AMERICAN ACADEMIC PUBLISHER

INTERNATIONAL JOURNAL OF MEDICAL SCIENCES

ISSN NUMBER: 2692 - 5206 Volume 6. No 03. March ,2026

DIAGNOSIS AND TREATMENT OF COMPLICATIONS OF LIMB THROMBOSIS IN PATIENTS WITH ACUTE LEUKEMIA

Makhmonov Lutfullo
PhD, chief physician of Samarkand Regional multi-network medical center,
Head of the department of Hematology of Samarkand State Medical University

Isomadinov Alisher
Surgeon in the microsurgery department of the Samarkand Regional multi-network medical center

Khaitov Abdusattor
Head of the microsurgery department of the Samarkand Regional multi-network medical center

Madasheva Anajan
PhD, Senior lecturer of the department of hematology
Samarkand State Medical University

Abstract. Patients with acute leukemia (AL), including acute myeloid leukemia (AML) and acute lymphoblastic leukemia (ALL), exhibit a dual hemostatic imbalance characterized by both bleeding and thrombotic tendencies. Limb thrombosis, encompassing venous (deep vein thrombosis, DVT) and arterial events, represents a challenging complication due to concurrent thrombocytopenia, coagulopathy, central venous catheter (CVC) use, and intensive chemotherapy. This prospective observational study analyzed 62 consecutive adult patients with AL who developed limb thrombosis at a tertiary hematology-oncology center in Tashkent, Uzbekistan, between January 2025 and December 2025. Diagnosis integrated clinical evaluation, D-dimer testing, duplex ultrasound for venous thrombosis, and CT angiography for arterial involvement or suspected pulmonary embolism (PE). Complications arose in 64.5% of cases, including PE in 25.8%, recurrent thrombosis in 19.4%, acute limb ischemia (ALI) in 12.9%, and post-thrombotic syndrome (PTS) in 14.5%. Low-molecular-weight heparin (LMWH) served as the primary anticoagulant in 83.9% of patients, frequently supported by platelet transfusions to maintain counts ≥30–50 × 10^9/L during therapy. Treatment achieved thrombus resolution or stabilization in 72.6% of cases; however, major bleeding (ISTH criteria) occurred in 16.1%, and limb amputation was required in 6.5% of ALI cases. These results demonstrate that individualized, multidisciplinary management balancing thrombotic and hemorrhagic risks can yield acceptable outcomes. Early diagnostic imaging and platelet-supported LMWH therapy are central to minimizing morbidity in this high-risk group.

Keywords: Acute leukemia, limb thrombosis, venous thromboembolism, acute limb ischemia, anticoagulation, thrombocytopenia, low-molecular-weight heparin, pulmonary embolism

Introduction. Acute leukemia (AL) predisposes patients to a wide spectrum of hemostatic disorders, ranging from life-threatening hemorrhage to thromboembolic events. Although bleeding secondary to thrombocytopenia and disseminated intravascular coagulation (DIC) is classically emphasized, thrombotic complications occur with notable frequency, affecting 4–11% of patients within the first year of diagnosis. Limb thrombosis—primarily upper-extremity CVC-related DVT, lower-extremity DVT, and less commonly arterial occlusion leading to acute limb ischemia—carries substantial morbidity, including pulmonary embolism, recurrent events, chronic venous insufficiency, and limb loss. Management is particularly complex in AL because

AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES
ISSN NUMBER: 2692 - 5206 Volume 6. No 03. March ,2026

standard anticoagulation must be carefully titrated against profound cytopenias, chemotherapy-induced endothelial damage, and the need for invasive procedures such as lumbar punctures or bone marrow biopsies.

Despite increasing awareness, prospective data on the diagnosis, complication spectrum, and real-world treatment outcomes of limb thrombosis specifically in AL patients remain limited, particularly in diverse healthcare settings. Existing guidelines from organizations such as the American Society of Hematology (ASH) and International Society on Thrombosis and Haemostasis (ISTH) provide general frameworks for cancer-associated thrombosis with thrombocytopenia, yet leukemia-specific recommendations are sparse. This study aimed to (1) describe the clinical presentation and diagnostic approach to limb thrombosis in AL, (2) quantify the incidence and types of associated complications, and (3) evaluate the safety and efficacy of contemporary treatment strategies, with emphasis on anticoagulation dosing, platelet support, and multidisciplinary care. The findings are intended to support the development of more tailored diagnostic and therapeutic protocols for this vulnerable population.

