JOURNAL OF MULTIDISCIPLINARY SCIENCES AND INNOVATIONS
VOLUME 5, ISSUE 06
MONTHLY JOURNALS
ISSN NUMBER: 2751-4390
IMPACT FACTOR: 9,08

DISSEMINATED INTRAVASCULAR COAGULATION SYNDROME: THE MODERN PARADIGM OF PATHOPHYSIOLOGY, EARLY DIAGNOSIS, AND PERSONALIZED THERAPY

Zaynutdinova D.L., Berdiyorova M.U.
Tashkent State Medical Institute
https://doi.org/10.5281/zenodo.20590370

Introduction: Disseminated intravascular coagulation (DIC) syndrome remains a critical problem in modern medicine, characterized by systemic activation of coagulation, impaired fibrinolysis, and endothelial dysfunction. Despite significant advances in understanding its molecular mechanisms, mortality associated with DIC remains unacceptably high (up to 78% in critical conditions). This article provides an in-depth review of current scientific concepts regarding DIC, including the new 2025 phase classification, strategies for early diagnosis at preclinical stages, and the role of a personalized approach in patient management.

Methodology: Statistical analysis included 50 scientific publications from the last five years concerning DIC syndrome following surgical procedures, trauma of various etiologies, and sepsis.

Keywords: DIC syndrome, coagulopathy, sepsis-induced coagulopathy (SIC), phase classification, endothelial dysfunction, immunothrombosis, ISTH diagnostic scales, personalized medicine.

Relevance: DIC syndrome is not an independent disease but a complex pathophysiological process secondary to severe clinical conditions such as sepsis, trauma, malignant neoplasms, and obstetric complications. Its global significance is confirmed by millions of cases reported annually in septic patients alone, with DIC doubling the risk of mortality. Historically, DIC was considered the terminal stage of consumptive coagulopathy; however, modern studies demonstrate that this concept is flawed and limits therapeutic opportunities. Today, the focus has shifted toward early recognition, making it possible to transform DIC from a “death sentence” into a manageable condition.

Pathophysiological Mechanisms: Immunothrombosis and Endothelial Dysfunction. The development of DIC is based on a complex interaction between inflammation and coagulation known as “immunothrombosis.” Role of the Endothelium and Pro-inflammatory Signals. The endothelium is a key regulator of microcirculation. In sepsis, endothelial injury triggers the release of tissue factor, initiating the extrinsic coagulation pathway. Histones released from damaged cells further activate thrombin and suppress fibrinolysis, creating conditions for microvascular thrombosis. Paradoxical Coagulopathy DIC syndrome is characterized by the paradoxical coexistence of systemic microvascular thrombosis and depletion of coagulation factors, leading to severe bleeding. Persistent suppression of fibrinolysis prevents clot dissolution and aggravates organ ischemia. Phase Classification and New Nomenclature (2025 Data). According to the latest communications from the International Society on Thrombosis and Haemostasis (ISTH, 2025), a phase-based approach is proposed: Pre-DIC Syndrome: Presence of a trigger (sepsis, trauma) without laboratory abnormalities. A high-risk group requiring monitoring. Early DIC Syndrome: Laboratory evidence of coagulation activation before the onset of bleeding. Represents a “window of opportunity” for early therapy. Overt DIC Syndrome: Marked coagulopathy, multiple organ dysfunction, and bleeding. A critical condition requiring intensive care. Several assessment systems are currently used:

• ISTH Overt DIC Score – the gold standard for diagnosing overt DIC with high specificity.
• Sepsis-Induced Coagulopathy (SIC) – optimal for early detection of sepsis-associated DIC using platelet count, PT-INR, and SOFA score.

• JAAM DIC Criteria – highly effective in critical care and trauma settings. Sequential Diagnostic AlgorithmTo improve diagnostic efficiency, a stepwise approach is recommended:

1. Screening of all at-risk patients (sepsis, trauma) using the SIC score.

2. Monitoring dynamic markers: platelet decline, PT-INR prolongation, and rising D-dimer levels.

3. Confirmation of overt DIC according to ISTH criteria before initiating specific therapy. Therapy DIC treatment should primarily target the underlying cause. The use of anticoagulants (heparin, antithrombin) remains controversial; however, their early administration during the initial phase of DIC shows potential for preventing progression to organ failure. A key trend is the integration of artificial intelligence and bioinformatics for patient phenotyping, enabling selection of individualized anticoagulant strategies based on coagulation profiles and comorbidities such as liver cirrhosis.

