Diagnostic value of joint detection of homocysteine and RDW CV on acute myocardial infarction

G.-X. HU, J. ZHANG, Y.-G. TIAN, Y.-H. LI, L. MOU, L.-J. QIAO

Department of Intensive Medicine, Shengli Oilfield Central Hospital, Dongying, Shandong, China

Abstract. – **OBJECTIVE:** We discussed the diagnostic value of joint detection of homocysteine (HCY) and red blood cell volume distribution width variable coefficient on acute myocardial infarction (AMI).

PATIENTS AND METHODS: We collected 300 coronary heart disease cases, among which there were 121 cases of stenocardia, 65 cases of ischemic heart failure, and 114 cases of AMI at the Department of Cardiology of our hospital during the period from January 2012 to June 2013. At the same time, we took 100 normal physical examinees as the control group, used the full-automatic cell-analyzer and the immunization to measure HCY and red blood cell distribution width (RDW) CV respectively and analyze their value in diagnosing AMI.

RESULTS: The differences among the four groups of HCY and RDW CV were statistically significant ($p < 0.05$). The HCY and RDW CV level in the AMI group were significantly higher than those of the other three groups ($p < 0.05$); the differences between the positive diagnosis rate of HCY, the RDW CV and their joint diagnosis in the AMI group were statistically significant ($p < 0.05$) while the differences between the positive diagnosis rate of HCY, RDW CV and their joint diagnosis in the control group were not statistically significant ($p > 0.05$). The detection sensitivity and specificity of HCY alone were respectively 72% and 86.00% with those of the RDW CV alone being 64.91% and 80.00%. The joint detection sensitivity and specificity were 83.33% and 93.00%, statistically different ($p < 0.05$). The concordance rate, the positive predictive value and the negative predictive value were 85%, 93.14% and 83.04%, respectively.

CONCLUSIONS: The HCY and RDW CV joint diagnosis of AMI had relatively high sensitivity, specificity, concordance rate, positive predictive value and negative predictive value.

Key words:
  Homocysteine (HCY), RDW CV, Acute myocardial infarction (AMI), Diagnostic value.

Introduction

The acute myocardial infarction (AMI) is a common disease among the middle-aged and senior people. Its high morbidity and lethality have severely threatened people's life quality[1,2]. The disease mainly leads to myocardial necrosis because of the acute and continuous ischemia and oxygen deficit of coronary artery. Generally, the correct diagnosis can be made based on typical clinical manifestation, electrocardiogram (ECG) characteristic evolution and the dynamic change of the serum biomarkers[3]. The serum index with high sensitivity and specificity to AMI was essential. Serum HCY was a non-essential amino acid, which can induce the emergence of thrombin, the platelet aggregation and the formation of atherosclerosis[4,5]. The red blood cell distribution width (RDW) CV was a parameter of the heterogeneity of the red blood cell. Usually, this parameter was highly sensitive in the diagnosis of anemia[6,7]. In this paper, we have collected 300 cases of coronary heart disease.

Patients and Methods

Patients

We collected 300 cases of coronary heart disease during the period from January 2012 to June 2013 at our hospital. Among these cases, there were 222 male patients and 78 female ones, aged from 35 to 75 years old and the average age of about 55.25 ± 6.79 years. There were 121 cases of stenocardia, 65 cases of ischemic heart failure, 114 cases of AMI (87 cases of ST-segment elevation myocardial infarction and 27 cases of non-ST-segment-elevation myocardial infarction). At the same time, we set the control group made up of 100 patients who were admitted into the hospital because of chest pain or suppression but were proved "coronary normal"

Corresponding Author: Lu-Jun Qiao, MD; e-mail: xy3450512zhipohua@163.com

by the coronary angiography. Among the 100 cases, there were 65 male patients and 35 female ones, aged from 30 to 80 years old with the average age of 55.78 ± 5.39 years old. The patients in the control group, without coronary disease, were diagnosed by 2 experts. All patients have been subject to definite diagnoses by CAG and fit for the clinical symptoms. The study followed family ethics after the patients have signed the informed consent agreement. As to the exclusion criteria, (1) the patients had serious diseases of organ failure, endocrine disease, deeline, blood system diseases, anemia and cancer, e.g. liver and kidney failure, cerebral infarction, etc.; (2) the patients had heart disease history, blood transfusion history within two weeks, or currently took medications which can influence the research; (3) the patients not following the requirements of this study, or those who took other treatment during the study or had been transferred to other hospitals; (4) the patients with critical condition, who were unable of participating in the research any more. The differences between the data of stenocardia, the ischemic heart, the AMI group, the control group and the general data were not statistically different ($p > 0.05$) (Table I).

