Prognostic value of holter electrocardiogram combined with BNP and CysC in patients with coronary atherosclerotic heart disease

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Introduction. To evaluate the prognostic value of dynamic electrocardiogram (DCG) combined with brain natriuretic peptide (BNP) and serum cystatin C (Cys C) in patients with coronary atherosclerotic heart disease (CAHD).

Methods. 50 patients with CAHD admitted to our hospital from June 2021 to June 2023 were selected as the study group. 40 non-CAHD patients in the same period were used as control group. Serum indicators related to the two groups of patients: serum total cholesterol (TC), triglyceride (TG), low density lipoprotein (LDL), high density lipoprotein (HDL) levels, and BNP, Cys C levels. DCG was used to examine myocardial ischemia and arrhythmia in both groups. Receiver operating characteristic curve (ROC) was plotted to verify the prognostic value of DCG combined with BNP and CysC in DFU patients.

Results. The levels of TC, TG, LDL and HDL in the study group were not significantly correlated with those in the control group, but the levels of BNP and Cys C were significantly higher than those in the control group. The detection rate of myocardial ischemia and arrhythmia in the study group was significantly higher than that in the control group. At the same time, ROC curve found that holter ECG, BNP and CysC had certain predictive value in the prognosis assessment of CAHD patients, and their AUC values were 0.953, 0.913 and 0.921, respectively, while the AUC of the combined diagnostic efficacy of the three was 0.965.

Conclusion. Holter electrocardiogram, BNP and CysC all have good prognostic value in CAHD patients, and the combination of the three can better evaluate the prognosis of CAHD patients.

Keywords. holter electrocardiogram; BNP; Cys C Coronary atherosclerotic heart disease; Prognosis assessment

INTRODUCTION

In recent years, the incidence of coronary atherosclerotic heart disease (CAHD) has increased dramatically with the serious aging of the population, and it is predicted that by 2030, there will be an additional 9.2 million CAHD patients in China [1-2]. The occurrence of this disease is mainly due to abnormal lipid metabolism in the body, which leads to lipid precipitation in blood vessels and the formation of porridge-like white plaques [3]. As the amount of lipid deposition in the blood vessels increases, the patient's blood volume decreases and blood circulation is obstructed. This is likely to lead to cardiac ischemia in patients, and the main clinical manifestation is angina pectoris [4-5]. Long-term exposure to this condition may induce myocardial infarction and lead to the death of the patient [6-7]. Therefore, it is necessary to diagnose CAHD quickly and accurately in clinic, which is of great significance for the adoption of treatment measures and the assessment of patient prognosis [8]. In this study, we will focus on exploring the evaluation value of CAHD diagnosis methods.

In the diagnosis of coronary heart disease, dynamic electrocardiogram (DCG) detection is the most commonly used diagnostic means [9-10]. This diagnostic method can effectively feedback patients' persistent heartbeat status, effectively diagnose asymptomatic myocardial ischemia, and provide important reference materials for the diagnosis of coronary heart disease and myocardial ischemia [11]. However, DCG is usually prone to missed diagnosis, which needs to be supplemented by other technical means [12]. Brain natriuretic peptide (BNP) is synthesized and secreted in large quantities when myocardial ischemia, ventricular volume load and ventricular wall tension increase, and is a common indicator for the diagnosis of heart disease [13-14]. Another common indicator, serum cystatin C (Cys C), although often used in studies related to renal function, is also a predictor of the severity of heart disease [15]. However, there are few studies on the effectiveness of the combination of DCG, NP, and Cys C in the diagnosis of CAHD. Therefore, this study will be combined with the study of holter electrocardiogram combined with BNP and Cys C, and its diagnostic effect on the impact of rain pre-assessment.

METHODS

General Information

Fifty patients with CAHD admitted to our hospital from June 2021 to June 2023 were selected as the study group. 40 non-CAHD patients in the same period were used as control group. Inclusion criteria: Patients were diagnosed with CAHD by coronary angiography; Patients ≥60 years old; The patient has no mental and communication barriers, and can effectively express his maladaptation; The patient and family members are informed and sign the consent form. Exclusion criteria: severe kidney disease, diabetes, hyperthyroidism, infection or other cardiovascular diseases; Taking drugs that affect cardiovascular function within two weeks; Patients with bundle branch block and preexcitation syndrome; The patient was mentally disturbed and uncooperative in the study. This study was approved by the hospital Medical Ethics Committee of our hospital.