Material and Methods. This analysis is based on data from contemporary multicenter studies and systematic reviews published between 2020 and 2025 on the diagnosis and treatment of DIC syndrome. Diagnostic approaches were evaluated using data from more than 1,500–2,000 critically ill patients with sepsis, trauma, and obstetric complications. The following methodologies were analyzed:

• Comparative evaluation of ISTH, SIC, and JAAM scoring systems.

• Assessment of coagulation parameters including platelet count, PT-INR, fibrinogen concentration, and D-dimer levels.

• Outcome analysis evaluating the relationship between early DIC resolution and 28-day survival.

Sensitivity and specificity criteria were used to assess the accuracy of scoring systems at different stages of coagulopathy progression.

Results. Analysis of available data revealed several important patterns:

1. Effectiveness of Early Diagnosis. The SIC score demonstrated significantly higher sensitivity during the early stages of sepsis compared with the ISTH score. More than 93% of patients who later developed overt DIC had previously met SIC criteria. This confirms that SIC allows identification of coagulopathy during the early, subclinical phase when timely intervention is most effective.

2. Prognostic ValueResolution of DIC is directly associated with improved survival. Platelet count and PT-INR are the most important predictors of outcome. In trauma-related DIC, diagnosis upon admission to the emergency department independently predicts lower survival and a higher risk of massive bleeding.

3. Limitations of Existing Approaches. Studies indicate conceptual limitations in the use of universal scoring systems. The heterogeneity of DIC (infectious, traumatic, and obstetric etiologies) requires etiology-specific assessment tools. SIC and JAAM scores are most reliable for septic patients, whereas the ISTH score remains preferable for diagnosing overt DIC with established organ dysfunction due to its high specificity.

The study emphasizes the need for sequential diagnostics: screening all high-risk patients with SIC followed by confirmation using the ISTH score. This strategy can transform DIC from a terminal stage of irreversible changes into a controllable condition and remains the most effective way to reduce mortality.

Conclusion. Successful management of DIC syndrome requires a thorough understanding of its dynamic and highly heterogeneous nature. The transition from the concept of

"consumptive coagulopathy" to that of early recognition of "compensated coagulopathy" using SIC scoring systems is essential for reducing mortality. The future of clinical practice lies in multidisciplinary management and the use of refined molecular markers to enable timely and precise therapeutic correction.

References

1. A.N. Belousov. Laboratory of Applied Nanotechnology of Belousov, Kharkiv National Medical University, Ukraine. (2025) Key Guidelines and Articles on the Diagnosis, Prevention, and Treatment of Disseminated Intravascular Coagulation: Conceptual Errors and Their Correction.

2- Ahsanullah Unar,Lorenzo Bertolino 1,Fabian Patauner Published: 22 August 2023 Pathophysiology of Disseminated Intravascular Coagulation in Sepsis: A Clinically Focused Overview

3- Andreas G. Tsantes, Stavroula Parastatidou, Emmanuel A. Tsantes Published: 28 January 2023 Sepsis-Induced Coagulopathy: An Update on Pathophysiology, Biomarkers, and Current Guidelines

4 - Andrew Retter, Beverley J Hunt 2023 Dec Consumptive coagulopathy in the ICU

5 - Ecaterina Scarlatescu, Jerrold H. Levy, Hunter Moore Journal of Thrombosis and Haemostasis March 2025 Disseminated intravascular coagulation and cirrhotic coagulopathy: overlap and differences. The current state of knowledge. Communication from the SSC of the ISTH

6 - Eri Nakano, Hideo Wada, Akitaka Yamamoto 20 August 2025 Diagnostic and Prognostic Evaluation of Disseminated Intravascular Coagulation Using the Disseminated Intravascular Coagulation Index

7 - Fangchen Gong, Xiangtao Zheng, Shanzhi Zhao - 2025 Jan Disseminated intravascular coagulation: cause, molecular mechanism, diagnosis, and therapy

8 - Florea Lupu1 | Gary Kinasewitz1 | Kenneth Dormer Received: 5 July 2020 The role of endothelial shear stress on haemodynamics, inflammation, coagulation and glycocalyx during sepsis

9 - Girum Tesfaye Kiya , Gemeda Abebe, Zeleke Mekonnen Hematology and Blood Disorders (2025) Exploring Disseminated Intravascular Coagulation (DIC): A Life-Threatening Paradox

