2014). Its incidence is rapidly increasing in developing countries such as Iran (Kazemi *et al*., 2013; Kazemi *et al*., 2015). In spite of sufficient treatment, patients still have a high mortality risk. CVD is a complex disease with various risk factors including dyslipidemia, hypertension, diabetes mellitus, overweight or obesity, and metabolic syndrome (Kazemi *et al*., 2011). Among them, lipid abnormality is the key risk factor for its development (Ibrahim *et al*., 2013; Wei *et al*., 2015). Lipid profile and concentration of lipoproteins of individuals are utilized for diagnosis and treatment of lipid-relevant disorders notably CVD (Daniels *et al*., 2008; Parinita *et al*., 2012). Lipid profile including levels of total cholesterol (TC), triglycerides (TG), high density lipoprotein cholesterol (HDL) and low density lipoprotein cholesterol (LDL) levels in serum. Several studies revealed the ratio of LDL/HDL-C (atherosclerosis index (ASTI)) and log TG/HDL-C (atherogenic index of plasma (AIP)) as strong and new risk indicators in CVD (Dobiás□ová *et al*., 2001). Therefore any undesired alterations in the levels of lipids make individuals more susceptible to extend CVD.

Generally, coronary artery bypass graft (CABG) surgery is needed to improve blood flow to the heart in patients with CVD (Serruys *et al*., 2009). The aim of the present case control study is to compare lipid profile and these indexes between candidate individuals for CABG surgery and normal people.

MATERIALS AND METHODS

Study population

The individuals recruited in this case-control study were 135 with CVD based on medical history (76 men and 59 women, 60.53 mean age years). The CVD patients referred to the cardiac surgery department of Vali-Asr hospital of Birjand, Iran for CABG surgery. The study protocol had been approved by BUMS' ethical committee. After selecting the population and taking their written consent, they entered the study.

There were 135 healthy subjects without any symptoms of CVD (78 men, 57 women, mean age 58.19 years) who served as the control group.

Biochemical analysis

Before CABG surgery, the fasting blood samples were collected into sterile tubes under aseptic conditions. The blood samples were centrifuged at 3000rpm for 5 minutes. The analysis of sera was performed in TC, TG, HDL-C and LDL-C levels using standard commercial kits (Technicon RA-100, USA). AIP and ASTI indexes were defined as the logarithm to the base 10 of the ratio of fasting plasma TG to HDL-C and the ratio of LDL to HDL-C, respectively (Onat *et al*., 2009).

STATISTICAL ANALYSIS

All results are expressed as the mean ± standard deviation (SD) of the indicated number of independent experiments.

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Table 1: Demographic characteristics of CHD patients and healthy cohorts

parameter	CHD patients (n=135)	Controls (n=135)	P value
Age (years old)	60.53±11.49	58.19±9.25	0.14
Gender (male/female, n)	76/59	78/57	0.11
Weight (kg)	70.73±0.25	69.83±1.04	0.25
BMI (kg/m2)	25.87±5.16	25.87±4.85	0.21
Opium addiction (%)	11.32±3.77*	3.58±1.09	0.008
Diabetes mellitus (%)	14.15±4.14*	4.88±1.11	0.008
Dyslipidemia (%)	33.73±5.55*	2.13±0.88	0.005
Hypertension (%)	20.75±5.15*	3.69±1.21	0.004

Data are expressed as mean ± SD (n = 135). *=statistically significant. BMI, body mass index

Table 2: Clinical characteristics of CHD patients and healthy cohorts

Parameter (mg/dl)	CHD patients (n=135)	Controls (n=135)	P value
TC	198.80±12.52*	167.98±8.07	o.oo7
TG	210.29±15.24*	141.10±18.14	0.008
HDL-C	37.85 ± 7.12*	57.88±5.11	0.003
LDL-C	165.89 ±11.89*	103.23±9.44	0.002
AIP	0.74±0.25*	0.38±0.33	0.001
ASTI	4.38±2.50*	1.78±1.87	0.001

Data are expressed as mean ± SD (n = 135). *=statistically significant.

The data were statistically analyzed by one-way ANOVA (SPSS 18, Chicago, IL). Tukey's post hoc test was used to compare the mean value of data between case and control groups, and p values < 0.01 were considered significant.

