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Distribution of ABO and Rh Blood Group Among Patients Undergoing Hemodialysis in Libya: A Cross-Sectional Study

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Abstract
The ABO blood group system is one of the most clinically important blood group systems and has been implicated in the susceptibility to various diseases, including cardiovascular and renal disorders. However, the relationship between ABO blood groups and chronic kidney disease remains controversial and has been insufficiently investigated in Libyan populations. This study aimed to determine the distribution of ABO and Rh blood groups among patients undergoing maintenance hemodialysis in western and southern Libya and to evaluate whether specific blood groups are overrepresented in this patient population. A cross-sectional descriptive study was conducted on 120 patients with end-stage renal disease receiving maintenance hemodialysis between 2021 and 2025. Participants were recruited from four dialysis centers in Libya, namely Misrata Medical Center, Gharyan Teaching Hospital, Brak General Hospital, and Bouzayan Gharyan Center. The patients' ages ranged from 20 to 80 years. ABO and Rh blood groups were determined using standard hemagglutination techniques. Data were analyzed using descriptive statistics and the chi-square test, with statistical significance considered at $p < 0.05$. Of the 120 patients enrolled, 58 (48.33%) were males and 62 (51.67%) were females. Blood group O was the most prevalent blood type, accounting for 45.83% of cases, followed by blood groups A (30.83%), B (19.17%), and AB (4.17%). Similar distribution patterns were observed in both male and female patients. No statistically significant differences in ABO blood group distribution were detected between genders ($p > 0.05$). Blood group O was the predominant ABO phenotype among hemodialysis patients in western and southern Libya, followed by groups A, B, and AB. The observed distribution pattern appears to reflect the general ABO blood group distribution commonly reported in the region, and no evidence of a significant association between a specific blood group and end-stage renal disease was identified. Further large-scale case-control studies involving healthy controls are recommended to clarify the potential role of ABO blood groups in chronic kidney disease.

Keywords: ABO blood groups; Rh factor; Hemodialysis; End-stage renal disease; Chronic kidney disease; Libya.

الملخص:

يُعد نظام فصائل الدم ABO من أهم أنظمة فصائل الدم من الناحية السريرية، وقد ارتبط بالقابلية للإصابة بأمراض متعددة، من بينها الاضطرابات القلبية الوعائية والكلوية. ومع ذلك، لا تزال العلاقة بين فصائل الدم ABO ومرض الكلى المزمن مثار جدل، ولم تحظَ بدراسة كافية في التجمعات السكانية الليبية. هدفت هذه الدراسة إلى تحديد توزيع فصائل الدم ABO وعامل الريزوس ((Rh) بين المرضى الخاضعين لغسيل الكلى المستمر في غرب وجنوب ليبيا، وتقييم ما إذا كانت بعض فصائل الدم أكثر تمثيلاً بين هذه الفئة من المرضى مقارنة بغيرها. أُجريت دراسة وصفية مقطعية على 120 مريضًا مصابًا بالمرحلة النهائية من الفشل الكلوي ويخضعون لغسيل كلوي مستمر خلال الفترة بين عامي 2021 و2025. تم تجنيد المشاركين من أربعة مراكز لغسيل الكلى في ليبيا، هي: مركز مصراتة الطبي، ومستشفى غريان التعليمي، ومستشفى براك العام، ومركز بوزيان غريان. تراوحت أعمار المرضى بين 20 و80 عامًا. حُددت فصائل الدم ABO وعامل الريزوس باستخدام تقنيات التلازن الدموي القياسية، وحُللت البيانات باستخدام الإحصاء الوصفي واختبار مربع كاي، مع اعتبار الفروق ذات دلالة إحصائية عند مستوى احتمال أقل من 0.05. من بين 120 مريضًا شملتهم الدراسة، كان 58 مريضًا (48.33%) من الذكور و62 مريضًا (51.67%) من الإناث. كانت فصيلة الدم O هي الأكثر شيوعًا، إذ مثّلت 45.83% من الحالات، تلتها فصيلة A بنسبة 30.83%، ثم فصيلة B بنسبة 19.17%، وأخيرًا فصيلة AB بنسبة 4.17%. لوحظت أنماط توزيع متشابهة بين المرضى الذكور والإناث، ولم تُلاحظ فروق ذات دلالة إحصائية في توزيع فصائل الدم ABO بين الجنسين. كانت