Literature review. Thromboembolic events represent a clinically significant yet understudied complication in acute leukemia. Large population-based and retrospective studies report a 2-year cumulative incidence of venous thromboembolism (VTE) of approximately 5.2% in AML and 4.5% in ALL, with the majority of events (up to 64%) occurring within the first 3 months of diagnosis—coinciding with induction chemotherapy and periods of thrombocytopenia. CVC-related upper-extremity DVT accounts for 55–76% of venous events, while lower-extremity DVT and pulmonary embolism comprise 20–33% and 8–15%, respectively. Arterial thrombosis, though rarer (1–3% overall, higher in AML), can present dramatically as acute limb ischemia, stroke, or myocardial infarction, particularly in acute promyelocytic leukemia (APL) or cases with high blast counts and leukostasis.

Risk factors for thrombosis in AL include older age, female sex, obesity, CVC placement, prior thrombotic history, cardiovascular comorbidities, adverse cytogenetics, and asparaginase use in ALL. Notably, current risk-assessment tools (Khorana score, ISTH-DIC score) perform poorly in this population, highlighting the need for leukemia-specific predictive models. Complications are frequent: recurrent VTE occurs in 18–21%, PE in 8–25%, and post-thrombotic syndrome in up to 30% of lower-extremity DVT survivors. In cases of acute limb ischemia associated with AL, systematic reviews document amputation rates of 30–31% and 30-day mortality approaching 36%, underscoring the aggressive nature of arterial events.

Diagnosis typically combines pretest probability assessment (adapted Wells criteria), D-dimer (though nonspecific in AL), and imaging. Duplex ultrasound remains the gold standard for suspected limb DVT (sensitivity >95% for proximal veins), while CT angiography is essential for arterial occlusion, central thrombosis, or PE. Treatment follows cancer-associated thrombosis principles but requires modification for thrombocytopenia. ISTH guidance recommends full-dose LMWH for platelet counts ≥50 × 10^9/L, platelet transfusion-supported full-dose anticoagulation for acute high-risk VTE with platelets 25–50 × 10^9/L, and dose reduction (50% therapeutic or prophylactic) for lower-risk events or more severe thrombocytopenia. LMWH is generally preferred over unfractionated heparin or direct oral anticoagulants (DOACs) in AL due to its shorter half-life, reversibility, and lower drug-interaction potential. Anticoagulation duration is often shortened (1–3 months or until remission and platelet recovery) compared with solid tumors. Data on DOAC safety and efficacy in AL remain limited because of trial exclusions.

AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES
ISSN NUMBER: 2692 - 5206 Volume 6. No 03. March ,2026

Despite these insights, prospective studies integrating diagnostic performance, complication rates, and treatment outcomes in AL patients with limb thrombosis are scarce. The present study addresses this evidence gap through systematic evaluation in a consecutive cohort.

Methods Study Design and Setting. This prospective observational cohort study was conducted at the Hematology-Oncology Department of a tertiary multi-profile medical center in Tashkent, Uzbekistan, from January 2025 to December 2025. The institutional review board approved the protocol, and written informed consent was obtained from all participants in accordance with the Declaration of Helsinki.

Participants Sixty-two adult patients (aged 18–65 years) with confirmed AL (AML or ALL according to WHO criteria) who developed clinically suspected or objectively confirmed limb thrombosis during the study period were enrolled consecutively. Exclusion criteria included pre-existing chronic limb thrombosis, isolated superficial vein thrombosis without extension or complications, or refusal of consent.

Diagnostic Assessment A standardized diagnostic protocol was applied: detailed clinical history and physical examination (including adapted Wells score for cancer patients), D-dimer assay, and urgent imaging. Duplex venous ultrasound was performed within 24 hours for suspected DVT. CT pulmonary angiography, CT venography, or CT angiography was utilized when PE, central venous involvement, or arterial occlusion was suspected. Arterial thrombosis was confirmed by CT angiography or, when indicated, conventional digital subtraction angiography. Imaging studies were independently reviewed by two experienced hematologists/radiologists.

Treatment Protocol Anticoagulation was initiated according to a risk-adapted strategy aligned with ISTH and ASH guidance. Therapeutic-dose LMWH (enoxaparin 1 mg/kg subcutaneously twice daily, renally adjusted) was the first-line agent. Platelet transfusion support was provided to maintain counts ≥30–50 × 10^9/L during full-dose therapy for high-risk events (e.g., proximal DVT, PE, or ALI). For lower-risk or more severe thrombocytopenia, dose reduction to 50% therapeutic or prophylactic dosing was applied. CVC management involved removal or exchange when clinically feasible and safe. Duration of anticoagulation was individualized (minimum 3 months or until sustained leukemia remission and platelet recovery >50 × 10^9/L). In select stable patients with platelets >50 × 10^9/L and no strong contraindications, DOACs were considered. All patients received multidisciplinary input from hematology, vascular surgery, interventional radiology, and critical care teams as needed. Weekly clinical and laboratory monitoring was performed for the first 3 months, followed by monthly assessments.

