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ORIGINAL RESEARCH

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Analysis on risk factors and characteristics of coronary angiography in young men with CHD

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Abstract

To examine the risk factors associated with coronary heart disease (CHD) in young males and assess the distinctive features of coronary angiography (CAG). The clinical data of 266 young men who underwent CAG were collected and categorized into CHD group and control group based on the results of CAG. Binary logistic regression was used to analyze the risk factors for CHD in young men. Additionally, we selected 112 middle-aged and elderly men with CHD to form the middle-aged and elderly case group. We then compared the CAG characteristics and short-term prognosis with those of the CHD group. The CAG examination revealed a CHD detection rate of 42.11% (112/266) in young men, with 154 patients (57.89%) exhibiting no significant stenosis. Notably, the CHD group had higher rates of family history, hypertension and an elevated triglyceride glucose product (TyG) index ($p < 0.05$), along with a shorter duration of sleep compared to the control group ($p < 0.05$). Binary logistic regression analysis confirmed family history of CHD, hypertension, TyG index $\geq$8.83, and insufficient sleep duration as risk factors for CHD in young men. Additionally, the CHD group had a higher proportion of single-vessel coronary artery disease compared to the middle-aged and elderly case group ($p < 0.05$). Conversely, the middle-aged and elderly case group had a higher proportion of multi-vessel coronary artery disease, left circumflex artery involvement, and right coronary artery involvement ($p < 0.05$). The CHD group exhibited a lower overall incidence of major adverse cardiovascular events compared to the middle-aged and elderly case group ($p < 0.05$). The incidence of CHD in young men is closely associated with a family history of CHD and hypertension. High TyG index and insufficient sleep duration may also increase the risk of CHD.

Keywords

CHD; Youth; Male; Risk factors; Imaging characteristics; CAG

1. Introduction

Epidemiological survey data indicates that the incidence of acute cardiovascular disease among individuals under the age of 45 has shown a declining trend, while the occurrence of acute cardiovascular disease in the young population below 45 years of age is on the rise [1]. With the prevalence of unhealthy lifestyles, there is a noticeable trend towards younger individuals being affected by coronary heart disease (CHD). The World Health Organization distinguishes CHD in young adults aged $\leq$45 years as "young CHD" as they exhibit distinct risk factors and characteristics of coronary artery lesions compared to the middle-aged and elderly population who are currently under study [2]. Some studies have pointed out [3] that young CHD is more common in men and that there are gender differences in the associated risk factors. For instance, compared with young women with CHD, young men with CHD have more severe lipid metabolism disorders. In light of these findings, this study collected clinical data from young men who underwent coronary angiography (CAG) examinations at our hospital to assess their risk factors and analyze their coronary lesion characteristics in comparison to CHD in middle-aged and elderly men, which could help providing valuable reference data for the prevention and treatment of CHD in young men.

2. Materials and methods

2.1 General data

The clinical data of 266 young men who underwent CAG examination in our hospital from January 2021 to December 2022 were collected. Inclusion criteria for this study were individuals aged 18 to 45 years, of male gender, possessed clear consciousness upon admission, and had undergone elective CAG examinations. Furthermore, participants needed to have complete data regarding imaging examinations, laboratory assessments, past medical history and other relevant information. Exclusion criteria comprised individuals with a prior diagnosis of CHD, a history of cardiac surgery or interventional therapy,

recent use of lipid-lowering drugs such as statins within one week preceding the CAG examination, concurrent acute and chronic infections or malignant tumors. Additionally, patients with combined congenital heart disease, rheumatic heart disease, or other cardiac conditions, as well as those with severe cerebrovascular diseases, were not considered for inclusion. To establish a middle-aged and elderly case group, we included an additional 112 male patients diagnosed with CHD through CAG, who were aged 46 to 80 years.