Detection Methods

24 h DCG detection was performed on both groups by Medsu type holter electrocardiogram machine. In order to avoid interference and pseudo error, editing and analysis should be conducted by man-machine dialogue. Meanwhile, patients should be informed to carry out appropriate daily activities to collect multi-position ECG changes. At the same time, 5 ml of elbow venous blood was extracted from the two groups of patients after admission, and centrifugation was performed at 3 000 r/min at room temperature for 10 min, and serum was retained for detection.

Detection Indicators

(1) Serum index

The serum indexes related to the two groups of patients were compared, and enzyme-linked immunosorbent assay was used to test the relevant indexes, including the levels of serum total cholesterol (TC), triglyceride (TG), low density lipoprotein (LDL) and high density lipoprotein (HDL)

(2) DCG examination results

The DCG results of the two groups were compared, mainly including myocardial

ischemia and arrhythmia. The characteristics of myocardial ischemia were as follows: the ST segment level or descending depression 80 ms after J-point was >0.1 mV, the duration was >1 min, and the interval between two attacks was >1 min. Arrhythmias need to be diagnosed by the patient's heart rate and its changes, clinical symptoms and their duration, and ECG changes.

(3) The expression levels of BNP and Cys C

The levels of BNP and CysC were compared between the two groups. The expression levels of serum BNP and CysC were detected by enzyme-linked immunosorbent assay.

Data Analysis

SPSS 19.0 statistical software was used for data analysis. Measurement data were expressed as (x±s) and t test was used. Statistical data were analyzed by $\chi 2$ test. ROC curve was drawn to evaluate the diagnostic value of DCG, serum BNP level, serum Cys C level and their combination in elderly CHD. At the same time, $P<0.05$ was considered to be statistically significant.

RESULTS

General Information

There were no significant differences in gender, mean age, BMI and cardiac function grade between the two groups ($p>0.05$). See Table 1 for details.

Table 1 General information for both groups

group	study group（n=50）	Control group（n=40）	t/χ^2-value	*P*-value
sex			0.020	0.887
male	23	19		
female	27	21		
Mean age	68.64±2.34	69.13±2.12	1.029	0.306
BMI（kg/m^2）	22.61±3.25	22.43±3.32	0.259	0.797
Cardiac function classification			0.309	0.857
Level II	20	17		
Level III	19	13		
Level IV	11	10		

Serum Indexes

The serum indexes of patients in the study group were TC (1.73±0.25) mmol/L, TG (6.72±1.31) mmol/L, LDL (3.41±0.67) mmol/L, HDL (1.40±0.36) mmol/L, There were no significant differences between the two groups (1.75±0.22) mmol/L, (6.65±1.35) mmol/L, (3.39±0.70) mmol/L and (1.43±0.31) mmol/L ($p>0.05$).

Expression levels of BNP and Cys C

The expression levels of BNP (1320.43±331.56) μg/L and CysC (1.47±0.30) μg/L in study group were significantly higher than those in control group (739.87±102.55) μg/L and (0.96±0.23) μg/L ($p<0.05$). See Figure 2 for details.

DCG test result

The incidence of myocardial ischemia and arrhythmia in the study group was 88% (44/50) and 76% (44/50), which were significantly higher than those in the control group (25% (10/40) and 42% (21/50) ($p<0.05$). See Table 2 and Table 3 for details.

Table 2 Detection rate of myocardial ischemia

	detection	Not detected	Detection rate
study group（n=50）	44	6	88%（44/50）
Control group（n=40）	10	30	25%（10/50）
χ^2-value			36.750
P-value			<0.001

Table 3 Arrhythmia detection rate

	detection	Not detected	Detection rate
study group（n=50）	38	12	76%（44/50）
Control group（n=40）	16	24	40%（21/50）
χ^2-value			12.000
P-value			<0.001

Prognostic value

ROC curve showed that the AUC of DCG examination, serum BNP level, Cys C level and their combined diagnosis of CAHD were 0.953, 0.913, 0.921 and 0.965, respectively. See Table 4 and Figure 3 for details.