Outcome Measures Primary outcomes included major complications (PE, recurrent thrombosis, ALI requiring intervention, PTS, major bleeding per ISTH criteria, and amputation) and composite treatment success (thrombus resolution or stabilization without recurrence or major sequelae at 3 months). Secondary outcomes encompassed overall survival, leukemia treatment delays, and hospital length of stay.

Statistical Analysis Data were analyzed using SPSS version 26.0. Continuous variables are presented as mean ± standard deviation or median (range); categorical variables as frequencies and percentages. Associations were evaluated with chi-square tests, independent t-tests, and logistic regression. Survival was assessed via Kaplan–Meier methods ($p < 0.05$ considered statistically significant).

Results. The cohort included 38 patients with AML (61.3%) and 24 with ALL (38.7%), with a mean age of 43.8 ± 12.1 years. Limb thrombosis most commonly manifested during induction chemotherapy (66.1%). Upper-extremity DVT (predominantly CVC-related) occurred

AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES
ISSN NUMBER: 2692 - 5206 Volume 6. No 03. March ,2026

in 53.2%, lower-extremity DVT in 32.3%, and arterial thrombosis leading to ALI in 14.5%. The median platelet count at thrombosis diagnosis was 42 × 10⁹/L (range 8–118).

Complications developed in 40 patients (64.5%). Pulmonary embolism was documented in 16 (25.8%), recurrent thrombosis in 12 (19.4%), acute limb ischemia requiring endovascular or surgical intervention in 8 (12.9%), and post-thrombotic syndrome in 9 survivors (14.5%). Major bleeding events (primarily gastrointestinal or intracranial) occurred in 10 patients (16.1%). Limb amputation was necessary in 4 cases (6.5%) of refractory arterial thrombosis.

LMWH was administered in 52 patients (83.9%), with platelet transfusion support in 41 (78.8% of those treated). The mean duration of anticoagulation was 3.1 months. Thrombus resolution or stabilization without major recurrence was achieved in 45 patients (72.6%). Leukemia treatment delays due to thrombosis management occurred in 27.4% of cases.

Table 1 Complications and Treatment Outcomes of Limb Thrombosis in Patients with Acute Leukemia (N = 62)

Complication / Outcome	Frequency (%)	n	AML (n=38) (%)	n	ALL (n=24) (%)	n	Treatment Success Rate (%)
Any complication	40 (64.5)		25 (65.8)		15 (62.5)		—
Pulmonary embolism	16 (25.8)		10 (26.3)		6 (25.0)		75.0
Recurrent thrombosis	12 (19.4)		8 (21.1)		4 (16.7)		66.7
Acute limb ischemia requiring intervention	8 (12.9)		6 (15.8)		2 (8.3)		62.5
Post-thrombotic syndrome	9 (14.5)		6 (15.8)		3 (12.5)		77.8
Major bleeding (ISTH grade 3–4)	10 (16.1)		7 (18.4)		3 (12.5)		—
Limb amputation	4 (6.5)		4 (10.5)		0		—
Overall treatment success (resolution/stabilization)	45 (72.6)		26 (68.4)		19 (79.2)		72.6

Note. Success defined as thrombus resolution or stabilization without recurrence or major sequelae at 3-month follow-up. Interobserver agreement for imaging interpretation was excellent (Cohen's κ = 0.86). Patients with arterial thrombosis or PE had significantly higher rates of treatment delays and poorer short-term outcomes compared with isolated venous events.

Discussion. This prospective study confirms a substantial burden of limb thrombosis complications in patients with acute leukemia, with over 64% experiencing clinically significant events. The predominance of CVC-associated upper-extremity DVT aligns with prior large cohorts, while the observed rates of PE (25.8%) and arterial ALI (12.9%) highlight the aggressive thrombotic phenotype in AL, particularly AML. Duplex ultrasound demonstrated high diagnostic utility for venous thrombosis, whereas CT angiography proved indispensable for detecting arterial involvement and central complications.

LMWH-based anticoagulation, supported by targeted platelet transfusions, achieved reasonable efficacy (72.6% success) with an acceptable safety profile, consistent with ISTH guidance statements. However, the non-negligible rates of major bleeding (16.1%) and amputation (6.5%) underscore the ongoing therapeutic dilemma in profoundly thrombocytopenic patients. Shorter anticoagulation duration (mean 3.1 months) reflects pragmatic adaptation to leukemia treatment phases and platelet recovery. Multidisciplinary collaboration was essential for managing ALI cases, often requiring endovascular thrombectomy or surgical intervention alongside chemotherapy initiation.

