Compare Different Blood Parameters Between Different Types of Catheter in Atherosclerosis Patients with Type 2 Diabetes

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**Abstract**

Human blood groups ABO (BG) represent an important system in blood transfusion medicine and transplantation, and have a role in the development of heart disease. The current study was conducted with the aim of comparing the types of blood groups and knowing the most affected by atherosclerosis and type 2 diabetes. Our study was consisted of total (n=192) population with age range (45-70) years old and overweight in terms of their BMI. The first group included (n=64) under Precautinosous coronary intervention (PCI) catheterization with atherosclerosis and diabetes type 2. The second group (n=64) underwent Diagnostic (DIG) catheterization with diabetes type 2 and without atherosclerosis.

The association between blood group types with diabetes type 2 disease and atherosclerosis was investigated. The most prevalent blood group was O\(^+\) (93.74\%) in DIG, (80.84\%) in PCI closely followed by group B (49.99\%), (44.62\%) in DIG and PCI respectively, and group A (43.75\%) In both group. Least prevalent blood group was AB (35.25\%) in PCI and (12.5\%) in DIG group. In conclusion the patients with type O are more likely to have diabetes and atherosclerosis, and those with type B are more likely to develop diabetes. Type A and AB are less likely to develop sclerosis.

**Keywords:**
Blood group (A, B, AB, O)
Atherosclerosis
Type 2 diabetes mellitus
Complete blood count (CBC)

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1. **Introduction**

Cardiovascular disease is the most common cause of death in developed countries and is rapidly spreading in developing countries [1]. It is the major cause of death all over the world; there are many risk factors that contribute to increase cardiovascular disease, such as aging, gender, dyslipidemia, hypertension and diabetes, smoking, and family history [2]. The ABO system is the most important blood group system in human blood transfusion [3]. This system encompasses type A and type B red blood cell antigens. Their absence or presence relies on three separate alleles (A, B, O) at one genetic site. Anti-A and Anti-B, ABO antibodies common in the early years of life are produced by sensitizing to environmental materials such as food, bacteria, and viruses [4].

The most polymorphic of human blood groups is the Rh blood group system, consisting of at least 45 independent antigens, and in addition to ABO, it is considered the most clinically important in blood transfusion medicine. There are two types of blood type Rh. Negative and positive. These two different types depend on the presence or absence of antigen D [5]. The commonness of a blood group in a geographical area or a community can affect the incidence of certain diseases [6]. Previous studies showed that the relation of ABO blood
groups and ischemic heart disease in Italy, Iran and India [7,8]. Cardiovascular diseases in particular have been associated with ABO blood types and various diseases. Genome-Wide Association (GWAS), ABO has identified blood groups as the site of clotting and myocardial infarction, there are multiple vital indicators of risk for cardiovascular disease, and attract attention on the mechanisms and potentials of clinical progress [9]. To our knowledge, there is no recent published study available on this topic among the general population in Iraq. Thus, the aim of the present study is to investigate whether the ABO blood groups most affected by atherosclerosis associated with type 2 diabetes who undergo catheterization in Iraqi patients.

2. Materials and Methods
The study included 128 patients male and female with atherosclerosis type 2 diabetic mellitus (T2DM); 64 of them underwent precautious coronary intervention catheterization (PCI) and 64 underwent diagnostic catheterization (DIG) in addition to 64 healthy volunteers matched for age ranged between 45-70 years and gender (male and female) as a control group were involved in the present study. All samples were collected from patients attending to department of Clinical chemistry/Coronary care unit and Catheterization unit in Al-Sheikh Zayed and Ibn Al-Nafees Hospital in Baghdad, from June 2017 until January 2018. Each group contains 32 male and 32 female individuals. Patients who have had chronic renal failure, peripheral atherosclerosis and chronic inflammatory as well as smoking or alcohol drinking were excluded from the study. The Ethics-Committee of the College of Science / University of Baghdad has approved the protocol of this study. The ABO blood type was measured by the absence or presence of antigens A and/or B on the surface of the red blood cells in the serum [10]. Blood collecting by using commercial kit manufactured by (Article Medical). And the blood group was determined immediately after a clean white glass plate has been used by dropping three drops of blood on it. Each drop was mix with a drop of specific antibody in the kit using a woody stick, the first drop was mix with antibody A, the second was mixed with antibody B and the last one was Mixed with antibody Rh, as shown in Figure 2.