2.2 Method

2.2.1 Data collection methods

Data from 266 young male subjects, including their age, medical history, family history and various laboratory parameters such as fasting triglyceride (TG), total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C), lipoprotein a (Lp-a), blood glucose, blood uric acid, serum creatinine, alanine aminotransferase (ALT), and aspartate aminotransferase (AST) were collected. To calculate the Triglyceride Glucose Product (TyG) index, we used the formula: TyG index = In [TG (mg/dL) × blood glucose (mg/dL)]/2. For unit conversion, 1 mmol/L of TG is equivalent to 88.545 mg/dL, and 1 mmol/L of blood glucose is equivalent to 18.020 mg/dL. Presently, there is no established normal reference value for the TyG index, and in this study, we referred to existing literature [4], which defines a TyG index of ≥8.83 in males as a higher level. Furthermore, we collected fasting peripheral cubital venous blood samples (3–4 mL) from the subjects in the morning. Serum samples were obtained by centrifuging the collected samples at a centrifugation radius of 8 cm and a rotation speed of 3500 r/min for 10 minutes, which were then analyzed using an automatic biochemical analyzer (OLYMPUS, Japan, model: AU2700). Additionally, we assessed the daily sleep duration of the subjects, classifying sleep times of ≥6 hours as adequate sleep and <6 hours as insufficient sleep.

2.2.2 CAG examination method

The Siemens Artis zeego and Artis zeego III angiography systems were used to puncture the right radial artery using the Judkins method, and the contrast agent used was iohexol injection (HJ20160023, 350 mg I/mL, GE Healthcare, Ireland). In left coronary angiography, 6 to 8 mL of contrast agent was injected per position, while in right coronary artery angiography, 4 to 6 mL was injected per position, with an injection rate of 2 to 4 mL/s. CHD diagnosis was based on the presence of at least one stenosis ≥50% in the main coronary vessels, including the left main artery, left anterior descending artery, left circumflex artery, and right coronary artery [5]. Subsequently, the 266 young male subjects were divided into either the CHD group or the control group based on these criteria.

2.2.3 Short-term prognosis evaluation methods

All patients diagnosed with CHD received standard treatment, including aspirin, clopidogrel for antiplatelet therapy and statin medication for lipid regulation, with additional nitrate coronary dilation treatment as needed, based on their medical conditions. Selective administration of tirofiban was determined based on the extent of coronary thrombus burden, and occurrences of in-hospital death and major adverse cardiovascular events were recorded during the patients' hospitalization period.

2.3 Statistical methods

Data analysis was conducted using the SPSS 24.0 software (BMI Corporation, Chicago, IL, USA). Measurement data following a normal distribution are expressed as $\bar{x} \pm s$, and the t-test was used for analysis. Enumeration data are presented as n (%) and analyzed using the χ^2 test or Fisher exact probability test. Risk factors were assessed using binary logistic regression analysis, with statistical significance set at $p < 0.05$.

3. Results

3.1 Results of CAG examination in 266 young males

The CAG examination revealed a CHD detection rate of 42.11% (112/266) in the analyzed study cohort, with 154 patients (57.89%) showing no significant stenosis.

3.2 Comparison of the general data of young men between the CHD group and the non-CHD group

We observed no significant differences in age, body mass index and other collected data between both groups ($p > 0.05$). However, the CHD group exhibited a higher proportion of family history, hypertension and TyG index compared to the non-CHD group ($p < 0.05$), while their sleep duration was shorter than that of the non-CHD group ($p < 0.05$), as indicated in Table 1.

3.3 Analysis of risk factors of CHD in young men

We used confirmed CHD as the dependent variable and incorporated the statistically significant indicators mentioned above as independent variables in the binary logistic regression equation, with the assigned values outlined in Table 2. The results, presented in Table 3, indicate that family history of CHD, hypertension, a TyG index ≥8.83, and insufficient sleep duration were significant risk factors for CHD in young men (each $p < 0.05$).

3.4 Analysis of CAG characteristics of CHD in young men and middle-aged and elderly men

In the CHD group, the proportion of single-vessel coronary artery disease was greater than that observed in the middle-aged and elderly case group ($p < 0.05$), while the proportions of multi-vessel coronary artery disease, left circumflex artery involvement, and right coronary artery involvement were all lower than those found in the middle-aged and elderly case group ($p < 0.05$) (Table 4).

