Diagnostic Value of Echocardiography Combined with Residual Cholesterol for Asymptomatic Myocardial Ischaemia in Coronary Artery Disease

Feng Chun Lin, Xiao Fei He and Qing Qing Li

Department of Ultrasound Diagnosis, Hefei BOE Hospital, Anhui, China

ABSTRACT

This study aimed to investigate the diagnostic value of combined echocardiography and residual cholesterol in asymptomatic myocardial ischaemia. One hundred and fifty-seven patients were seen at Hefei BOE Hospital from 2019 to 2022. The patients were divided into two groups, the observation group (n=90, confirmed asymptomatic myocardial ischaemia) and the control group (n=67, negative diagnosis), based on coronary angiography. The observation group had significantly higher residual cholesterol levels (p=0.001). A combined approach of echocardiography and serum residual cholesterol values showed statistically higher accuracy (p<0.05), with ROC curve analysis supporting the superiority of this method [AUC 0.788 (0.711-0.865), Yoden index 0.576]. It also demonstrated higher sensitivity (88.9%) and specificity (68.7%). The study concluded that combined echocardiography and serum residual cholesterol testing offer superior diagnostic efficacy and practicality for asymptomatic myocardial ischaemia, recommending it for the clinical use.

Key Words: *Echocardiography, Residual cholesterol, Asymptomatic myocardial ischaemia, Diagnosis.*

How to cite this article: Lin FC, He XF, Li QQ. Diagnostic Value of Echocardiography Combined with Residual Cholesterol for Asymptomatic Myocardial Ischaemia in Coronary Artery Disease. *J Coll Physicians Surg Pak* 2024; **34(01)**:115-117.

Cardiovascular disease affects approximately 330 million individuals in China, with a significant 11.39 million subset suffering from coronary heart disease.[1] Coronary artery disease, characterised by atherosclerotic plaques, can lead to myocardial tissue ischaemia, hypoxia, or necrosis. Despite advances in diagnosing and treating coronary heart diseases, rates of subsequent myocardial infarction, stroke, and peripheral arterial disease remain high. Modifiable cardiovascular disease risk factors, including smoking, hypertension, dyslipidaemia, diabetes, and obesity, can be managed to reduce mortality, but the residual risk remains.[2] In recent years, higher residual cholesterol has been identified as an independent risk factor for atherosclerotic heart disease, irrespective of LDL levels.[3] This study aimed to evaluate the diagnostic value of combining echocardiography and residual cholesterol measures for early detection of asymptomatic myocardial ischaemia in patients with coronary artery disease.

Asymptomatic myocardial ischaemia, characterised by lack of symptoms such as chest pain but evident in ECG changes like ST-segment shifts or T-wave inversion, is a concern for clinicians.

Correspondence to: Dr. Xiao Fei He, Department of Ultrasound Diagnosis, Hefei BOE Hospital, Anhui, China
E-mail: hexf13815@126.com

Received: December 13, 2022; Revised: June 23, 2023; Accepted: July 31, 2023
DOI: https://doi.org/10.29271/jcpsp.2024.01.115

This study assessed 157 patients (100 males, 57 females, average age 59.64 ± 7.19 years) suspected of this condition at Hefei BOE Hospital. Coronary angiography confirmed 90 cases forming the observation group, with the remaining 67 as controls.

Morning fasting venous blood was collected and analysed for biochemical parameters, including triglycerides, total cholesterol, HDL-C, and LDL-C levels. Residual cholesterol referred to the amount of cholesterol within the body that is aside from LDL-C and HDL-C. This encompasses elements such as triglycerides and intermediate-density lipoprotein cholesterol (IDL-C). Echocardiography was performed to assess heart structure and function, specifically focusing on abnormal ventricular wall motion. A residual cholesterol threshold of >0.51 mmol/L and presence of abnormal wall motion served as the two diagnostic criteria.[4,5] In a combined diagnosis, a positive diagnosis was made if either of the two tests produced a positive result indicating the presence of myocardial ischaemia.

The comparison of the general conditions of the two groups showed that there were no statistical differences in age, gender composition, history of hypertension, history of smoking, history of diabetes, BMI level, TC, LDL-C, and HDL-C levels; the TG levels in the observation group were higher than those in the control group, and the differences were statistically significant (p<0.05). Comparison of residual cholesterol levels in the observation group and control group showed that the observation group had significantly higher levels (1.12 ± 0.91 mmol/L *vs.* 0.66±0.36 mmol/L), a difference that was statistically significant (t=3.895, p=0.001).

Table I: Positive predictive value and accuracy of three testing methods for asymptomatic myocardial ischaemia, n (%).

Testing Method		Gold Standard		Positive Predictive Value	Accuracy
		Observation Group (n=90)	Control Group (n=67)		
Echocardiography	Positive	61	22	61/83 (73.49)	106/157 (67.52)
	Negative	29	45		
Residual cholesterol	Positive	54	23	54/77 (70.13)	98/157 (62.42)
	Negative	36	44		
Combined detection method	Positive	80	21	80/101 (79.21)	126/157 (80.25)
	Negative	10	46		
χ^2				2.001	12.633
p				0.368	0.002

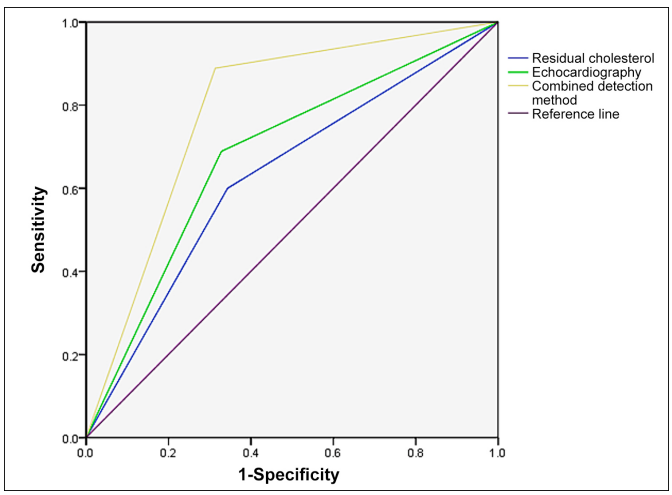

Figure 1: ROC curves of the predictive value of three testing methods for asymptomatic myocardial ischaemia.

