

The correlation of coronary artery involvement extent with white blood cell count in hospitalized patients

Mir Hossein Seyyed Mohammadzadeh¹, Hamid Reza Farrokh-Eslamloo², Kamal Khadem Vatan², Peyman Mikaili^{3,*}, Mohammad Hossein Asghari⁴, Golshan Fahimi⁵

¹Department of Cardiology, Faculty of Medicine, Urmia University of Medical Sciences, Urmia, Iran

²Public Health Department, Faculty of Health, Urmia University of Medical Sciences, Urmia, Iran

³Department of Pharmacology, Urmia University of Medical Sciences, Urmia, Iran

⁴Islamic Azad University, Urmia Branch, Urmia, Iran

⁵Faculty of Medicine, Urmia University of Medical Sciences, Urmia, Iran

ABSTRACT

Coronary artery disease was the leading death cause among both American women and men in 2003. Every 2 seconds, one person is affected by coronary artery events, while another one dies almost every minute from heart conditions. Cardiovascular diseases are the most common death causes among persons of 35 year olds in Iran. The percentage of death rate attributed to the cardiovascular diseases has increased from 26.6% in 1981 to 43.3% in 1996. There are numerous ways to examine patients with coronary artery involvement, e.g. angiography of coronary artery. A study of the relationship between white blood cell count (WBC) and coronary artery involvement may result in a quick and easy understanding of the coronary artery involvement in the hospitalized patients. In a sectional retrospective study, 385 patients were randomly selected from those cases, who underwent angiography of coronary artery in 2007. Then, the information concerning coronary artery involvement, the angiography results, and the experiments carried out prior to the angiography including the white blood cell counts recorded in the patients files were included the questionnaires, which had been provided in advance. After collecting the data, they were entered in the computer and they were statistically analyzed. Of 385 patients examined, 108 cases (46.75%) had an open coronary artery, 88 cases (22.85%) had a single vessel disease and 189 cases (49.09%) had more than a single vessel disease. The WBCs of 316 patients (82.1%) were 4,000-10,000 and the rest 69 cases (17.9%) were >10,000. The increase in the number of leukocytes, lymphocytes and PMNs is significantly correlated with the level of coronary artery involvement. However, no significant correlation was found between the percentages of eosinophils and monocytes and the level of coronary artery involvement. Consequently, the white blood cell count can be used as a simple, useful means of categorizing the patients for the purpose of treatment type and taking into a count the possible dangers.

INTRODUCTION

Coronary artery diseases have been the leading death cause among American men and women. Every 26 seconds on individual is afflicted with coronary artery events while another one dies due to heart problems almost every single minute. 40% of those individuals who have experienced cardiac coronary artery events die during their first year of disease [1]. Cardiovascular diseases are the most common death cause among the 35-year olds in Iran and the percentage of deaths attributed to cardiovascular diseases has increased from 26.6% in 1981 to 43.3% in 1996. Studies suggest that the start of atherosclerosis has decreased in terms of age on Iran [2].

There are various ways of examining patients with coronary artery involvement including invasive and non-invasive methods, one of which is the invasive coronary artery angiography methods through the conduction of which the coronary artery involvement can be precisely detected. In other to carry out angiography, patients can be selected based on several criteria.

Inflation has been demonstrated to be an important risk factor in causing cardiovascular events [3-5]. Patients with a high count of white blood cell are subject to a high risk of acute myocardial infarction [6], and even these patients encounter most of the acute cardiovascular events during angiography. Though the mechanism giving rise to this has not been totally found out, several theories regarding have been put forth, including the idea that leukocytes cause an increase in hypercoagulopathy, leading to leukocyte – mediated no reflow as well as indirect cardiotoxicity through an increase in inflammatory cytokines [7].

Since it is readily accessible and easy to conduct the test of counting the white blood cells in all patients, evaluating the relationship between the white blood cell count and coronary artery involvement can result in a punctual and easy detection of coronary artery involvement.

Since according to some studies, patients with more white blood cells suffer from various coronary artery involvements, it seems that the sooner these patients undergo coronary artery angiography, the better. This study aims at examining the relationship between the level of coronary artery involvement and white blood cell count.

MATERIALS AND METHODS

The population of our study consists of all those patients who consulted Taleghani Educational Center of Urmia in 1386 to undergo coronary artery angiography and who were selected randomly. Preliminary tests including measurement of white blood cell count were conducted in all patients who consulted Taleghani Hospital to undergo coronary artery angiography.