Methods

After having been admitted to the hospital, ml of fasting blood was extracted from the patients and preserved in the EDTA-K2 anti-freezing tube. The MoFlo Astrios EQ full-automatic cell-analyzer was applied to the RDW. ml of fasting blood was extracted and placed in the serum separating medium tube. The Hitachi 7600-00 full-automatic biochemical analyzer and the cyclophore method were applied to measure the HCY concentration. The result was positive if the concentration of HCY was more than 15 μmol/L (the normal value should be 5-15 μmol/L). The result was positive if the RDW CV was over 15% (the normal value should be 11%-15%).

Research Index

Comparison of HCY and RDW CV level of the four groups was determined. Further, the difference between the positive rate of the diagnosis of AMI by HCY, the RDW CV and the control group was determined. The sensitivity, the specificity, the concordance rate, the positive predictive value and the negative predictive value were used to diagnose AMI.

Statistical Analysis

SPSS 13.0 software (SPSS Inc., Chicago, IL, USA) was used for data analysis and the measurement data were expressed as mean value ± standard deviation (SD). The test for normal distribution. A *t*-test was carried out between each two groups. The analysis of Variance has been applied to multiple mean values which matched the requirements. The enumeration data were shown in the form of percentage and tested by chi-square test. The LSD test was used. The data were considered as statistically significant for $p < 0.05$.

Results

Comparison of HCY and RDW CV Level of the Four Groups

The differences among HCY and RDW CV level in the group of stenocardia, ischemic heart, AMI and control group were statistically significant ($p < 0.05$). While the HCY and RDW CV level in the AMI group were significantly higher than those of the other three groups ($p < 0.05$), as shown in Table II.

Diagnostic Value of HCY and RDW CV in AMI

It was stipulated that the positive diagnosis can be made if the result was positive based on both the HCY and RDW CV test. The differences between the positive diagnosis rate of HCY, the RDW CV and their joint diagnosis in the AMI

Table I. Characteristics of the clinical cases.

	Age (year)	Number of previous caesarean section	Number of pregnancies	Interval time from recent caesarean section (years)	Gestation (weeks)
Mean	32.20 ± 4.83	1.20 ± 0.61	3.60 ± 1.55	4.45 ± 1.34	8.34 ± 3.70
Range (min-max)	23-43	1-4	2-7	6 months-12 years	5-12

Table II. A comparison of the different types of clinical cases.

Clinical presentation	Vaginal bleeding	Abdominal pain	Vaginal bleeding abdominal pain	Asymptomatic	Massive bleeding after curettage
Case	11	1	5	8	5
Percentage	36.67%	3.33%	16.67%	26.67%	16.67%

group were statistically significant ($p < 0.05$) while the differences of the positive diagnosis rate of the control group were not statistically significant ($p > 0.05$). The detection sensitivity and specificity of HCY alone were respectively 68.42% and 86.00%, with those of the RDW CV alone of 64.91% and 84.00%. The joint detection sensitivity and specificity were 83.33% and 93.00%. The difference was statistically different ($p < 0.05$). The concordance rate, the positive predictive value and the negative predictive value were 87.85%, 93.14% and 83.04% respectively (Table III).