فصيلة الدم O هي النمط الظاهري السائد بين مرضى الغسيل الكلوي في غرب وجنوب ليبيا، تلتها فصائل A وB وAB على التوالي، ويبدو أن نمط التوزيع الملاحظ يعكس التوزيع العام لفصائل الدم ABO الشائع في المنطقة، دون وجود دليل واضح على ارتباط فصيلة دم معينة بالمرحلة النهائية من الفشل الكلوي. وتوصي الدراسة بإجراء دراسات حالة وشاهد أوسع نطاقًا تشمل أفرادًا أصحاء، لتوضيح الدور المحتمل لفصائل الدم ABO في مرض الكلى المزمن.

الكلمات المفتاحية: فصائل الدم ABO؛ عامل الريزوس (Rh)؛ الغسيل الكلوي؛ الفشل الكلوي في مرحلته النهائية؛ مرض الكلى المزمن؛ ليبيا.

Introduction

The kidneys are essential organs responsible for maintaining homeostasis by filtering metabolic waste products, regulating fluid and electrolyte balance, controlling acid–base equilibrium, and producing hormones involved in erythropoiesis and blood pressure regulation. Under normal physiological conditions, the kidneys filter approximately 180 liters of plasma per day, ensuring the elimination of toxins and maintenance of internal balance (1). Chronic kidney disease (CKD) is defined as abnormalities of kidney structure or function that persist for more than three months and have important implications for health. Progressive deterioration of renal function can eventually lead to end-stage renal disease (ESRD), in which the kidneys are unable to adequately perform their physiological functions and renal replacement therapy, including hemodialysis or kidney transplantation, becomes necessary (2). The global prevalence of CKD has increased substantially and represents a major public health challenge associated with increased morbidity, mortality, and healthcare costs (3). Several factors contribute to the development and progression of CKD, including diabetes mellitus, hypertension, cardiovascular disease, obesity, genetic predisposition, and certain congenital or acquired renal disorders. Diabetes mellitus and hypertension are recognized as the leading causes of ESRD worldwide (4). The ABO blood group system, first described by Karl Landsteiner in 1900, remains the most clinically significant blood group system and constitutes the foundation of modern transfusion medicine (5). The ABO system comprises four principal blood groups: A, B, AB, and O. These blood groups are determined by the presence or absence of A and B carbohydrate antigens expressed on the surface of red blood cells and various epithelial and endothelial tissues. Individuals with blood group A express N-acetylgalactosamine, whereas those with blood group B express D-galactose. Blood group O lacks these terminal carbohydrate structures and expresses only the unmodified H antigen (6). ABO antigens are not confined to erythrocytes; they are also expressed on endothelial cells, platelets, vascular tissues, and epithelial cells of several organs, including the kidneys. In renal tissue, ABO antigens have been identified on glomerular and peritubular capillary endothelium, tubular epithelial cells, and collecting ducts (7). Consequently, increasing evidence suggests that ABO blood groups may influence susceptibility to various diseases through their effects on inflammation, endothelial function, thrombosis, and immune responses (8). Recent studies have demonstrated associations between ABO blood groups and several chronic diseases, including cardiovascular disease, diabetes mellitus, malignancies, and certain renal disorders. However, data regarding the relationship between ABO blood groups and chronic kidney failure remain limited and inconsistent, particularly in North African populations. Investigating this association may contribute to identifying potential risk factors and improving early detection and preventive strategies among susceptible individuals (9). Therefore, the present study aimed to determine the distribution of ABO and Rh blood groups among patients undergoing maintenance hemodialysis in different regions of Libya and to evaluate whether specific blood groups are overrepresented in this patient population by comparing the observed distribution with findings reported in previous regional and international studies.

