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Research Article

# Diagnostic Value of Initial Laboratory Parameters in Predicting Hemothorax among Adult Patients with Isolated Blunt Thoracic Trauma Presenting to the Emergency Department: A Retrospective Observational Study

Veysi Siber[1], Sinan Özdemir[2], Serdal Ateş[3], Zafer Beşer[1], Hatice Kübra Siber[4], Meryem Sara Dayan[1], Ahmet Burak Erdem[1]

[1]Clinic of Emergency Medicine, University of Health Scienes Türkiye, Ankara Etlik City Hospital, Ankara, Türkiye
[2]Clinic of Emergency Medicine, Düzce Atatürk State Hospital, Düzce, Türkiye
[3]Clinic of Emergency Medicine, University of Health Sciences Türkiye, Ankara Training and Research Hospital, Ankara, Türkiye
[4]Department of Family Medicine, Reyhanlı District Health Directorate, Hatay, Türkiye

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**ORCID IDs of the authors:** V.S. 0000-0003-2856-8303, S.Ö. 0000-0001-7396-0529, S.A. 0000-0003-2224-2134, Z.B. 0000-0001-6373- 8588, H.K.S. 0009-0008-2947-3932, M.S.D. 0009-0008-1580-6492, A.B.E. 0000-0002-3618-6252.

## ABSTRACT

**Objective:** Hemothorax is a serious complication of blunt thoracic trauma requiring early recognition. While computed tomography (CT) is the diagnostic gold standard, imaging delays in unstable patients necessitate alternative early markers. This study evaluated the predictive value of initial laboratory parameters in adult patients with isolated blunt thoracic trauma.

**Methods:** This retrospective study included adults with isolated blunt thoracic trauma presenting to a tertiary emergency department between March 1, 2023, and March 1, 2024. Based on CT findings, patients were categorized as hemothorax-positive or hemothorax-negative. Demographic data, admission laboratory results, and outcomes were extracted from the hospital information system. Laboratory variables included complete blood count, platelet indices, venous blood gas analysis, lactate, and coagulation parameters. Group comparisons were conducted to assess the associations between these variables and the presence of hemothorax.

**Results:** A total of 414 patients were evaluated (median age: 55 years; 69.8% male). Hemothorax was identified in 171 patients (41.3%) based on chest CT. Compared with the non-hemothorax group, the hemothorax group had significantly higher median white blood cell counts ($P = 0.027$), lymphocyte counts ($P = 0.032$), and serum lactate levels ($P < 0.001$), whereas venous pH values were significantly lower ($P < 0.001$).

**Conclusion:** Elevated white blood cell, lymphocyte count, lactate levels, and decreased venous pH at admission may help predict hemothorax in isolated blunt chest trauma, especially when imaging is delayed. Platelet indices showed no diagnostic utility.

**Keywords:** Blunt trauma, hemothorax, lactic acid, lymphocyte, emergency service, hospital

**Corresponding author:** Veysi Siber, **E-mail:** veysiber.ss@gmail.com

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## INTRODUCTION

Thoracic trauma is a significant contributor to trauma-related morbidity and mortality worldwide, accounting for roughly 10-15% of trauma cases presenting to emergency departments (EDs).[1,2] Blunt thoracic trauma commonly results from mechanisms such as motor vehicle collisions, falls from a height, and physical assault, with mortality rates ranging from 10% to as high as 60%.[3] Hemothorax, which occurs as a consequence of blunt thoracic trauma, is characterized by the accumulation of blood in the pleural cavity and, if not promptly diagnosed, may lead to severe impairments in respiratory mechanics, gas exchange, and hemodynamic stability.[4,5]

The diagnosis of hemothorax should involve an integrated assessment of clinical findings, radiologic imaging, and laboratory parameters.[6] Although chest computed tomography (CT), a routinely used imaging modality, can accurately identify the presence and extent of hemothorax, the need for early clinical decision-making before imaging highlights the potential role of laboratory markers.[7,8] In particular, complete blood count (CBC) parameters, lactate levels, blood gas findings, and coagulation tests may assist in predicting both hemodynamic status and possible pleural pathologies in trauma patients.[9]

In trauma populations, lactate levels are widely recognized as markers of tissue hypoperfusion and have been associated with increased mortality.[10] Moreover, growing evidence suggests that hematologic markers such as platelet indices [mean platelet volume (MPV), platelet distribution width (PDW), platelet large cell ratio (P-LCR)] may reflect the inflammatory response and thrombotic tendency following trauma.[11] However, the predictive value of these parameters in identifying hemothorax remains unclear. Within this framework, assessing the relationship between initial ED laboratory findings and the occurrence of hemothorax is crucial for early risk stratification and for guiding optimal treatment decisions.

