Jurnal Ilmu dan Teknologi Kesehatan
https://ejurnal.poltekkesjakarta3.ac.id/index.php/jitek/
Volume 13, Issue 1, Page 57 – 62 DOI: 10.32668/jitek.v13i1.2074
e-ISSN: 2338-9109

Correlation Between ABO Blood Group And Activated Partial Thromboplastin Time (APTT) And Prothrombin Time (PT) Pathway Coagulation Parameters

1st Nur Vita Purwaningsih[1]

2nd Tri Ade Saputro[2*]

3rd Ellies Tunjung Sari Maulidiyanti[3]

[1,2,3] Technology Laboratory Medic, Faculty Health Science, Unniversitas Muhammadiyah Surabaya, East Java, Indonesia

[*]email*: triade13@um-surabaya.ac.id*

Keywords:
ABO blood group
APTT
PT

Abstract

Background: The ABO blood group is known to affect the levels of several coagulation factors, such as factor VIII and von Willebrand factor (vWF), which can affect the results of coagulation time. This study aims to analyze the relationship between ABO blood group and the coagulation parameters Activated Partial Thromboplastin Time (APTT) and Prothrombin Time (PT). Methods: This analytical cross-sectional study involved 45 healthy Medical Laboratory Technology students from Muhammadiyah University of Surabaya. Inclusion criteria were healthy volunteers; exclusion criteria included bleeding disorders, recent transfusion, smoking, or refusal to consent. Conducted in May 2025 at the Clinical Pathology Laboratory, data were analyzed using one-way ANOVA. Ethical approval was obtained from KEPK FIK Muhammadiyah University of Surabaya (No. 057/KEPK/F/V/FIK/2025). Results: The test results showed that the distribution of APTT and PT data was normal and homogeneous. There was a significant difference between blood groups on APTT values ($p = 0.006$), but there was no significant difference on PT values ($p = 0.605$). Blood type O has a higher APTT value than other blood types. Conclusion: There is a significant relationship between ABO blood group and APTT values, but not with PT. The difference in APTT values may be influenced by lower vWF and factor VIII levels in blood group O. This finding is important to consider in the interpretation of coagulation test results in clinical laboratories.

Received: Augs 2025
Accepted: Sept 2025
Published: Sept 2025

INTRODUCTION

Blood groups are important (1) in transfusion medicine and forensic pathology. Blood groups are also associated with diseases such as duodenal ulcers, diabetes mellitus, urinary tract infections, and incompatibility between mother and fetus causing hemolytic disease in newborns (2). ABO blood classification is based on the antigenic properties of red blood cells. The ABO group gene is on chromosome 9, while the Rh system is on chromosome 1. Type A individuals have antigen A, type B individuals have antigen B, and type AB individuals have both; type O individuals have neither of these antigens. These A and B antigens are complex oligosaccharides found on the surface of red blood cells that differ in their terminal sugar~~s~~ group (3).

The important blood glycoprotein vWf (von Willebrand factor) not only has an important role in maintaining hemostasis, but also carries antigens of the ABO blood group system. It has also been found that people with blood type O have reduced vWf expression compared to blood types A, B, and AB. Therefore, bleeding and clotting times are strongly influenced by ~~t~~he ABO blood group system. Insufficient vWf can cause bleeding complaints, while high levels can be a risk factor for venous thrombosis (3,4).

Clotting factors are proteins that exist in the blood are activated when tissues or blood vessels are damaged (5). APTT and PT are used to screen the coagulation deficiency (1). PT detects extrinsic and general disorders of the coagulation pathway. Abnormal results are usually observed when factor I (FI), FII, FV, FVII, and FX are deficient, while APTT screens for intrinsic and general coagulation pathway abnormalities. It monitors the activity of FI, FII, FV, FVIII, FIX, FX, FXI, and FXII (6).

The ABO blood group is known to affect hemostasis as it is a major determinant of von Willebrand factor (vWF) and FVIII plasma levels. Theoretically, variations in ABO blood group antigens can affect the glycosylation and degradation processes of vWF and FVIII proteins, thereby influencing their plasma concentrations (7,8). (9) Research shows that individuals non-O blood groups are more likely to have venous thromboembolism (VTE) than individuals non-O blood groups and have significantly greater levels (about 25%) of vWF and FVIII (10) which is one of the diseases for individuals non-O blood groups. Similarly, according to (11) plasma vWF levels and FVIII activity were significantly increased in individuals non-O blood type compared to those with type O blood in both groups. Therefore, this study aimed to determine the relationship between ABO blood type and APTT, as well as PT~~.~~

METHODS

Design

This research is an analytical study with a cross-sectional design to assess the level of APTT and PT. This research was conducted in May 2025. The location of the study was the clinical pathology laboratory of Muhammadiyah University of Surabaya.