The data regarding coronary artery involvement, angiography results and experiments prior to angiography including the counting of white blood cells have been recorded in the patients' documents. It is necessary to count the white blood cells, so that angiography can be carried out which is available in the patients' files, out of which these data were extracted and the questionnaires completed.

The questionnaires containing demographic information (gender, age), history of high blood pressure diseases, diabetes and results of angiography have been extracted from the patients' documents and completed.

The data were analyzed using the SPSS 16 software. Initially, the descriptive data were presented as tables of frequency distribution and various diagrams. Next, the relationship between independent and dependent (coronary artery involvement) variables were statistically tested based on the type of the variable using Chi-square test and t-Test.

RESULTS

In this study, 385 files were randomly selected from those patients who referred to Taleghani Hospital in 2007 to undergo coronary artery angiography and the data were included within the questionnaires after the files had been examined. The data having been collected and statistically analyzed, the results obtained are as follows:

The total number of patients was 385, who consisted of 242 males (62.9%) and 143 females (37.1%). 73 patients (19%) had a history of diabetes mellitus, while 312 patients (81%) lacked any history of diabetes mellitus. 148 patients (38.7%) had a history of hypertension whereas 237 ones (61.6%) lacked this. 77 cause (20%) had a history of dyslipidemia as well, 308 patients (80%) however, lacked a history of dyslipidemia. The blood relatives of so patients (20.8%) had encountered family history of cardiovascular disease was observed among other 305 cases (79.2%). There was a smoking history among 135 patients (35.6%). This was not true for the rest 250 patients (64.9%).

The white blood cell count of 316 (82.1%) amounted to 4,000-10,000 and 69 patients had white blood cell count (17.9%) amounted to over 10,000. The ejection fraction of 252 patients (65.5%) and that of 133 other patients (34.5%) amounted to $\leq 50\%$ and $> 50\%$, respectively In the study we conducted, 108 patients out of the total 385 patients suffered from open coronary artery, 88 patients from single vessel disease and 189 others from more than single vessel disease.

108 patients with open coronary artery consisted of 46 males (42.4%) and 62 females (57.4%). 88 patients who had single vessel disease consisted of 57 males (64.6%) and 31 females (35.2%); and finally those 189 patients suffering from, more than single vessel disease were composed of 139 males (73.5%) and 50 females (26.5%). Based on statistical studies ($p=0.000$) there was a significant statistical correlation between gender and the extent of coronary artery involvement ($p=0.000$). In our study, 73 patients suffered from diabetes, consisting of 13 patients (12%) with open coronary artery, 13 ones (14.8%) with a single vessel disease and 47 others (24.9%) with more than single vessel disease.

Of 312 patients without diabetes, 95 cases (88%) had open coronary artery, 75 cases (85.26%) had single vessel disease and 142 cases (75.1%) had more than a single vessel disease. In this study, a significant relationship was found between coronary artery disease and history of diabetes ($p=0.013$). In our study, 148 patients had a history of hypertension, 45 patients (41.7%) of whom suffered from open coronary artery; 24 patients (27.3%) from single vessel disease and 79 patients (41.8%) from more than single vessel disease.

237 patients lacked a history of hypertension, 63 of whom (58.3%) suffered from open coronary artery, 64 patients (72.7%) from single vessel disease and 110 patients (58.2%) from more than single vessel disease. A significant relationship was observed between a history of hypertension and the extent of coronary artery disease ($p=0.049$). Therefore, of total patients had a history of cardiovascular disease among blood relatives, 16 cases (17.6%) had open coronary artery disease, 15 cases (17%) had a single vessel disease and 46 others (24.3%) had more than a single vessel disease. 305 patients had a history of relative cardiovascular disease among their blood relatives, of whom 89 cases with coronary disease (82.4%) had open coronary artery, 73 cases (83%) had a single vessel disease and 143 others (75.7%) had more than a single vessel disease.

In this study, no significant relationship between a history of cardiovascular disease among blood relatives and the extent of coronary artery involvement was observed ($p=0.239$). In this study, 135 patients had a history of smoking. 26 patients (24.1%) had open coronary artery disease; 31 cases (35.2%) had a single vessel disease and 78 others (41.3%) had more than a single vessel disease. Of 250 patients lacked any history of smoking, 82 cases (75.9%) had open coronary artery disease; 75 cases (64.8%) had a single vessel disease and others (58.7%) had more than a single vessel disease.

