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Association of ABO and Rh blood groups with survival and clinicopathological characteristics in patients with gastric adenocarcinoma: a single-center retrospective cohort study

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ABSTRACT

Aims: Identifying factors affecting the prognosis of gastric cancer is clinically important. Although ABO and Rh blood groups have been suggested to have a prognostic role in various malignancies, their impact in gastric cancer remains unclear. This study aimed to evaluate the association of ABO and Rh blood groups with clinicopathological characteristics and overall survival in patients with gastric adenocarcinoma.

Methods: In this retrospective single-center study, 320 patients diagnosed with gastric adenocarcinoma were included. Demographic and clinical data were obtained from electronic medical records. Overall survival was analyzed using the Kaplan-Meier method, and differences between groups were compared using the log-rank test. Cox regression analysis was performed to identify prognostic factors.

Results: The mean age of the patients was 70.2±9.5 years, and 68.4% were male. Among clinicopathological characteristics, only surgical treatment showed a statistically significant association with ABO blood groups (p=0.047). The median overall survival was 15.8 months. No statistically significant association was found between ABO blood groups (p=0.223) or Rh factor (p=0.850) and overall survival. The presence of metastasis was significantly associated with overall survival (p<0.001). A statistically significant difference in overall survival was observed according to primary surgical treatment status (p<0.001). In multivariate analysis, only surgical treatment was identified as an independent prognostic factor (HR: 0.58; 95% CI: 0.40-0.85; p=0.005).

Conclusion: ABO and Rh blood groups may not have a significant independent prognostic impact on overall survival in patients with gastric adenocarcinoma. In contrast, clinical factors such as metastasis and surgical treatment were identified as key determinants of survival. These findings suggest that prognosis in gastric cancer is more closely related to disease extent and treatment strategies rather than blood group characteristics.

Keywords: ABO blood group, gastric cancer, prognostic factors, Rh factor, survival

INTRODUCTION

Gastric cancer remains one of the leading causes of cancer-related mortality worldwide. According to recent global cancer statistics, gastric cancer ranks among the most common malignancies and constitutes a major public health problem, particularly in developing countries.[1,2] The fact that a substantial proportion of patients are diagnosed at an advanced or metastatic stage negatively affects survival outcomes.[3] Therefore, a better understanding of prognostic factors in gastric cancer and their integration into clinical practice is of great importance.

In recent years, there has been increasing interest in potential biomarkers that may influence tumor biology and patient prognosis. In this context, the ABO blood group system has emerged as a potential factor associated with both cancer development and prognosis in various malignancies.[4,5] ABO antigens are thought to play roles in cell adhesion, membrane signaling, inflammation, and immune response processes, which may influence tumor development and progression through these mechanisms.[6] Epidemiological studies investigating the relationship between ABO blood groups and gastric cancer have reported that blood group A may be associated with an increased risk of gastric cancer.[4,7] However, studies evaluating the impact of ABO blood groups on survival have yielded conflicting results. While some studies have shown that certain blood groups are associated with poorer prognosis,[8] others have found no significant association between blood groups and survival.[9,10] These discrepancies may be attributed to heterogeneity in patient populations, sample sizes, and study designs.

The relationship between Rh blood group and cancer prognosis has been evaluated in a limited number of studies, and the available data suggest that its prognostic value remains unclear.[11] Therefore, evaluating ABO and Rh blood groups together may provide a more comprehensive understanding of potential factors influencing prognosis in gastric cancer.

In this study, we aimed to evaluate the association of ABO and Rh blood groups with clinicopathological characteristics and overall survival in patients with gastric adenocarcinoma. In addition, the effects of clinically relevant factors, including metastasis status and primary surgical treatment, were analyzed to identify the major determinants of prognosis. Unlike many previous studies that focused primarily on cancer risk or evaluated ABO blood groups alone, our study simultaneously assessed ABO and Rh blood groups in a relatively large real-world cohort of patients with gastric adenocarcinoma treated over a 15-year period. Therefore, this study provides contemporary real-world evidence regarding the prognostic relevance of blood group systems in routine clinical practice.

