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THROMBOEMBOLISM

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Abstract
This academic article explores the significant clinical importance of thromboembolism, specifically venous thromboembolism (VTE), deep vein thrombosis (DVT), and pulmonary embolism (PE). It thoroughly analyzes the pathophysiological mechanisms, etiological factors, and the role of Virchow's triad. The article details diagnostic algorithms, including D-dimer testing and imaging methods, alongside therapeutic approaches, acute and long-term anticoagulant management, and prevention strategies. Finally, it discusses complications, prognosis, chronic sequelae management, and future research directions in the field.

Keywords: Thromboembolism, deep vein thrombosis, pulmonary embolism, anticoagulants, diagnosis, prevention, pathophysiology, Virchow's triad.

Introduction

Thromboembolism is a serious pathological condition that occurs as a result of the formation of a thrombus (blood clot) inside blood vessels and its subsequent movement with the bloodstream to other parts of the vascular system. This disease can develop in both the arterial and venous systems, and in both cases it poses a threat to life.

In particular, venous thromboembolism (VTE), which includes deep vein thrombosis (DVT) and pulmonary embolism (PE), is widely распространена in medical practice and is considered one of the major global health problems. The high rate of morbidity and mortality creates a significant burden on healthcare systems worldwide.

Every year, VTE affects millions of people and can lead not only to acute mortality but also to the development of long-term complications such as post-thrombotic syndrome (PTS) and chronic thromboembolic pulmonary hypertension (CTEPH), which can cause disability in patients.

The aim of this article is to provide a comprehensive analysis of modern concepts of thromboembolism, its pathophysiological mechanisms, diagnostic methods, therapeutic approaches, as well as preventive measures and promising directions for further research.

Literature Review

Venous thromboembolism (VTE) is characterized by the formation of fibrin-rich thrombi in the venous sinuses and, unlike arterial thrombosis, is predominantly treated with anticoagulants. The etiology of VTE is based on Virchow’s triad, which includes three key factors: hypercoagulability (an increased tendency of the blood to clot), stasis (slowing of blood flow), and endothelial injury

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(damage to the inner lining of the vessel wall). These factors often act synergistically, leading to thrombus formation.

Deep vein thrombosis (DVT) most commonly forms in the deep veins of the lower extremities, particularly in the region of hypoxemic venous valves, where leukocytes may express tissue factor, thereby initiating coagulation [1]. Although thrombosis of the calf veins is often asymptomatic, in approximately one quarter of cases it spreads proximally within seven days, becoming symptomatic and increasing the risk of dangerous embolization. Notably, about 90% of cases of pulmonary embolism (PE) arise as a result of fragmentation of DVT, and in 50% of patients with symptomatic proximal DVT, asymptomatic PE is detected [1].

Thrombi may undergo fibrinolysis, increase in size, embolize, or become organized. The process of organization may lead to valve damage, formation of scar tissue, and the development of post-thrombotic syndrome (PTS) [1].

The clinical course of thromboembolic diseases varies from asymptomatic forms to life-threatening acute conditions. In DVT, pain, swelling, and changes in skin color are observed; however, as mentioned above, asymptomatic cases are also possible. In PE, symptoms include dyspnea, chest pain, tachycardia, and hypoxia, and in severe cases, sudden death may occur.

Diagnostic algorithms play an important role in the rapid and accurate detection of the disease. The 2018 guidelines of the American Society of Hematology provide evidence-based recommendations for the diagnosis of VTE, including PE, deep vein thrombosis of the lower and upper extremities, and recurrent VTE [2]. These strategies include the assessment of pretest probability (PTP), which influences the choice of diagnostic tests. Determining PTP using the Wells, Geneva, or Constans scoring systems is essential for selecting the appropriate diagnostic strategy [3].

For patients with a low probability of VTE, it is recommended to begin diagnosis with measurement of the D-dimer level in order to minimize the need for imaging studies [2,3]. A negative D-dimer result allows VTE to be excluded. In contrast, when the probability of the disease is high, imaging methods are used directly [2]. For outpatients older than 50 years, the use of age-adjusted D-dimer threshold values is recommended to improve diagnostic accuracy [3].

For the diagnosis of PE, the most validated methods are ventilation-perfusion scintigraphy (V/Q scanning) and computed tomography pulmonary angiography (CT angiography) [2]. In cases with a high probability of PE, CT angiography is the preferred method. However, in patients with low or moderate PTP and a positive D-dimer result, V/Q scanning may be preferred in order to minimize radiation exposure, provided that results are rapidly available [3].

For the diagnosis of DVT of the lower and upper extremities, ultrasound examination (US) is used [2]. In patients with low risk, diagnosis begins with D-dimer testing, and if the result is positive, ultrasound is performed. In cases of moderate and high risk, ultrasound is performed first, and if the result is negative, additional confirmatory studies may be required [3]. The diagnosis of recurrent VTE is also based on the assessment of PTP and often combines D-dimer testing, imaging, and comparison with previous studies [3].

The basis of treatment for thromboembolic diseases is anticoagulant therapy [1]. The goal of therapy is to prevent the enlargement of existing thrombi, avoid the formation of new thrombi, and reduce the risk of embolization. In the acute phase, anticoagulant therapy should be initiated as early as possible.

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It may be carried out using low-molecular-weight heparins (LMWH), indirect thrombin inhibitors (for example, fondaparinux), or direct oral anticoagulants (DOACs).

