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Original Article

Application of quality intima-media thickness test in assessing carotid vascular function in obese people at high altitudes and risk of coronary heart disease

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Abstract: Objective: Our aim was to investigate application of the quality intima-media thickness (QIMT) technique in evaluating carotid vascular function in obese people who live at high altitudes and correlation between carotid artery intima-media thickness (IMT) and coronary heart disease (CHD). Methods: People living in high altitude areas were enrolled in our study. There were 228 obese people (obese group) and 150 healthy normal people (normal group). Participants from both groups received measurements of IMT using QIMT method and risks of CHD were evaluated using the 10-year risk prediction model for ischemic cardiovascular diseases (ICVD) in Chinese population. Association between IMT and risk of CHD was studied. Results: We found that the value of common carotid artery IMT in obese group (0.67±0.11 mm) was higher than in normal group (0.55±0.07 mm). Compared to people in normal group, those in obese group had higher risk of CHD with greater risk score (all P<0.05). Logistic regression analysis showed that IMT>0.9 mm was an independent risk factor for CHD (P=0.028, after adjustment OR=3.631, 95% CI=1.152-11.441). Conclusion: QIMT method can effectively measure IMT and assist in predicting risk of CHD for obese people living at high altitudes.

Keywords: Quality intima-media thickness test, high altitude, obese people, carotid vascular function, risk of coronary heart disease

Introduction

Obese people, especially those living at high altitudes, are more likely to have chronic diseases such as ischemic heart disease and diabetes [1-3]. Quality intima-media thickness (QIMT) is a new technique that uses radio frequency signals for a dynamic and real-time measurement and imaging of changes of vascular intima-media thickness (IMT) [4-6]. Indices from QIMT, especially those relating to carotid artery, may be associated with risk of coronary heart disease (CHD). However, this association in obese population living at high altitudes has not yet been verified [7-10]. Therefore, we conducted the present study and selected 228 obese people (obese group) and 150 healthy normal people (normal group) living at high altitudes to investigate the application value of QIMT in assessing carotid vascular function in obese people at high altitudes and risk of CHD.

Materials and methods

Participants

People living at high altitudes were selected for the study. There were 228 obese people (obese group, body mass index (BMI): 28-32) and 150 healthy normal people (normal group). The study was approved by the Ethics Committee of Karamay Central Hospital of Xinjiang and informed consent was obtained.

All participants received a carotid ultrasound check and QIMT test. Patients with cerebrovascular disease, heart disease, or diabetes were excluded from the study.

QIMT test

Participants were not allowed to take alcohol the day before QIMT test nor to take alcohol, strong tea, or coffee on the day of the test. The

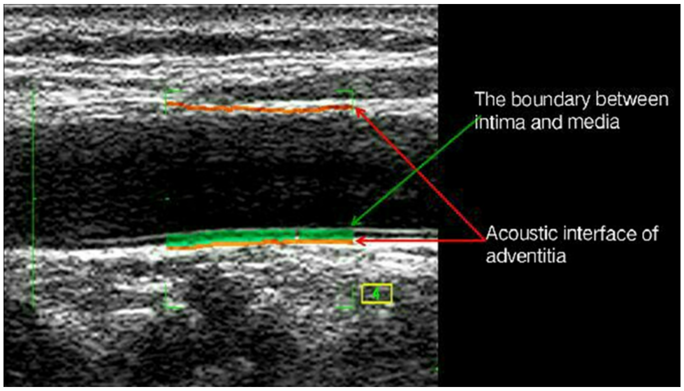

Figure 1. QIMT image. QIMT, quality intima-media thickness.

examination required that participants had an empty stomach or didn't eat or drink anything for at least 2 hours before the procedure. Examinees couldn't wear clothes with turtlenecks and removed necklaces or other accessories before the test. During the test, examinees lied in supine position without pillow in a quiet and relaxed state for over 15 minutes. Diastolic and systolic blood pressure was first measured, to make sure it was stable. Next, information including gender and blood pressure was entered into the ultrasound device. Frequency of the ultrasound probe was set at 7-12 MHz. In the long-axis view of carotid artery, the bifurcation area was first located. The probe was adjusted to make sure ultrasound beam was perpendicular to the anterior and posterior wall of the artery and their intima and media were exposed. Afterward, QIMT function was turned on and the area which was about 1.0 cm away from the common carotid artery (CCA) bifurcation was measured. Frame length was set at 15 mm and probe was placed in the region of interest. QIMT was able to automatically measure IMT of carotid artery in one to six cardiac cycles. QIMT image can be seen in **Figure 1**.

Other indices

Information including CCA-IMT, BMI, high-density lipoprotein cholesterol (HDL-C), and total cholesterol (TC) was collected. During the biochemical test, 3 mL of venous blood sample was taken from each participant who hadn't eaten or drank for at least 2 hours prior. Blood sample was placed in room temperature for 30 minutes with no addition of anticoagulant. After that, it was centrifuged at 3,000 rpm for 15 minutes. Serum was collected and kept at -20°C for later detection. Values of HDL-C and TC were detected using an enzyme test kit.

CHD risk assessment

Using the 10-year risk prediction model for ischemic cardiovascular diseases (ICVD) in Chinese population, a retrospective assessment of ICVD risk in patients before onset was performed. If the value of 10-year risk of ICVD<10%, it was considered that subject had low risk of ICVD. If the value was between 10% and 20%, it was considered medium risk. Subject had high risk if the value was >20% [11].