METHODS

Ethics

The study was approved by the Van Training and Research Hospital Clinical Researches Ethics Committee (Date: 10.04.2026, Decision No: GOKAEK/2026-04/27). The study was conducted in accordance with the principles of the Declaration of Helsinki. Written informed consent was waived by the ethics committee due to the retrospective design and the use of anonymized data.

Study Design and Patient Selection

This retrospective, single-center study was conducted to evaluate the association of ABO and Rh blood groups with clinicopathological characteristics and overall survival in patients with gastric adenocarcinoma. A total of 320 patients diagnosed and treated for gastric adenocarcinoma at the Medical Oncology Clinic of Van Training and Research Hospital, University of Health Sciences, between January 2010 and January 2025 were included in the study. Patients with histopathologically confirmed gastric adenocarcinoma and available ABO and Rh blood group data were included. Patients with missing key clinical data or unavailable baseline information were excluded. Patients who were alive at the last follow-up were censored in survival analyses.

Data Collection and Variables

Demographic and clinical data were retrospectively obtained from the hospital's electronic medical records system. The recorded variables included age, sex, tumor location, histopathological characteristics, presence of metastasis, treatment modalities, and follow-up duration. Metastasis status was determined based on clinical and radiological evaluations at the time of diagnosis. Primary surgical treatment was defined as surgical resection of the primary gastric tumor, including total gastrectomy, subtotal/distal gastrectomy, and gastrectomy combined with regional lymph node dissection (D1 or D2 lymphadenectomy). The majority of surgical procedures were performed with curative intent. Surgical treatment status was recorded as a binary variable (yes/no) for survival analyses. ABO and Rh blood group data were obtained from patient records. Clinical stage information was not available for all patients because of the retrospective study design, the long study period, and incomplete staging documentation in some historical medical records. Therefore, stage data could only be obtained for a subset of patients.

Survival Definitions

Overall survival (OS) was defined as the time from the date of diagnosis to death or last follow-up. Patients who were alive at the last follow-up or had no documented death record were censored at the date of last confirmed contact.

Statistical Analysis

The data analyses were performed using SPSS software (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean±standard deviation or median (minimum-maximum), while categorical variables were presented as frequencies and percentages (%). The Chi-square test or Fisher's exact test was used to compare categorical variables between groups. Overall survival was analyzed using the Kaplan–Meier method, and differences between groups were evaluated with the log-rank test. Cox proportional hazards regression analysis was performed to identify prognostic factors. Variables that were statistically significant in univariate analysis or considered clinically relevant were included in the multivariate model. Collinearity between metastasis status and primary surgical treatment was assessed using correlation analysis. A moderate-to-strong inverse correlation was observed between these variables (r=-0.566). Given the close clinical and statistical relationship between metastasis status and surgical treatment, metastasis was not included in the primary multivariable Cox regression model in order to minimize model instability and potential overadjustment. The prognostic impact of metastasis was therefore evaluated in univariate analyses and Kaplan-Meier survival analyses.

Results were reported as hazard ratios (HR) with 95% confidence intervals (CI). All analyses were two-sided, and a p-value of <0.05 was considered statistically significant.

RESULTS

A total of 320 patients were included in the study. The mean age was 70.2±9.5 years, and 68.4% of the patients were male. The clinical and demographic characteristics of the patients are presented in **Table 1**. Stage information was available for 230 patients. Missing stage data were mainly related to incomplete documentation in historical medical records because of the retrospective nature and long study period of the cohort. The majority of cases were at an advanced stage, and metastasis was present in 68.5% of patients.

The associations between ABO blood groups and clinicopathological characteristics are shown in **Table 2**. Among the analyzed variables, only surgical treatment status was significantly associated with ABO blood groups (p=0.047). No significant differences were observed between groups in terms of metastasis status, Lauren classification, differentiation, or survival status (all p>0.05).