Discussion

The coronary heart disease is a common-seen acute cardiovascular disease among the middle aged and senior people. Based on the great amount of epidemic disease data, the morbidity of coronary disease[8] was 12% in cities, 0.48% in rural areas and 0.77% overall. As the city is becoming better and better, the morbidity goes higher[9]. What is more importantly, we should enhance the prevention to lower the morbidity so that the population under high risk can avoid the disease and the patients could be diagnosed as early as possible to get proper treat-

ment[10]. Coronary atherosclerotic cardiopathy was the heart disease caused by the atherosis and the accompanying narrow or blocked vessel lumen, ischemia, oxygen deficit or necrosis. WTO divided coronary disease into five clinical types[11,12]: the asymptomatic myocardial ischemia, the stenocardia, the myocardial infarction, the ischemic cardiac failure and the sudden death. In this paper, we studied three types. The AMI[13-15] was caused by continuous and serious myocardial ischemia and the accompanying acute necrosis of myocardium. Clinically, it showed symptoms of chest pain, acute circulatory dysfunction and the changes in ECG indicating various symptoms including myocardial damage, ischemia, etc. The clinical symptom included serious chest pain, acute circulatory dysfunction, arrhythmia, heart failure, fever, the increase of white blood cell count and myocardial damage serum marker enzyme and the progressive changes in ECG[16]. The most important index for screening the population under high-risk was specificity. In this paper, we have studied HCY and RDW CV. The increase of the formal index would cause the formation of atherosis and the latter was related to anemia[17].

Here, we examined HCY and RDW CV level of the fasting blood of patients with various diseases. The result indicated that the HCY and

Table III. A comparison of operative outcomes between laparoscopy-guided curettage and ultrasound-guided curettage.

	Number of previous caesarean section	Number of previous abortion	Apart time of previous caesarean section (years)	Blood loss volume (mL)	Menstrual cycle recovery (days)	Rate of serum beta-hCG reduction (%)*
Ultrasound-guided curettage	1.14 ± 0.3	1.86 ± 1.03	3.71 ± 3.36	17.50 ± 4.16	37.14 ± 3.79	88.43 ± 10.50
Laparoscopy-guided curettage	1.09 ± 0.30	2.82 ± 1.83	4.01 ± 2.59	15.91 ± 3.36	36.64 ± 1.36	76.31 ± 15.23
p	0.70	0.14	0.80	0.83	0.43	0.04

*The reduction rate of serum hCG = Preoperative serum hCG - Postoperative serum hCG (three days after operation) / Preoperative serum hCG.

RDW CV level of AMI patients were significantly higher than that of those patients with stenocardia, ischemic heart or the control group. It indicated high expression of these two serum indexes in the AMI patients so that these two indexes can be used for diagnosing AMI. The screening results also showed that the joint detection of the two indexes had high sensitivity and specificity, respectively 83.33% and 93.00%. The positive predictive value and the negative predictive value were relatively high, 93.14% and 83.04% respectively. Therefore, if we integrated both indexes, we can find the true patients and exclude the non-patients as early as possible. If we only made a diagnosis based on only one of the indexes, there may be many misdiagnoses or missed diagnosis. The detection sensitivity and specificity of HCY alone were respectively 68.42% and 86.00%, with those of the RDW CV alone of 64.91% and 84.00%. The sensitivity and specificity of the joint detection were respectively 83.33% and 93.00%. In this case, the best treatment timing may be missed, which was harmful to the patients and may worsen the disease. The joint detection can greatly reduce the amount of misdiagnoses or missed diagnoses and realize early treatment. The simple operation and fast test speed make it applicable in clinical application.

Conclusions

Above all, the HCY and RDW in the diagnosis of AMI has a relatively high sensitivity, specificity, concordance rate, positive predictive value and negative predictive value, therefore, it is worthy of clinical application; however, there will still be situations of misdiagnosis or missed diagnosis. Further clinical diagnosis is still needed.

―――――――――――

Conflict of Interest

The Authors declare that there are no conflicts of interest.

References

1) SUN SJ, WU XP, SONG HL, LI GQ. Baicalin ameliorates isoproterenol-induced acute myocardial infarction through iNOS, inflammation, oxidative stress and P38MAPK pathway in rat. Int J Clin Exp Med 2015; 8: 22063-22072.

