

# Catheter-Related Superficial Venous Thrombosis of the Upper Extremity: A Narrative Review of Current Evidence, Diagnostic Pathways, and Management Strategies

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**Abstract:** Catheter-related superficial venous thrombosis (SVT) of the upper extremity is a frequent complication of peripheral venous cannulation and longer peripheral devices such as midline catheters and peripherally inserted central catheters (PICCs). Although historically regarded as a benign and self-limited condition, upper-extremity SVT is increasingly recognized as a clinically meaningful entity within a continuum that includes chemical or mechanical phlebitis, extensive superficial thrombophlebitis, catheter-related deep vein thrombosis (UEDVT), septic thrombophlebitis, and rarely pulmonary embolism. Contemporary practice remains heterogeneous, largely because high-quality evidence supporting specific antithrombotic strategies in catheter-provoked upper-extremity SVT is limited. Duplex ultrasonography is central to modern management, as it confirms the diagnosis, quantifies thrombus extension, defines proximity to the deep venous system, and rules out concomitant UEDVT. Available data suggest that many patients with limited cannula-provoked SVT can be managed conservatively after catheter removal and symptomatic therapy, whereas patients with active cancer, extensive thrombosis, progression, or proximity to the axillary subclavian system may warrant anticoagulation on an individualized basis. Septic thrombophlebitis requires urgent catheter removal, blood cultures, targeted intravenous antibiotics, and multidisciplinary management. Prevention through vascular access stewardship, optimal device selection, and attention to catheter-to-vein ratio is likely the most impactful approach to reduce the burden of disease.

**Keywords:** upper extremity, superficial venous thrombosis, peripheral intravenous catheter, midline catheter, peripherally inserted central catheter, anticoagulation

## Introduction

Peripheral intravenous catheters are the most commonly used invasive devices in hospital medicine. Their complications, often perceived as “minor”, are frequent drivers of pain, treatment interruption, repeated cannulation, escalation to more invasive access, and potentially increased healthcare utilization. Available syntheses suggest that peripheral intravenous catheter failure and infusion-related phlebitis remain common across hospital settings, with reported rates varying widely according to catheter type, surveillance intensity, and the clinical definition adopted. Beyond patient discomfort, these complications also generate measurable organizational and economic consequences through repeated cannulation, premature device failure, escalation to more invasive access, delayed treatment delivery, and longer resource utilization. Large contemporary syntheses confirm that non-infectious peripheral intravenous catheter complications in adults remain common and clinically relevant, despite improvements in catheter materials and insertion/maintenance practices.<sup>1</sup> Meta-analytic data likewise suggest that infusion-related phlebitis continues to occur at a substantial rate, with heterogeneity partly reflecting differences in definitions and surveillance intensity.<sup>2</sup> These complications matter not only because they cause discomfort, but because they can exhaust peripheral venous access, precipitate device escalation, and delay time-sensitive therapies. Within this broad “PIVC complication” phenotype, catheter-related superficial thrombophlebitis and

ultrasound-confirmed upper-extremity superficial venous thrombosis (UESVT) occupy a clinically important interface between inflammation and thrombosis. A systematic review focusing specifically on upper-extremity peripheral vein thrombophlebitis underscores how common the problem is, while also highlighting the inconsistency of definitions and the consequent uncertainty around optimal therapy.<sup>3</sup> The evidence gap becomes even more evident in the Cochrane review addressing treatment for superficial infusion thrombophlebitis of the upper extremity, which concluded that high-quality randomized evidence remains limited and that existing trials do not support a single clearly superior pharmacological strategy across clinical scenarios.<sup>4</sup> These uncertainties translate into variable real-world practice, in which clinicians may either undertreat high-risk phenotypes or overtreat low-risk, self-limited disease.

The clinical context has also evolved. Hospital vascular access practice has expanded beyond short peripheral cannulas toward longer devices such as midline catheters and PICCs, often used to preserve peripheral veins or to deliver antibiotics and other intravenous therapies reliably. Yet these devices have distinctive thrombotic profiles. Device-specific risks interact with a shifting inpatient case mix characterized by older age, multimorbidity, higher cancer prevalence, and more frequent systemic inflammatory states, all of which increase susceptibility to thrombosis. As a result, catheter-related thrombosis, including superficial thrombosis, has become more visible in internal medicine and requires a clearer diagnostic and therapeutic framework.

