

## Original Article

# The Effect of Blast Percentage at Diagnosis on Disease Prognosis and Survival Outcomes in Patients with Acute Myeloid Leukemia

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## ABSTRACT

**Aim:** The prognostic impact of morphological features in patients with acute myeloid leukemia (AML) remains under investigation. This study aimed to evaluate differences in laboratory findings, relapse and mortality rates, overall survival (OS), and progression-free survival between patients with lower and higher blast percentages at diagnosis.

**Methods:** This retrospective study included 88 patients with de novo AML who were diagnosed and treated at our tertiary care center between January 2015 and August 2024.

**Results:** Of the 88 patients included in the study, 44 (50%) had ≤66% blasts at diagnosis, whereas the remaining 44 (50%) had >66% blasts at diagnosis. The 5-year OS rates were 36% in both groups (p=0.34). The 5-year progression-free survival rates were 52% in patients with ≤66% blasts and 71% in patients with >66% blasts (p=0.90).

**Conclusion:** In this cohort, blast percentage at diagnosis did not have a significant prognostic impact in patients with AML. No significant difference was observed in survival outcomes between patients with higher and lower blast percentages. Consistent with current guidelines, genetic and molecular findings remain essential for risk stratification in AML.

**Keywords:** Acute myeloid leukemia, blast percentage, risk classification, prognosis

## Introduction

Acute myeloid leukemia (AML) is a highly heterogeneous hematologic malignancy characterized by diverse clinical presentations, cytogenetic profiles, and molecular abnormalities. AML is the most common form of acute leukemia in adults [1]. The percentage of immature blast cells in bone marrow or peripheral blood is traditionally used in the diagnosis of AML, together with recurrent genetic abnormalities and other disease-defining features [2-4]. Bone marrow aspiration and trephine biopsy are usually performed during the diagnostic work-up. Both patient-related and leukemia-related factors influence treatment outcomes. Increasing knowledge of disease heterogeneity and the use of predictive

variables such as age, comorbidities, performance status, and cytogenetic abnormalities have changed the management of patients with AML [5]. Response to induction therapy is a well-known independent prognostic factor for overall survival (OS) and relapse risk in AML [6]. Blast percentage in bone marrow is important for diagnosis, prognosis, and response assessment in myelodysplastic syndromes, myeloproliferative neoplasms, and AML [7,8]. At present, cytogenetic and molecular abnormalities are the major determinants of prognosis in AML [4]. However, some patients do not have characteristic chromosomal abnormalities or detectable genetic mutations and are therefore categorized as intermediate-risk. Considerable heterogeneity in treatment response and prognosis exists within this group. Thus, simple and accessible

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markers that may support risk assessment remain clinically relevant. The French-American-British classification is based on morphological features, but the prognostic impact of morphology in AML remains under investigation. Recent studies have suggested that certain morphological findings may be associated with specific chromosomal abnormalities [9-12].

In this retrospective study, we assessed the morphological, immunophenotypic, cytogenetic, and molecular characteristics of 88 patients with AML admitted to our tertiary care center. The aim of this study was to evaluate differences in relapse rate, mortality rate, OS, and PFS between patients with lower and higher blast percentages at diagnosis.

## Methods

### Study Design and Data Collection

This retrospective study included 88 adult patients with de novo AML who were diagnosed and treated at Selçuk University Hospital between January 2015 and August 2024. Patients aged  $\geq 18$  years with a diagnosis of AML were identified from electronic medical records. Demographic characteristics, disease status, induction and consolidation treatments, laboratory parameters, and cytogenetic findings were collected. All procedures were conducted in accordance with the 1964 Declaration of Helsinki and its later amendments. Informed consent was obtained from all patients. Ethics committee approval was obtained from the Selçuk University Faculty of Medicine Ethics Committee (date: 21.11.2023, approval number: 2023/550).