This study sought to determine the diagnostic utility of initial laboratory parameters for predicting hemothorax in adult patients with isolated blunt thoracic trauma presenting to the ED.

### MAIN POINTS

- Higher admission white blood cell and lymphocyte counts are significantly associated with the presence of hemothorax in adults with isolated blunt thoracic trauma. Increased serum lactate levels and decreased venous pH values may serve as early biochemical indicators for diagnosing hemothorax.
- Platelet indices (mean platelet volume, platelet distribution width, platelet–large cell ratio) showed no significant diagnostic value in predicting the presence of hemothorax.
- In situations where imaging may be delayed, these laboratory parameters can provide early risk stratification and support clinical decision-making.

## MATERIAL AND METHODS

### Study Design and Setting

This retrospective observational study, conducted at a single center, was reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology guidelines to ensure methodological transparency and completeness. It incorporated both descriptive and analytical components. Ethical approval was granted by the Clinical Research Ethics Committee of University of Health Scienes Türkiye, Ankara Etlik City Hospital (approval no.: AEŞH-BADEK-2024-307, date: 03.04.2024), and the study adhered to the principles outlined in the Declaration of Helsinki. As all data were anonymized, the requirement for informed consent was waived.

### Participants

Adults aged 18 years or older who presented to the ED with isolated blunt thoracic trauma between March 1, 2023, and March 1, 2024, were enrolled. Based on chest CT results, relevant specialist consultations, and clinical assessments, patients were classified as hemothorax-positive or hemothorax-negative.

### Exclusion criteria

- Pregnant patients,
- Active external bleeding,
- Cases with documented liver or splenic laceration,
- Penetrating thoracic trauma,
- Receiving anticoagulant therapy,
- Concomitant bleeding from other organ systems,
- A known pre-existing hematologic disorder (e.g., thrombocytopenia, myelodysplastic syndrome, leukemia),
- Underwent major surgery within the past month,
- Missing laboratory or imaging data,
- Patients whose medical records could not be accessed or whose diagnoses were uncertain.

### Data Collection Process

All study data were retrospectively retrieved from the Hospital Information Management System. Medical records of all eligible patients were reviewed individually using protocol numbers matched to patient identifiers; however, no personal identifying information was recorded in the study file. The data collection process was conducted in the following order:

**1. Patient Selection:**

All adult patients aged over 18 years who presented to the ED trauma unit during the study period were screened. Among these, patients with thoracic trauma were identified. Only those with a confirmed diagnosis of isolated blunt thoracic trauma, based on discharge summaries, consultation notes, CT reports, and final diagnoses, were included.

**2. Imaging Evaluation:**

CT reports of all thoracic trauma patients were reviewed, and those with a documented diagnosis of hemothorax were identified. The diagnosis was based on radiology reports that

explicitly stated "hemothorax." Patients without hemothorax constituted the comparison group.

**3. Clinical Data Collection:**

The following demographic and clinical variables were recorded for each patient using a standardized data collection form:

- Age and sex
- Comorbidities (hypertension, diabetes mellitus, chronic obstructive pulmonary disease, chronic kidney disease)
- Trauma-related clinical findings and injuries (rib fracture, sternal fracture, pneumothorax, need for blood transfusion)
- Requirement for tube thoracostomy
- Disposition from the ED [discharge, ward admission, intensive care unit (ICU) admission]
- Mortality data based on 24-hour and 30-day outcomes

**4. Collection of Laboratory Parameters:**

For all patients, initial laboratory results obtained at ED admission were documented. These parameters were grouped as follows:

- **CBC:**
  - White blood cell (WBC) count, red blood cell count, and hemoglobin (Hb) level, hematocrit, neutrophils, lymphocytes, monocytes
  - Mean corpuscular volume, mean corpuscular Hb
  - Platelet count (PLT), MPV
  - PDW,
  - P-LCR
- **Blood Gas and Coagulation Tests:**
  - pH, base excess, lactate level
  - International normalized ratio

**5. Data Entry and Quality Control:**

All data were entered by two independent researchers. A 10% random sample was selected for cross-checking to ensure accuracy. Cases with incomplete or inconsistent data were excluded from the analysis.

**6. Data Classification:**

Patients were classified into two primary groups according to the presence of hemothorax confirmed by chest CT imaging:

- Hemothorax-positive group
- Hemothorax-negative group

**Statistical Analysis**

Statistical analyses were conducted using Jamovi software (version 2.5.7). Categorical variables were presented as frequencies and percentages. Continuous variables with a normal distribution were presented as mean ± SD, while those without a normal distribution were presented as medians with interquartile ranges [(IQR); $25^{th}$-$75^{th}$ percentiles]. The distribution of continuous variables was assessed using the Kolmogorov-Smirnov test and histogram evaluation. Group comparisons for categorical data were performed using the chi-square test or Fisher's exact test. For continuous variables with a normal distribution, the either Student's t-test or Welch's t-test was applied, depending on variance homogeneity as assessed by Levene's test. Non-normally distributed continuous variables were compared using the Mann-Whitney U test. In subgroup analyses, Bonferroni correction was applied to adjust *P* values. A *P* value < 0.05 was considered statistically significant.

## RESULTS

During the study period, 12.561 adult patients presented to the ED trauma unit. Of these, 11,764 were excluded for not meeting the criteria for isolated thoracic trauma. As a result, 797 patients were evaluated for eligibility. Following application of the exclusion criteria, 383 additional patients were excluded for the following reasons: pregnancy (n=16), active external bleeding (n=41), penetrating thoracic trauma (n=37), bleeding involving other organ systems (n=157), ongoing anticoagulant therapy (n=11), missing laboratory or imaging data (n=113), and known pre-existing hematologic disorders (n=8). After applying all exclusion criteria, 414 patients were eligible and included in the final analysis (Figure 1).

The study cohort comprised 414 adult patients with isolated blunt thoracic trauma. The mean age was 54.2 ± 19.5 years and males accounted for 69.8% of the population. The most common comorbidities were hypertension (13.5%) and diabetes mellitus (4.1%) (Table 1).

Laboratory analyses at the time of ED admission revealed a median WBC count of 12.0 × $10^9$/L (IQR: 8.8-15.7), a Hb level of 13.2 g/dL (IQR: 11.8-14.9), and a mean PLT of 246 ± 82 × $10^9$/L. The median venous lactate level was 2.1 mmol/L (IQR: 1.4-3.1), and venous pH was 7.39 (IQR: 7.34-7.42). The base deficit was -0.4 mmol/L (IQR: -0.5 to -0.3), suggesting a mild metabolic disturbance in a subset of the cohort (Table 1).

Regarding traumatic thoracic findings, hemothorax was observed in 171 patients (41.3%), rib fractures in 171 patients (41.3%), and pneumothorax in 65 patients (15.7%). Chest tube placement was performed in 51 patients (12.3%), and 28 (6.8%) received blood transfusions (Table 1).

Regarding clinical outcomes, 57.2% of patients (n=237) required admission to the ICU, while 28.5% were admitted to general wards and 14.3% were discharged from the ED. The 30-day mortality rate was 2.4% (n=10) (Table 1).

