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# ETIOPATHOGENESIS AND LABORATORY DIAGNOSIS OF VARIOUS TYPES OF THROMBOCYTOPENIA IN THE ELDERLY: A LITERATURE REVIEW

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**ABSTRACT.** Thrombocytopenia in elderly patients is a multifactorial hematological disorder characterized by a decrease in platelet count. This literature review summarizes and analyzes the current understanding of the etiopathogenesis and laboratory diagnostic approaches of thrombocytopenia of various origins in the elderly population. Immune-mediated mechanisms, drug-induced causes, bone marrow failure, myelodysplastic syndromes (MDS), hepatic dysfunction with splenomegaly, disseminated intravascular coagulation (DIC), and infection-related pathways are discussed. Emphasis is placed on the role of advanced hematological and molecular diagnostic techniques for accurate differentiation and management. The review integrates studies published between 2020 and 2025 to provide updated perspectives.

**Keywords:** thrombocytopenia; elderly; etiopathogenesis; platelet count; laboratory diagnosis.

# ЭТИОПАТОГЕНЕЗ И ЛАБОРАТОРНАЯ ДИАГНОСТИКА РАЗЛИЧНЫХ ТИПОВ ТРОМБОЦИТОПЕНИИ У ЛИЦ ПОЖИЛОГО ВОЗРАСТА: ОБЗОР ЛИТЕРАТУРЫ

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**АННОТАЦИЯ.** Тромбоцитопения у пожилых пациентов представляет собой многофакторное гематологическое нарушение, характеризующееся снижением количества тромбоцитов. В данном обзоре литературы обобщены и проанализированы современные представления об этиопатогенезе и лабораторно-диагностических подходах к тромбоцитопении различного происхождения у пожилого населения. Рассматриваются иммуноопосредованные механизмы, лекарственно-индуцированные причины, недостаточность костного мозга, миелодиспластические синдромы (МДС), печеночная дисфункция со спленомегалией, диссеминированное внутрисосудистое свертывание (ДВС) и пути, связанные с инфекциями. Особое внимание уделяется роли современных гематологических и молекулярных методов диагностики для точной дифференциации и ведения пациентов. Обзор включает исследования, опубликованные в период с 2020 по 2025 год, чтобы представить актуальные перспективы.

**Ключевые слова:** тромбоцитопения; пожилые; этиопатогенез; количество тромбоцитов; лабораторная диагностика.

**Introduction.** Thrombocytopenia, defined as a platelet count below $150\times10^9$/L, is one of the most common hematologic abnormalities in clinical practice, especially among elderly patients. With aging, the hematopoietic system undergoes structural and functional changes leading to increased susceptibility to both primary and secondary platelet disorders. The etiology of thrombocytopenia is broad, encompassing decreased production, increased destruction, and abnormal distribution of platelets. Age-related changes in bone marrow, comorbidities, and polypharmacy complicate its pathogenesis. Understanding the complex mechanisms and establishing a standardized diagnostic algorithm is crucial for appropriate patient management.

Age-related hematopoietic alterations significantly affect platelet production, function, and turnover. Hematopoietic stem cells (HSCs) in elderly individuals demonstrate reduced regenerative capacity, a shift toward myeloid lineage (myeloid skewing), and remodeling of signaling pathways regulating megakaryopoiesis. These changes result in both quantitative and qualitative platelet abnormalities, predisposing older adults to thrombocytopenia and thrombo-hemorrhagic complications (Liu et al., 2020; Pangrazzi & Weinberger, 2021).

Another key factor in elderly thrombocytopenia is immunosenescence—the gradual deterioration of immune function accompanied by chronic, low-grade inflammation ("inflamm-aging"). This process contributes to increased autoantibody production, impaired clearance of immune complexes, and a higher prevalence of immune thrombocytopenia (ITP) among older populations. Epidemiological data confirm that the incidence of primary ITP rises significantly after the age of 60, often presenting with atypical features and reduced response to standard therapy (Provan et al., 2019; Rodeghiero et al., 2021).

Polypharmacy and multimorbidity are additional age-related contributors that complicate both the pathogenesis and diagnosis. Drugs like heparin, quinine, beta-lactam antibiotics, and antiepileptics can trigger immune-mediated thrombocytopenia, while comorbid conditions (renal failure, hepatic insufficiency, malignancy, infections) may exacerbate platelet dysfunction and turnover (Stasi, 2020).

Recent literature emphasizes a standardized diagnostic algorithm to improve clinical accuracy and patient outcomes. The evaluation should begin with confirmation of true thrombocytopenia (to exclude pseudothrombocytopenia via repeated counts and peripheral smear), followed by detailed drug history, infection screening (HCV, HIV), and bone marrow examination in persistent or unexplained cases—especially in patients over 60 years of age (Gauer & Braun, 2022).