## Methods of Literature Synthesis

This narrative review was based on a non-systematic but structured search of the PubMed/MEDLINE and Scopus databases, supplemented by backward citation tracking from relevant reviews, observational studies, registry analyses, randomized trials, and guideline documents. The search focused on combinations of the following terms: “upper extremity”, “superficial venous thrombosis”, “superficial thrombophlebitis”, “peripheral intravenous catheter”, “midline catheter”, “PICC”, “catheter-related thrombosis”, “upper extremity deep vein thrombosis”, “ultrasonography”, and “anticoagulation”. Priority was given to English-language articles most relevant to catheter-related upper-extremity superficial venous thrombosis, with particular attention to studies addressing anatomy, thrombus extension, concomitant deep venous thrombosis, cancer, infection, and management strategies.

In parallel, the increasing incidence of catheter-related superficial venous thrombosis must be interpreted within the context of a profound evolution in hospital vascular access practices. The growing reliance on longer peripheral devices, such as midline catheters and peripherally inserted central catheters (PICCs), reflects a necessary response to contemporary clinical needs, including prolonged intravenous therapies, antimicrobial stewardship, and preservation of peripheral venous capital. These devices are no longer exceptional tools but represent an integral component of modern inpatient care. Consequently, catheter-related thrombotic complications should not be regarded merely as sporadic adverse events, but rather as foreseeable consequences of an expanding and indispensable medical practice.

This narrative review synthesizes the contemporary literature on catheter-related UESVT, integrating pathophysiology, epidemiology, diagnostic reasoning, and management strategies. Particular emphasis is placed on anatomy-driven risk stratification and the careful, explicit distinction between evidence derived directly from upper-extremity infusion thrombophlebitis and evidence extrapolated from lower-limb SVT trials or broader catheter-related thrombosis frameworks.

## Definitions and Clinical Spectrum

Catheter-related venous inflammation and thrombosis in the upper extremity represents a spectrum rather than a single entity. At one end lies uncomplicated mechanical or chemical phlebitis, which may cause erythema and tenderness at or near the insertion site without a demonstrable intraluminal thrombus. At the other end lies septic thrombophlebitis and catheter-associated deep venous thrombosis, conditions with potential systemic consequences. Between these extremes sits catheter-related UESVT, commonly referred to in clinical settings as superficial thrombophlebitis, characterized by a painful, indurated venous cord with local inflammation and ultrasound evidence of thrombus in a superficial vein segment.

Terminological inconsistency across studies has practical consequences. Reports may label a clinical syndrome “phlebitis” without confirmatory imaging, while others restrict the term “superficial venous thrombosis” to ultrasound-confirmed thrombosis. This inconsistency contributes to widely variable incidence estimates and complicates comparisons between therapeutic strategies. Nonetheless, from a management standpoint, ultrasound-confirmed UESVT carries distinct questions: the thrombus length, its progression over time, its proximity to the deep venous system, and the patient’s systemic thrombotic risk. These parameters, more than the superficial-versus-deep label alone, determine the likelihood of clinically meaningful propagation and the appropriateness of anticoagulation.

Device type strongly influences phenotype. Short peripheral cannulas typically provoke distal disease with prominent inflammatory features driven by local endothelial irritation and infusate-related injury. Midline catheters and PICCs, by contrast, have longer intravascular segments, often a larger catheter diameter, and are placed in veins that may communicate more directly with the axillary-subclavian system. This increases concern regarding thrombus extension and may lower the clinical threshold for imaging and anticoagulation. The clinical spectrum, pathophysiological mechanisms, ultrasound findings and clinical implications of these entities are summarised in [Table 1](#).

## Pathophysiology

The pathogenesis of catheter-related UESVT reflects Virchow’s triad in a device-driven setting. Endothelial injury occurs at insertion and may persist due to catheter micro-motion, friction against the venous wall, repeated access manipulation, or inadequate securement. The seminal work by Maki and Ringer identified key contributors to infusion-related phlebitis, emphasizing that catheter factors and infusion characteristics influence local injury and inflammatory responses.<sup>5</sup> Subsequent critical reviews have reinforced that phlebitis and thrombophlebitis are multifactorial and that both mechanical trauma and chemical irritation are central drivers.<sup>6</sup>

Chemical injury arises from hyperosmolar solutions, extreme pH medications, vesicants, and high-concentration infusions, all of which can amplify endothelial activation and inflammatory cell recruitment. Mechanical injury is magnified when catheter size is large relative to vein caliber, increasing friction and generating altered shear stress.