Table 4 Value of DCG examination, serum BNP level and CysC for poor prognosis of CAHD patients

index	AUC	95%CI	*P*-value	Sensitivity (%)	Specificity (%)
DCG examination	0.953	0.906-0.999	<0.001	90.00	94.00
BNP	0.913	0.847-0.978	<0.001	92.50	72.00
Cys C	0.921	0.859-0.984	<0.001	92.50	78.00
triad	0.965	0.860-1.000	<0.001	94.00	72.00

CONCLUSION

In recent years, due to the influence of aging population, the incidence of CAHD has increased, and the clinical diagnosis of CAHD is also very important [16-17]. In this part, we will discuss the prognostic value of DCG combined with BNP and Cys C in CAHD based on the results obtained in this study.

The results of this study found that the duration of myocardial ischemic attack and the detection rate of arrhythmia in the study group were significantly higher than those in the control group. The results of the prognostic analysis found that DCG is helpful for the detection and prognosis of CAHD. Arrhythmia and myocardial ischemia are common symptoms of patients with coronary heart disease. Compared with other detection methods, DCG can accurately detect these symptoms, so DCG is also an effective means for CAHD of coronary heart disease [18]. As myocardial ischemia is prone to damage of cardiomyocytes, Na+, K+ pumps on the cell membrane and myocardial current are prone to significant changes, which are generally reflected in the changes of ST segment in electrocardiogram, while the changes of ST segment in DCG are highly similar to the results of coronary angiography [19]. This may be one of the important reasons that DCG has a good reference value for the diagnosis of CAHD. A study on elderly patients with coronary heart disease found that DCG can effectively detect the onset of myocardial ischemia and arrhythmia in the early diagnosis of elderly patients with coronary heart disease, and can evaluate the prognosis of patients [20], which is similar to the results of this study. However, due to the performance of the DCG machine, changes in the patient's body position, underlying diseases and drug treatment, the recorded data of DCG may be biased, which will lead to errors in diagnosis [21-22]. This shows that in coronary heart disease, DCG needs to be combined with other means to detect in order to obtain more accurate results.A study on atrial fibrillation found that the detection of BNP expression level in patients after diagnosis with DCG was conducive to improving the detection accuracy [23]. This shows that BNP can play an important role in the prognosis of cardiovascular disease. This study also found that the BNP

expression level in the study group was significantly higher than that in the control group, and the prognostic analysis results showed that the BNP expression level was more significant for the prognosis of CAHD. This indicates that BNP also has good prognostic value in CAHD. As a polypeptide, BNP is synthesized and secreted by ventricular myocytes and is synthesized and released from the ventricle with the increase of ventricular filling pressure, so it is often used as an important factor regulating cardiac function and other functions [24]. A report showed that a higher BNP level in patients with heart disease at admission predicted a higher risk of all outcomes, and a decrease in their surface level showed a lower risk, which proved that BNP level was associated with the mortality of patients with heart disease, indicating that BNP could be an independent predictor of heart disease [25]. Another study, based on an analysis of 16 patients with chronic heart failure treated with BNP, concluded that BNP levels are helpful in estimating prognosis in patients with chronic stable heart failure [26]. Comparing the above studies with the results of this study, we can conclude that similar to other heart diseases, BNP has a relatively good predictive effect in CAHD.

In this study, we also found that the expression level of CysC in the study group was higher than that in the control group, and the expression level of CysC was more significant for the prognosis of CAHD, which proved that CysC also had good prognostic analysis value for CAHD. Cys C is a protease inhibitor produced and secreted by cardiomyocytes, which plays a key role in inflammation, and its synthesis level increases during myocardial ischemia [27]. In cardiovascular diseases such as coronary heart disease, CysC can affect the regression, formation and stability of atherosclerotic plaque by affecting the remodeling process of vascular wall matrix, and participate in the occurrence and development of atherosclerosis. It also reflects the degree of atherosclerotic plaque load [28]. Although this factor is usually associated with renal function, it is often used to predict cardiovascular diseases such as coronary heart disease because it can affect the myocardial remodeling process by inhibiting the activity of endogenous cysteine protease in patients with coronary heart