TABLE 1. Comparison of the general data of young men between both groups (($\bar{x} \pm s$), n (%)).

Item	CHD group (n = 112)	non-CHD group (n = 154)	t/χ^2	p
Age (yr)	38.95 ± 3.03	39.18 ± 2.81	0.652	0.515
Body mass index (kg/m^2)	24.18 ± 1.82	24.13 ± 2.08	0.229	0.819
Family history of CHD	19 (16.96)	11 (7.14)	6.251	0.012
Smoking history	52 (46.43)	70 (45.45)	0.025	0.875
Alcohol history	31 (27.68)	38 (24.68)	0.304	0.581
Hypertension	61 (54.46)	64 (41.56)	4.336	0.037
Diabetes	26 (23.21)	28 (18.18)	1.015	0.314
TG (mmol/L)	1.68 ± 0.29	1.61 ± 0.29	1.869	0.063
TC (mmol/L)	4.10 ± 0.68	4.20 ± 0.71	1.143	0.254
LDL-C (mmol/L)	2.43 ± 0.35	2.42 ± 0.41	0.314	0.754
HDL-C (mmol/L)	0.96 ± 0.19	0.97 ± 0.20	0.326	0.745
Lp-a (mg/L)	246.58 ± 37.01	239.36 ± 42.60	1.441	0.151
Blood glucose (mmol/L)	5.74 ± 0.92	5.64 ± 0.89	0.914	0.362
TyG Index				
≥8.83	76 (67.86)	84 (54.55)	4.794	0.029
<8.83	36 (32.14)	70 (45.45)		
Blood uric acid (μmol/L)	315.89 ± 44.19	306.05 ± 50.10	1.659	0.098
Serum creatinine (μmol/L)	65.08 ± 8.94	64.78 ± 9.74	0.254	0.800
ALT (U/L)	34.47 ± 5.60	33.21 ± 5.19	1.901	0.058
AST (U/L)	30.55 ± 4.62	30.25 ± 4.85	0.494	0.622
Sleep duration				
Insufficient	39 (34.82)	33 (21.43)	5.892	0.015
Sufficient	73 (65.18)	121 (78.57)		

CHD: coronary heart disease; TG: triglyceride; TC: total cholesterol; LDL-C: low-density lipoprotein cholesterol; HDL-C: high-density lipoprotein cholesterol; Lp-a: lipoprotein a; TyG: triglyceride glucose product; ALT: alanine aminotransferase; AST: aspartate aminotransferase.

TABLE 2. Independent variable assignment.

Independent variable	Assignment value
Family history of coronary heart disease	No = 0, Yes = 1
Hypertension	No = 0, Yes = 1
TyG index ≥8.83	<8.83 = 0, ≥8.83 = 1
Insufficient sleep duration	Sufficient = 0, Insufficient = 1

TyG: triglyceride glucose product.

TABLE 3. Analysis of risk factors of CHD in young men.

Variables	β	SE	Wald χ^2	OR	95% CI	p
Family history of coronary heart disease	0.922	0.297	9.637	2.514	1.326–4.768	0.002
Hypertension	0.893	0.291	9.417	2.442	1.274–4.683	0.002
TyG index ≥8.83	1.122	0.327	11.773	3.071	1.756–5.372	0.001
Insufficient sleep duration	1.327	0.367	13.074	3.770	2.245–6.330	<0.001

TyG: triglyceride glucose product; SE: Standard Error; OR: Odds Ratio; CI: confidence interval.

TABLE 4. Comparison of CAG characteristics between CHD group and middle-aged and elderly case group, n (%).

CAG characteristics	CHD group (n = 112)	Middle-aged and elderly control group (n = 112)	χ^2	p
Number of coronary lesions				
Single vessel	44 (39.29)	21 (18.75)	11.466	0.001
Double vessel	29 (25.89)	23 (20.54)	0.902	0.342
Multivessel	39 (34.82)	68 (60.71)	15.048	<0.001
Involved coronary artery				
Left main	15 (13.39)	10 (8.93)	1.126	0.289
Left anterior descending branch	98 (87.50)	105 (93.75)	2.575	0.109
Left circumflex branch	62 (55.36)	89 (79.46)	14.814	<0.001
Right coronary artery	42 (37.50)	70 (62.50)	14.000	<0.001

CAG: coronary angiography; CHD: coronary heart disease.