**Table 1** Clinical Spectrum and Diagnostic Framework of Catheter-Related Superficial Venous Thrombosis of the Upper Extremity (UESVT)

| Clinical Entity                  | Pathophysiology                                                                                           | Typical Clinical Features                                               | Duplex Ultrasound Findings                                         | Clinical Significance                                |
|----------------------------------|-----------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|--------------------------------------------------------------------|------------------------------------------------------|
| Mechanical or chemical phlebitis | Endothelial irritation caused by catheter motion or irritating infusates (pH, osmolarity, vesicant drugs) | Local erythema, pain and warmth at insertion site without palpable cord | No intraluminal thrombus                                           | Benign and self-limited condition                    |
| Catheter-related UESVT           | Endothelial injury and venous stasis leading to superficial vein thrombosis                               | Painful, tender and indurated venous cord with surrounding erythema     | Non-compressible superficial vein containing intraluminal thrombus | Risk of extension to the deep venous system          |
| Extensive or proximal UESVT      | Thrombus extending toward axillary or subclavian veins                                                    | Severe pain, proximal arm swelling and tenderness                       | Thrombus close to or involving deep venous junctions               | Increased risk of propagation and pulmonary embolism |
| Catheter-related UEDVT           | Thrombus formation in deep veins, frequently associated with PICCs or midlines                            | Arm swelling, cyanosis, venous collaterals                              | Thrombus in axillary, brachial or subclavian veins                 | Requires full-dose anticoagulation                   |
| Septic thrombophlebitis          | Bacterial colonisation of thrombus and catheter                                                           | Fever, rigors, purulence and persistent bacteraemia                     | Thrombus with inflammatory features and positive blood cultures    | High morbidity requiring urgent treatment            |

**Notes:** This table summarises the spectrum of catheter-related venous disease in the upper extremity, ranging from uncomplicated phlebitis to septic thrombophlebitis and deep vein thrombosis. Duplex ultrasonography plays a central role in defining thrombus extent and guiding management.

These mechanical factors become particularly salient with midline catheters and PICCs, where the catheter may occupy a substantial fraction of the venous lumen, promoting flow disturbance and local stasis.

Systemic prothrombotic states modulate risk. Cancer, infection, systemic inflammation, obesity, prior venous thromboembolism, and immobilization can shift the hemostatic balance toward thrombosis. In catheter-related thrombosis more broadly, cancer-specific risk determinants are well recognized, and cancer patients are a key subgroup in which “superficial” catheter-associated thrombosis may behave less benignly due to higher baseline thrombotic propensity and frequent need for durable venous access.<sup>7,8</sup>

## Epidemiology and Clinical Burden

Even in modern catheter care systems, PIVC complications remain common. A large systematic review and meta-analysis of adult peripheral intravenous catheter non-infectious complications confirmed frequent catheter failure driven by phlebitis and other mechanical complications.<sup>1</sup> A meta-analysis focusing on infusion phlebitis similarly demonstrated non-trivial incidence across studies, while emphasizing substantial heterogeneity in reported rates.<sup>2</sup> A systematic review concentrating on upper-extremity thrombophlebitis further reinforced that this is a frequent and clinically important problem, but with variability driven by inconsistent definitions and surveillance strategies.<sup>3</sup>

The burden extends beyond discomfort. Recurrent phlebitis and superficial thrombophlebitis can deplete peripheral veins, necessitate repeated cannulations, and increase reliance on longer devices. These events can delay antimicrobials or other intravenous therapies, which is particularly relevant in sepsis, endocarditis, complex pneumonias, and oncology. A large administrative database analysis reported increased clinical and economic burden associated with peripheral intravenous catheter-related complications, supporting the notion that these events have measurable downstream consequences.<sup>9</sup>

Infectious complications also matter. Although peripheral catheter-related bloodstream infection is less frequent than central line-associated infection, prospective data identify patient- and process-level risk factors, and such infections can complicate thrombophlebitis phenotypes.<sup>10,11</sup> In high-risk settings, infection and thrombosis may amplify each other, contributing to septic thrombophlebitis or persistent bacteremia.