Table 1. Demographic and clinical characteristics of patients (n=320)

Variable	n (%)
Age (years), mean±SD	70.2±9.5
Gender	
Female	101 (31.6)
Male	219 (68.4)
Clinical stage*	
Stage I–II	32 (13.9)
Stage III–IV	198 (86.1)
Metastasis status*	
Absent	75 (31.5)
Present	163 (68.5)
Surgical treatment	
No	145 (45.3)
Yes	175 (54.7)
Lauren classification*	
Intestinal	57 (23.6)
Diffuse	179 (74.0)
Differentiation*	
Well/moderate	79 (44.9)
Poor	97 (55.1)
ABO blood group	
O	95 (29.7)
A	153 (47.8)
B	44 (13.8)
AB	28 (8.8)
Rh factor	
Negative	38 (11.9)
Positive	282 (88.1)
Survival status	
Alive	99 (30.9)
Dead	221 (69.1)

*Due to missing data, the total number of patients varies for some variables.
Abbreviations: SD: Standard deviation

In the overall survival analysis, the median survival time for the entire cohort was 15.8 months. The median survival times according to ABO blood groups were 15.6 months for group O, 15.5 months for group A, 13.1 months for group B, and 28.4 months for group AB (Table 3). Kaplan–Meier analysis showed no significant difference in overall survival among ABO blood groups (log-rank p=0.223) (Figure 1).

Table 3. Overall survival analysis according to ABO blood groups

Blood group	n	Events (n)	Median OS (months)	95% CI
O	95	67	15.6	11.9–19.4
A	153	108	15.5	13.7–17.2
B	44	32	13.1	5.1–21.2
AB	28	14	28.4	5.0–51.8
Total	320	221	15.8	14.1–17.5

OS: Overall survival, CI: Confidence interval
Log-rank test p=0.223.

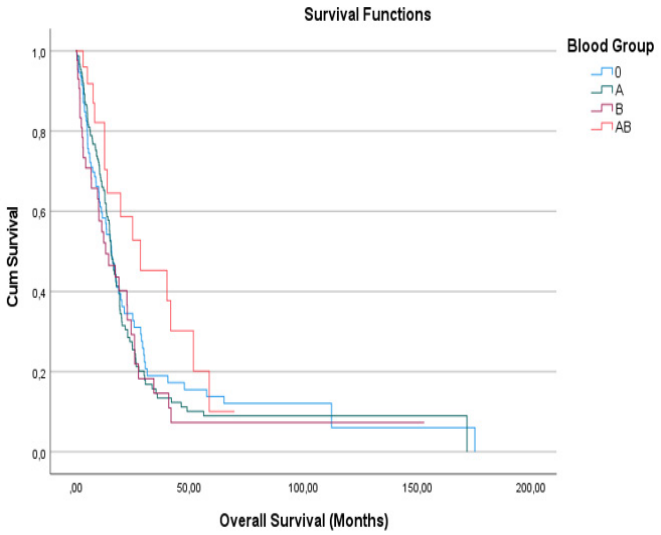

Figure 1. Kaplan–Meier overall survival curves according to ABO blood groups (log-rank p=0.223)

Table 2. Association between ABO blood groups and clinicopathological characteristics

Variable	O (n=95)	A (n=153)	B (n=44)	AB (n=28)	p
Metastasis*					0.91
Absent	23 (31.9)	38 (33.0)	9 (28.1)	5 (26.3)	
Present	49 (68.1)	77 (67.0)	23 (71.9)	14 (73.7)	
Surgical treatment					**0.047**
No	53 (55.8)	60 (39.2)	22 (50.0)	10 (35.7)	
Yes	42 (44.2)	93 (60.8)	22 (50.0)	18 (64.3)	
Lauren classification*					0.77
Intestinal	14 (19.2)	27 (23.5)	12 (34.3)	4 (21.1)	
Diffuse	57 (78.1)	85 (73.9)	23 (65.7)	14 (73.7)	
Differentiation*					0.50
Well/moderate	24 (42.9)	33 (40.2)	12 (52.2)	10 (66.7)	
Poor	32 (57.1)	49 (59.8)	11 (47.8)	5 (33.3)	
Survival status					0.15
Alive	28 (29.5)	45 (29.4)	12 (27.3)	14 (50.0)	
Dead	67 (70.5)	108 (70.6)	32 (72.7)	14 (50.0)	