### Patient and Disease Characteristics

Adult patients with AML, excluding those with acute promyelocytic leukemia, were included. Patients received either intensive induction chemotherapy with a 3+7 regimen (idarubicin plus cytarabine or daunorubicin plus cytarabine) or hypomethylating agent plus venetoclax therapy according to age, performance status, and clinical suitability. Bone marrow aspiration, bone marrow biopsy, flow cytometry, cytogenetic analysis, and fluorescence in situ hybridization were evaluated at diagnosis. In bone marrow aspirates obtained at diagnosis, 400 cells were counted for each patient. Blast percentage was assessed in conjunction with flow cytometry and bone marrow biopsy findings.

### Statistical Analysis

Statistical analyses were performed using IBM SPSS statistics version 25 (IBM Corp., Armonk, NY, USA). The analysis included 88 patients. The distribution of variables was evaluated using analytical and visual methods, including histograms and probability plots. Normality was assessed using the Kolmogorov-Smirnov and Shapiro-Wilk tests. Continuous variables were compared using Student's t-test for normally distributed data and the Mann-Whitney U test for non-normally distributed data. Categorical variables were compared using the chi-square test or Fisher's exact

test, as appropriate. Survival analyses were performed using the Kaplan-Meier method. Cox regression analysis was used for multivariate survival analysis. Variables with  $p \leq 0.25$  in univariate analysis were included in the multivariate model. A p value of  $< 0.05$  was considered statistically significant.

## Results

### Patient Characteristics

A total of 88 patients with AML were evaluated retrospectively. Forty-eight patients (54.5%) were male and 40 (45.5%) were female. The median age at diagnosis was 62 years (range, 18-88 years). The median values and ranges for white blood cell (WBC) count, neutrophil count, lymphocyte count, hemoglobin (Hb), mean corpuscular volume (MCV), platelet (PLT) count, creatinine, uric acid, lactate dehydrogenase (LDH), aspartate aminotransferase (AST), alanine aminotransferase (ALT), albumin, fibrinogen, C-reactive protein (CRP), and bone marrow blast percentage were  $8 \times 10^9/L$  (0.2-275),  $1.5 \times 10^9/L$  (0.01-182),  $2.2 \times 10^9/L$  (0.01-69.8), 8.8 g/dL (2.8-15.2), 92.3 fL (70-115),  $68 \times 10^9/L$  (6-297), 0.8 mg/dL (0.3-2.1), 5.4 mg/dL (2.1-13.2), 400 U/L (122-1963), 21 U/L (3-110), 17 U/L (3-125), 3.7 g/dL (2.4-5.0), 334 (91-1354) mg/dL, 26 (3-330) mg/L, and 66% (20-95), respectively. Patients were classified into two groups according to the median blast percentage at diagnosis. Patients with  $\leq 66\%$  blasts were defined as the low blast percentage group ( $n=44$ , 50%), whereas patients with  $> 66\%$  blasts were defined as the high blast percentage group ( $n=44$ , 50%), as shown in Table 1.

### Overall Outcomes

The median OS of the entire cohort was 13.5 months (range, 0.3-100.7 months). Of the 88 patients, 44 (50%) had  $\leq 66\%$  blasts at diagnosis and 44 (50%) had  $> 66\%$  blasts at diagnosis. The 5-year OS rates were 36% in both groups ( $p=0.34$ ), as shown in Figure 1. The 5-year PFS rates were 52% in patients with  $\leq 66\%$  blasts and 71% in patients with  $> 66\%$  blasts ( $p=0.90$ ), as shown in Figure 2.

### Cox Regression Analysis

In univariate analysis, variables associated with OS were age  $\leq 62$  years ( $p<0.001$ ), sex ( $p=0.11$ ), Hb level  $> 8.8$  g/dL ( $p=0.008$ ), and ELN risk classification ( $p=0.21$ ). In multivariate Cox regression analysis, age  $\leq 62$  years ( $p<0.001$ ) and Hb level  $> 8.8$  g/dL ( $p=0.01$ ) remained significant predictors of OS (Table 2).

In univariate analysis, variables associated with PFS were age  $\leq 62$  years ( $p=0.01$ ) and PLT count  $> 68 \times 10^9/L$  ( $p=0.23$ ). In multivariate Cox regression analysis, only age  $\leq 62$  years ( $p=0.02$ ) remained a significant predictor of PFS (Table 2).