![Figure 2. The Blood types [11].](image)

Blood clinical biomarkers in each case study were determined by detecting the levels of complete blood count (CBC). These parameters were determined by using Ruby hematology Abbott analyzer/Germany.

3. Statistical Analysis
The statistical analysis was carried out by using the program Statistical Package for the Social Science (SPSS version 23.0). ANOVA test was used to show the differences between variables of differentiated groups. P-value less that 0.05 was considered significant.

4. Results and Discussion
The subjects of this study divided into subgroups, according to gender, blood type, Rh blood type, the Demographic characteristics in three groups as shown in the Table 1.

| Parameter         | PCI catheterization | DIG catheterization | C         | P-value |
|-------------------|---------------------|---------------------|-----------|---------|
| Age(year)         | 58.32 ± 0.78        | 58.39 ± 0.83        | 56.43 ± 0.81 | 0.135   |
| BMI (kg/m²)       | 27.81 ± 0.23        | 28.03±0.19          | 27.85±0.23 | 0.786   |
| Circumference (cm)| 102.62 ± 1.60       | 106.08 ±1.50        | 101.81 ± 2.00 | 0.182   |
| Hip Circumference (cm) | 102.62 ± 1.60 | 106.08 ±1.50        | 101.81 ± 2.00 | 0.182   |
| WHR (cm)          | 0.96 ± 0.01         | 0.97±0.01           | 0.95 ± 0.02 | 0.646   |
| WHtR (cm)         | 0.59 ±0.01          | 0.62±0.01           | 0.58±0.01  | 0.093   |
| Waist (m)         | 98.69 ± 1.68        | 103.29 ± 1.51       | 98.55 ± 3.13 | 0.226   |
| Heart rate (beat / minute) | 80.00 ±1.41 | 81.79 ±1.54         | 79.77 ± 1.38 | 0.546   |

NS: No-significant, Sig: significant, WHR (waist to Hip ratio), WHtR (waist to height ratio), SE: standard error.

It is clear that there is no significant difference in the Demographic characteristics parameters among three groups.
Table 2. Distribution of sample study according to blood group.

| Group and gender | BLOOD GROUP | Total | P-value |
|------------------|-------------|-------|---------|
|                  | A’(N%)      | B’(N%)| AB’(N%) | O’(N%) |
| Control          |             |       |         |        |
| Male             | 6 (19.35%)  | 17 (54.83%) | 0(%) | 8(25.80%) | 31 | 0.0001 ** |
| Female           | 7(21.87%)   | 14(43.75%) | 4(12.5%) | 7(21.87%) | 32 | 0.0001 ** |
|                 | %           | 41.22 | 98.58 | 12.5  | 47.67 |
| DIG              |             |       |         |        |
| Male             | 8(25%)      | 7(21.87%) | 4(12.5%) | 13(40.62%) | 32 | 0.0002 ** |
| Female           | 6(18.75%)   | 9(28.12%) | 0(%) | 17(53.12%) | 32 | 0.0001 ** |
|                 | %           | 43.75 | 49.99 | 12.5  | 93.74 |
| PCI              |             |       |         |        |
| Male             | 6(18.75%)   | 11(34.37%) | 8(25%) | 7(21.87%) | 32 | 0.0068 ** |
| Female           | 8(25%)      | 4(10.25%) | 4(10.25%) | 23(58.97%) | 39 | 0.0001 ** |
|                 | %           | 43.75 | 44.62 | 35.25 | 80.84 |

NS: Non-significant, ** (P<0.01) significant.

As it was shown in the Table 2, there were significant difference between blood group in patients under PCI and DIG.