RESULTS

Demographic characteristics

In the present study, we compared lipid profile and AIP and ASTI indexes between 135 candidates of CABG surgery (case group) and 135 healthy individuals (control group). Demographic and clinical characteristics of these groups are shown in tables 1 and 2. The age means of the case and control participants were 60.53 and 58.19 years, respectively. Of the CDH patients, 11.32%, 14.15%, 33.73% and 20.75% had opium addiction, diabetes mellitus, dyslipidemia and hypertension, respectively. As it is shown in table 1, there was no significant difference in terms of age, gender, weight and BMI. The *p*-value for other parameters between case and control groups were less than 0.01 which is statistically significance ($p<0.01$).

Clinical characteristics

As it is manifested in table 2, lipid profile comparison between the two groups (case and control) indicated the TC, TG, HDL-C and LDL-C parameters had the *P*-values of 0.007, 0.008, 0.003 and 0.002, respectively which are statistically dramatic ($p<0.01$). Also, there is a statistically significant difference for AIP and ASTI indexes between patients and healthy groups ($p=0.001$, table 2).

DISCUSSION

The alternations of the serum levels of lipid profile, i.e., increased total cholesterol, triglyceride and LDL-C as well as decreased HDL-C, are major contributors to CVD (Hadaegh *et al*., 2009; Conkbayir *et al*., 2015). As non-invasive parameters, AIP and ASTI indicators reveal the presence of LDL or TG in CVD serum. More recently, investigators have demonstrated that these parameters can be considered as predictors of CVD (Collaboration *et al*., 2005; Bampi *et al*., 2009). Furthermore, in conditions where other atherogenic risk parameters seem normal, AIP may be the diagnostic alternative choice. In the current study, we compared lipid variables, AIP and ASTI indexes between 135 candidates for CABG surgery and 135 healthy controls.

As it was shown in table 1, all of the parameters including age, weight and BMI were approximately matched in both CVD patients and control groups. Moreover, opium drug consumption, diabetes mellitus, dyslipidemia and hypertension are seen significantly more in patients than in controls. According to previous studies, all of these parameters are important risk factors for CVD (Kazemi *et al*., 2015).

The comparison of lipid profile in table 2 showed that serum levels of TC, TG and LDL-C of CVD patients increased, while their serum level of HDL-C decreased more than the controls ($P<0.01$). In agreement with our study, Nwagha *et al.* (2006) showed massive contribution of TG to cardiovascular risk (Nwagha *et al*., 2006). In fact, high levels of TG have been linked with an increased incidence of CVD (Hokanson *et al*., 1996). Furthermore, the results indicated that AIP and ASTI have a statistically marked difference ($p=0.001$) between patients and healthy people. It reveals their positive association with severity of CVD.

In line with our study, Hadaegh *et al*. (2009) reported that among Iranian men, TG/HDL-C ratio has disclosed a considerable adjusted (multivariable) risk ratio of 1.75 (Hadaegh *et al*., 2009) which is similar to observations of Onat *et al*. (Onat *et al*., 2010). In 2007, Onat *et al*. demonstrated that among women with myocardial ischemia, the TG/HDL-C ratio was monitored to be an independent predictor of cardiovascular incidents and of mortality in multi-adjusted models (Bittner *et al*., 2009).

CONCLUSION

Our results illustrated that lipid profile and AIP and ASTI indexes significantly increased in CHD compared to normal people. Therefore, change in lipid profile as a risk factor of CHD affects these indexes. In conclusion, AIP and ASTI should be used to measure CVD severity prior to CABG surgery since it is a simple, noninvasive, and efficient method of recognizing the extent of coronary atherosclerosis. The present study can help prevent CVD and reduce its subsequent mortality. Modified lifestyle and application of healthy diet is recommended.

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REFERENCES

Bampi ABA, Rochitte CE, Favarato D, Lemos PA, Luz PLd. (2009) Comparison of non-invasive methods for the detection of coronary atherosclerosis. *Clinics,* **64**(7): 675-82.

Bittner V, Johnson BD, Zineh I, Rogers WJ, Vido D, Marroquin OC, *et al*. (2009) The triglyceride/high-density lipoprotein cholesterol ratio predicts all-cause mortality in women with suspected myocardial ischemia: A report from the Women's Ischemia Syndrome Evaluation (WISE). *Am. Heart J.,* **157**(3): 548-555.

Conkbayir C, Burak A and Ökçün EB (2005) Lipid Variables Related to the Extent and Severity of Collaboration APCS. A comparison of lipid variables as predictors of cardiovascular disease in the Asia Pacific region. *Ann epidemiol*., **15**(5): 405-413.