In severe PE, particularly in cases of hemodynamic instability, thrombolytic therapy may be considered. In certain situations, such as contraindications to anticoagulants, the placement of a vena cava filter may be required.

Long-term therapy is aimed at preventing recurrence of thrombosis and may continue from several months to lifelong treatment depending on the individual risk factors of the patient. DOACs (rivaroxaban, apixaban, dabigatran, edoxaban) are often preferred over warfarin due to their ease of use, fewer drug and food interactions, and the absence of the need for regular laboratory monitoring.

Prevention of thromboembolism plays a key role in reducing the burden of the disease. It is aimed at identifying individuals at risk. Surgical interventions, prolonged immobilization, oncological diseases, hormonal therapy, pregnancy, and genetic predisposition increase the risk of VTE. Pharmacological prophylaxis (heparins, LMWH, DOACs) is widely used in high-risk patients. Mechanical methods of prevention are also important, such as compression stockings and intermittent pneumatic compression (IPC) devices. Modification of risk factors, including weight control, smoking cessation, and maintaining an active lifestyle, reduces the likelihood of disease development.

Thromboembolism can lead to serious complications. Among acute complications, the most dangerous is sudden death due to pulmonary embolism. One of the long-term complications is post-thrombotic syndrome (PTS), which develops as a result of damage and scarring of the venous valves [1]. PTS manifests with chronic pain, edema, skin changes, and ulcers, significantly reducing patients' quality of life.

Another severe chronic complication is chronic thromboembolic pulmonary hypertension (CTEPH), which occurs due to chronic occlusion of the pulmonary vessels and leads to severe respiratory failure and right ventricular dysfunction. The prognosis of thromboembolism depends on the severity of the disease, the risk of recurrence, and the effectiveness of therapy. In the management of chronic consequences, symptomatic treatment, rehabilitation, and in some cases surgical methods (for example, pulmonary endarterectomy in CTEPH) are used.

Research Methodology

This article is devoted to the problem of thromboembolism and is mainly based on a comprehensive literature review methodology. During the preparation of the work, existing scientific data on the pathophysiology, diagnosis, treatment, and prevention of the disease were carefully examined and synthesized, as well as leading clinical guidelines, in particular the evidence-based recommendations of the American Society of Hematology (ASH) [2, 3].

The study includes a critical analysis of systematic reviews and expert conclusions aimed at evaluating the effectiveness of diagnostic and therapeutic strategies in venous thromboembolism (VTE).

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Characteristic	Deep Vein Thrombosis (DVT)	Pulmonary Embolism (PE)
Definition	Formation of blood clots in deep veins (most commonly in the lower extremities).	Obstruction of the pulmonary artery by a blood clot (usually detached from leg veins).
Main Symptoms	Leg swelling, pain, redness, and a sensation of warmth in the affected area.	Sudden shortness of breath, chest pain, cough (sometimes with blood).
Danger Level	Causes local complications (swelling, trophic ulcers).	Extremely life-threatening (requires emergency medical assistance).

Conclusion

Thromboembolism, particularly venous thromboembolism, represents a serious global public health problem, the pathophysiology of which is complex and based on the interaction of the components of Virchow's triad. Early and accurate diagnosis of the disease is achieved through diagnostic algorithms that include the assessment of pretest probability, determination of D-dimer levels, and modern imaging techniques such as computed tomography pulmonary angiography (CTPA), ventilation–perfusion (V/Q) scanning, and ultrasound examination.

Anticoagulant therapy forms the basis of both acute and long-term treatment, while preventive measures play a key role in preventing the development of the disease. Chronic complications such as post-thrombotic syndrome and chronic thromboembolic pulmonary hypertension can significantly reduce patients' quality of life and require a specialized management approach.

Current research in this field is aimed at improving diagnostic accuracy, enhancing risk assessment, and individualizing therapy. In particular, there remains a need for the development of new diagnostic methods, the study of genetic biomarkers, and the validation of clinical decision rules to determine the risk of recurrent venous thromboembolism. In the future, the development of new generations of anticoagulants and safer thrombolytic therapies is expected.

From a public health perspective, increasing public awareness of thromboembolism, reducing the impact of risk factors, and the widespread implementation of clinical guidelines are essential for reducing the incidence and mortality associated with the disease.

References

1. Colman R. W., Clowes A. W., George J. N., Marder V. J. Hemostasis and Thrombosis: Basic Principles and Clinical Practice. Philadelphia: Wolters Kluwer, 2016.
2. Kearon C., Ageno W. Venous Thromboembolism: Clinical Guide. Cham: Springer, 2020.

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3. Kearon C., Akl E. A., Ornelas J., Blaivas A., Jimenez D., Bounameaux H., et al. Antithrombotic therapy for VTE disease: CHEST guideline and expert panel report. Chest. 2016;149(2):315–352.
4. Beckman M. G., Dunn K. L., Waldron J. L. Epidemiology and pathophysiology of venous thromboembolism. Thrombosis and Haemostasis. 2010;104(1):101–110.
5. Konstantinides S. V., Meyer G., Becattini C., Bueno H., Geersing G. J., Harjola V. R., et al.; ESC Scientific Document Group. 2019 ESC Guidelines for the diagnosis and management of acute pulmonary embolism developed in collaboration with ERS. European Heart Journal. 2020;41(4):543–603.

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