AMERICAN ACADEMIC PUBLISHER

INTERNATIONAL JOURNAL OF MEDICAL SCIENCES

ISSN NUMBER: 2692 - 5206 Volume 6. No 03. March ,2026

Conclusion. Limb thrombosis in patients with acute leukemia is associated with a high rate of serious complications, including pulmonary embolism, recurrence, acute limb ischemia, and bleeding. Nevertheless, systematic early diagnosis utilizing duplex ultrasound and CT angiography, combined with individualized LMWH anticoagulation and platelet transfusion support, enables successful management in the majority of cases. A multidisciplinary, risk-adapted approach—incorporating hematology, vascular specialists, and critical care—is crucial to optimize outcomes while minimizing treatment interruptions and morbidity. Greater awareness of this complication, along with further research into predictive biomarkers and novel anticoagulants, will be essential to refine care and improve prognosis for this complex patient population.

References:

1. Bontinis, A., et al. (2022). Acute leukemia presenting as acute lower limb ischemia: Systematic review and case report. *Vasa, 51*(1), 18–26. https://doi.org/10.1024/0301-1526/a000977
2. Carvalho, L. V., et al. (2025). Challenges in evaluating thromboembolic risk in acute leukemia: Clinical profiling and limitations of current scoring systems. *Research and Practice in Thrombosis and Haemostasis*. https://doi.org/10.1016/j.rpth.2025.100341
3. De Stefano, V., et al. (2005). The risk of thrombosis in patients with acute leukemia: Occurrence of thrombosis at diagnosis and during treatment. *Journal of Thrombosis and Haemostasis, 3*(9), 1985–1992. https://doi.org/10.1111/j.1538-7836.2005.01338.x
4. Key, N. S., et al. (2020). Venous thromboembolism prophylaxis and treatment in patients with cancer: ASCO guideline update. *Journal of Clinical Oncology, 38*(5), 496–520. https://doi.org/10.1200/JCO.19.01461
5. Ku, G. H., et al. (2009). Venous thromboembolism in patients with acute leukemia: Incidence, risk factors, and effect on survival. *Blood, 113*(17), 3911–3917. https://doi.org/10.1182/blood-2008-10-184838
6. Mitrovic, M., et al. (2023). Arterial thrombosis in patients with acute myeloid leukemia. *Cancers, 15*(11), 3060. https://doi.org/10.3390/cancers15113060
7. Mitrovic, M., et al. (2024). Venous thromboembolism in patients with acute myeloid leukemia: A systematic review and meta-analysis. *Thrombosis Journal, 22*, Article 25. https://doi.org/10.1186/s12959-024-00607-6
8. Poh, C., et al. (2020). Incidence of upper extremity deep vein thrombosis in acute leukemia. *Blood Advances, 4*(19), 4777–4786. https://doi.org/10.1182/bloodadvances.2020002540
9. Vu, K., et al. (2015). A retrospective study of venous thromboembolism in acute leukemia patients. *Leukemia & Lymphoma, 56*(1), 184–190. https://doi.org/10.3109/10428194.2014.916801
10. Gazkhanovna, M. A., Makhmatovich, A. K., & Utkirovich, D. U. (2022). Clinical efficacy of extracorporeal and intravascular hemocorrection methods in psoriasis. Academicia: An International Multidisciplinary Research Journal, 12(2), 313-318.
11. Madasheva, A. G., & Abdiev, K. M. (2023). Blood transfusion therapy in patients with vitamin B12 deficiency anemia after resection of 2/3 of the stomach. Science and Education, 4(5), 407-412.
12. Мадашева, А. Г., & Жураева, М. З. (2019). Биохимические показатели и комплексное лечение больных псориазом с лечебным плазмаферезом. Достижения науки и образования, (10 (51)), 78-82.

AMERICAN ACADEMIC PUBLISHER

INTERNATIONAL JOURNAL OF MEDICAL SCIENCES

ISSN NUMBER: 2692 - 5206 Volume 6. No 03. March ,2026

13. Мадашева, А., Бергер, И., Махмудова, А., Абдиев, К., & Амерова, Д. (2025). Лабораторная диагностика. восточная европа. лабораторная диагностика, 14(1), 87-96.
14. Мадашева, А. Г. (2022). Клинико-неврологические изменения у больных гемофилией с мышечными патологиями. Science and Education, 3(12), 175-181.
15. Мадашева, А. Г. (2022). Коррекция диффузной алопеции при железодефицитной анемии. Science and Education, 3(12), 231-236.
16. Мадашева, А. Г., Дадажанов, У. Д., Абдиев, К. М., Маматкулова, Ф. Х., & Махмудова, А. Д. (2019). Динамика электронейромиографических показателей и эффективность электрической стимуляции мышц у больных гемофилией с мышечными атрофиями. Достижения науки и образования, (10 (51)), 26-30.
17. Мадашева, А. Г., & Жураева, М. З. (2019). Биохимические показатели и комплексное лечение больных псориазом с лечебным плазмаферезом. Достижения науки и образования, (10 (51)), 78-82.