Device selection strongly shapes epidemiology. PICCs are associated with increased venous thromboembolism risk compared with other central venous devices, as shown in a large systematic review and meta-analysis.<sup>12</sup> In medical inpatients, central venous catheters are major determinants of UEDVT risk, reinforcing the importance of device exposure and dwell time.<sup>13</sup> Comparative studies suggest that midline catheters may have a different complication profile compared with PICCs.<sup>14–16</sup> In a cohort comparison, midlines were not uniformly “safer” but were associated with distinctive risks, including superficial thrombosis signals.<sup>17</sup> A multicenter study of short-term indications found meaningful differences between midlines and PICCs, supporting the need for tailored device selection rather than a one-size-fits-all strategy.<sup>18</sup> A systematic review and meta-analysis comparing midline catheters versus PICCs similarly concluded that complication patterns differ between devices, including differential risks of superficial thrombosis.<sup>19</sup> These findings have direct implications for internal medicine, where device choice is often driven by anticipated therapy duration rather than by formal thrombosis risk stratification.

## Clinical Presentation and Diagnostic Pathways

Catheter-related UESVT typically presents with pain and tenderness along a superficial vein, often accompanied by erythema, warmth, and induration. Patients may describe a “tight” or “cord-like” sensation. The physical finding of a palpable tender cord is suggestive, but clinical examination alone cannot reliably differentiate isolated superficial thrombosis from concomitant UEDVT, particularly when swelling is prominent. Marked upper-limb swelling, cyanosis, prominent collateral veins, or symptoms extending to the upper arm should heighten suspicion for deep venous involvement, especially in the presence of PICCs, midlines, cancer, or prior VTE.<sup>20–22</sup>

Duplex ultrasonography is therefore central to contemporary management. Ultrasound confirms the presence of superficial thrombus, measures its length, assesses whether it is propagating, evaluates proximity to deep venous junctions, and rules out concomitant UEDVT. In practice, imaging is particularly important when symptoms are extensive, proximal, progressive, or when host-level thrombotic risk is high. ICU cohorts illustrate that phlebitis risk

is influenced by both catheter characteristics and systemic illness, suggesting that clinical appearance may not reliably indicate thrombotic burden in critically ill patients.<sup>10</sup>

One of the strongest real-world signals supporting risk-stratified imaging and management is the audit of cannula-provoked UESVT, which showed striking variation in treatment intensity. That audit is particularly informative because it showed that thrombus extension and major bleeding were infrequent overall, whereas clinically relevant events clustered in patients with active malignancy, thereby supporting a selective rather than routine anticoagulation strategy. Importantly, thrombus extension and major bleeding were rare overall but occurred in the cancer subgroup, indicating that cancer status modifies both thrombotic risk and harm from anticoagulation and supporting a more individualized approach rather than routine escalation for all.<sup>23,24</sup>

In this context, structured risk assessment tools may support diagnostic reasoning. The Michigan Risk Score, originally developed to stratify the risk of catheter-associated thrombosis, explicitly incorporates the presence of indwelling venous catheters, including both superficial and multi-lumen devices, as a key determinant of thrombotic risk. Although not specifically validated for isolated upper-extremity superficial venous thrombosis, the score underscores a clinically relevant principle: catheter characteristics and permanence are central drivers of thrombosis risk and should be systematically considered during diagnostic evaluation. Integrating such risk-based frameworks may help identify patients who warrant closer surveillance or earlier ultrasonographic assessment.

## Natural History and Thromboembolic Risk

Upper-extremity superficial thrombophlebitis has historically been regarded as a benign entity.

Data from large prospective registries such as RIETE further show that specific patient phenotypes, including those with underlying bleeding-prone disorders, experience a complex balance between thrombotic recurrence and hemorrhagic complications during VTE follow-up, reinforcing that the natural history of venous thrombosis is highly heterogeneous.<sup>25</sup> The importance of the provoking context is also supported by RIETE analyses showing that recurrence risk after provoked VTE is not uniform and may still be influenced by residual biological activity, including persistent D-dimer elevation after treatment discontinuation.<sup>26</sup> However, contemporary understanding recognizes a continuum between superficial and deep thrombosis, especially when thrombosis involves proximal superficial veins that communicate with the axillary system. Long-term follow-up data on upper-extremity venous thrombosis, encompassing both superficial and deep disease, suggest that recurrence, post-thrombotic symptoms, and bleeding are clinically relevant outcomes and that management strategies vary considerably in practice.<sup>27–29</sup>