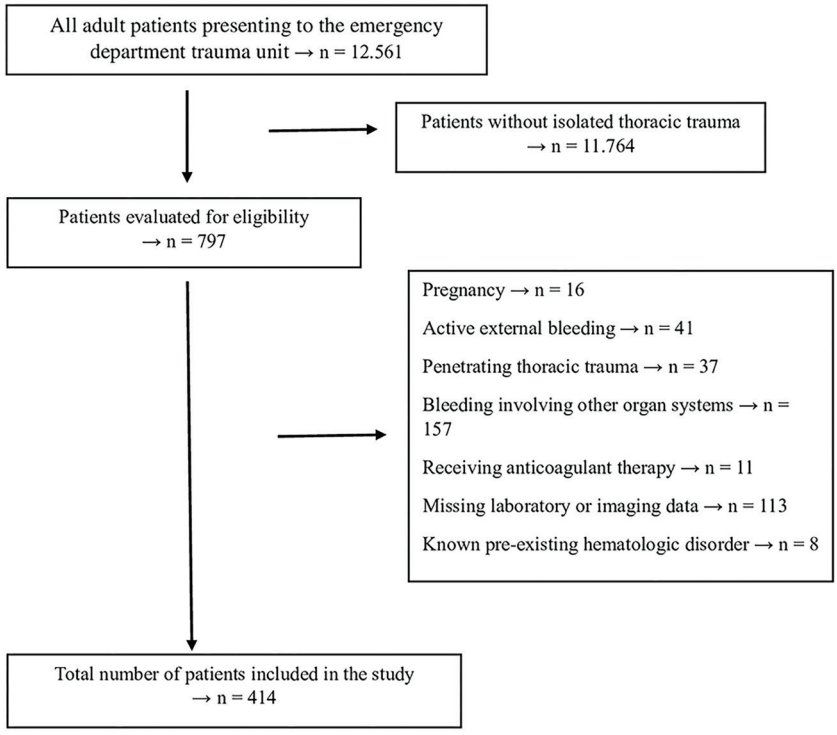


**Figure 1.** Patient flow diagram

**Table 1.** Distribution of Patients' Demographic Characteristics, Comorbidities, Laboratory Parameters, and Clinical Findings

| | n=414 |
|---|---|
| Age, years, mean ± SD | 54.2 ± 19.5 |
| Sex, n (%) | |
| Male | 289 (69.8 %) |
| Female | 125 (30.2 %) |
| Comorbidities, n (%) | |
| Hypertension | 56 (13.5 %) |
| Diabetes mellitus | 17 (4.1 %) |
| Chronic kidney disease | 2 (0.5 %) |
| Chronic kidney disease | 1 (0.2 %) |
| Laboratuar parametreleri, median (IQR 25-75) / mean ± SD | |
| WBC, $10^9$/L | 12.0 (8.8-15.7) |
| RBC, $10^{12}$/L | 4.5 (4.1-5.0) |
| Hemoglobin, g/dL | 13.2 (11.8-14.9) |
| Hematokrit, % | 41 (37-45) |
| MCV, fL | 90 (87-93) |
| MCH, pg | 29 (28-31) |
| Platelet, $10^9$/L | 246 ± 82 |
| MPV, fL | 10.5 ± 0.9 |
| Neutrophil, $10^9$/L | 8.7 (5.9-12.8) |
| Lymphocyte, $10^9$/L | 1.8 (1.1-2.9) |
| Monocyte, $10^9$/L | 0.74 (0.55-0.98) |
| PDW, % | 12.0 ± 2.0 |
| RDW, % | 13.2 (12.7-14.3) |
| PLCR, % | 28.5 ± 7.4 |
| Venous blood pH, - | 7.39 (7.34-7.42) |
| Base excess, mmol/L | 0.4 (0.3-0.5) |
| Lactate, mmol/L | 2.1 (1.4-3.1) |
| INR, - | 1.05 (0.99-1.14) |
| Thoracic injuries, n (%) | |
| Hemothorax | 171 (41.3 %) |
| Pneumothorax | 65 (15.7 %) |
| Rib fracture | 171 (41.3 %) |
| Sternal fracture | 8 (1.9 %) |
| Chest tube requirement | 51 (12.3 %) |
| Blood transfusion requirement | 28 (6.8 %) |
| Emergency department disposition, n (%) | |
| Discharged from the emergency department | 59 (14.3 %) |
| Admitted to the ward | 118 (28.5 %) |
| Admitted to the ICU | 237 (57.2 %) |
| 30-day mortality, n (%) | 10 (2.4 %) |

WBC, white blood cell; RBC, red blood cell; MCV, mean corpuscular volume; MCH, mean corpuscular hemoglobin; MPV, mean platelet volume; PDW, platelet distribution width; RDW, red cell distribution width; PLCR, platelet large cell ratio; INR, international normalized ratio; ICU, intensive care unit; SD, standard deviation.