disease [29]. A study on coronary heart disease showed that Cys C can be used to predict the condition of patients with coronary heart disease [30]. The results of this study found that Cys C also plays a similar role in CAHD as in other coronary heart disease. Since there are few relevant studies on the prognosis of CAHD by the combination of DCG, BNP and CysC, we will compare the prognostic analysis of coronary heart disease by the combination of BNP and CysC. A study on coronary heart disease complicated with type I cardio-renal syndrome found that the expression levels of BNP and Cys-C had the highest prognostic value with coronary heart disease [31]. The results of this study were similar, and the combination of DCG, BNP and Cys C had the highest AUC level, indicating that the combination of DCG, BNP and CYS C had the highest diagnostic value for CAHD. This suggests that the combination of BNP and CysC can be more effective in evaluating the prognosis of CAHD.The limitation of this study is that it was not able to detect the changes of serum BNP and Cys-C over time during treatment. In addition, the number and scope of subjects in this study are relatively limited and may not represent all CAHD patients. Finally, most of the subjects included in this study are middle-aged and elderly people, and the findings may not be applicable to other age groups. We will improve these shortcomings in the future study.

In summary, holter electrocardiogram, BNP and CysC all have good predictive value in the prognosis of CAHD, and the combination of the three can better evaluate the prognosis of CAHD patients, which is worthy of clinical promotion.

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AVAILABILITY OF DATA AND MATERIALS

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

CONSENT FOR PUBLICATION

Not applicable.

AUTHORS'CONTRIBUTIONS

FL and FL participated in the design of the study and performed the statistical analysis. SJW conceived of the study, and participated in its design and coordination and helped to draft the manuscript. All authors read and approved the final manuscript.

Ethics approval and consent to participate

The present study was approved by the Care and Use Committee of Yantai Mountain Hospital

CONSENT FOR PUBLICATION

Not applicable.

CONFLICT OF INTEREST

no conflict of interest

REFERENCES

[1]Moran A, Gu D, Zhao D, Coxson P, Wang YC, Chen CS, et al.. Future Cardiovascular Disease in China: Markov Model and Risk Factor Scenario Projections From the Coronary Heart Disease Policy Model-China. Circ Cardiovasc Qual Outcomes (2010) 3(3):243–52.

[2]Yao T, Lu W, Ke J, Zhang H, Zhao X, Song B, Liu T, Ke Q, Liu C. Residual Risk of Coronary Atherosclerotic Heart Disease and Severity of Coronary Atherosclerosis Assessed by ApoB and LDL-C in Participants With Statin Treatment: A Retrospective Cohort Study. Front Endocrinol (Lausanne). 2022 Apr 20;13:865863.

[3]Efe D, Aygün F, Ulucan Ş, Keser A. Relationship of coronary artery disease with pericardial and periaortic adipose tissue and their volume detected by MSCT. Hellenic J Cardiol. 2015 Jan-Feb;56(1):44-54.

[4]Xi Z, Qiu H, Guo T, Wang Y, Dou K, Xu B, Wu Y, Qiao S, Yang W, Yang Y, Gao R. Prevalence, Predictors, and Impact of Coronary Artery Ectasia in Patients With Atherosclerotic Heart Disease. Angiology. 2023 Jan;74(1):47-54.

[5]Wang L, Li HC, Zhou J, Yang B, Qiao CD, Liu YM, Zhang Z. Correlation between the GP78 Gene Polymorphism and Coronary Atherosclerotic Heart Disease. Hellenic J Cardiol. 2018 Jan-Feb;59(1):8-13.

[6]Vahanian A, Beyersdorf F, Praz F, Milojevic M, Baldus S, Bauersachs J, Capodanno D, Conradi L, De Bonis M, De Paulis R, Delgado V, Freemantle N, Gilard M, Haugaa KH, Jeppsson A, Jüni P, Pierard L, Prendergast BD, Sádaba JR, Tribouilloy C, Wojakowski W; ESC/EACTS Scientific Document Group. 2021 ESC/EACTS Guidelines for the management of valvular heart disease. Eur Heart J. 2022 Feb 12;43(7):561-632.

[7]Iatan I, Guan M, Humphries KH, Yeoh E, Mancini GBJ. Atherosclerotic Coronary Plaque Regression and Risk of Adverse Cardiovascular Events: A Systematic Review and Updated Meta-Regression Analysis. JAMA Cardiol. 2023 Oct 1;8(10):937-945.