Evidence from UEDVT cohorts contextualizes the thromboembolic risk. In the RIETE registry, patients with upper-extremity DVT had clinically meaningful rates of recurrence and pulmonary embolism, reinforcing that upper-extremity thrombosis is not trivial and that device-associated thrombosis is an important driver of this phenotype.<sup>30</sup> This reinforces that upper-extremity venous thrombosis should not be dismissed as clinically trivial and that anatomical proximity to the axillary-subclavian system may have prognostic implications beyond local symptoms alone. Earlier prospective and observational studies documented pulmonary embolism occurring in association with UEDVT.<sup>31</sup> Consistently, statin therapy has been associated with lower short-term mortality in patients with acute symptomatic pulmonary embolism, supporting a protective effect in the acute phase of venous thromboembolism.<sup>32</sup> Real-world data from the RIETE registry also show that pulmonary embolism remains associated with substantial hospitalisation rates and healthcare burden, highlighting that thrombotic complications of venous disease have important clinical and system-level consequences.<sup>33</sup> Catheter-related thrombosis appears particularly associated with pulmonary embolism in upper-extremity DVT populations.<sup>34</sup> These findings do not imply that isolated, distal, cannula-provoked superficial thrombosis carries a high pulmonary embolism risk; rather, they support the principle that anatomy and proximity to deep venous drainage matter, and that superficial thrombosis near deep venous junctions warrants a more cautious stance.

## Management: General Measures and Symptomatic Therapy

The first therapeutic principle is triggering control. When feasible, the offending catheter should be removed, as persistent mechanical irritation can maintain endothelial injury and inflammation. Symptomatic therapy is appropriate for many patients, particularly those with limited distal disease, low systemic thrombotic risk, and ultrasound exclusion

of deep venous involvement. The Cochrane review of superficial infusion thrombophlebitis treatment found that evidence for specific topical or systemic interventions is limited and does not establish a single best approach, supporting a pragmatic symptomatic strategy when risk is low.<sup>4</sup>

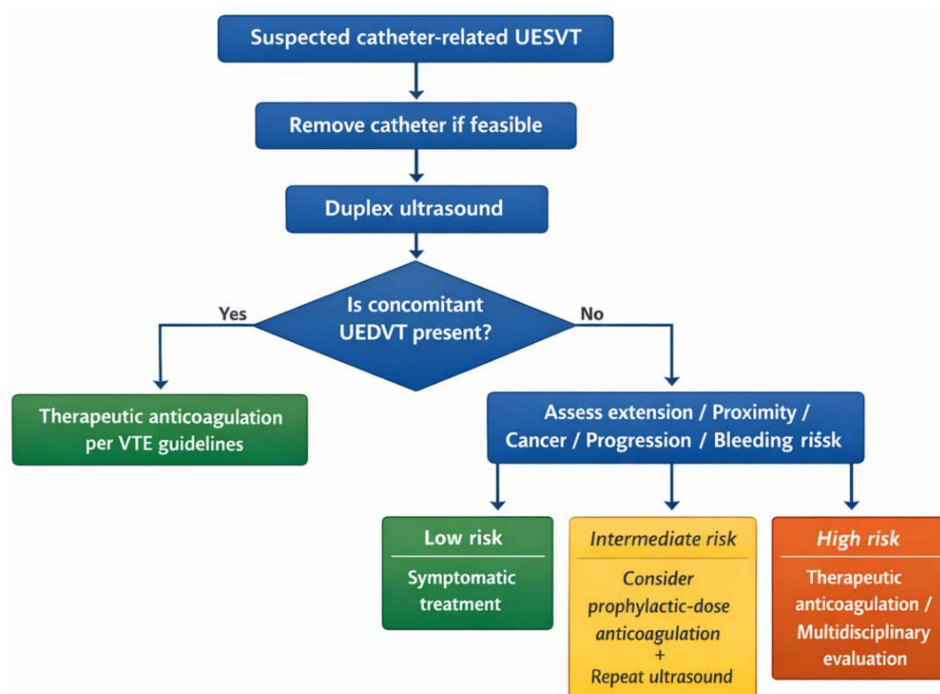
Catheter management policy also influences outcomes. In a randomized equivalence trial, routine time-based replacement of peripheral intravenous catheters was not superior to clinically indicated replacement in key clinical outcomes, supporting stewardship approaches that reduce unnecessary cannulations while maintaining close monitoring and prompt removal when complications arise.<sup>7</sup> A subsequent Cochrane review reached similar conclusions, reinforcing that routine scheduled replacement is not clearly beneficial when appropriate surveillance and clinically indicated replacement are in place.<sup>8</sup> These principles matter because repeated cannulation can exacerbate venous injury and contribute to a cycle of phlebitis, venous depletion, and escalation to higher-risk devices.