*Due to missing data, the total number of patients varies for some variables.
p-values were calculated using the chi-square test or Fisher–Freeman–Halton exact test

A statistically significant difference in overall survival was observed according to the presence of metastasis (p<0.001) (**Figure 2**). Similarly, a significant difference in overall survival was found based on primary surgical treatment status (p<0.001) (**Figure 3**). No significant difference in overall survival was observed according to Rh blood group (p=0.850) (**Figure 4**).

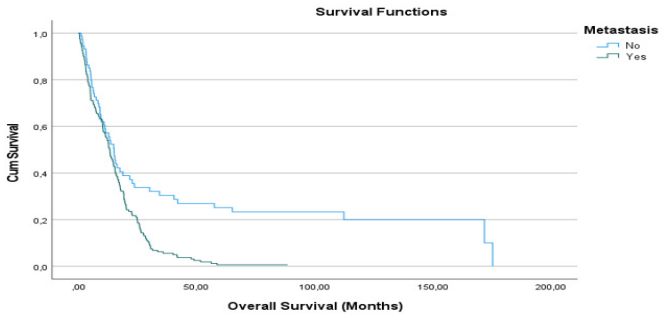

Figure 2. Kaplan–Meier overall survival curves according to metastasis status (log-rank p<0.001)

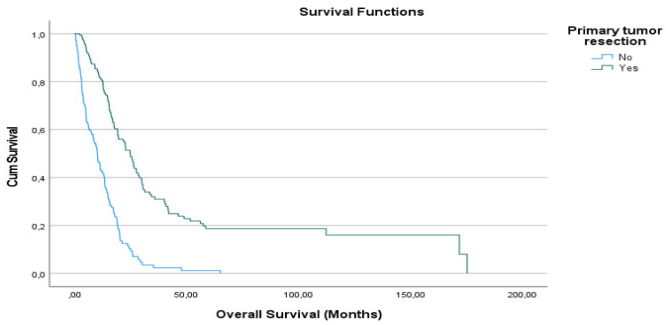

Figure 3. Kaplan–Meier overall survival curves according to primary surgical treatment status (log-rank p<0.001)

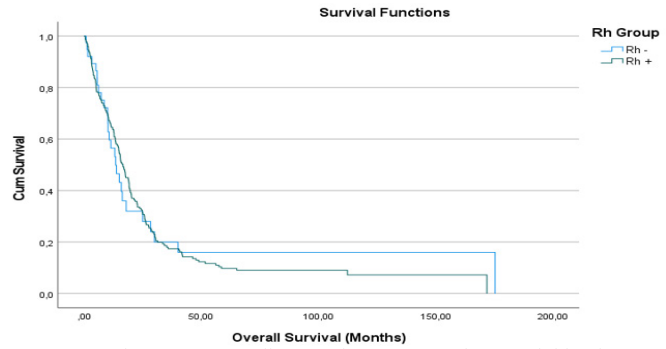

Figure 4. Kaplan–Meier overall survival curves according to Rh blood groups (log-rank p=0.850)

In univariate Cox regression analysis, the presence of metastasis was significantly associated with survival (HR: 1.90; 95% CI: 1.30-2.80; p=0.001). In multivariate analysis, only surgical treatment was identified as an independent prognostic factor (HR: 0.58; 95% CI: 0.40–0.85; p=0.005). Collinearity assessment demonstrated a moderate-to-strong inverse correlation between metastasis status and primary surgical treatment (r=-0.566). Because these variables were closely related both clinically and statistically, metastasis was excluded from the primary multivariable model. Nevertheless, metastasis remained a significant prognostic factor in univariate Cox regression analysis (HR: 1.90; 95% CI: 1.30–2.80; p=0.001) and Kaplan–Meier survival analysis (log-rank p<0.001). ABO and Rh blood groups were not found to have a significant impact on survival (**Table 4**).

