

Causes of Thrombus in the Leg and Surgical Methods for its Prevention

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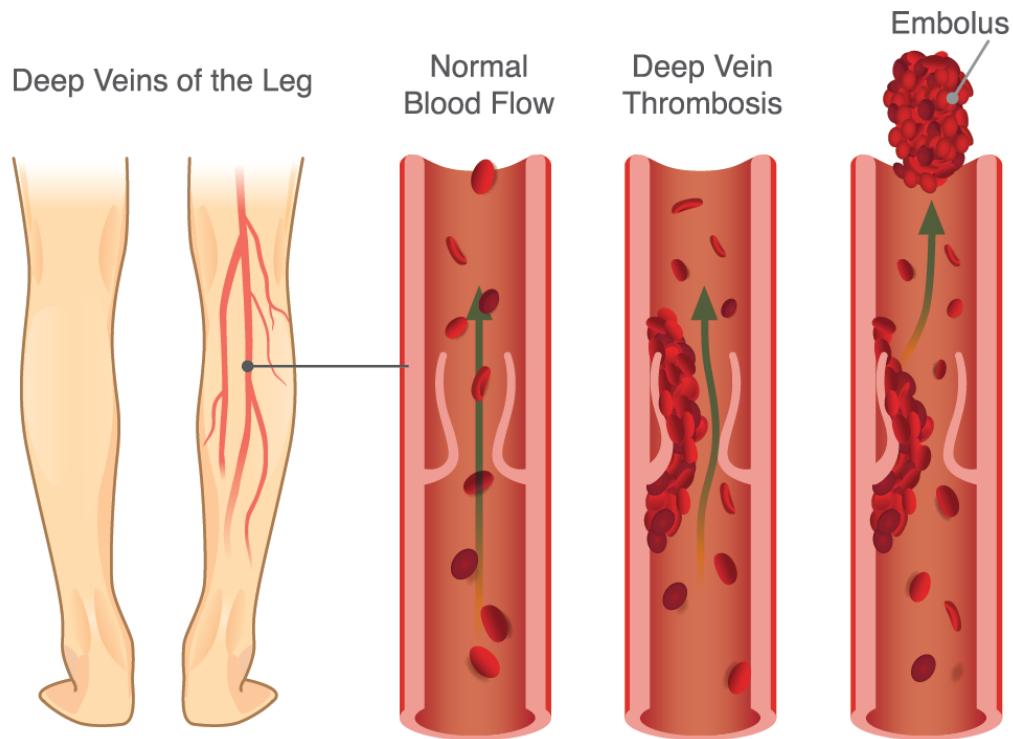
Abstract: Lower limb thrombosis represents a major vascular disorder associated with high morbidity and risk of life-threatening complications such as pulmonary embolism. The development of thrombus in the leg results from complex interactions between vascular wall injury, blood flow disturbance, and hypercoagulability. This article analyzes the primary etiological factors responsible for lower extremity thrombosis and evaluates modern surgical approaches used to prevent thrombus formation and progression. Emphasis is placed on early risk identification, timely surgical intervention, and prevention of long-term vascular complications that lead to chronic venous insufficiency and disability. Lower extremity thrombus formation is a complex pathological condition arising from dynamic interactions between coagulation abnormalities, venous flow disturbances, and structural changes of the vascular wall. This process leads to partial or complete obstruction of venous circulation and creates a significant risk for fatal embolic events. Surgical prevention techniques have become increasingly important in modern clinical practice due to the growing number of high-risk patients and the limitations of pharmacological prophylaxis alone. This article provides an expanded analysis of the underlying mechanisms of thrombus development in the leg and evaluates the clinical effectiveness of operative approaches aimed at preventing thrombus propagation and life-threatening complications, with special attention to long-term functional recovery and reduction of disability.

Keywords: leg thrombosis, deep vein thrombosis, venous thromboembolism, hypercoagulability, venous stasis, thrombectomy, inferior vena cava filter, surgical prevention.

Introduction:

Thrombosis of the lower extremities is one of the most frequent manifestations of venous thromboembolism and remains a significant cause of preventable mortality worldwide. It occurs when a blood clot forms inside the deep or superficial veins of the leg, obstructing normal blood flow and creating a risk for embolization. The classical pathophysiological basis of thrombus formation is described by Virchow's triad, which includes endothelial injury, blood flow stagnation, and increased coagulability. Prolonged immobility, major surgical procedures, malignancies, trauma, pregnancy, hormonal therapy, and inherited thrombophilic disorders significantly increase the risk of thrombus formation. Without effective prevention and treatment, leg thrombosis can lead to pulmonary embolism, post-thrombotic syndrome, chronic pain, skin changes, and venous ulcers.