## Discussion

Accurate prognostic assessment is essential in AML because post-remission treatment strategies, including chemotherapy and hematopoietic stem cell transplantation, are guided

**Table 1. Clinical and laboratory characteristics of patients according to blast percentage at diagnosis**

| Parameters                                               | Patients with ≤66% blasts at diagnosis | Patients with >66% blasts at diagnosis | p value |
|----------------------------------------------------------|----------------------------------------|----------------------------------------|---------|
| Number of patients (n, %)                                | 44, 50%                                | 44, 50%                                |         |
| Age, years; median (range)                               | 63 (34-88)                             | 62 (18-84)                             | 0.39    |
| Sex (female/male)                                        | 15 (34.1%)/29 (65.9%)                  | 25 (56.8%)/19 (43.2%)                  | 0.03    |
| WBC count (×10 <sup>9</sup> /L)                          | 3.9 (0.2-275.9)                        | 15.7 (1.0-124.3)                       | 0.19    |
| Neutrophil count (×10 <sup>9</sup> /L)                   | 1.6 (0.01-182.9)                       | 1.5 (0.09-62.0)                        | 0.39    |
| Lymphocyte count (×10 <sup>9</sup> /L)                   | 1.7 (0.13-69.8)                        | 4.0 (0.01-56.6)                        | 0.16    |
| Hemoglobin (g/dL)                                        | 8.8 (3.2-13.8)                         | 8.9 (2.8-15.2)                         | 0.41    |
| MCV (fL)                                                 | 92.8 (70.0-115.0)                      | 92.0 (72.0-111.8)                      | 0.38    |
| Platelet count (×10 <sup>9</sup> /L)                     | 48 (8-230)                             | 47.5 (6-297)                           | 0.87    |
| Creatinine (mg/dL)                                       | 0.8 (0.4-2.1)                          | 0.8 (0.3-1.8)                          | 0.68    |
| Uric acid (mg/dL)                                        | 5.3 (2.7-13.2)                         | 5.8 (2.1-11.9)                         | 0.38    |
| Lactate dehydrogenase (U/L)                              | 380 (142-1798)                         | 453 (145-1963)                         | 0.19    |
| Aspartate aminotransferase (U/L)                         | 20 (8-60)                              | 21 (6-110)                             | 0.30    |
| Alanine aminotransferase (U/L)                           | 17 (5-66)                              | 17 (3-125)                             | 0.36    |
| Albumin (g/dL)                                           | 3.6 (2.4-5.0)                          | 3.6 (2.6-4.9)                          | 0.29    |
| Fibrinogen (mg/dL)                                       | 317.5 (91-1354)                        | 350 (94-665)                           | 0.22    |
| C-reactive protein (mg/L)                                | 21.5 (3-330)                           | 30.5 (5-128)                           | 0.73    |
| ELN risk classification (favorable/intermediate/adverse) | 1 (2.3%)/39 (88.6%)/4 (9.1%)           | 2 (4.5%)/38 (86.4%)/4 (9.1%)           | 0.84    |
| The rate of post-induction remission                     | 36 (81.8%)/8 (18.2%)                   | 38 (86.4%)/6 (13.6%)                   | 0.56    |
| Relapse rate, yes/no                                     | 8 (18.2%)/36 (81.8%)                   | 7 (15.9%)/37 (84.1%)                   | 0.77    |
| Mortality rate, yes/no                                   | 24 (54.5%)/20 (45.5%)                  | 25 (56.8%)/19 (43.2%)                  | 0.83    |