## Anticoagulation: Evidence, Extrapolation and Pragmatic Decision-Making

The most debated aspect of catheter-related UESVT is the role, dose and duration of anticoagulation. Direct randomized evidence for upper-extremity catheter-related SVT is scarce, and practice frequently extrapolates from lower-limb SVT trials and from catheter-related thrombosis/UEDVT management frameworks. The cannula-provoked UESVT audit suggests that many non-cancer patients do well with conservative management, while complications cluster in cancer patients, supporting a risk-adapted strategy rather than routine anticoagulation for all.<sup>24,35–40</sup>

Lower-limb SVT trials establish that superficial thrombosis can be clinically important and treatable in selected settings. In the CALISTO trial, prophylactic-dose fondaparinux reduced thromboembolic complications in leg SVT, providing high-quality evidence that anticoagulation can prevent clinically meaningful events in patients with sufficiently extensive SVT.<sup>41</sup> In the SURPRISE trial, rivaroxaban appeared non-inferior to fondaparinux for preventing thromboembolic complications in superficial vein thrombosis, supporting the plausibility of oral low-dose strategies in appropriate patients.<sup>42</sup> These data should not be directly generalized to catheter-provoked upper-extremity SVT. In contrast with lower-limb spontaneous SVT, upper-extremity catheter-related disease is frequently triggered by a removable mechanical factor, may involve smaller thrombus burden, and often occurs in hospitalized patients with competing risks of bleeding, infection, and need for ongoing venous access. Therefore, lower-limb SVT trials should be regarded as indirect supportive evidence only, useful for conceptual orientation but insufficient to justify automatic therapeutic extrapolation.

Beyond anticoagulation, adjunctive therapies may influence prognosis: in the RIETE registry, statin use was independently associated with reduced mortality in patients with deep vein thrombosis, suggesting pleiotropic vascular and antithrombotic effects that could be relevant also in high-risk catheter-related thrombosis phenotypes.<sup>43</sup> These effects are biologically plausible, as statins exert antithrombotic, anti-inflammatory, endothelial-stabilising, and potentially profibrinolytic actions that may influence thrombus propagation and vascular outcomes across different venous thromboembolic phenotypes.<sup>44,45</sup> In upper-extremity catheter-related SVT, a pragmatic approach is to reserve anticoagulation for scenarios in which extension risk is plausibly meaningful. To facilitate clinical decision-making, we propose a structured, anatomy-based and risk-adapted management algorithm integrating ultrasonographic findings and patient-level risk factors (Figure 1). This includes extensive thrombosis, progressive symptoms despite catheter removal, thrombosis that is proximal or close to deep venous junctions, significant limb swelling suggesting impaired outflow, and strong systemic risk factors such as active malignancy. In such cases, prophylactic-dose anticoagulation may be considered, particularly when bleeding risk is acceptable. A practical risk-adapted management strategy according to thrombus extent, anatomical location and patient-related risk factors is summarised in Table 2. Importantly, bleeding risk during anticoagulation is influenced by metabolic and vascular factors, including low LDL-cholesterol levels, which have been associated with an increased risk of major bleeding in patients with venous thromboembolism in large registry-based studies.<sup>45</sup> More refined bleeding-risk modelling may further improve individualized treatment decisions. In RIETE-based analyses, machine-learning approaches have shown that prediction of major bleeding during anticoagulation is feasible, although performance remains constrained by the heterogeneity of real-world patients and by the multidimensional nature of bleeding risk.<sup>46</sup> When ultrasound identifies concomitant UEDVT, the patient should be treated according to established VTE frameworks with therapeutic anticoagulation, because the evidence base for DVT treatment is far stronger than for isolated superficial thrombosis.



**Figure 1** Proposed clinical algorithm for catheter-related upper-extremity superficial venous thrombosis (UESVT). In patients with suspected UESVT, catheter removal and duplex ultrasonography are recommended to confirm diagnosis, assess thrombus extent, and exclude concomitant upper-extremity deep vein thrombosis (UEDVT). If UEDVT is present, therapeutic anticoagulation should be initiated according to VTE guidelines. In the absence of UEDVT, management should be risk-adapted based on thrombus extent, proximity to deep veins, symptom progression, cancer status, and bleeding risk, distinguishing low-risk patients suitable for conservative treatment from intermediate- and high-risk patients who may require anticoagulation.