### Comparative Analysis Based on Hemothorax Status

When patients were grouped according to the presence of hemothorax, statistically significant differences were observed in several clinical and laboratory variables (Table 2).

Hypertension was significantly more prevalent among patients with hemothorax than in those without ($P < 0.001$). Among laboratory parameters, WBC was elevated in the hemothorax group [(12.5 (IQR: 9.2-17.2) $\times 10^9$/L vs. 11.7 (IQR: 8.6-14.6) $\times 10^9$/L; $P = 0.027$] and lymphocyte count was also higher [2.1 (IQR: 1.2-3.0) $\times 10^9$/L vs. 1.6 (IQR: 1.1-2.2) $\times 10^9$/L; $P = 0.032$]. In contrast, venous blood pH was significantly lower in the hemothorax group [7.37 (IQR: 7.33-7.41) vs. 7.40 (IQR: 7.36-7.43), $P < 0.001$]. Lactate levels were significantly elevated in patients with hemothorax [2.3 mmol/L (IQR 1.6-3.4) vs. 1.8 mmol/L (IQR 1.3-2.8); $P < 0.001$] (Table 2).

**Table 2.** Association Between Patients' Demographic Characteristics, Comorbidities, Laboratory Parameters, and Clinical Findings and the Presence of Hemothorax

| | Hemothorax | | *P* value |
|---|---|---|---|
| | **Present (n=171)** | **Absent (n=243)** | |
| Age, years, mean ± SD | 53.8 ± 18.8 | 54.5 ± 19.9 | 0.752[1] |
| Sex, n (%) | | | |
| Male | 127 (74.3%) | 162 (66.7%) | 0.097[2] |
| Female | 44 (25.7%) | 81 (33.3%) | |
| Comorbidities, n (%) | | | |
| Hypertension | 40 (23.4%) | 16 (6.6%) | **< 0.001[2]** |
| Diabetes mellitus | 9 (5.3%) | 8 (3.3%) | 0.320[2] |
| Laboratory, median (IQR 25-75) / mean ± SD | | | |
| WBC, $10^9$/L | 12.5 (9.2-17.2) | 11.7 (8.6-14.6) | **0.027[3]** |
| RBC, $10^{12}$/L | 4.5 (4.0-4.9) | 4.5 (4.1- 5.0) | 0.753[3] |
| Hemoglobin, g/dL | 13.4 (11.8-15.0) | 13.1 (11.8-14.9) | 0.695[3] |
| Hematokrit, % | 41 (37-45) | 41 (37-45) | 0.793[3] |
| MCV, fL | 91 (88-93) | 90 (87-93) | 0.109[3] |
| MCH, pg | 30 (29-31) | 29 (28-30) | 0.137[3] |
| Platelet, $10^9$/L | 240 ± 67 | 251 ± 91 | 0.194[1] |
| MPV, fL | 10.5 ± 0.8 | 10.4 ± 1.0 | 0.371[1] |
| Neutrophil, $10^9$/L | 9.4 (6.1-15.0) | 8.3 (5.8-11.3) | 0.062[3] |
| Lymphocyte, $10^9$/L | 2.1 (1.2-3.0) | 1.6 (1.1-2.2) | **0.032[3]** |
| Monocyte, $10^9$/L | 0.74 (0.57-1.04) | 0.74 (0.54-0.95) | 0.221[3] |
| PDW, % | 12.1 ± 1.9 | 12.0 ± 2.1 | 0.573[1] |
| RDW, % | 13.2 (12.7-14.0) | 13.2 (12.8-14.6) | 0.225[3] |
| PLCR, % | 28.9 ± 6.9 | 28.2 ± 7.8 | 0.289[1] |
| Venous blood pH, | 7.37 (7.33-7.41) | 7.40 (7.36-7.43) | **< 0.001[3]** |
| Base excess, mmol/L | 0.4 (0.3-0.6) | 0.3 (0.3-0.5) | 0.188[3] |
| Lactate, mmol/L | 2.3 (1.6-3.4) | 1.8 (1.3-2.8) | **< 0.001[3]** |
| INR, - | 1.05 (1.00-1.14) | 1.05 (0.98-1.13) | 0.762[3] |
| Thoracic injuries, n (%) | | | |
| Pneumothorax | 54 (31.6%) | 11 (4.5%) | **< 0.001[2]** |
| Rib fracture | 134 (78.4%) | 37 (21.6%) | **< 0.001[2]** |
| Sternal fracture | 4 (2.3%) | 4 (1.6%) | 0.723[4] |
| Chest tube requirement | 47 (27.5 %) | 4 (1,6%) | **< 0.001[2]** |
| Blood transfusion requirement | 28 (6.8 %) | 0 | |
| Emergency department disposition, n (%) | | | |
| Discharged from the emergency department | 7 (4.1%) | 5 (21.4%) | |
| Admitted to the ward | 19 (11.1%) | 99 (40.7%) | **< 0.001[2]** |
| Admitted to the ICU | 145 (84.8%) | 92 (37.9%) | |
| 30-day mortality, n (%) | 9 (5.3%) | 1 (0.4%) | **0.002[4]** |