Lipid Variables Related to the Extent and Severity of Coronary Artery Disease in Non-Diabetic Turkish Cypriots. (2015) *Iran J Public Health,* **44**(9): 1196-203.

Dobiásová M and Frohlich J (2001). The plasma parameter log (TG/HDL-C) as an atherogenic index: correlation with lipoprotein particle size and esterification rate inapob-lipoprotein-depleted plasma (FER HDL). *Clin. Biochem.,* **34**(7): 583-588.

Daniels SR and Greer FR (2008) Lipid screening and cardiovascular health in childhood. *Pediatrics*, **122**(1): 198-208.

Hadaegh F, Khalili D, Ghasemi A, Tohidi M, Sheikholeslami F and Azizi F (2009) Triglyceride/ HDL-cholesterol ratio is an independent predictor for coronary heart disease in a population of Iranian men. *Nutr Metab. Cardiovasc. Dis.,* **19**(6): 401-408.

Hokanson JE and Austin MA (1996) Plasma triglyceride level is a risk factor for cardiovascular disease independent of high-density lipoprotein cholesterol level: a metaanalysis of population-based prospective studies. *J Cardiovasc Risk.*, **3**(2): 213-219.

Ibrahim MM, Ibrahim A, Shaheen K and Nour MA (2013). Lipid profile in Egyptian patients with coronary artery disease. *The Egyptian Heart Journal (EHJ)*, **65**(2): 79-85.

Kazemi T, Rezvani MR, Sharifzadeh G-R, Sadri A, Moghaddam M and Reza H *et al*. (2015) The Prevalence of Traditional Cardiovascular Risk Factors in Low Socioeconomic Use individuals in Birjand 2008 (East IRAN). *Cardio-Thor. Med. J.*, **3**(1): 263-269.

Kazemi T, Sharifzadeh G, Javadinia SA and Salehiniya H (2015). Prevalence of Cardiovascular Risk Factors among Nurse Population in the East of Iran, 2011. *Int. J. Travel Med*., **3**(4): 133-136.

Kazemi T, Sharifzadeh G, Zarban A, Fesharakinia A. (2013) Comparison of components of metabolic syndrome in premature myocardial infarction in an Iranian population: a case-control study. *Int. J. Prev. Med.,* **4**(1): 110-114.

Kazemi T, Sharifzadeh GR, Zarban A, Fesharakinia A, Rezvani MR and Moezy SA (2011) Risk factors for premature myocardial infarction: A matched case-control study. *J. Res. Health Sci.,* **11**(2): 77-82.

McCullough PA. (2007) Coronary artery disease. *Clin. J. Am Soc Nephrol*., **2**(3): 611-616.

Nwagha UI and Igwe J (2006) Atherogenic Index of Plasma: A significant indicator for the onset of Atherosclerosis during menopause in hypertensive females of South East Nigeria. *Med. College. J.,* **10**(2): 67-71.

Onat A, Can G, Kaya H and Hergenç G (2010). Atherogenic index of plasma (log 10 triglyceride/high-density lipoprotein−cholesterol) predicts high blood pressure, diabetes, and vascular events. *J. Clin. Lipidol.,* **4**(2): 89-98.

Parinita K (2012). Study of serum lipid profile in individuals residing in and around Nalgonda. *Int. J. Pharm. Bio. Sci.,* **2**(1): 110-116.

Rashid MA, Edwards D, Walter FM and Mant J (2014) Medication taking in coronary artery disease: A systematic review and qualitative synthesis. *Ann. Fam. Med.*, **12**(3): 224-32.

Scarborough P, Bhatnagar P, Wickramasinghe K, Smolina K, Mitchell C and Rayner M (2010) Coronary heart disease statistics 2010 edition. British Heart Foundation., London, UK.

Serruys PW, Morice MC, Kappetein AP, Colombo A, Holmes DR and Mack MJ *et al*. (2009). Percutaneous

coronary intervention versus coronary-artery bypass grafting for severe coronary artery disease. *N. Engl. J. Med.,* **360**(10): 961-972.

Wei Y, Guo H, The E, Che W, Shen J and Hou L *et al*. (2015). Persistent lipid abnormalities in statin-treated coronary artery disease patients with and without diabetes in China. *Int. J. Cardiol.,* **182**: 469-475.