DISCUSSION

In this study, we evaluated the impact of ABO and Rh blood groups on overall survival in patients with gastric adenocarcinoma and demonstrated that neither blood group system was a significant prognostic factor for survival. In contrast, clinical factors such as the presence of metastasis and the application of primary surgical treatment were found to be key determinants of survival.

The relationship between ABO blood groups and gastric cancer has been extensively investigated. Several epidemiological and meta-analysis studies have reported that blood group A is associated with an increased risk of gastric cancer.[4,7,12] However, findings regarding the impact of ABO blood groups on survival have been inconsistent. While some studies have reported an association between certain blood groups and poor prognosis,[8,13] others have found no significant relationship between blood groups and survival outcomes.[9,10,14] The lack of a significant association between ABO blood groups and overall survival in our study is consistent with studies involving larger patient cohorts that have reported no prognostic impact. Although patients with blood group AB demonstrated the longest median overall survival in our cohort (28.4 months), this difference did not reach statistical significance. One possible explanation is the relatively small number of patients in the AB subgroup (n=28), which may have limited the statistical power to detect modest survival differences between blood groups. Therefore, the observed numerical survival advantage in the AB group should be interpreted cautiously and requires confirmation

Table 4. Univariate and multivariate Cox regression analysis for overall survival

Variable	Univariate HR	95% CI	p	Multivariate HR	95% CI	p
Age	1.01	0.99–1.02	0.320	1.00	0.97–1.02	0.844
Gender (male vs female)	0.75	0.50–1.12	0.158	0.70	0.42–1.16	0.164
Metastasis (present vs absent)	1.90	1.30–2.80	0.001	—	—	—
Surgery (yes vs no)	0.45	0.32–0.64	<0.001	0.58	0.40–0.85	0.005
ABO blood group			0.820			0.822
A vs O	1.20	0.80–1.80	0.350	1.25	0.76–2.04	0.374
B vs O	1.15	0.70–1.90	0.580	1.02	0.52–2.01	0.959
AB vs O	0.85	0.45–1.60	0.620	1.11	0.43–2.86	0.827
Rh (positive vs negative)	1.05	0.65–1.70	0.850	1.02	0.51–2.02	0.959

Reference category: Blood group O. HR: Hazard ratio, CI: Confidence interval, Variables that were statistically significant in univariate analysis or considered clinically relevant were included in the multivariate model. Metastasis was excluded from the primary multivariable model because of its moderate-to-strong inverse correlation with surgical treatment (r=-0.566).

in larger multicenter cohorts with a greater representation of less common blood groups.

From a biological perspective, ABO antigens are known to play roles in cell adhesion, tumor cell migration, angiogenesis, and immune response.[6,15] Additionally, the ABO gene locus has been shown to interact with molecular pathways related to inflammation and thrombosis.[16] However, the limited reflection of these biological mechanisms on clinical survival outcomes highlights the multifactorial nature of prognosis in gastric cancer. Indeed, factors such as molecular subtypes, genetic alterations, and the tumor microenvironment are considered to have a more substantial impact on prognosis.[3,17] One possible explanation for this discrepancy is that the biological effects of ABO antigens may be more relevant to cancer susceptibility and early tumor development than to disease progression after diagnosis. Once gastric adenocarcinoma has developed, survival outcomes are likely driven predominantly by established clinical and tumor-related factors such as disease stage, metastatic burden, treatment response, molecular characteristics, and patient performance status. Consequently, any potential biological influence of ABO antigens may be overshadowed by these stronger determinants of prognosis.

The relationship between Rh blood group and cancer prognosis has been less extensively studied, and available data are limited. Some population-based studies have reported no significant association between Rh factor and cancer risk or prognosis.[11,18] Consistent with these findings, our study also demonstrated no significant impact of Rh blood group on overall survival.