Materials and Methods

Study Design and Setting

This retrospective cross-sectional study was conducted among patients with end-stage renal disease undergoing maintenance hemodialysis between January 2021 and December 2025. The study included dialysis centers from different regions of Libya, namely the Dialysis Unit at Misrata Medical Center, the Dialysis Unit at Gharyan Teaching Hospital, the Dialysis Unit at Brak General Hospital, and the Dialysis Unit at Bouzayan Gharyan Center.

Study Population

A total of 120 patients receiving regular hemodialysis were enrolled in the study. The participants' ages ranged from 20 to 80 years. Patients diagnosed with end-stage renal disease and receiving maintenance hemodialysis during the study period were included. Patients with incomplete medical records or unknown blood group status were excluded from the study.

Data Collection

Demographic and clinical information, including age, sex, and dialysis status, were collected from patients' medical records. Venous blood samples were obtained under aseptic conditions for ABO and Rhesus (Rh) blood group determination.

ABO and Rh Blood Group Determination

ABO and Rh blood grouping was performed using standard hemagglutination techniques with commercially prepared anti-A, anti-B, and anti-D antisera according to the manufacturer's instructions. Agglutination patterns were interpreted to determine the ABO blood group and Rh status of each participant.

Statistical Analysis

Data were entered and analyzed using the Statistical Package for Social Sciences (SPSS) software version 26.0. Descriptive statistics were presented as frequencies and percentages. The distribution of ABO and Rh blood groups among hemodialysis male patients was compared with female patients. The chi-square test was used to assess associations between categorical variables, and a p-value of less than 0.05 was considered statistically significant.

Ethical Considerations

The study protocol was reviewed and approved by the Institutional Ethics Committee of the Faculty of Nursing, University of Gharyan [ethics approval number to be inserted]. Data were obtained from existing medical records under conditions of confidentiality, and patient identifiers were removed prior to analysis in accordance with the Declaration of Helsinki.

Results

A total of 120 patients with end-stage renal disease undergoing maintenance hemodialysis were included in the study. The participants comprised 58 males (48.33%) and 62 females (51.67%), indicating a nearly equal gender distribution, with a slight predominance of female patients (Figure 1).

Figure 1 demonstrates that females constituted a marginally higher proportion of the study population than males. However, the difference between the two groups was minimal, suggesting that chronic kidney failure requiring hemodialysis affects both sexes at comparable frequencies within the studied population.

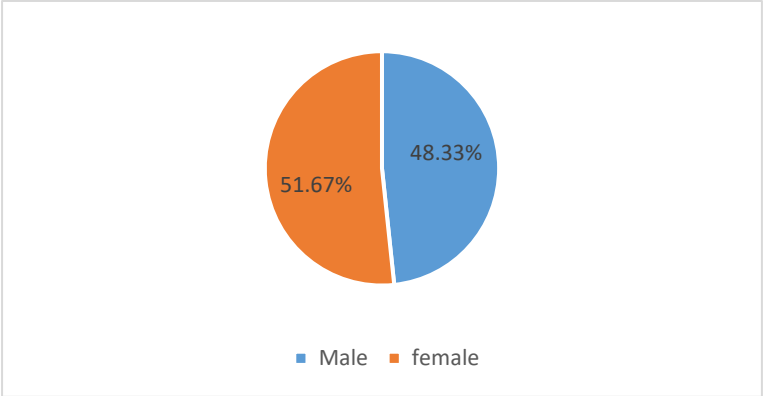

Figure 1 Distribution of patients with renal failure according gender

As shown in Table 1, blood group O was the predominant ABO blood type among hemodialysis patients, accounting for 45.83% of cases. Blood group A represented 30.83% of patients, followed by blood group B (19.17%), whereas blood group AB was the least frequent, accounting for only 4.17% of the study population.as figure 2