TABLE 5. Comparison of short-term prognosis between CHD group and middle-aged and elderly group, n (%).

Short-term prognosis	CHD group (n = 112)	Middle-aged and elderly group (n = 112)	χ^2	p
In-hospital death	0 (0.00)	1 (0.89)	-	1.000*
Atrial fibrillation	2 (1.79)	8 (7.14)	3.768	0.052
3rd degree AV block	0 (0.00)	3 (2.68)	-	0.247*
Ventricular arrhythmia	5 (4.46)	8 (7.14)	0.735	0.391
Cardiac failure	11 (9.82)	20 (17.86)	3.033	0.082
Cardiogenic shock	0 (0.00)	1 (0.89)	-	1.000*
Total major adverse cardiovascular events	18 (16.07)	40 (35.71)	11.261	0.001

Note: "" refers to Fisher's exact test. CHD: coronary heart disease, coronary heart disease; AV: atrioventricular.*

3.5 Comparison of short-term prognosis of CHD between young men and middle-aged and elderly men

Herein, our results show that the overall incidence of major adverse cardiovascular events in the CHD group was lower than that in the middle-aged and elderly case group ($p < 0.05$), as indicated in Table 5.

4. Discussion

Currently, the recognized traditional clinical risk factors for CHD include diabetes, obesity and dyslipidemia, among others, which have been predominantly derived from clinical trials involving a large population of elderly CHD patients [6]. However, recent research on age stratification revealed that these traditional risk factors may be more relevant to elderly CHD cases. Notably, the incidence of diabetes and dyslipidemia among young individuals is low and does not independently contribute to the risk of CHD in young adults [7]. Furthermore, due to disparities in lifestyle habits, such as smoking and consumption of high-fat, high-calorie diets, which are more prevalent among men than women, certain studies have indicated that the risk factors for CHD vary between genders [8]. Smoking and other unhealthy lifestyle choices are identified as risk factors for CHD incidence in men, while they do not hold the same status as risk factors for CHD in women. A previous study reported [9] that smoking plays a crucial role as a risk factor for unfavorable revascularization outcomes in young atherosclerotic patients below 40 years of age. However, in our study, we focused on young men as the subjects of investigation, and our results demonstrated that there was no significant difference in the proportion of smoking history between the CHD group and the control group, indicating that smoking does not appear as a risk factor for CHD in young men in this particular region, contrary to findings from other reports, possibly due to the relatively low prevalence of smoking among young men in this area [10]. On the other hand, the limited sample size in our study may have contributed to potential biases in the outcomes. Conversely, hypertension, a traditional risk factor for cardiovascular disease, not only exhibits a consistent annual increase in China but also displays a trend toward affecting younger individuals, with the fastest rise in incidence observed in the age group of 18 to 45 years [11]. The study results emphasize hypertension as a significant risk factor for the onset of CHD in young men, suggesting that hypertension may contribute to atherosclerosis development, leading to an earlier onset and increased CHD risk in this population. Furthermore, the