Main outcome measures

Main outcome measures included difference in IMT value between two groups and whether or not IMT>0.9 mm was an independent risk factor for CHD.

Statistical analysis

SPSS 22.0 was applied for statistical analysis. Count data were expressed as number and percentage (n, %) and comparison between groups was conducted by χ^2 test. Measurement data are presented as mean ± standard deviation and t-test for two independent samples was used for comparison between two groups. Multiple logistic regression analysis was conducted to analyze independent risk factor for CHD. Initial variants included those that were found to have statistical significance in univariate analysis. Forward stepwise regression was applied for variant selection. The alpha-to-enter significance level was 0.05, while alpha-to-remove significance level was 0.10. A value of $P<0.05$ was considered statistically significant.

Results

BMI, HDL-C, and TC in the two groups

There was significant difference in BMI between two groups (P<0.001). However, there was no significant difference in level of HDL-C and TC (both P>0.05). See **Table 1**.

Table 1. Comparison of BMI, HDL-C, and TC in the two groups

Group	Case	BMI (kg/m^2)	HDL-C (mmol/L)	TC (mmol/L)
Obese	228	30.16±2.56	1.29±0.27	1.08±0.56
Normal	150	22.57±2.12	1.32±0.28	0.99±0.52
t		30.140	1.041	1.572
P		<0.001	0.298	0.117

Note: BMI, body mass index; HDL-C, high-density lipoprotein cholesterol; TC, total cholesterol.

Table 2. Comparison of risk of CHD in the two groups

Group	Case	Risk score	Average incidence rate (%)
Obese	228	4.23±4.14	12.70±7.75
Normal	150	2.13±2.93	12.51±6.20
t		5.387	0.252
P		<0.001	0.801

Note: CHD, coronary heart disease.

Table 3. Logistic regression analysis of various clinical factors

Factors	OR	95% CI	P
Smoking	3.031	1.782-5.114	0.000
LDL	2.713	1.042-7.194	0.042
CH	1.982	1.042-3.764	0.041
Carotid artery IMT	3.631	1.152-11.441	0.028
Constant	0.017	-	0.000

Note: LDL, low-density lipoprotein; CH, cholesterol; IMT, intima-media thickness; OR, odds ratio; CI, confidence interval.

Table 4. Comparison of CCA-IMT in the two groups

Group	Case	CCA-IMT (mm)
Obese	228	0.67±0.11
Normal	150	0.55±0.07
t		12.138
P		0.000

Note: CCA, common carotid artery; IMT, intima-media thickness.

Risk assessment of CHD in the two groups

There was significant difference in risk score between the two groups (P<0.05, **Table 2**).

Correlation between IMT and risk of CHD

The value of CCA-IMT in obese group was higher than in normal group (obese group 0.67±0.11 mm, normal group 0.55±0.07 mm, P<0.001). Compared to normal people, obese people had higher risk of CHD and higher risk score (P<0.05). Logistic regression analysis found that IMT>0.9 mm was an independent risk factor for CHD (P=0.028, after adjustment OR=3.631, 95% CI=1.152-11.441). The positive and negative predictive values of carotid artery IMT for CHD were 82.7-89.9% (+PV) and 36.4-55.6% (-PV) respectively. Logistic regression analysis showed that smoking, low-density lipoprotein, cholesterol, and carotid artery IMT were all independent risk factors for CHD. See **Tables 3** and **4**.

Discussion

Due to colder weather at high altitudes, people living there tend to consume more meat and alcohol to stay warm. Large consumption of foods rich in fat can cause disorder of lipid metabolism and obesity, increasing the incidence rate of atherosclerosis [12, 13].

In the present study, we assessed the 10-year risk of CHD in both obese and normal groups. We found that CHD risk score in obese group was higher than in normal group. This finding was consistent with previous studies [14, 15]. Therefore, in order to control incidence rate of CHD in obese people living at high altitudes with low oxygen levels, preventative interventions should be given to these people during early stages so that their quality of life can be improved [16-18]. In the present study, there was no difference in average incidence rate of CHD between the two groups. The reason behind this requires further investigation as the sample size in our study was relatively small [19].

IMT in obese people didn't reach the thickening level in our present study. The normal value of carotid artery IMT is no more than 0.9 mm; if 0.9<IMT≤1.2 mm, there is intima-media thickening; 1.2<IMT≤1.4 mm can suggest formation of plaque, while IMT>1.4 mm can suggest narrowing of carotid artery. In the present study, the value of CCA-IMT in obese group (0.67±0.11 mm) was higher than in normal group (0.55±0.07 mm). Novikova et al. reported that level of IMT between obese and non-obese people was significantly different and was related to risk of atherosclerosis and CHD [20]. This finding is consistent with results of our present study.

There are, however, some limitations to the present study. Due to small sample size, the accuracy of our study results may have been affected to some extent. Also, since cases selected for the study were all related to people living at high altitudes, our results cannot be applied for all populations.

In conclusion, QIMT test can effectively measure IMT and help predict risk of CHD. It can be used as a reliable method for early detection of arteriosclerosis.

Disclosure of conflict of interest

None.

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