Table (1): The distribution of blood group among patients with renal failure

Blood group	N	%
A	37	30.83
AB	5	4.17
B	23	19.17
O	55	45.83
Total	120	100

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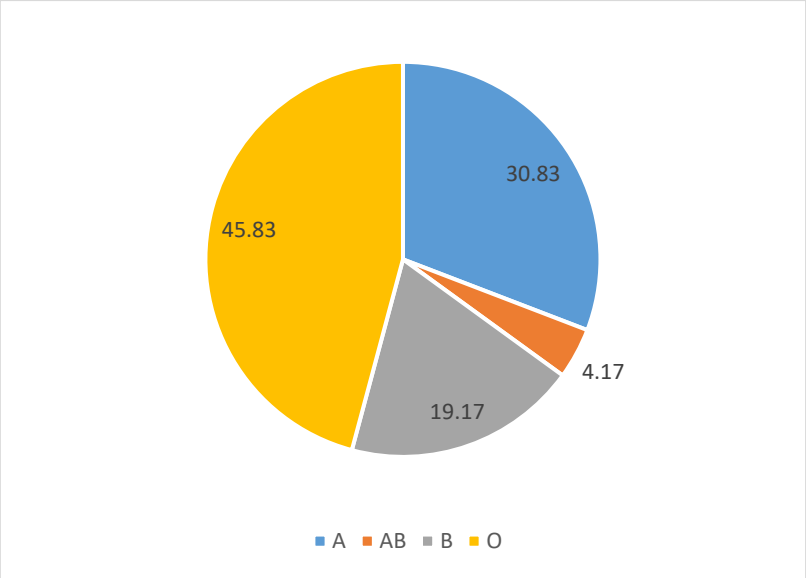

Figure 2: The distribution of blood group among patients with renal failure

Gender-specific analysis revealed a similar distribution pattern. Among male patients, blood group O was the most prevalent (44.82%), followed by blood groups A (32.75%), B (17.24%), and AB (5.17%) (Table 2). Likewise, among female patients, blood group O remained the predominant blood type (46.77%), followed by A (29.03%), B (20.97%), and AB (3.23%) (Table 3).

Table (2): The distribution of blood groups among male patients with Renal failure

Blood group	N	%
A	19	32.75
AB	3	5.17
B	10	17.24
O	26	44.82
Total	58	100

Table (3): The distribution of blood group among female patients with Renal failure

Blood group	N	%
A	18	29.03
AB	2	3.23
B	13	20.97
O	29	46.77
Total	62	100

Comparison of the overall ABO blood group distribution between male and female patients (Table 4) using the chi-square test demonstrated no statistically significant difference ($\chi^2 = 0.65$, df = 3, P = 0.885). The comparable distribution patterns observed in both sexes indicate that gender does not significantly influence the distribution of ABO blood groups among patients with end-stage renal disease undergoing hemodialysis in the present study population.

Table (4): The distribution of blood groups between male & female patients with Renal failure

Blood group	Male patients		Female patients		P value
	N	%	N	%	
A	19	32.75	18	29.03	>0.05
AB	3	5.17	2	3.23	>0.05
B	10	17.24	13	20.97	>0.05
O	26	44.82	29	46.77	>0.05
Total	58	100	62	100	

Discussion

The present study investigated the distribution of ABO blood groups among hemodialysis patients in southern and western Libya. The findings demonstrated that blood group O was the predominant blood type (45.83%), followed by groups A, B, and AB. In addition, no statistically significant differences in ABO blood group distribution were observed between male and female patients.

The predominance of blood group O observed in the present study is generally consistent with the reported distribution of ABO blood groups in Libya and neighboring countries, where blood group O represents the most common phenotype in the general population. Our findings are in agreement with the study conducted by Abbas et al. (2019), who reported that blood group O was the most prevalent blood type among patients with chronic kidney disease and found no convincing evidence of a strong association between a specific ABO blood group and renal dysfunction (10). Similarly, Hassoon et al. (2013) observed that blood group O was the predominant phenotype among hemodialysis patients and concluded that the distribution of ABO blood groups among dialysis patients closely resembled that of the general population (11).