The finding of a significant association between the presence of metastasis and overall survival in our study is expected and is consistent with previous studies demonstrating that disease stage is one of the strongest prognostic determinants in gastric cancer.[3,9,19] Tumor burden and the pattern of dissemination directly affect survival in metastatic disease. This observation underscores that prognosis in advanced gastric cancer is largely determined by the extent of disease. Because metastasis status was strongly associated with the likelihood of undergoing primary surgical treatment, both variables could not be interpreted entirely independently within the same prognostic framework. This relationship should be considered when interpreting the multivariable results.

The significantly better survival observed in patients who underwent primary surgical treatment is another important finding. Previous studies have shown that surgery, when applied to appropriately selected patients, may provide a survival benefit.[11,20] In the present cohort, primary surgical treatment mainly consisted of gastrectomy-based procedures with regional lymph node dissection, reflecting routine surgical management strategies for gastric adenocarcinoma. However, because metastasis status was closely associated with surgical treatment in our cohort and detailed data regarding metastatic burden were not available, the independent contribution of surgery should be interpreted with caution. Therefore, our findings should not be considered evidence supporting surgical treatment in oligometastatic disease, but rather as an observation derived from a retrospective real-world cohort.

In multivariate analysis, only surgical treatment was identified as an independent prognostic factor, highlighting the prognostic importance of treatment-related interventions. This finding emphasizes the importance of individualized treatment strategies in clinical practice. Careful patient selection and appropriate treatment planning play a crucial role in determining survival outcomes.

Although the association between ABO blood groups and gastric cancer has been investigated previously, most available studies have focused on cancer susceptibility rather than long-term survival outcomes. Furthermore, data evaluating ABO and Rh blood groups simultaneously in real-world gastric adenocarcinoma cohorts remain limited. By including a relatively large cohort with long-term follow-up and comprehensive clinicopathological evaluation, our study provides additional evidence suggesting that blood group systems have limited prognostic utility compared with established clinical factors such as metastasis and surgical treatment.

Limitations

The strengths of our study include a relatively large patient cohort and the use of real-world data. However, several limitations should be acknowledged. Missing data for certain clinical variables (such as incomplete staging information) may have limited the statistical power of the analyses. Furthermore, stage information was unavailable for a proportion of patients, which may have reduced the precision of prognostic analyses and limited the evaluation of stage-adjusted survival outcomes. Additionally, the retrospective and single-center design may introduce selection bias and unmeasured confounding factors. In addition, detailed information regarding performance status (ECOG PS), metastatic sites, treatment regimens, and laboratory-based prognostic biomarkers was not consistently available for all patients. Therefore, the potential impact of these established prognostic factors on survival outcomes could not be fully evaluated.

Nevertheless, our findings are clinically relevant as they reflect a patient population commonly encountered in routine practice. Overall, our results suggest that prognosis in gastric cancer is more strongly influenced by disease extent and treatment strategies rather than blood group characteristics.

CONCLUSION

This study suggests that ABO and Rh blood groups may not have a significant prognostic impact on survival in patients with gastric adenocarcinoma. These findings indicate that the prognostic value of blood groups, despite being easily accessible biomarkers in clinical practice, may be limited. In contrast, clinical factors such as the presence of metastasis and surgical treatment were confirmed to be key determinants of survival. Overall, our results suggest that disease extent and treatment strategies should be prioritized over blood group characteristics in prognostic evaluation in clinical practice.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was approved by the Van Training and Research Hospital Clinical Researches Ethics Committee (Date: 10.04.2026, Decision No: GOKAEK/2026-04/27).

Informed Consent
This retrospective study used pre-existing anonymized patient data. No additional intervention was performed, and there was no direct patient contact. The study was approved by the Ethics Committee, and the requirement for written informed consent was waived by the ethics committee.

Peer Review Process
This manuscript was subject to external peer review.

Conflict of Interest
The authors declare no conflicts of interest related to this study.

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The authors received no financial support for the conduct or publication of this research.

Author Contributions
Concept: EŞ, AG; Design: EŞ, AG; Control: EŞ, AG; Data Collection and/or Processing: EŞ, AG; Analysis and/or Interpretation: EŞ, AG; Literature Review: EŞ, AG; Article Writing: EŞ, AG; Critical Review: EŞ, AG.

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