From a pragmatic standpoint, three management scenarios may be distinguished. Low-risk patients with limited distal thrombosis, clear catheter-provoked disease, rapid symptom improvement after catheter removal, and no ultrasound evidence of extension or concomitant UEDVT can usually be managed conservatively with catheter removal, symptomatic therapy, and clinical follow-up. Intermediate-risk patients with more extensive superficial thrombosis, persistent symptoms, proximity to the axillary-subclavian venous axis, or relevant prothrombotic conditions may be considered for prophylactic-dose anticoagulation for a limited course, usually guided by repeat ultrasonography and bleeding risk. High-risk patients with concomitant UEDVT, clear thrombus progression, marked limb swelling suggesting impaired venous outflow, septic thrombophlebitis with extensive thrombus burden, or very high-risk cancer-associated disease should be

**Table 2** Risk-Adapted Management of Catheter-Related Upper-Extremity Superficial Venous Thrombosis

| Clinical Scenario                                         | Recommended Management                                                                                              | Rationale                                                                               |
|-----------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| Localised distal UESVT following short peripheral cannula | Catheter removal and symptomatic treatment (non-steroidal anti-inflammatory drugs, limb elevation, warm compresses) | Most cases resolve after removal of the mechanical trigger                              |
| UESVT with limited thrombus and no major risk factors     | Conservative management without routine anticoagulation                                                             | Low risk of thrombus extension and unfavourable risk-benefit profile of anticoagulation |
| Extensive UESVT or proximity to axillary-subclavian veins | Consider prophylactic-dose anticoagulation                                                                          | Higher probability of propagation to the deep venous system                             |

(Continued)

**Table 2** (Continued).

| Clinical Scenario                                | Recommended Management                                                                                | Rationale                                                         |
|--------------------------------------------------|-------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|
| Progressive symptoms after catheter removal      | Repeat duplex ultrasound and consider anticoagulation                                                 | Ongoing thrombotic activity is likely                             |
| Active cancer or strong prothrombotic condition  | Lower threshold for anticoagulation                                                                   | Higher thrombotic burden and worse natural history                |
| Concomitant upper-extremity deep vein thrombosis | Full-dose anticoagulation according to VTE guidelines                                                 | Evidence-based management for deep venous thrombosis              |
| Septic thrombophlebitis                          | Immediate catheter removal, blood cultures and intravenous targeted antibiotics $\pm$ anticoagulation | Infection control is mandatory; anticoagulation is individualised |

**Notes:** Management of catheter-related UESVT should be individualised according to thrombus burden, anatomical location and patient-related thrombotic risk. Routine anticoagulation is not indicated in all patients but is appropriate in high-risk or progressive disease.

managed according to established VTE frameworks, generally with therapeutic-dose anticoagulation and duration individualized according to the underlying provoking factor and persistence of risk.

Cancer deserves special attention. The thrombotic risk associated with central venous access in cancer patients is well described, and reviews specifically addressing epidemiology and prevention of catheter-related thrombosis in cancer populations provide important mechanistic and clinical context.<sup>23</sup> For therapeutic decisions, contemporary cancer-associated thrombosis guidelines support DOACs or LMWH in many patients, while emphasizing individual bleeding risk and tumor site considerations.<sup>47,48</sup> In practical terms, LMWH remains an important option in patients with luminal gastrointestinal or genitourinary malignancies, high bleeding risk, significant drug-drug interactions, or unstable oral intake, whereas DOACs may be appropriate in selected patients with acceptable bleeding risk and no major interaction concerns. Duration should be individualized, but continuation beyond the initial treatment phase is often appropriate while cancer remains active, anticancer therapy is ongoing, or the catheter remains necessary.<sup>49</sup> These frameworks are directly relevant when superficial catheter-related thrombosis occurs in a cancer patient and is extensive or proximal, or when there is coexistent deep thrombosis.

This subgroup deserves separate consideration because thrombotic burden, catheter dependence, recurrence risk, and bleeding risk often coexist and evolve dynamically during anticancer treatment. In cancer patients, treatment decisions should account not only for thrombus location and extension, but also for tumor site, platelet count, mucosal involvement, anticipated invasive procedures, and the expected duration of catheter need. Contemporary literature on cancer-associated thrombosis also supports a more nuanced distinction between incidental and symptomatic thromboembolic presentations, reinforcing that management cannot rely on a one-size-fits-all approach.