[1]Independent Samples t-test, , [2]chi-square test, [3]Mann-Whitney U test, [4]Fisher's Exact test. WBC, white blood cell; RBC, red blood cell; MCV, mean corpuscular volume; MCH, mean corpuscular hemoglobin; MPV, mean platelet volume; PDW, platelet distribution width; RDW, red cell distribution Width, PLCR, platelet large cell ratio; INR, international normalized ratio; ICU, intensive care unit; SD, standard deviation.

Regarding thoracic injuries, pneumothorax (31.6% vs. 4.5%, *P* < 0.001), rib fractures (78.4% vs. 21.6%, *P* < 0.001), chest tube placement (27.5% vs. 1.6%, *P* < 0.001), and blood transfusion (16.4% vs. 0%, *P* < 0.001) occurred significantly more often in the hemothorax group (Table 2).

A significant association was found between ED disposition and hemothorax status (*P* < 0.001 by chi-square test). Subgroup analysis showed that patients admitted to the ICU differed significantly from both discharged patients and those admitted to the general ward (both *P* < 0.001), whereas no significant difference was observed between the discharged and general ward groups (*P* > 0.005). Furthermore, 30-day mortality was markedly higher in the hemothorax group than in the non-hemothorax group (5.3% vs. 0.4%, *P* = 0.002) (Table 2).

Additionally, in the subgroup analysis of patients with hemothorax (Table 3), non-survivors (n=9) had higher WBC and lymphocyte counts, higher lactate levels, and lower venous pH compared with survivors. Pneumothorax, sternal fracture, and the need for blood transfusion were also observed more frequently in this group. These findings indicate that both laboratory parameters and specific clinical injury characteristics are associated with 30-day mortality.

**Table 3.** The Relationship Between Demographic Characteristics, Comorbidities, Laboratory Parameters, and Clinical Findings of Patients with Hemothorax and the Presence of Mortality