Population, Sample Size And Sampling Technique

The population in this study was Medical Laboratory Technology Students at Muhammadiyah University of Surabaya. In this study, the samples used were citrate plasma and whole blood. which had the following criteria:

Inclusion criteria

All healthy volunteer students of the Medical Laboratory Technology of Muhammadiyah Surabaya University

Exclusion criteria :

Students who are known to have bleeding, students who have been transfused with blood three months ago, smokers, and / or who refuse to give consent.

Ethical consideration

This research conducted an ethical clearance at KEPK FIK Muhammadiyah Surabaya University with the number 057/KEPK/F/V/FIK/2025. Informed consent was obtained from all participants recruited for the study.

Sample collection and analysis

A total of six milliliters of venous blood was collected aseptically from the participants through venepuncture and divided for two different analyses. The first part consisted of 4,5 mL of blood that was placed into a bottle containing 0,5 mL-of 3.2% trisodium citrate. This sample was then spin at 4000 rpm for 10 minutes, allowing the plasma to be separated for PT and APTT testing. The second part included 1,5 mL of blood that was collected in an EDTA anticoagulant tube for blood grouping.

ABO blood grouping

The ABO blood grouping was done by the slide method. The process includes placing a ~~A~~ drop of anti-A, -B, and -AB on a white glass slide a drop of blood sample. The slide was tilted gently back and forth for 4 min and was observed for agglutination.

Procedure for PT and APTT Examination:

The Prothrombin Time (PT) and Activated Partial Thromboplastin Time (APTT) tests were performed using citrated plasma with a ratio of 1 part 3.2% sodium citrate anticoagulant to 9 parts of blood. Blood samples were collected via venipuncture and immediately centrifuged at 3,000 rpm for 15 minutes to obtain platelet-poor plasma. The tests were conducted on fresh plasma within two hours of collection.

For the PT test, 100 µL of plasma was placed in a test cuvette and incubated at 37°C for 1 minute. Then, 200 µL of thromboplastin reagent (containing calcium) was added, and the clotting time was measured using an automated coagulometer until fibrin formation was detected.

For the APTT test, 100 µL of plasma was mixed with 100 µL of APTT reagent (containing an activator such as kaolin or silica and phospholipids) and incubated at 37°C for 3 minutes. Subsequently, 100 µL of 0.025 M calcium chloride was added, and the clotting time was measured automatically.

Analysis Data

The results of the analysis were subjected to ANOVA. ANOVA was used to determine whether there was a statistically significant difference in the mean values of APTT and PT among the four blood groups (A, B, AB, and O). Basis for the test selection:

Independent variable: ABO blood group (4 categories)

Dependent variables: APTT and PT values (numerical/interval data)

Since the study involved more than two independent groups, a one-way ANOVA was the appropriate statistical test. If the ANOVA results show a p-value < 0.05, it indicates a significant difference in APTT or PT values between at

least two blood groups. Conversely, if $p > 0.05$, it means there is no significant difference in coagulation parameters among the ABO blood groups.

RESULTS AND DISCUSSION

This study was conducted to determine the relationship between the ABO blood groups with coagulation parameters APTT and PT. Data analysis was carried out on 45 subjects grouped by blood type A, B, AB, and O. Data were analyzed using a normality test (Shapiro-Wilk), a homogeneity of variance test (Levene), and a one-way ANOVA test to see the difference in mean APTT and PT values between blood groups. The results of descriptive and inferential data processing are presented in the form of tables and descriptions below to provide a comprehensive overview of the distribution and significance of data between groups.