2) WANG C, WANG SX, DONG PS, WANG LP, DUAN NN, WANG YY, WANG K, LI ZZ, WEI LJ, MENG YL CHENG JX. Pathological observation of acute myocardial infarction in Chinese miniswine. Int J Clin Exp Med 2015; 8: 20829-20836.

3) Yao XL, Lu XL, Yan CY, Wan QL, Peng GC, Lu YM. Circulating miR-122-5p as a potential novel biomarker for diagnosis of acute myocardial infarction. Int J Clin Exp Pathol 2016; 9: 16014-16019.

4) AKYÜREK Ö, AKBAL E, GÜNEŞ F. Increase in the risk of ST elevation myocardial infarction is associated with homocysteine level. Arch Med Res 2014; 45: 501-506.

5) GOKAY S, CIÇEK D, MÜDERRISOGLU H. Hyperhomocysteinemia in a young woman presenting with acute myocardial infarction: a case report. Interv Med Appl Sci 2013; 5: 39-42.

6) LIPPI G, BUONOCORE R, CERVELLIN G. Value of red blood cell distribution width on emergency department admission in patients with venous thrombosis. Am J Cardiol 2016; 117: 670-675.

7) HOFFMANN JJ, NABBE KC, VAN DEN BROEK NM. Effect of age and gender on reference intervals of red blood cell distribution width (RDW) and mean red cell volume (MCV). Clin Chem Lab Med 2015; 53: 2015-2019.

8) XIAOJUN D, YONG X, YUANJIE F. Assessment and prediction of AMI by serum HCY. Pract Clin J 2014; 11: 116-119.

9) WANG C, LIHONG Y, XIANGJUN Z. The serum level change of cTnI, TNF-α, hs-CRP in AMI patients and the clinical meaning. Modern Biol Med 2012; 12: 2940-2942.

10) ZHOU LJ, MEI YF, JIN H, WANG LF, GAO QP, LI SJ, LI WM. The effect of homocysteine on fibrinolytic system in human umbilical vein endothelial cells. Zhonghua Xin Xue Guan Bing Za Zhi 2005; 33: 810-814.

11) YAN G, KONG W, WANG D, QIAO Y, SHA X, CHENG T, ZHANG H, HOU J, TANG C, MA G. Impact of plasma homocysteinemia on contrast-induced nephropathy after percutaneous coronary intervention in patients with coronary syndrome. Zhonghua Xin Xue Guan Bing Za Zhi 2016; 44: 32-37.

12) DANESE E, LIPPI G, MONTAGNANA M. Red blood cell distribution width and cardiovascular diseases. J Thorac Dis 2015; 7: E402-411.

13) TIAN L, YANG Y, ZHU J, LIU L, LIANG Y, LI J, YU B. Impact of previous stroke on short-term myocardial reinfarction in patients with acute ST segment elevation myocardial infarction: an observational multicenter study. Medicine (Baltimore) 2016; 95: e2742.

14) NUTI SV, QIN L, RUMSFELD JS, ROSS JS, MASOUDI FA, NORMAND SL, MURUGIAH K, BERNHEIM SM, SUTER LG, KRUMHOLZ HM. Association of admission to veterans affairs hospitals vs non-veterans affairs hospitals with mortality and readmission rates among older men hospitalized with acute myocardial infarction, heart failure, or pneumonia. JAMA 2016; 315: 582-592.

15) TALANAS G, FIORE G, TERROSU P. Primary angioplasty with manual thrombectomy alone as a therapeutic strategy in a patient with acute myocardial infarction and severe anemia. Hellenic J Cardiol 2016; 57: 48-52.

16) ANIKHOVSKAYA IA, KUBATIEV AA, SALAKHOV IM, TEBLOEV KI, YAKOVLEV MY. Changes of endotoxin concentra-

tion in blood serum in patients with uncomplicated acutemyocardial Q-infarction. Patol Fiziol Eksp Ter 2015; 3: 55-61.

17) DINC T, SENOL K, YILDIZ B, KAYILIOGLU I, SOZEN F. Association between red cell distribution width and mean platelet volume with appendicitis: a myth or a fact? Bratisl Lek Listy 2015; 116: 499-501.