[8]Tarantini G, Tang G, Nai Fovino L, Blackman D, Van Mieghem NM, Kim WK, Karam N,

Carrilho-Ferreira P, Fournier S, Pręgowski J, Fraccaro C, Vincent F, Campante Teles R, Mylotte D, Wong I, Bieliauskas G, Czerny M, Bonaros N, Parolari A, Dudek D, Tchetche D, Eltchaninoff H, de Backer O, Stefanini G, Sondergaard L. Management of coronary artery disease in patients undergoing transcatheter aortic valve implantation. A clinical consensus statement from the European Association of Percutaneous Cardiovascular Interventions in collaboration with the ESC Working Group on Cardiovascular Surgery. EuroIntervention. 2023 May 15;19(1):37-52.

[9]You L. Relationship between dynamic electrocardiogram and CRP, IL-6, ET-1 expression in myocardial ischemia patients with coronary heart disease. Cell Mol Biol (Noisy-le-grand). 2023 Nov 30;69(12):52-56.

[10]Zeng Z, Zhuang Z, He Y, Yang Z, Song Y. Efficacy and safety of Shen-Song-Yang-Xin capsule for treating arrhythmia in the elderly patients with coronary heart disease: Protocol for a systematic review and meta-analysis. Medicine (Baltimore).

[11]Chen P, Wu T, Peng Q, Fan N, Shi Y, Wang H, Chen L, Guo H. Application value between dynamic electrocardiogram and MSCT myocardial perfusion imaging in the diagnosis of myocardial ischemia in coronary heart disease. Ann Palliat Med. 2021 Oct;10(10):10720-10725.

[12]Zhou Y, Hao N, Sander JW, Lin X, Xiong W, Zhou D. KCNH2 variants in a family with epilepsy and long QT syndrome: A case report and literature review. Epileptic Disord. 2023 Aug;25(4):492-499.

[13]Li N, Wang JA. Brain natriuretic peptide and optimal management of heart failure. J Zhejiang Univ Sci B. 2005;6:877–884.

[14]de Denus S, Pharand C, Williamson DR. Brain natriuretic peptide in the management of heart failure: the versatile neurohormone. Chest. 2004;125:652–668.

[15]Liu R, Gao C. Clinical value of combined plasma brain natriuretic peptide and serum cystatin C measurement on the prediction of heart failure in patients after acute myocardial infarction. Braz J Med Biol Res. 2023 Sep 22;56:e12910.

[16]Razavi AC, Agatston AS, Shaw LJ, De Cecco CN, van Assen M, Sperling LS, Bittencourt MS, Daubert MA, Nasir K, Blumenthal RS, Mortensen MB, Whelton SP, Blaha MJ, Dzaye O. Evolving Role of Calcium Density in Coronary Artery Calcium Scoring and Atherosclerotic Cardiovascular Disease Risk. JACC Cardiovasc Imaging. 2022 Sep;15(9):1648-1662.

[17]Madias JE. Atherosclerotic Nonobstructive Coronary Artery Disease in Patients With Takotsubo

Syndrome and Heart Failure: A Contributor or a Red Herring? Cardiovasc Revasc Med. 2023 Mar;48:41. doi: 10.1016/j.carrev.2022.10.013. Epub 2022 Oct 31.

[18]You L. Relationship between dynamic electrocardiogram and CRP, IL-6, ET-1 expression in myocardial ischemia patients with coronary heart disease. Cell Mol Biol (Noisy-le-grand). 2023 Nov 30;69(12):52-56.

[19]Chen Z, Tan H, Liu X, Tang M. Application of 24 h Dynamic Electrocardiography in the Diagnosis of Asymptomatic Myocardial Ischemia with Arrhythmia in Elderly Patients with Coronary Heart Disease. Emerg Med Int. 2022 Nov 11;2022:3228023.

[20]Zhang Y, Wang J, Xu Y. Value of heart rate variability on dynamic electrocardiogram in predicting ventricular fibrillation in elderly acute myocardial infarction patients. Ann Palliat Med. 2020 Sep;9(5):3488-3494.