| | Mortality | | *P* value |
|---|---|---|---|
| | **Yes (n=9)** | **No (n=162)** | |
| Age, years, mean ± SD | 62.0 ± 18.2 | 53.4 ± 18.8 | 0.183[1] |
| Sex, n (%) | | | |
| Male | 5 (55.6%) | 122 (75.3%) | 0.238[2] |
| Female | 4 (44.4%) | 40 (24.7%) | |
| Comorbidities, n (%) | | | |
| Hypertension | 1 (11.1%) | 39 (24.1%) | 0.687[2] |
| Diabetes mellitus | 1 (11.1%) | 8 (4.9%) | 0.393[2] |
| Laboratory, median (IQR 25-75) / mean ± SD | | | |
| WBC, $10^9$/L | 18.2 (17.6-24.4) | 12.1 (8.8-16.4) | **0.027[3]** |
| RBC, $10^{12}$/L | 4.0 (3.8-4.5) | 4.6 (4.1-5.0) | 0.753[3] |
| Hemoglobin, g/dL | 11.4 (9.9-12.6) | 13.6 (11.8-15.0) | 0.695[3] |
| Hematokrit, % | 37 (34-40) | 41 (37- 45) | 0.793[3] |
| MCV, fL | 89 (88-91) | 91 (87-94) | 0.109[3] |
| MCH, pg | 28 (27-29) | 30 (29-31) | 0.137[3] |
| Platelet, $10^9$/L | 251 ± 53 | 240 ± 68 | 0.194[1] |
| MPV, fL | 10.4 ± 0.8 | 10.5 ± 0.9 | 0.371[1] |
| Neutrophil, $10^9$/L | 15.5 (14.3-18.1) | 9.0 (6.0-13.8) | 0.062[3] |
| Lymphocyte, $10^9$/L | 3.7 (2.5-5.2) | 2.1 (1.2-2.8) | **0.032[3]** |
| Monocyte, $10^9$/L | 0.83 (0.55-1.07) | 0.74 (0.57-1.03) | 0.221[3] |
| PDW, % | 12.2 ± 1.8 | 12.1 ± 1.9 | 0.573[1] |
| RDW, % | 14.1 (13.2-17.2) | 13.1 (12.7-13.9) | 0.225[3] |
| PLCR, % | 28.6 ± 6.6 | 29.0 ± 7.0 | 0.289[1] |
| Venous blood pH, | 7.26 (6.82-7.33) | 7.38 (7.34-7.41) | **< 0.001[3]** |
| Base excess, mmol/L | 0.5 (0.3-0.8) | 0.4 (0.3-0.6) | 0.188[3] |
| Lactate, mmol/L | 7.5 (4.1-8.2) | 2.2 (1.6-3.3) | **< 0.001[3]** |
| INR, - | 1.24 (1.18-1.55) | 1.05 (0.99-1.14) | 0.762[3] |
| Thoracic injuries, n (%) | | | |
| Pneumothorax | 6 (66.7%) | 48 (29.6%) | **0.029[2]** |
| Rib fracture | 8 (88.9%) | 126 (77.8%) | 0.686[2] |
| Sternal fracture | 2 (22.2%) | 2 (1.2%) | **0.014[2]** |
| Chest tube requirement | 5 (55.6%) | 42 (25.9%) | 0.117[2] |
| Blood transfusion requirement | 6 (66.7%) | 22 (13.6%) | **< 0.001[2]** |
| Emergency department disposition, n (%) | | | |
| Discharged from the emergency department | 0 | 7 (4.3%) | |
| Admitted to the ward | 1 (11.1%) | 18 (11.1%) | |
| Admitted to the ICU | 8 (88.9%) | 137 (84.6%) | |

[1]Independent Samples t-test, [2]Fisher's exact test, [3]Mann-Whitney U test; WBC, white blood cell; RBC, red blood cell; MCV, mean corpuscular volume; MCH, mean corpuscular hemoglobin; MPV, mean platelet volume; PDW, platelet distribution width; RDW, red cell distribution width; PLCR, platelet large cell ratio, INR, international normalized ratio; ICU, intensive care unit; SD, standard deviation.

## DISCUSSION

This study assessed the ability of initial laboratory parameters to predict hemothorax in adult patients presenting to the ED with isolated blunt thoracic trauma. The findings demonstrated that WBC count, lactate level, venous pH, and lymphocyte count were significantly associated with the presence of hemothorax. In contrast, traditional platelet indices such as MPV, PDW, and P-LCR did not demonstrate significant diagnostic value.