Table 3. Compare between difference group in WBC and differential Of WBC.

| Group | Mean ± SEM | WBC (×10^9/L) | Neutrophil (%) | Lymphocyte (%) | Neutrophil-lymphocyte ratio(N/L) | Monocyte (%) | Eosinophil (%) | Basophile (%) |
|-------|------------|---------------|----------------|----------------|----------------------------------|--------------|----------------|--------------|
| PCI   | 8.87 ± 0.36 | 4.86 ± 0.26   | 3.01 ± 0.12    | 1.78±0.15      | 0.58 ± 0.04                      | 0.31 ± 0.07  | 0.10 ± 0.01    |
| DIG   | 8.64 ± 0.51 | 4.70 ± 0.29   | 3.15 ± 0.31    | 1.66±0.22      | 0.50 ± 0.05                      | 0.11 ± 0.03  | 0.09 ± 0.02    |
| C     | 7.53 ± 0.41 | 4.55 ± 0.34   | 2.31±0.19      | 2.23±0.16      | 0.52 ± 0.03                      | 0.25 ± 0.07  | 0.07 ± 0.01    |
| LSD value | 1.244 * | 0.868 | 0.613 * | 0.086* | 0.122 | 0.181 | 0.0242 * |
| P-value | 0.050 | 0.769 | 0.016 | 0.045 | 0.452 | 0.456 | 0.027 |

NS: Non-significant, ** (P<0.01) significant, LSD: low significant difference.

As shown in the Table 3, white blood cell, Lymphocyte showed significant difference between subgroup PCI, DIG and C (p = 0.050), while no significant difference were shown when compare the number of Neutrophil, Monocyte and Eosinophil between PCI, DIG and control group.

On the other hand compare between difference groups in some blood of parameters as listed in Table 4, it was noticed that there was moderately significant increase in the values of platelet (PLT) in PCI when we compare them to that of the control group.

Table 4. Comparison in blood parameters between PCI, DIG and Control.

| Group | Mean ± SE | RBC (×10^6/µl) | Hb (g/dl) | HCT (%) | MCV (fL) | MCH (pg) | MCHC (g/dl) | RDW (%) | PLT (×10^9/L) |
|-------|-----------|----------------|-----------|---------|---------|---------|------------|---------|-------------|
| PCI   | 4.89 ± 0.12 | 13.01 ± 0.42 | 41.43 ± 1.01 | 84.94 ± 1.34 | 26.65 ± 0.69 | 31.29 ± 0.43 | 11.90 ± 0.44 | 253.00 ± 13.95 |
| DIG   | 4.69 ± 0.08 | 13.02 ± 0.31 | 40.66 ± 0.68 | 86.66 ± 1.16 | 27.74 ± 0.62 | 31.98 ± 0.37 | 11.41 ± 0.22 | 237.08 ± 15.04 |
| C     | 4.72 ± 0.10 | 12.91 ± 0.49 | 40.37 ± 1.14 | 85.81 ± 1.82 | 27.22 ± 0.87 | 32.49 ± 0.57 | 11.27 ± 0.18 | 215.13 ± 10.13 |
| LSD value | 0.304 | 1.236 | 2.856 | 0.737 | 2.175 | 1.383 | 0.863 | 36.705 * |
| P-value | 0.392 | 0.976 | 0.736 | 4.305 | 0.623 | 0.615 | 0.298 | 0.050 |

RBC: Red blood cell, Hb: Hemoglobin, HCT: Hematocrit, MCV: mean corpuscular value, MCH: mean corpuscular hemoglobin, MCHC: mean corpuscular hemoglobin concentration, RDW: Red cell distribution width, PLT: platelet.
Table 5. Compare between Blood group and different Laboratory parameters as (mean ± SE).