10 - Girum Tesfaye Kiya, Gemeda Abebe, Zeleke Mekonnen Published: January 16, 2025 A comparison of disseminated intravascular coagulation scoring systems and their performance to predict mortality in sepsis patients: A systematic review and meta-analysis

11 - Girum Tesfaye Kiya, Zeleke Mekonnen, Elsah Tegne August 2025 Disseminated intravascular coagulation, associated factors and clinical outcomes among critically Ill septic adults admitted to a tertiary hospital in Ethiopia: A prospective longitudinal study

12 - Hideo Wada, Takeshi Matsumoto & Yoshiki Yamashita Journal of Intensive Care Diagnosis and treatment of disseminated intravascular coagulation (DIC) according to four DIC guidelines

13 - Hongyu YangXiaochun MaXiaochun MaXu Li Front. Med., 31 January 2025 The diagnosis of DIC: a current overview

14 - Iba, T; Maier, CL; Scarlatescu, E; Levy, JH Published in: Semin Thromb Hemost February 2026 Updated definition and scoring of disseminated intravascular coagulation in 2025: communication from the ISTH SSC Subcommittee on Disseminated Intravascular Coagulation

15 - Ibnu Umar, Reza Widianto Sujud (2020): May Hemostasis and Disseminated Intravascular Coagulation (DIC)

16 - Jecko Thachil 2020 Aug Disseminated intravascular coagulation - new pathophysiological concepts and impact on management

17 - Kazuma Yamakawa, Kohji Okamoto, Yoshinobu Seki International Journal of Hematology Published: 16 December 2024 Clinical practice guidelines for management of disseminated intravascular coagulation in Japan 2024.
18 - Massimo Girardis , Sascha David, Ricard Ferrer 2024 Springer-Verlag GmbH Germany, part of Springer Nature Understanding, assessing and treating immune, endothelial and haemostasis dysfunctions in bacterial sepsis
19 - Narcis I. Popescu, Cristina Lupu, Florea Lupu THE INTERSECTION OF THE IMMUNE AND HEMOSTATIC SYSTEMS| March 31, 2022 Disseminated intravascular coagulation and its immune mechanisms
20 - Satoshi Gando, Marcel Levi & Cheng-Hock Toh Published: 06 June 2025 Disseminated intravascular coagulation
21 - Satoshi Gando, Marcel Levi, Cheng-Hock Toh 2025 Jun Disseminated intravascular coagulation
22 - Sawsen Bouzidi, Mayssa Daiki, Amen Allah Nasr eCollection 2020. [Disseminated intravascular coagulation: role of the International Society on Thrombosis and Haemostasis (ISTH) diagnostic scoring system] -
23 - Sifeng Fu, Sihan Yu, Liang Wang, Xiaochun Ma and Xu Li (2022) 22:28 Unfractionated heparin improves the clinical efficacy in adult sepsis patients: a systematic review and meta-analysis
24 - Toshiaki Iba , Cheryl L Maier , Ecaterina Scarlatescu Epub 2025 Aug 19. Introducing the New Definition and Diagnostic Criteria of Disseminated Intravascular Coagulation Released by the International Society on Thrombosis and Haemostasis in 2025
25 - Toshiaki Iba, Marcel Levi, Jerrold H. Levy 2020 Sepsis-Induced Coagulopathy and Disseminated Intravascular Coagulation
26 - Toshiaki Iba, Jerrold H. Levy, Cheryl L. Maier Journal of Thrombosis and Haemostasis July 2025 Updated definition and scoring of disseminated intravascular coagulation in 2025: communication from the ISTH SSC Subcommittee on Disseminated Intravascular Coagulation
27 - Toshiaki Iba, Julie Helms, Jean Marie Connors & Jerrold H. Levy Published: 23 May 2023 The pathophysiology, diagnosis, and management of sepsis-associated disseminated intravascular coagulation
28 - Toshiaki Iba, Makoto Arakawa and Jecko Thachil Intensive Care Med. 2020 Newly Proposed Sepsis-Induced Coagulopathy Precedes International Society on Thrombosis and Haemostasis Overt-Disseminated Intravascular Coagulation and Predicts High Mortality
29 - Toshiaki Iba, Marcel Levi, Jerrold H. Levy Journal of Thrombosis and Haemostasis November 2022 Intracellular communication and immunothrombosis in sepsis
30 - Wakana Takahashi, Taro Yoneda, Hayato Koba International Journal of Infectious Diseases January 2021 Potential mechanisms of nafamostat therapy for severe COVID-19 pneumonia with disseminated intravascular coagulation