In our study, a significant relationship was observed between a history of smoking and the extent of coronary artery involvement ($p=0.012$). In this study, of 77 patients had a history of dyslipidemias, 14 cases (13%) had an open coronary artery disease; 13 cases (14.8%) had a single vessel disease and the rest 50 cases had more than a single vessel disease. There was a significant relationship between a history of dyslipidemias and the extent of coronary artery involvement ($p=0.008$). In our study, of 316 patients with WBC ranged between 4,000–10,000, 102 cases (94.4%) had an open coronary artery disease; 79 cases (89.8%) had a single vessel disease and the rest 135 cases (71.4%) had more than a single vessel disease. Of 69 patients with WBC amounted to over 10,000, 6 cases (5.6%) had an open coronary artery disease; 9 cases (10.2%) had single vessel disease and the rest 54 cases (28.6%) had more than a single vessel disease (**Figure 1**).

In the study conducted a significant relationship between high WBC and the extent of coronary artery involvement was observed ($p=0.000$). In our study, of 223 patients with the lymphocyte percentage $<34\%$, 55 cases (50.9%) had an open coronary arteries; 43 cases (48.9%) had a single vessel disease and the rest 125 cases (66.1%) had more than a single vessel disease. Of 162 patients with a lymphocyte percentage $>34\%$, 53 cases (49.1%) had an open coronary artery disease, 45 cases (51.1%) had a single vessel disease and the rest 64 cases (33.9%) had more than a single vessel disease. A significant relationship was observed between the lymphocyte percentage and the extent of coronary arteries ($p=0.006$).

In our study, of 129 patients with PMN $<59\%$, 44 cases (40.7%) had an open coronary artery disease; 34 cases (38.6%) had a single vessel disease and the rest 51 cases (27%) had more than a single vessel disease. A significant relationship was observed between the percentage of PMNs and the extent of coronary artery involvement ($p=0.028$).

In our study, of 317 patients with a eosinophiles percentage $<2.7\%$, 89 patients (82.4%) had an open coronary artery disease; 78 patients (88.6%) had more than a single vessel, disease. 86% of the patients had an eosinophiles percentage of $>2.7\%$, 19 patients of 17.6% had an open coronary artery disease, 10 cases (11.4%) had a single vessel disease and the rest 39 ones (20.6%) had more than a single vessel disease. There was no significant relationship between the percentage of eosinophiles and the extent of coronary artery involvement ($p=0.170$). In this study, of 288 patients (74.8%) with a monocyte percentage of $<4\%$, 77 cases (71.3%) had open coronary artery

disease, 69 cases (78.4%) had a single vessel disease and the rest 142 cases (75.1%) had more than a single vessel disease.

Of 97 patients (25.2%) with monocyte percentage $>4\%$, 31 cases (28.7%) had an open coronary artery disease, 19 cases (21.6%) had a single vessel disease and the rest 74 ones (24.9%) had more than a single vessel disease. In our study, no significant relationship was observed between the monocyte percentage and the extent of coronary involvement ($p=0.516$). Found to be $<50\%$, 43 patients of whom (39.8%) suffered from open coronary disease; 58 patients (65.9%) had single vessel disease and 150 others (79.4%) had more than single vessel disease. The correlation of frequency distribution of coronary artery involvement based on WBC count has been summarized in **Figure 2**.

Of 134 patients with the fraction $>50\%$, 65 cases had open coronary artery disease; 30 cases (34.1%) had a single vessel disease and the rest 39 ones (20.6%) had more than a single vessel disease. There was a significant relationship between the ejection fraction (EF) and the extent of coronary artery involvement ($p=0.000$).

DISCUSSION AND CONCLUSION

Coronary artery diseases have been the leading death cause among both American men and women in 2003. These are also the most widespread death cause of those over 35 years old in Iran. There are several ways to examine those who suffer from coronary artery disease including invasive and non-invasive methods. One of the invasive methods is coronary artery angiography which can lead to a precise understanding of the coronary artery disease. The relationship between the white blood cell count and the possibility of anphorctusmiocard or intents coronary events has been examined in numerous studies. Barron and his colleagues studied the relationship between white blood cell count and epicardial blood flow and myocardial perfusion in 975 patients and concluded that patients with narrow coronary arteries have more white blood cells compared with those suffering from open coronary arteries. Additionally, they found out that a larger number of white blood cells leads to a reduction in epicardial blood flow and myocardial perfusion [7].