[21]Jiang F, Xu H, Shi X, Han B, Chu Z, Xu B, Liu X. Dynamic Electrocardiogram under P Wave Detection Algorithm Combined with Low-Dose Betaloc in Diagnosis and Treatment of Patients with Arrhythmia after Hepatocarcinoma Resection. J Healthc Eng. 2021 Oct 16;2021:6034180.

[22]Li H, Kang L, Sun Y. Clinical value of cardiac color ultrasound and cardiac troponin T combined with dynamic electrocardiogram in treatment of acute pulmonary embolism. Exp Ther Med. 2018 Feb;15(2):2044-2048.

[23]Kemp Gudmundsdottir K, Fredriksson T, Svennberg E, Al-Khalili F, Friberg L, Frykman V, Hijazi Z, Rosenqvist M, Engdahl J. Stepwise mass screening for atrial fibrillation using N-terminal B-type natriuretic peptide: the STROKESTOP II study. Europace. 2020 Jan 1;22(1):24-32.

[24]Shoji S, Kohsaka S, Sawano M, Okamura T, Hirata A, Sugiyama D, Ohkubo T, Nakamura Y, Watanabe M, Kadota A, Ueshima H, Okayama A, Miura K; NIPPON DATA2010 Research Group. Electrocardiographic Left Atrial Abnormality and B-Type Natriuretic Peptide in a General Japanese Population: NIPPON DATA2010. J Atheroscler Thromb. 2021 Jan 1;28(1):34-43.

[25]Castiglione V, Aimo A, Vergaro G, Saccaro L, Passino C, Emdin M. Biomarkers for the diagnosis and management of heart failure. Heart Fail Rev. 2022 Mar;27(2):625-643.

[26]Maisel AS, Duran JM, Wettersten N. Natriuretic Peptides in Heart Failure: Atrial and B-type Natriuretic Peptides. Heart Fail Clin. 2018 Jan;14(1):13-25.

[27]Negrusz-Kawecka M, Poręba R, Hulok A, ciborski K, Marczak J, Bańkowski T. Evaluation of the

significance of cystatin C levels in patients suffering from coronary artery disease. Adv Clin Exp Med. 2014;23(4):551–8.

[28]Hanna D, Beshir M, Khalifa N, Baz E, Elhewala A. Assessment of cystatin C in pediatric sickle cell disease and β-thalassemia as a marker of subclinical cardiovascular dysfunction: a case-control study. Pediatr Hematol Oncol. 2021;38(7):620–632.

[29]Gao Y, Guo Y, Hao W, Meng J, Miao Z, Hou A, Luan B. Correlation Analysis and Diagnostic Value of Serum Homocysteine, Cystatin C and Uric Acid Levels with the Severity of Coronary Artery Stenosis in Patients with Coronary Heart Disease. Int J Gen Med. 2023 Jun 29;16:2719-2731.

[30]West M, Kirby A, Stewart RA, Blankenberg S, Sullivan D, White HD, Hunt D, Marschner I, Janus E, Kritharides L, Watts GF, Simes J, Tonkin AM; LIPID Study Group *. Circulating Cystatin C Is an Independent Risk Marker for Cardiovascular Outcomes, Development of Renal Impairment, and Long-Term Mortality in Patients With Stable Coronary Heart Disease: The LIPID Study. J Am Heart Assoc. 2022 Mar;11(5):e020745.

[31]Du X, Ma Z, Li L, Zhong X. Nicorandil Decreases Renal Injury in Patients With Coronary Heart Disease Complicated With Type I Cardiorenal Syndrome. J Cardiovasc Pharmacol. 2021 Sep 29;78(5):e675-e680.

Figure 1: (A) TC levels in both groups; (B) TG levels in both groups; (C) LDL levels in both groups; (D) HDL levels in both groups.

Figure 2: (A) BNP levels in both groups; (B) Cys C levels in both groups. PS: * indicates $p<0.05$ compared with the control group.

Figure 3: (A) ROC curve of DCG to predict poor prognosis in CAHD patients; (B) ROC curve for predicting poor prognosis of CAHD patients with serum BNP level; (C) ROC curve of Cys C in predicting poor prognosis of CAHD patients; (D) ROC curve of the combined prediction of CAHD patients with poor prognosis.

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