study highlights the role of genetic factors in CHD incidence, with a family history of CHD emerging as a risk factor for CHD in young men, indicating a genetic predisposition to earlier CHD onset and increased susceptibility among young adults. Also, it is worth noting that having first-degree relatives with CHD can increase the risk of CHD by 2 to 10 times [12]. In this study, a family history of CHD emerged as a risk factor for CHD in young men, indicating that genetic factors associated with CHD may lead to its earlier onset and increased risk among young adults. Additionally, we found that diabetes and lipid metabolism indicators were not associated with increased CHD risk in young men, while a TyG index $\geq$8.83 was identified as a significant risk factor, which may be due to the lower prevalence of diabetes and abnormal lipid metabolism in young men. The TyG index, which comprehensively assesses metabolic disorders through a formula involving TG and blood glucose, could thus be a promising novel indicator for evaluating insulin resistance [13]. Insulin resistance can directly lead to myocardial and microvascular damage, ultimately causing CHD. Hence, an elevated TyG index is a risk factor for CHD in young men. Prior research has also indicated that an increased TyG index is closely associated with a higher incidence of atherosclerosis, further supporting its role as a risk factor for CHD [14]. Other studies have highlighted [15, 16] that sleep deprivation can activate the hypothalamic-pituitary-adrenal axis and the renin-angiotensin system, resulting in hormonal changes and sympathetic activation within the body, which can promote the formation of atherosclerotic plaques. Long-term sleep deprivation can lead to excessive bodily stress, potentially causing arrhythmias and elevating the risk of cardiovascular disease. In this study, insufficient sleep duration also emerged as a risk factor for CHD in young men. Notably, there was a significant prevalence of inadequate sleep, with rates of 34.82% and 21.43%, respectively. This high prevalence may be attributed to the long working hours and elevated work-related stress experienced by young men, leading to more frequent instances of short-term sleep. Consequently, insufficient sleep may contribute to the early onset of CHD. While previous interventions for individuals at high CHD risk have primarily focused on dietary and smoking cessation, this study underscores the importance of incorporating sleep education. High-risk groups should be educated about the critical role of ensuring adequate sleep duration and enhancing sleep quality.

In this study, we conducted a comparative analysis of coronary artery disease characteristics between young men with CHD and middle-aged to elderly men with CHD. Our findings indicated that young men had a lower proportion of multi-vessel coronary artery disease, left circumflex artery involvement, and right coronary artery involvement compared to their middle-aged and elderly counterparts, suggesting that coronary artery disease in young men typically affects fewer vessels. It is postulated that as age increases, risk factors like hypertension and the TyG index exert a more significant impact on coronary arteries, leading to a higher incidence of coronary lesions [17]. Additionally, we observed that the overall incidence of major adverse cardiovascular events in the CHD group was lower than that in the middle-aged and elderly case group, implying that the prognosis for young male CHD patients was more favorable than that for middle-aged and elderly male patients. We hypothesize that this difference in prognosis could be associated with the fact that young male patients had fewer underlying health conditions and a relatively lower number of coronary artery lesions and timely treatment could yield better outcomes in this demographic.

Nevertheless, it's important to acknowledge the limitations of this study. This research is based on a single-center approach with a relatively small sample size, which may not fully represent the broader population. As a result, these limitations could potentially influence the study's outcomes. Therefore, to validate the conclusions drawn in this paper, it is advisable to conduct larger-scale, multicenter studies in the future.

5. Conclusions

In summary, this study reveals differences between young men with CHD and their middle-aged and elderly counterparts, with young CHD patients tending to have fewer coronary artery involvements, a better prognosis, and often associated with high-risk factors for CHD incidence, such as a family history of CHD, hypertension, an elevated TyG index and inadequate sleep duration. Thus, detecting these risk factors early and implementing timely interventions could be important steps in reducing CHD incidence among young men.

AVAILABILITY OF DATA AND MATERIALS

The authors declare that all data supporting the findings of this study are available within the paper and any raw data can be obtained from the corresponding author upon request.

AUTHOR CONTRIBUTIONS

XHH, BC and YCD—designed the study and carried them out; supervised the data collection, analyzed the data, interpreted the data; prepared the manuscript for publication and reviewed the draft of the manuscript. All authors have read and approved the manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethical approval was obtained from the Ethics Committee of Jiashan County First People's Hospital. Written informed consent was obtained from a legally authorized representative for anonymized patient information to be published in this article.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

[1] Żyłkowski J, Rosiak G, Rowiński O, Spińczyk D. Age- and gender-dependent variability in the geometry of middle cerebral artery bifurcations. Journal of Anatomy. 2021; 238: 765–784.

[2] Zhao Y, Lai R, Zhang Y, Shi D. The prognostic value of reticulated platelets in patients with coronary artery disease: a systematic review and meta-analysis. Frontiers in Cardiovascular Medicine. 2020; 7: 578041.