In the study conducted by Sabatine and his colleagues, the correlation between white blood cells and the extent of coronary artery involvement in patients suffering from acute coronary syndrome was explored.

The participants of the study were 2208 patients who had undergone angiography. The results indicate that a large number of white blood cells in patients suffering from Non ST unstable angina, elevation of epicardial coronary arteries, a high extent of coronary arteries and over 6-month mortality [8].

In this study, the relationship between blood cells and the extent of coronary arteries among 385 patients who have consulted Taleghani hospital to undergo angiography has been examined. We concluded that an increase in the number of leukocytes is significantly related to the extent of coronary arteries ($p=0.000$) which in keeping with the studies conducted by Barron and Sabatine.

In Cavusoglu's study, 389 male patients have been examined who had undergone angiography. In addition to white blood count, other inflammatory markers including CRP, ESR, myeloperoxidase, Tissue inhibitor of metalloproteinase with regard to coronary artery involvement have been examined. of these, the only independent marker was the white blood cell count that was related to coronary artery involvement and even the frequent involvement of coronary artery had a correlation with white blood cell count [9-10]. In the study we conducted a significant relationship between the extent of coronary artery involvement and the high white blood cell count was observed which is consistent with the study aforementioned. In addition, 242 patients out of the total 385 patients were males, 139 of whom (73.5%) suffered from single vessel disease, indicating that there is a significant correlation between coronary artery involvement and gender in the study we carried out ($p=0.000$). In the study conducted by Sukhija and colleagues to delineate the relationship between inflammatory markers and the intensity of coronary artery, 249 patients have been examined in a prospective study. The serum level of hs-CRP, interleukin-6 and TNF- α were measured in patients who suffered from chest ache or had referred to undergo angiography. According to this study, there is no relationship between CRP inflammatory markers, interleukin-6 and TNF- α and the extent of coronary artery involvement in the angiography of CAD patients [11-13].

In our study, there was a significant relationship between inflammatory WBC, percentage of lymphocyte and that of neutrophils and the extent of coronary artery involvement but the measurement of other inflammatory markers such as CRP, ESR, interleukin-6 and TNF- α has not been made in our study. In the study carried out by Rasouli and his colleagues, a significant correlation was found to exist between the number of leukocytes, neutrophils and eosinophils and the extent of coronary artery involvement. In our enquiry, a significant relationship was found

between the total number of leukocytes and neutrophils and the extent of coronary artery involvement which is compatible with Rasouli's study. However, no significant relationship was observed between eosinophils and extent of coronary artery involvement which is incompatible with Rasouli's and his colleagues' study ($p=0.170$, $p=0.28$). No significant relationship was observed between lymphocyte, monocytes, ESR, ha CRP and the extent of coronary artery involvement in the study conducted by Rasouli and his colleagues [14].

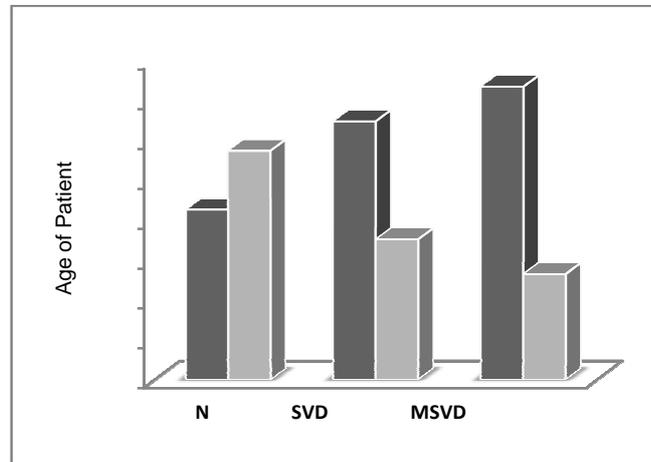


Figure 1: Correlation of frequency distribution of coronary artery involvement based on gender of the studied patients

Abbreviations: N=Normal; SVD=Single Vessel Disease; MSVD=More than Single Vessel Disease. Dark columns: males, light columns: females.