Table 1. Average APTT and PT

Blood Group	n	APTT (Mean±SD)	PT (Mean±SD)
A	10	28.7 ± 2.5	12.4 ± 1.1
B	12	29.1 ± 2.3	12.1 ± 1.0
AB	8	30.5 ± 2.1	11.9 ± 1.2
O	15	32.3 ± 2.7	12.0 ± 1.3

Before conducting the difference test, we used the normality and homogeneity tests. The results of the Shapiro-Wilk normality test showed that the APTT and PT data were normally distributed, with p values of 0.094 for APTT and 0.132 for PT ($p > 0.05$). Furthermore, the results of the homogeneity test using Levene's Test showed that the variance of APTT and PT data between blood group groups was homogeneous, with p values of 0.282 for APTT and 0.218 for PT ($p > 0.05$), resulting in data that were able to fulfill the assumptions for parametric analysis.

Table 2. One-way ANOVA Test Results of APTT and PT Values Based on ABO Blood Groups

Parameters	F	p-value
APTT	4.812	0.006
PT	0.621	0.605

One-way ANOVA analysis revealed a statistically significant difference in APTT values among the different blood groups ($F = 4.812$, $p = 0.006$). Conversely, for the PT parameter, no significant difference was observed between blood groups ($F = 0.621$, $p = 0.605$). These findings indicate that blood group is significantly associated with APTT values but not with PT values.

The results showed a significant difference in APTT values based on ABO blood group, with blood group O having a longer APTT value than non-O blood groups. This is consistent with previous findings that individuals with blood type O have lower levels of factor VIII and von Willebrand factor (vWF), which play an important role in the intrinsic pathway of coagulation and affect APTT values. The research of (12–14) confirmed that factor VIII and vWF levels are significantly lower in individuals with blood type O compared to non-O blood types. This difference impacts global coagulation test results such as APTT, where individuals with blood type O tend to have prolonged APTT values.

In contrast, PT values showed no significant difference between blood groups in this study. This may be explained by the fact that PT reflects the extrinsic pathway of coagulation, which is more stable and less affected by variations in factor VIII and vWF levels. The study by (15) also supports this finding, showing that PT is not significantly affected by blood group. Differences in factor VIII and vWF levels by blood group have clinical implications, especially in the risk of thrombosis (16). Individuals with non-O blood groups have higher levels of factor VIII and vWF, which are associated with an increased risk of venous thromboembolism. The study by (17) stated that the non-O blood group is an independent risk factor for thrombosis.

Based on the differences in APTT values by blood group, some researchers have suggested the need for adjustment of APTT reference ranges that are specific to each blood group. This aims to improve the accuracy of diagnosis of coagulation disorders and avoid misinterpretation of laboratory results. The study of (18) supports this approach by establishing blood group-specific coagulation test reference ranges.

Overall, this study confirms that the ABO blood group affects APTT values, but not PT. This difference is mainly due to variations in factor VIII and vWF levels between blood groups. Therefore, it is important for clinical and laboratory practitioners to consider blood group in the interpretation of coagulation test results, as well as consider adjusting the reference range accordingly to improve the accuracy of diagnosis and patient management.

CONCLUSION

This study has concluded that there is a significant difference between ABO blood group and APTT values, with blood group O showing a longer APTT, possibly due to lower vWF and factor VIII levels. In contrast, there was no significant association between ABO blood group and PT values. For future studies, it is recommended that direct measurement of factor VIII and von Willebrand factor (vWF) levels be conducted to support a more in-depth interpretation of the relationship between blood type and APTT values.

ACKNOWLEDGEMENT

The researcher would like to thank Universitas Muhammadiyah Surabaya for supporting the research facilities.

REFERENCES

1. Do L, Favaloro E, Pasalic L. An Analysis of the Sensitivity of the Activated Partial Thromboplastin Time (APTT) Assay, as Used in a Large Laboratory Network, to Coagulation Factor Deficiencies. Am J Clin Pathol. 2022;158(1):132–41. https://doi.org/10.1093/ajcp/aqac013
2. Khan M, Din Z, Haq NU, Farooq S, Hasan F. Difference of Clotting Time and Bleeding Time in the ABO Blood Groups. Pakistan J Med Heal Sci. 2022;16(7):903–5. DOI: https://doi.org/10.53350/pjmhs22167903
3. Kaur M, Singh A, Bassi R, Kaur D. Blood group distribution and its relationship with bleeding time and clotting time. Natl J Physiol Pharm Pharmacol. 2015;5(3):253–7. doi: http://dx.doi.org/10.5455/njppp.2015.5.2609201433
4. Chanu LL, Singh RB, Rajkumari B, Anal SR. Bleeding Time and Clotting Time in Different Blood Groups- a Cross Sectional Study. J Evol Med Dent Sci. 2019;8(22):1813–5. https://www.jemds.com/data_pdf/rajkumar%20singh-.pdf