Our results also align with those reported by Alalawi et al. (2022) in Dubai. In their retrospective study of 224 maintenance hemodialysis patients, blood group O-positive represented approximately 45% of all patients and remained the most common phenotype among both Emirati and non-Emirati individuals. Although blood group O predominated among diabetic dialysis patients in that cohort, the investigators found no evidence that ABO blood group independently influenced overall mortality. These findings support the conclusion of the present study that the predominance of blood group O does not necessarily imply an increased susceptibility to ESRD but rather reflects regional blood group frequencies (12)

Musleh (2022) reported that blood group O was the most frequent blood group among patients with renal failure in Salah Al-Din Governorate, Iraq. The study further suggested that individuals with blood group O may be more susceptible to renal disease and may experience more severe renal impairment than patients with other ABO blood groups (13)

Within the same national context, Azab and Alshoukry (2023) examined the distribution of ABO and Rh blood groups among 250 hemodialysis patients attending the Tripoli Center, comparing them with 100 healthy Libyan controls. In their cohort, blood group O was likewise the most common phenotype among hemodialysis patients (52.4%), followed by A (35.2%), B (8.4%), and AB (4%), a ranking that closely mirrors the pattern observed in the present study, where O (45.83%), A (30.83%), B (19.17%), and AB (4.17%) followed the same order, albeit with a somewhat lower proportion of group O and a higher proportion of group B. Azab and Alshoukry found no significant difference in the simple ABO distribution between their hemodialysis patients and healthy controls, in line with the non-significant associations reported in the present study; however, when ABO and Rh phenotypes were combined into eight subgroups, a significant difference emerged between patients and controls, a comparison the present study could not perform because no matched healthy control group was recruited. Regarding Rh status,

Rh-positive individuals clearly outnumbered Rh-negative individuals among their hemodialysis patients (92% versus 8%), a pattern broadly consistent with the Rh distribution generally described in the Libyan population. Together, these two Libyan studies support blood group O as the consistently predominant ABO phenotype among hemodialysis patients across different regions of the country, while suggesting that any association between combined ABO/Rh phenotype and renal failure may become apparent only when patients are directly compared with a matched healthy control group, an approach recommended for future studies in this population (15).

In a related line of evidence, Storry and Olsson (2009) demonstrated that ABO antigens are widely expressed on tissues other than erythrocytes, including renal tissues, and suggested that these antigens may participate in several pathological processes, including thrombosis and vascular injury (14).

The absence of statistically significant differences between male and female patients in the present study indicates that sex does not influence the distribution of ABO blood groups among hemodialysis patients. This observation is in agreement with the findings of Abbas et al. (2019) and Hassoon et al. (2013), who likewise reported no significant gender-related differences in ABO blood group frequencies among patients with chronic kidney disease and those undergoing maintenance hemodialysis (10,11).

Several limitations of the present study should be acknowledged. First, no matched healthy control group was recruited, which precluded direct statistical comparison between hemodialysis patients and the general population, unlike some of the studies discussed above. Second, the retrospective, single-timepoint design does not allow assessment of whether ABO or Rh phenotype influences the rate of progression to end-stage renal disease over time. Third, potential confounders such as underlying cause of renal failure, duration of dialysis, and comorbidities (e.g., diabetes mellitus and hypertension) were not analyzed in relation to blood group, and the sample was drawn from four dialysis centers, which may limit generalizability to other regions of Libya. These limitations should be addressed in future prospective, multicenter, case-control studies.

Overall, the present findings indicate that blood group O is the predominant ABO phenotype among Libyan hemodialysis patients and that the observed distribution of ABO blood groups closely resembles that reported in the general population. Consequently, the present data do not support a strong association between a particular ABO blood group and the risk of chronic kidney failure. Further large-scale multicenter case-control studies including healthy controls and adjustment for potential confounding variables are warranted to clarify the potential role of ABO blood groups in the pathogenesis of chronic kidney disease and end-stage renal disease (10-15).

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