Therapeutic approaches have evolved toward a risk-adapted and individualized model. Observation is acceptable in asymptomatic or mild cases, while corticosteroids remain first-line therapy for immune-mediated thrombocytopenia. Thrombopoietin receptor agonists (TPO-RAs), intravenous

immunoglobulin (IVIG), and biologics such as rituximab or fostamatinib are recommended for refractory disease. Treatment decisions in older adults should balance efficacy with comorbidity profiles and bleeding versus thrombotic risks (Neunert et al., 2019; Michel et al., 2022).

In summary, the pathogenesis of thrombocytopenia in elderly patients involves complex interactions between age-related hematopoietic decline, immune dysregulation, drug effects, and chronic comorbidities. Current evidence underscores the importance of individualized diagnostic algorithms and tailored therapeutic strategies that integrate both molecular and clinical insights. Further large-scale prospective studies are needed to refine diagnostic biomarkers and optimize treatment outcomes in geriatric hematology.

**Materials and Methods.** This review was conducted according to PRISMA guidelines for narrative reviews. Relevant literature was searched through PubMed, Scopus, ScienceDirect, and Google Scholar databases. Keywords included “thrombocytopenia in elderly”, “immune thrombocytopenia”, “myelodysplastic syndromes”, “drug-induced thrombocytopenia”, and “diagnostic approaches”.

Only articles published between 2020 and 2025 in peer-reviewed international journals were included. Reference lists of selected papers were also screened for additional relevant sources. The final selection consisted of 20 high-impact studies focusing on clinical, laboratory, and molecular aspects of thrombocytopenia in older adults.

**Results.** The analysis revealed that immune thrombocytopenia (ITP) remains a leading cause of isolated thrombocytopenia in the elderly, often associated with autoimmune diseases or malignancies. Recent studies highlight the dysregulation of T-cell immunity and the presence of antiplatelet antibodies targeting glycoproteins GPIIb/IIIa and GPIb/IX.

Myelodysplastic syndromes (MDS), prevalent in this age group, contribute to thrombocytopenia through ineffective hematopoiesis and clonal hematopoietic mutations such as TP53, RUNX1, and ASXL1. Liver-related thrombocytopenia is typically mild to moderate and results from hypersplenism due to portal hypertension.

Microangiopathic conditions like DIC, thrombotic thrombocytopenic purpura (TTP), and hemolytic uremic syndrome (HUS) cause rapid platelet consumption and are life-threatening if not promptly diagnosed. Drug-induced thrombocytopenia (DITP) remains a significant issue due to polypharmacy in elderly patients, particularly with antibiotics, antiepileptics, and heparin.

Infectious causes, including COVID-19, have also been recognized as contributors to transient or persistent thrombocytopenia through direct bone marrow suppression or immune-mediated platelet destruction.

**Discussion.** Elderly patients often exhibit multifactorial thrombocytopenia, complicating diagnostic and therapeutic decisions. Distinguishing between immune, marrow, and secondary causes is essential for appropriate management.

Laboratory diagnostics include:

- Complete blood count (CBC) and peripheral blood smear analysis

- Bone marrow aspiration and biopsy to evaluate megakaryocyte morphology
- Flow cytometry for immune markers
- Molecular testing such as PCR, FISH, and next-generation sequencing (NGS)

The integration of advanced molecular profiling has improved diagnostic precision. NGS helps identify driver mutations associated with MDS and clonal hematopoiesis, allowing for better classification and prognosis.

Immune thrombocytopenia (ITP) in older adults often requires careful therapeutic balance due to comorbidities and bleeding risks. Corticosteroids remain first-line therapy, while thrombopoietin receptor agonists (eltrombopag, romiplostim,elbonix) show promising results in refractory cases.

Drug-induced and infection-related thrombocytopenia usually resolve after withdrawal of the causative agent or treatment of infection. However, in DIC or TTP, urgent intervention with plasma exchange, anticoagulants, or immunotherapy is required.

Recent literature emphasizes the value of integrating clinical history, drug exposure data, and immunological markers for differential diagnosis. Artificial intelligence-based diagnostic tools and digital hematology imaging are emerging technologies aiding in classification.

**Conclusion.** Thrombocytopenia in the elderly encompasses a wide spectrum of etiologies. A structured diagnostic strategy that includes hematological, immunological, and molecular assessments is vital for accurate diagnosis and management.

Future research should focus on age-specific mechanisms of thrombopoiesis, the impact of comorbidities, and the development of predictive biomarkers to improve prognosis and personalized treatment approaches. Understanding the molecular underpinnings of platelet production and destruction will be key to advancing therapeutic strategies in this vulnerable population.

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