Deep Vein Thrombosis (DTV)



Surgical strategies play a vital role in high-risk patients and in cases where conservative therapy is insufficient, making the evaluation of operative preventive methods clinically essential. Thrombosis of the leg veins remains one of the most dangerous vascular conditions encountered in medical practice due to its silent onset, rapid progression, and unpredictable complications. It often develops as a consequence of prolonged immobilization, major trauma, surgical interventions, oncological diseases, metabolic disorders, hormonal imbalance, and inherited coagulation defects. Venous blood stagnation and endothelial dysfunction promote activation of the coagulation cascade, resulting in intravascular clot formation. In many patients, early symptoms are minimal or nonspecific, leading to delayed diagnosis and increased risk of thrombus migration into the pulmonary circulation. While conservative prevention with anticoagulants and compression therapy is widely used, it is not always sufficient in patients with extensive thrombosis or contraindications to drug therapy. Therefore, surgical prevention has emerged as a crucial strategy to interrupt the progression of venous obstruction, restore blood flow, and protect the patient from irreversible systemic consequences.

Research Methods and Approaches:

This study is based on a structured review of clinical observations, hospital records, and scientific publications published between 2010 and 2024 concerning lower limb thrombosis and its surgical prevention.

Deep Vein Thrombosis (DVT)

If a blood clot (thrombosis) develops in the deep veins of the leg (less commonly in the arm) it is referred to as a Deep Vein Thrombosis or DVT

Pulmonary Embolism (PE)

If part of the clot becomes dislodged it is referred to as an embolus and can travel through the venous circulation until it reaches the lungs: a pulmonary embolism or PE

Venous Thromboembolism (VTE)

Venous thromboembolism or VTE is the collective term for both DVT and PE (Figure 1)