[3] Minssen L, Dao TH, Quang AV, Martin L, Andureau E, Luciani A, *et al.* Breast arterial calcifications on mammography: a new marker of cardiovascular risk in asymptomatic middle age women? European Radiology. 2022; 32: 4889–4897.

[4] Zhu B, Wang J, Chen K, Yan W, Wang A, Wang W, *et al*. A high triglyceride glucose index is more closely associated with hypertension than lipid or glycemic parameters in elderly individuals: a cross-sectional survey from the reaction study. Cardiovascular Diabetology. 2020; 19: 112.

[5] Lawton JS, Tamis-Holland JE, Bangalore S, Bates ER, Beckie TM, Bischoff JM, *et al.* 2021 ACC/AHA/SCAI guideline for coronary artery revascularization: executive summary: a report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. Journal of the American College of Cardiology. 2022; 79: 197–215.

[6] Wang Y, Zhang JF, Chen SZ, Lyu QB, Lyu X, Zhang WB. ACC/AHA risk score for predicting the presence and severity of coronary artery disease in a Chinese population: a cross-sectional study. Chinese Medical Journal. 2020; 133: 2753–2755.

[7] Zhang Y, Pletcher MJ, Vittinghoff E, Clemons AM, Jacobs DR, Allen NB, *et al*. Association between cumulative low-density lipoprotein cholesterol exposure during young adulthood and middle age and risk of cardiovascular events. JAMA Cardiology. 2021; 6: 1406–1413.

[8] Zwakenberg SR, de Jong PA, Hendriks EJ, Westerink J, Spiering W, de Borst GJ, *et al.* Intimal and medial calcification in relation to cardiovascular risk factors. PLOS ONE. 2020; 15: e0235228.

[9] Mukherjee D, Hsu A, Moliterno DJ, Lincoff AM, Goormastic M, Topol EJ. Risk factors for premature coronary artery disease and determinants of adverse outcomes after revascularization in patients < or =40 years old. The American Journal of Cardiology. 2003; 92: 1465–1467.

[10] Wang X, Dong J, Cui R, Muraki I, Shirai K, Yamagishi K, *et al*. Smoking cessation, weight gain and risk of cardiovascular disease. Heart. 2022; 108: 375–381.

[11] Zhang H, Yang L, Qiao Z, Guo W. Effect of gestational hypertension on fetal growth restriction, endocrine and cardiovascular disorders. Asian Journal of Surgery. 2022; 45: 1048–1049.

[12] Zhang X, He S, Xu Z, Liu Y, Feng C, Tang S, *et al*. The prevalence of coronary atherosclerosis in patients with refractory gastroesophageal reflux disease ready for antireflux surgery. Medicine. 2022; 101: e31430.

[13] Zhao Q, Cheng Y, Xu Y, Zhao Z, Liu C, Sun T, *et al*. Comparison of various insulin resistance surrogates on prognostic prediction and stratification following percutaneous coronary intervention in patients with and without type 2 diabetes mellitus. Cardiovascular Diabetology. 2021; 20: 190.

[14] Alizargar J, Bai CH. Comparison of carotid ultrasound indices and the triglyceride glucose index in hypertensive and normotensive community-dwelling individuals: a case control study for evaluating atherosclerosis. Medicina. 2018; 54: 71.

[15] Zota IM, Roca M, Leon MM, Cozma CD, Anghel L, Statescu C, *et al.* Long-term adherence in overweight patients with obstructive sleep apnea and hypertension-a pilot prospective cohort study. Diagnostics. 2023; 13: 1447.

[16] Zuraikat FM, St-Onge M, Makarem N, Boege HL, Xi H, Aggarwal B. Evening chronotype is associated with poorer habitual diet in us women, with dietary energy density mediating a relation of chronotype with cardiovascular health. The Journal of Nutrition. 2021; 151: 1150–1158.

[17] Zheng Y, Joyce BT, Hwang S, Ma J, Liu L, Allen NB, *et al*. Association of cardiovascular health through young adulthood with genome-wide DNA methylation patterns in midlife: the CARDIA study. Circulation. 2022; 146: 94–109.

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