WBC: White blood cell, MCV: Mean corpuscular volume

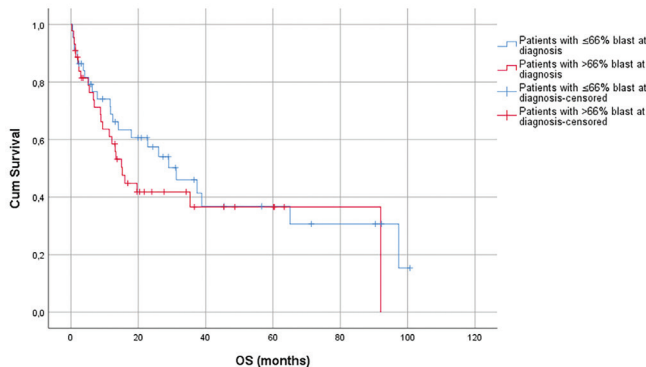


**Figure 1.** Overall survival according to blast percentage at diagnosis  
OS: Overall survival

by the expected risk of relapse and the risk of non-relapse mortality [13]. Reliable prognostic indicators may help clinicians optimize treatment decisions and improve patient outcomes. At diagnosis, cytogenetic and molecular analyses are the primary tools used for risk stratification in AML. The 2022 ELN recommendations incorporate newly defined molecular markers and emphasize dynamic risk assessment based on treatment response [4]. However, many patients are classified as intermediate-risk, and not all patients have detectable karyotypic abnormalities or molecular alterations

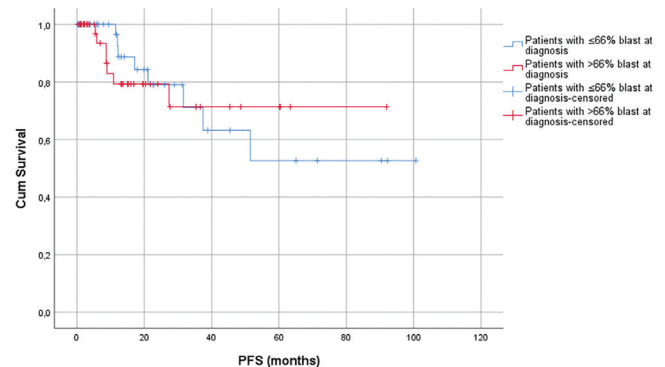


**Figure 2.** Progression-free survival according to blast percentage at diagnosis

that clearly guide prognosis [4,13]. In the present study, most patients were in the intermediate-risk group according to the ELN 2022 classification.

The primary aim of this study was to evaluate whether blast percentage at diagnosis affects survival outcomes and prognosis in AML. The median blast percentage at diagnosis was 66%. Therefore, clinical and laboratory characteristics, relapse rate, mortality rate, OS, and PFS were compared between patients with ≤66% blasts and those with >66% blasts at diagnosis. No significant differences were observed between the groups

**Table 2. Univariate and multivariate analyses (Cox model) of overall survival and progression-free survival**

| <b>A. Parameters for overall survival</b>          |                                  |                            |                              |                                |                |
|----------------------------------------------------|----------------------------------|----------------------------|------------------------------|--------------------------------|----------------|
|                                                    | <b>Favorable factors</b>         | <b>Univariate analyses</b> | <b>Multivariate analyses</b> |                                |                |
| <b>Parameter</b>                                   |                                  | <b>p value</b>             | <b>Hazard ratio</b>          | <b>95% confidence interval</b> | <b>p value</b> |
| Age                                                | ≤62 years                        | <0.001                     | 3.278                        | 1.716-6.262                    | <0.001         |
| Sex                                                | Female                           | 0.11                       | 0.719                        | 0.393-1.316                    | 0.28           |
| Blast percentage at diagnosis                      | ≤66%                             | 0.34                       |                              |                                |                |
| Leukocytes (×10 <sup>9</sup> /L)                   | ≤8×10 <sup>9</sup> /L            | 0.29                       |                              |                                |                |
| Hemoglobin (g/dL)                                  | >8.8 g/dL                        | 0.008                      | 0.470                        | 0.253-0.873                    | 0.01           |
| Platelets (×10 <sup>9</sup> /L)                    | >68×10 <sup>9</sup> /L           | 0.54                       |                              |                                |                |
| ELN risk classification                            | (favorable/intermediate/adverse) | 0.21                       | 2.135                        | 0.942-4.838                    | 0.06           |
| <b>B. Parameters for progression-free survival</b> |                                  |                            |                              |                                |                |
|                                                    | <b>Favorable factors</b>         | <b>Univariate analyses</b> | <b>Multivariate analyses</b> |                                |                |
| <b>Parameter</b>                                   |                                  | <b>p value</b>             | <b>Hazard ratio</b>          | <b>95% confidence interval</b> | <b>p value</b> |
| Age                                                | ≤62 years                        | 0.01                       | 3.730                        | 1.204-11.556                   | 0.02           |
| Sex                                                | Female                           | 0.73                       |                              |                                |                |
| Blast percentage at diagnosis                      | ≤66%                             | 0.90                       |                              |                                |                |
| Leukocytes (×10 <sup>9</sup> /L)                   | ≤8×10 <sup>9</sup> /L            | 0.32                       |                              |                                |                |
| Hemoglobin (g/dL)                                  | >8.8 g/dL                        | 0.59                       |                              |                                |                |
| Platelets (×10 <sup>9</sup> /L)                    | >68×10 <sup>9</sup> /L           | 0.23                       | 1.655                        | 0.575-4.769                    | 0.35           |
| ELN risk classification                            | (favorable/intermediate/adverse) | 0.87                       |                              |                                |                |