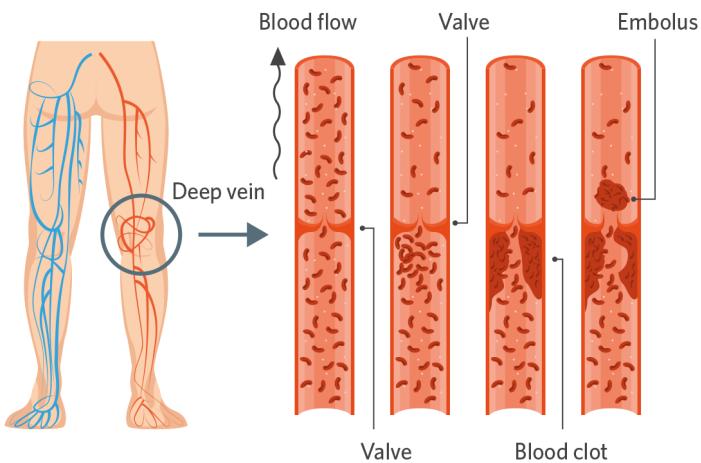


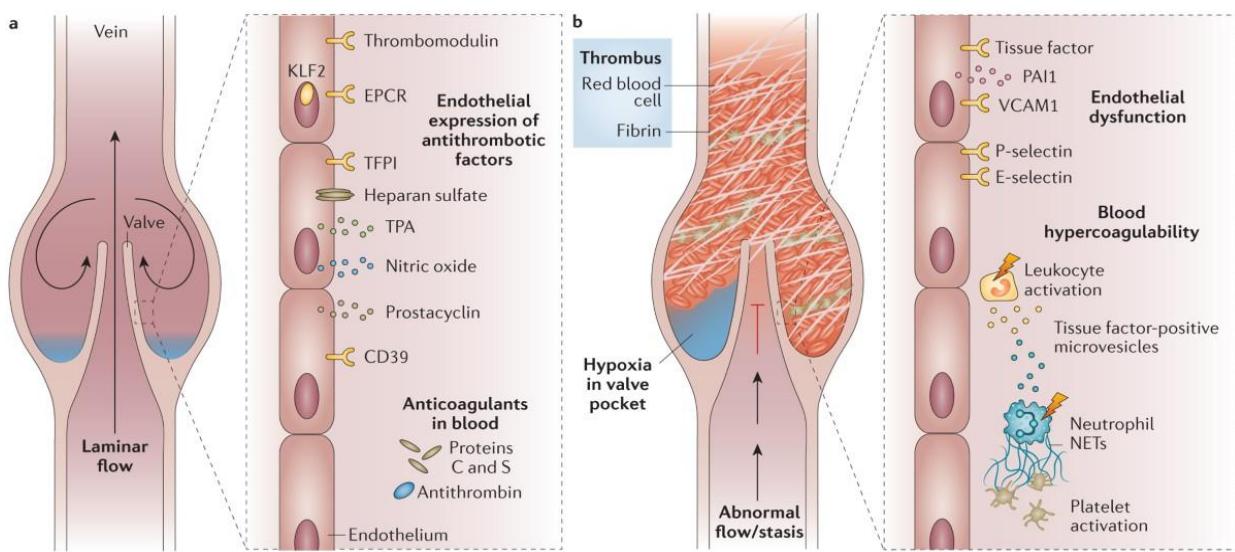
Figure 1: Venous Thromboembolism

10 million people around the world develop VTE each year.⁵

Data were collected from patients diagnosed with deep vein thrombosis confirmed by duplex ultrasonography, venography, or computed tomography angiography. Risk factors such as age, immobilization, recent surgery, oncological disease, obesity, pregnancy, and genetic predisposition were analyzed. Surgical techniques evaluated included venous thrombectomy, catheter-directed thrombolysis, implantation of inferior vena cava filters, and prophylactic venous ligation in selected high-risk cases. Outcome measures included thrombus recurrence, incidence of pulmonary embolism, venous patency, postoperative complications, and long-term functional recovery.

Results:

Analysis showed that the most frequent causes of leg thrombus formation were prolonged immobility, postoperative states, malignant diseases, and hypercoagulable conditions. Patients with multiple risk factors demonstrated significantly higher thrombus burden and greater tendency toward proximal vein involvement. Surgical prevention methods demonstrated high effectiveness in selected patients.



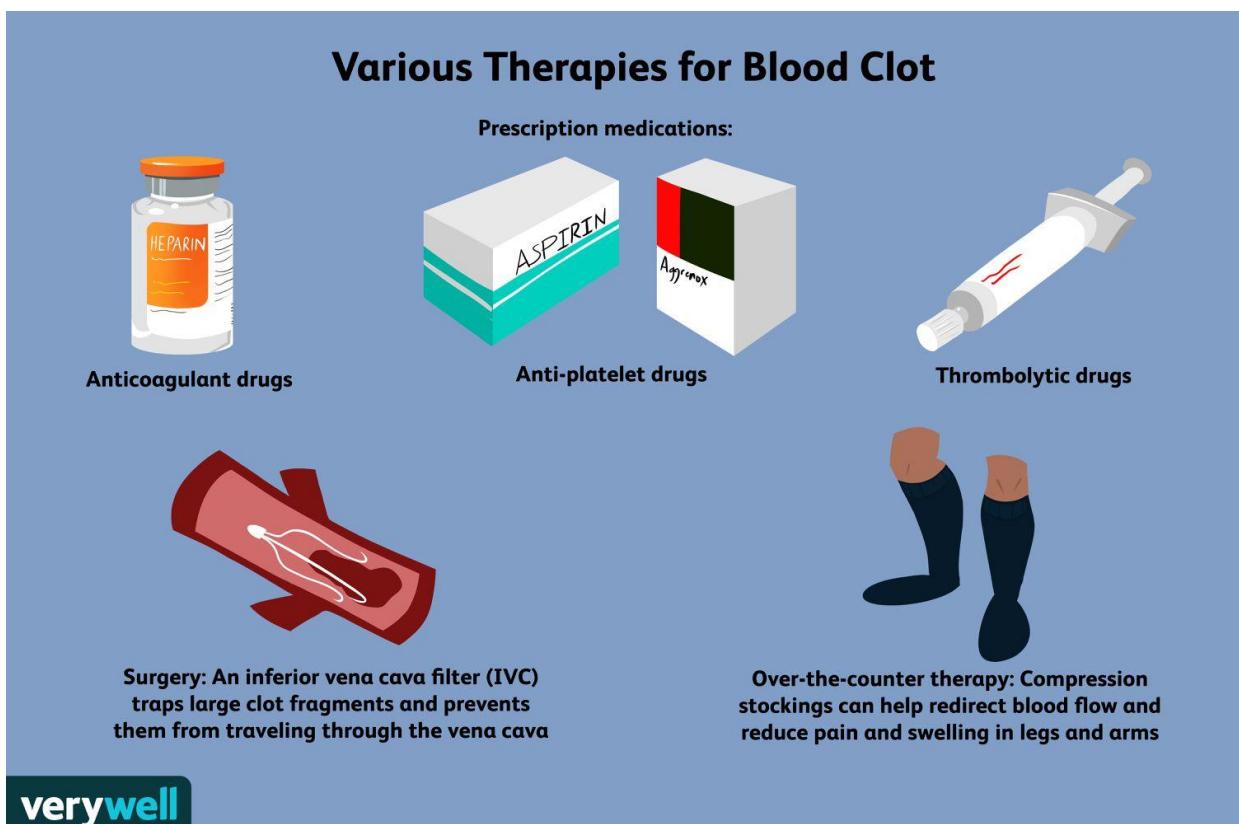
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Venous thrombectomy provided rapid restoration of blood flow and reduced the risk of embolic complications in acute massive thrombosis. Catheter-directed thrombolysis achieved effective thrombus dissolution with preservation of venous valves in many patients. Inferior vena cava filter placement significantly reduced the incidence of pulmonary embolism in individuals with