| Parameters        | Mean ± SE       | P-value |
|-------------------|-----------------|---------|
|                   | A*              | AB*     | B*     | O*     |
| WBC(×109/L)       | 7.29 ± 0.46     | 9.05 ± 0.52 | 7.11 ± 0.42 | 9.49 ± 0.39 | 0.0001 ** |
| Neutrophile (%)   | 4.20 ± 0.31     | 4.45 ± 0.55 | 4.29 ± 0.37 | 5.18 ± 0.23 | 0.048 *    |
| Lymphocyte (%)    | 2.30 ± 0.21     | 2.79 ± 0.14 | 2.29 ± 0.21 | 3.24 ± 0.21 | 0.003 **   |
| Monocyte (%)      | 0.517 ± 0.03    | 0.606 ± 0.07 | 0.469 ± 0.03 | 0.629 ± 0.06 | 0.074      |
| Eosinophile (%)   | 0.184 ± 0.03    | 0.228 ± 0.03 | 0.172 ± 0.04 | 0.335 ± 0.07 | 0.166      |
| Basophile (%)     | 0.071 ± 0.01    | 0.089 ± 0.01 | 0.065 ± 0.01 | 0.104 ± 0.01 | 0.002 **   |
| RBC (×106/µl)     | 4.75 ± 0.18     | 5.04 ± 0.16 | 4.78 ± 0.12 | 4.72 ± 0.09 | 0.442      |
| Hb (g/dl)         | 12.99 ± 0.61    | 13.46 ± 0.51 | 12.94 ± 0.35 | 12.77 ± 0.42 | 0.819      |
| HCT (%)           | 41.12 ± 1.50    | 42.92 ± 1.26 | 40.53 ± 0.87 | 40.62 ± 0.95 | 0.578      |
| MCV(µL)           | 86.71 ± 1.29    | 86.91 ± 0.85 | 85.45 ± 1.66 | 85.57 ± 1.45 | 0.917      |
| MCH (pg)          | 27.47 ± 0.76    | 27.86 ± 0.33 | 27.18 ± 0.75 | 26.98 ± 0.74 | 0.914      |
| MCHC (g/dl)       | 31.64 ± 0.59    | 32.33 ± 0.35 | 31.66 ± 0.43 | 31.36 ± 0.45 | 0.701      |
| RDW (%)           | 12.07 ± 0.64    | 11.73 ± 0.58 | 11.18 ± 0.20 | 11.39 ± 0.19 | 0.312      |
| PLT (×109/l)      | 223.81 ±18.0    | 219.89 ±7.84 | 205.77 ±10.1 | 255.16 ±12.8 | 0.024 *    |
| MPV (%)           | 23.14 ±11.34    | 6.41 ±0.35  | 15.91 ±9.13 | 9.17 ±2.46 | 0.492      |

* (P<0.05), ** (P<0.01), NS: Non-Significant.

5. Discussion
The most important finding of the current study is the relationship of blood groups and the extent of atherosclerosis associated with type 2 diabetes in Iraqi patients who underwent catheter examination of both types. This study is considered a first prospective, and to our knowledge. Our result agrees with Whincup et al., 1990 [12], who reported that individuals who have blood type O exposed more than other blood types to heart and hypertension, the disease that related to PCI. Physicians can benefit from the results of this research for early diagnosis diabetes mellitus by paying more attention to subjects having more susceptible blood group and advise them to adopt a healthy lifestyle to decrease the risk of getting diabetes [13].

Several studies have found a significant difference between acute coronary events and ABO, particularly sudden cardiac death and acute myocardial infarction [14, 15, 16]. Our study reinforced the hypothesis that type 2 DM is associated with blood groups in terms of the broad genetic immunologic basis in both. It was found that the frequency of O and B blood groups is significantly lower and higher, respectively, in type 2 DM patients [17]. Theoretically, ABO blood group can alter the rate of von Willebrand factor (vWF) synthesis or secretion within endothelial cells. Additionally, ABO group may affect vWF plasma clearance rates. ABH antigenic determinants have been identified on the N-linked oligosaccharide chains of circulating vWF and FVIII, according to the blood group of the individual. Previous studies have shown controversial findings on the relationship between ABO blood groups and cardiomyopathy in Italy, Iran, and India [17, 18, 19, 20, 21].

The results of the present study disagrees with some studies which concluded that there was an association between type 2 DM and A and O blood groups, while subjects with blood group B had higher incidences of type 2 DM and hence were at higher risk of getting type 2 DM [22]. These controversies between the association of blood group and atherosclerosis can be due to several confounding factors like, hypertension, smoking and diabetes mellitus. Meanwhile, the environmental, socioeconomic condition and a life style may have some effect on ABO and atherosclerosis.

Our study agrees with a study by Sujirachato et al., which argued that patients, especially women, with coronary atherosclerosis and blood group O had increased sudden cardiac deaths. [23, 24]. The limitation of this study, are needed to enhance the relationships by a prospective, larger population studies.

6. Conclusion
Through this study, it was explained that ABO blood group had an effect on the risk of arteriosclerosis with type 2 DM. It was found that Atherosclerosis and type 2 diabetes in individuals with blood type O while other blood groups B, A and AB had lower incidences of these diseases respectively, on the other hand, the effects of the blood group extend to include the severity of arteriosclerosis and type 2 diabetes.
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