5. Okeke C, Okoro U, Babatunde A. Variations in activated partial thromboplastin time and prothrombin time in individuals of A, B, AB, and O blood groups. Iraqi J Hematol. 2018;7(2):85. https://journals.lww.com/ijhm/fulltext/2018/07020/variations_in_activated_partial_thromboplastin.7.aspx
6. Chen Z, Yu M. Effect of ABO Blood Groups , Age and Gender on Coagulation Assays in Patients With Acute Deep Vein Thrombosis. 2021;1–12. DOI: 10.21203/rs.3.rs-184439/v1
7. Salim EI, Shaaban AN, Seleem AK, Attia ZI. Impact of ABO gene polymorphism and von Willebrand factor on genetic susceptibility to acute lymphoblastic leukemia in Egyptian pediatric patients. Egypt J Med Hum Genet [Internet]. 2025; Tersedia pada: https://doi.org/10.1186/s43042-024-00633-z
8. Ward SE, Sullivan JMO, Donnell JSO. Review Article The relationship between ABO blood group , von Willebrand factor , and primary hemostasis. 2020;136(25):2864–74. https://doi.org/10.1182/blood.2020005843
9. Leeman M, Choi J, Hansson S, Storm MU, Nilsson L. Proteins and antibodies in serum, plasma, and whole blood—size characterization using asymmetrical flow field-flow fractionation (AF4). Anal Bioanal Chem. 2018;410(20):4867–73. DOI: 10.1007/s00216-018-1127-2
10. Zhang H, Mooney CJ, Reilly MP. ABO blood groups and cardiovascular diseases. Int J Vasc Med. 2012;2012. DOI: 10.1155/2012/641917
11. Liu X, Chen X, Yang J, Guo R. Association of ABO blood groups with von Willebrand factor, factor VIII and ADAMTS-13 in patients with lung cancer. Oncol Lett. 2017;14(3):3787–94. doi: 10.3892/ol.2017.6619
12. Chen Z, Dai X, Cao J, Tan X, Chen S, Yu M. Reference intervals for coagulation tests in adults with different ABO blood types. J Clin Lab Anal. 2022;36(3):1–9. doi: 10.1002/jcla.24269
13. Amania N. Frekuensi Alel Golongan Darah Sistem a-B-O Pada Populasi Suku Osing Desa Kemiren Kabupaten Banyuwangi. Bioma J Biol dan Pembelajaran Biol. 2020;5(1):11–21. DOI: https://jurnal.unmuhjember.ac.id/index.php/BIOMA/article/view/3680
14. Choi Q, Kim JE, Kim SY, Han KS, Kim HK. Influence of ABO type on global coagulation assay results: Effect of coagulation factor VIII. Clin Chem Lab Med. 2015;53(9):1425–32. DOI: 10.1515/cclm-2014-0909
15. Mitsuguro M, Okamoto A, Shironouchi Y, Sano M, Miyata S, Neki R, et al. Effects of factor VIII levels on the APTT and anti-Xa activity under a therapeutic dose of heparin. Int J Hematol. 2015;101(2):119–25. DOI: 10.1007/s12185-014-1702-z
16. Assagaf KK, Bodhi W, Yamlean PVY, Lippi G, Salvagno GL, Tarperi C, et al. Prothrombotic State Induced by Middle-Distance Endurance Exercise in Middle-Aged Athletes. J Ilm Farm [Internet]. 2018;5(3):253–7. DOI: 10.1055/s-0038-1667115
17. Rios DRA, Fernandes AP, Figueiredo RC, Guimarães DAM, Ferreira CN, Simões e Silva AC, et al. Relationship between ABO blood groups and von Willebrand factor, ADAMTS13 and factor VIII in patients undergoing hemodialysis. J Thromb Thrombolysis. 2012;33(4):416–21. DOI: 10.1007/s11239-012-0719-5
18. Höglund J, Karlsson T, Johansson T, Ek WE, Johansson Å. Characterization of the human ABO genotypes and their association to common inflammatory and cardiovascular diseases in the UK Biobank. Am J Hematol. 2021;96(11):1350–62. DOI: 10.1002/ajh.26307