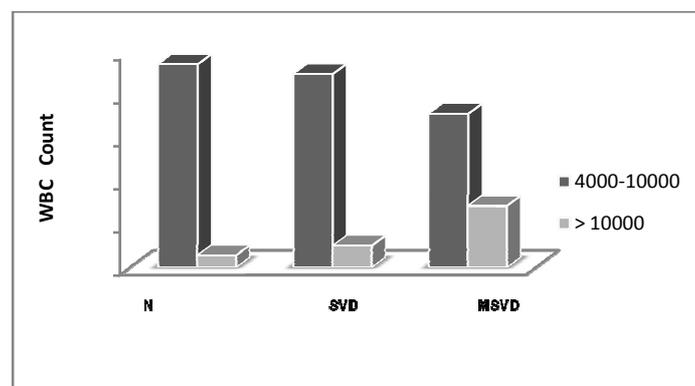


Figure 2: The correlation of frequency distribution of coronary artery involvement based on WBC count

Abbreviations: N=Normal; SVD=Single Vessel Disease; MSVD=More than Single Vessel Disease.

In the study we conducted a significant relationship was observed between the extent of lymphocyte percentage and the extent of coronary artery involvement which is in consistent with the study carried out by Rasouli and his colleagues ($p=0.006$). Furthermore, no significant correlation between monocyte percentage and the extent of coronary artery involvement which is in keeping with the study of Rasouli and his colleagues ($p=0.516$). Inflammatory markers of ESR and CRP have not been measured in our study. A significant relationship among a history of diabetes, smoking and dyslipidemia (which has been proved to be one of the factors of coronary artery diseases) and the extent of coronary artery involvement was observed ($p=0.013$, $p=0.049$, $p=0.012$ and $p=0.008$); however, there was no significant relationship between a history of cardiovascular diseases in blood relatives and the extent of coronary artery involvement ($p=0.239$). In our study, patients with 50% ejection fraction demonstrated a far more significant extent of coronary artery involvement than those with > 50% ejection fraction ($p=0.000$).

Based on our study, white blood cell count serves as a predictive factor in the extent of coronary artery involvement. In this enquiry, a large number of white blood cells, lymphocyte, and neutrophils leads to the possible increase in

single vessel disease. Therefore, white blood cell count, and the percentages of lymphocyte and neutrophils can be used as a useful, simple means for categorizing the patients to select treatment type and to consider the possible risks. consequently, if considered along with the know factors and clinical signs of the patients, white blood cell count can play a role in decision – making concerning angiography.

Acknowledgement

The authors wish to thank Mr. Seyed Hatam Tamimi Sa'd, Urmia University, Department of English Language, for his helpful contribution in editing and preparing the English translation of the final manuscript.

REFERENCES

- [1] Thom T, Haase N, Rosamond W, Howard VJ, Rumsfeld J, Manolio T, et al. *Circulation*, **2006**;113:85-151.
- [2] Saeid E. *Iranian Heart journal*, **2001**, 2(2):28-31.
- [3] Ross R. *N. Engl. J. Med.*, **1999**, 340:115-126.
- [4] Ridker PM, Cushman M, Stampfer MJ, et al. *N Eng J Med*, **1997**, 336:973-979.
- [5] Ridker PM, Buring JE, Shih et al. *Circulation*, **1998**, 98:731-733.
- [6] Yarnell JW, Baker JA, et al. *Circulation*, **1991**, 83:836-844.
- [7] Barron HV, Cannon CP, Murphy SA. et al. *Circulation*, **2000**, 7:102(19):2329-34.
- [8] Sabatine MS, Morrow DA, Cannon CP, Murphy SA, Demopolos LA, Dibattiste PM et al. *J Am Cell Cardiol*, **2002**, 40(10):1761-8.
- [9] Fangl, Wei H, Mak KH, Xiong Z, Song J, Lim YL et al. *Can J Cardiol*, **2004**, 20(14):1433-8.
- [10] Cavusoglu E, Chopra V, Gupta A, Ruwende C, Yanamadadas GC et al. *Am J Cardiol*, **2006**, 98(9):1189-3.
- [11] Furman MI, Gore JM, Anderson FA, Buda JA, Goodman SG et al. *Am Heart J*, **2004**;147(1):42-8.
- [12] Kruk M, Kares M, Przulski J, Bektap, Kepka C et al, *Int J Cardiol*, **2007**, 116(3):376-82.
- [13] Sukhija R, Fahdi I, Garza L, Finkl, et al. *Am J Cardiol*, **2007**, 99(7): 879-84.
- [14] Rasouli M, Kiasari AM, Bagheri B et al. *Clin Chim Acta*. **2007**, 377(1-2):127-32.