Blunt thoracic trauma can lead to various intrathoracic and extrathoracic complications, with hemothorax being among the most severe and life-threatening complications.[12,13] In hemothorax, blood accumulation within the thoracic cavity can mechanically limit respiratory function, impair oxygenation, and reduce systemic perfusion, thereby accelerating clinical deterioration.[6] Early diagnosis and intervention may reduce the need for invasive procedures and improve clinical outcomes. Although chest CT is considered the gold standard for diagnosing hemothorax, it may be delayed in hemodynamically unstable patients. Therefore, the contribution of laboratory parameters assessed prior to CT becomes particularly valuable in early clinical decision-making.[14,15]

In the present study, WBC levels and lymphocyte counts were significantly elevated in the hemothorax group ($P$ = 0.027 and $P$ = 0.032, respectively). This may reflect the systemic inflammatory response and activation resulting from trauma-induced tissue injury. Consistent with our results, previous studies have reported that elevated WBC and lymphocyte counts in the acute phase of trauma are associated with greater clinical severity and increased risk of complications.[16,17] These results suggest that CBC parameters may assist in the early identification of traumatic hemothorax. The clinical relevance of these parameters becomes particularly evident in cases where imaging is delayed or patients are hemodynamically unstable. At admission to the ED, patients presenting with elevated WBC and lymphocyte counts, increased lactate levels, and decreased pH are more likely to have a hemothorax. Such patients should be prioritized for expedited imaging, closely monitored, and considered for early tube thoracostomy if necessary. In this way, laboratory findings may serve not only as diagnostic adjuncts but also as tools for clinical prioritization.

Increased intrathoracic pressure due to hemothorax can restrict lung expansion, disrupt the ventilation-perfusion balance, and consequently lead to impaired tissue oxygenation and lactate accumulation.[18] Consistent with this pathophysiological mechanism, our study showed significantly higher lactate levels in the hemothorax group (median: 2.3 mmol/L vs. 1.8 mmol/L; $P$ < 0.001). This observation supports previous reports highlighting lactate as a prognostic marker of hypoperfusion and systemic inflammation in trauma patients.[19,20]

Venous pH levels were also significantly lower in the hemothorax group ($P$ < 0.001). This decrease may reflect both respiratory acidosis due to ventilation-perfusion mismatch and metabolic acidosis resulting from hypoperfusion secondary to hemorrhage. Previous studies have demonstrated that the pH level serves as an early prognostic marker in trauma-induced hemorrhagic shock.[21,22]

However, no statistically significant differences in the platelet indices MPV, PDW, and P-LCR were observed between the hemothorax and control groups. Although these parameters have previously been shown to reflect hematologic dynamics and microcirculatory responses following trauma in various patient populations,[23,24] our findings suggest that they did not demonstrate sufficient diagnostic performance to predict hemothorax among patients with isolated thoracic trauma. This discrepancy may be attributed to factors such as sample selection, timing of laboratory measurements, or coexisting systemic variables.

### Study Limitations

This study has certain limitations. Primarily, its retrospective, single-center nature may have introduced selection bias and limited the ability to draw causal inferences. Additionally, potential confounding variables such as prehospital interventions, the mechanism and severity of the trauma, and patients' baseline coagulation status were not included in the analysis. Moreover, time-dependent changes in laboratory parameters were not evaluated; this aspect may serve as a valuable focus for prospective studies.

## CONCLUSION

This study demonstrates that WBC count, lactate level, pH, and lymphocyte count may serve as significant predictors of hemothorax in patients presenting with isolated blunt thoracic trauma. In contrast, platelet indices did not appear to have discriminative value in this patient population. These findings contribute to identifying supportive laboratory markers for early risk stratification and clinical decision-making in the ED setting.

### Ethics

**Ethics Committee Approval:** This study was designed as a single-center, retrospective, descriptive observational analysis. Ethical approval was obtained from the Clinical Research Ethics Committee of University of Health Scienes Türkiye Ankara Etlik City Hospital (approval no.: AEŞH-BADEK-2024-307, date: 03.04.2024).

**Informed Consent:** Retrospective study. Permission was obtained from hospital management to collect study data from the Information Management System.

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### Footnotes

### Author Contributions

Concept Design – V.S., S.Ö., A.B.E.; Data Collection or Processing – V.S., S.A., Z.B., H.K.S., M.S.D.; Analysis or Interpretation – S.Ö., S.A.; Literature Review – V.S., S.A., Z.B., H.K.S., M.S.D.; Writing, Reviewing and Editing – V.S., A.B.E.

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