When comparing the accuracy of the three testing methods, the combined detection method showed more accuracy than either echocardiography or residual cholesterol testing alone. The difference was statistically significant (p <0.05, Table I).

The ROC curves for the diagnosis of asymptomatic myocardial ischaemia by the 3 methods were constructed separately, in which the area under the curve (AUC) value for the diagnosis of asymptomatic myocardial ischaemia using residual cholesterol alone was 0.628 (95% CI: 0.540-0.717, p=0.006, Yorden index = 0.257, sensitivity = 60.0%, specificity = 65.7%). Similar values for asymptomatic myocardial ischaemia using echocardiography alone was 0.680, 0.595-0.766, <0.001, 0.350, 67.8%, and 67.2%, respectively. The combined predictive efficacy of these two methods was found to be the highest: the AUC value was 0.788 (with a 95% CI of 0.711, AUC=0.865, p=0.001), the Youden index was 0.576, the sensitivity was 88.9%, and the specificity was 68.7% (Figure 1).

Residual cholesterol is a hot topic of research in recent years in relation to coronary atherosclerotic heart disease, calculated from total cholesterol, HDL-C and LDL-C in serum, which can be obtained during the routine examination of patients and is easy to operate. Previous studies had shown that every 1 mmol/L increase in residual cholesterol levels was associated with a 2.8-fold increase in the risk of ischaemic heart disease.[3] Langsted *et al*. confirmed the association of high levels of residual cholesterol with major cardiovascular and cerebrovascular events in a cohort study of 109,574 patients recruited from the Copenhagen General Population Study (CGPS).[6]

In a precedent controlled study with 12,563 participants, a subset analysis revealed a notable relationship between residual cholesterol ≥0.51 mmol/L and coronary heart disease (OR=1.952, 95% CI=1.276-2.988, p=0.002).[4] Adopting the same cut-off in the present study, residual cholesterol above 0.51 mmol/L accurately predicted asymptomatic myocardial ischaemia (AUC=0.628), affirming the prognostic potential of residual cholesterol for coronary atherosclerotic disease. Its inclusion in routine clinical diagnostics warrants further exploration. When combined with echocardiography, residual cholesterol yielded a significantly improved AUC of 0.788, highlighting its superior sensitivity and specificity compared to stand-alone testing.

This study, being a unicentric, retrospective analysis with a non-randomised sample, posed limitations to the generalisability of the results. Residual cholesterol, calculated from multiple data points and not-yet-a-routine clinical measures, may involve potential error. Furthermore, interactions between residual cholesterol and variables like age, sex, blood pressure, and diabetes are not fully clarified, warranting further investigation. In conclusion, combining echocardiography and residual cholesterol testing can enhance the diagnosis of asymptomatic myocardial ischaemia, demonstrating high sensitivity and specificity. Its implementability due to ease of use and accessibility makes it beneficial in clinical settings.

ETHICAL APPROVAL:

This study was approved by the Ethics Committee of the Hebei BOE Hospital, China.

COMPETING INTEREST:

The authors declared no competing interest.

AUTHORS' CONTRIBUTION:

FL: Disease diagnosis, statistical analysis, and manuscript writing.

XH: Research design and writing.
QL: Disease diagnosis, personnel coordination, and case follow-up.
All authors approved the final version of the manuscript.

REFERENCES

1. Report on Cardiovascular Health and Diseases in China 2021: An updated summary. *Biomed Environ Sci* 2022; **35 (7):**573-603. doi: 10.3967/bes2022.079.
2. Ihm SH, Bakris G, Sakuma I, Sohn IS, Koh KK. Controversies in the 2017 ACC/AHA Hypertension Guidelines: Who can be eligible for treatments under the new guidelines? An Asian Perspective. *Circ J* 2019; **83(3)**:504-10. doi: 10.1253/circj.CJ-18-1293.
3. Castañer O, Pintó X, Subirana I, Amor AJ, Ros E, Hernáez Á, *et al.* Remnant cholesterol, not LDL cholesterol, is associated with incident cardiovascular disease. *J Am Coll Cardiol* 2020; **76(23):**2712-24. doi: 10.1016/j.jacc.2020.10.008.
4. Kexin W, Yaodong D, Wen G, Rui W, Jiaxin Y, Xiaoli L, *et al.* Association of increased remnant cholesterol and the risk of coronary artery disease: A retrospective study. *Front Cardiovasc Med* 2021; **8**:740596. doi: 10.3389/fcvm.2021.740596.
5. Stillman AE, Oudkerk M, Bluemke DA, de Boer MJ, Bremerich J, Garcia EV, *et al.* Imaging the myocardial ischemic cascade. *Int J Cardiovasc Imaging* 2018; **34 (8):**1249-63. doi: 10.1007/s10554-018-1330-4.
6. Langsted A, Madsen CM, Nordestgaard BG. Contribution of remnant cholesterol to cardiovascular risk. *J Intern Med* 2020; **288(1):**116-27. doi: 10.1111/joim.13059.