in WBC count, neutrophil count, lymphocyte count, Hb, MCV, PLT count, creatinine, uric acid, LDH, AST, ALT, albumin, fibrinogen, or CRP levels at diagnosis. In addition, age and ELN risk classification were similar between the groups. However, sex distribution differed significantly, with a higher proportion of female patients in the >66% blast group (56.8% vs. 34.1%,  $p=0.03$ ). Relapse and mortality rates were also comparable between the groups. Similarly, blast percentage at diagnosis was not associated with significant differences in OS or PFS.

Several studies have evaluated the prognostic relevance of morphological findings in AML. Ballo et al. [14] reported that blast vacuolization was associated with poor blast clearance after standard induction chemotherapy, inferior survival, CD15-positive immunophenotype, and a higher frequency of adverse-risk AML according to ELN risk stratification. Short et al. [15] demonstrated that peripheral blood blast clearance was an independent prognostic factor for survival and response to induction chemotherapy in AML, with blast disappearance by day 5 or earlier identified as the most discriminating cut-off for OS. Another study showed that a higher percentage of leukemic blasts with vacuoles was associated with lower complete response rates after first-cycle induction chemotherapy and worse OS and event-free survival [10]. In contrast, our study focused on the quantitative blast percentage at diagnosis rather than specific morphological features such as vacuolization. In our cohort, a higher blast percentage at diagnosis did not have a significant prognostic impact on survival outcomes.

### Study Limitations

This study has several limitations. First, it was conducted retrospectively at a single tertiary care center with a relatively small sample size, which may limit the generalizability of the findings. Second, the study population was heterogeneous with respect to treatment approaches, including both intensive induction chemotherapy and hypomethylating agent-based therapies. Third, comprehensive molecular and cytogenetic data were not consistently available for all patients because of the retrospective nature of the study. Finally, the follow-up duration varied among patients, and the retrospective design may have introduced selection and information bias. Despite these limitations, this study provides valuable insight into the prognostic impact of blast percentage at diagnosis in patients with AML.

### Conclusion

In conclusion, blast percentage at diagnosis did not appear to have a significant prognostic impact in patients with AML. No significant difference was observed in survival outcomes between patients with high and low blast percentages. Similarly, laboratory findings were largely comparable between the groups. Consistent with current guidelines, genetic and molecular findings remain indispensable for risk stratification in AML.

## Ethics

**Ethics Committee Approval:** Ethics committee approval was obtained from the Selçuk University Faculty of Medicine Ethics Committee (date: 21.11.2023, approval number: 2023/550).

**Informed Consent:** Informed consent was obtained from all patients included in this study.

## Footnotes

### Authorship Contributions

Medical Practices: R.Ç., A.E.Ç., Concept: M.D., Design: M.D., Data Collection or Processing: R.Ç., A.E.Ç., Analysis or Interpretation: R.Ç., Literature Search: R.Ç., Writing: R.Ç.

**Conflict of Interest:** No conflict of interest was declared by the authors.

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