contraindications to anticoagulant therapy. Early surgical intervention was associated with lower rates of post-thrombotic syndrome, improved venous patency, and better long-term functional outcomes. Clinical observations demonstrated that thrombus formation in the lower limb was most frequently associated with prolonged bed rest, postoperative states, malignant processes, and coagulation disorders. Patients exposed to several risk factors simultaneously showed more extensive venous involvement and higher probability of proximal clot localization. Surgical interventions produced favorable outcomes in the majority of properly selected cases. Mechanical removal of the thrombus resulted in immediate restoration of venous patency and rapid regression of limb edema and pain. Endovascular techniques facilitated controlled clot dissolution and preserved venous valve function, which significantly improved long-term circulation. Protective implantation of venous filters effectively reduced the occurrence of pulmonary embolism in patients who were unable to receive anticoagulant therapy. Follow-up evaluations revealed reduced rates of chronic venous insufficiency, decreased recurrence of thrombosis, and improved physical activity in surgically treated patients.

Discussion:

The findings confirm that leg thrombosis is a multifactorial disease in which systemic and local factors act synergistically to initiate clot formation. While anticoagulant therapy remains the cornerstone of treatment, surgical prevention methods are essential in high-risk patients and in cases of extensive or complicated thrombosis.



Thrombectomy is particularly valuable for preventing irreversible venous damage when performed early, whereas thrombolysis allows preservation of venous valve function and reduces long-term venous hypertension. Inferior vena cava filters play a crucial protective role in patients who cannot receive anticoagulation or who experience recurrent embolic events. Selection of the appropriate surgical method depends on thrombus location, severity, patient stability, and comorbid conditions. The integration of surgical and pharmacological strategies significantly reduces mortality and long-term disability associated with venous thromboembolism. The obtained results confirm that lower limb thrombosis is not a consequence of a single pathological trigger but develops through the cumulative influence of systemic and local factors. Although medication remains the first-line preventive measure, surgical methods play a decisive role in

advanced and high-risk conditions. Early operative intervention allows interruption of the pathological cascade before permanent venous damage occurs. Endovascular procedures provide minimally invasive alternatives with lower trauma and faster recovery, while open techniques remain indispensable in massive and limb-threatening thrombosis. Mechanical prevention of embolization using vascular filters offers life-saving protection for patients with unstable coagulation status. The integration of surgical prevention with individualized pharmacological strategies forms a synergistic approach that significantly reduces mortality and the burden of long-term complications.

Conclusion:

Thrombosis of the lower limb develops as a result of combined disturbances in blood flow, coagulation, and vascular wall integrity. Timely identification of risk factors and early surgical prevention in selected cases are critical for reducing life-threatening complications and improving long-term outcomes. Surgical methods such as thrombectomy, catheter-directed thrombolysis, and inferior vena cava filter implantation effectively prevent thrombus progression and pulmonary embolism when applied appropriately. A comprehensive approach that combines preventive measures, pharmacological therapy, and surgical intervention offers the best strategy for reducing the burden of leg thrombosis and its complications. Lower extremity thrombus formation is driven by multifactorial mechanisms involving circulatory stagnation, coagulation activation, and vascular wall injury. Surgical prevention methods represent a vital component of modern thrombosis management, particularly in patients with extensive disease or limited tolerance to anticoagulant therapy. Timely application of operative techniques not only decreases the risk of fatal embolic events but also preserves venous function and improves long-term quality of life. A combined strategy based on early detection, risk stratification, and appropriate surgical intervention remains the most effective approach for reducing the clinical and social impact of leg thrombosis.

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