Guideline recommendations for venous thromboembolic disease provide additional structure. CHEST guidance remains central to treatment decisions when superficial thrombosis extends to deep veins or when concomitant UEDVT is identified.<sup>39</sup> ESC guidance on acute pulmonary embolism provides a complementary framework when symptoms suggest PE or when embolic complications are suspected.<sup>40</sup> In this sense, UESVT management can be viewed as a two-tier strategy: conservative management for low-risk isolated superficial thrombosis, and escalation to VTE-guideline-driven therapeutic anticoagulation when deep involvement or high extension risk is present. In patients receiving anticoagulant therapy for venous thromboembolism, statin use has been independently associated with lower all-cause mortality in RIETE, suggesting a potential role for statins as adjunctive therapy in high-risk thrombotic settings.<sup>49</sup> This protective effect appears to extend beyond lipid lowering, possibly reflecting favourable interactions with coagulation, inflammation and endothelial function during anticoagulant treatment.<sup>50,51</sup>

When anticoagulation is temporarily contraindicated because of major bleeding, management becomes particularly challenging and should prioritize thrombus extent, ongoing embolic risk, and the feasibility of delayed reintroduction of anticoagulant therapy, rather than reflexive use of invasive measures.<sup>52</sup>

Similarly, baseline hematologic parameters may refine hemorrhagic risk assessment during anticoagulant treatment, as lower hemoglobin values have also been associated with worse clinical outcomes in acute venous thromboembolism.<sup>53,54</sup>

## Septic Thrombophlebitis and Catheter-Related Infection

Septic thrombophlebitis is uncommon but potentially severe. It should be suspected when local thrombophlebitis is accompanied by fever, rigors, purulence, positive blood cultures, or persistent bacteremia despite appropriate therapy. Peripheral intravenous catheter infections can occur and are clinically relevant; prospective data identify risk factors and support the need for vigilance in patients with complicated catheter courses.<sup>11</sup> Septic thrombophlebitis requires urgent catheter removal, blood cultures, and targeted intravenous antibiotics. In oncology and ICU populations, *Staphylococcus aureus* bloodstream infection associated with catheter-related thrombosis has been linked to significant complications, often prompting prolonged therapy and careful line management.<sup>36</sup> In critically ill cancer patients, catheter-related *S. aureus* bacteremia and catheter-related thrombosis have been examined as an integrated clinical problem, reinforcing that thrombosis and infection may coexist and require coordinated management.<sup>38</sup> The decision to anticoagulate in septic thrombophlebitis is not grounded in robust randomized evidence and is best individualized, but anticoagulation may be considered when thrombus burden is extensive, when there is concern that infected thrombus contributes to persistent bacteremia, or when deep venous involvement is present.

## Prevention and Vascular Access Stewardship

Prevention is likely the most effective strategy for reducing catheter-related UESVT burden. The epidemiology of phlebitis and thrombophlebitis indicates multifactorial risk, with catheter characteristics, dwell time, insertion technique, securement, and infusate properties all contributing.<sup>5,6</sup> In critically ill cohorts, phlebitis risk is influenced by illness severity and care processes, highlighting that prevention must be embedded within broader clinical pathways rather than limited to insertion technique alone.<sup>10</sup>

Device selection is crucial. PICCs are associated with increased VTE risk, particularly in high-risk populations.<sup>12–16</sup> Midlines may offer advantages in some short-term indications, but comparative data demonstrate different complication patterns, including superficial thrombosis signals that should be weighed against infection risk and therapy needs.<sup>17–20</sup> The association between catheter diameter and thrombosis risk in midline users supports a mechanistically coherent prevention target: minimize catheter-to-vein ratio and select the smallest device that meets clinical requirements.<sup>21</sup> A randomized trial comparing midline devices with different antithrombogenic mechanisms underscores that device design and thrombosis prevention strategies remain active areas of investigation.<sup>20</sup>

At the system level, stewardship approaches that reduce unnecessary cannulation and favor clinically indicated replacement have evidence support.<sup>7,8</sup> These approaches decrease repeated insertion trauma while maintaining safety when appropriate monitoring and prompt removal for complications are ensured. Ultimately, prevention is best conceptualized as a continuous process that begins with device selection and continues through daily necessity assessment, infusion planning, monitoring for early signs of phlebitis or thrombosis, and timely device removal.

Effective prevention of catheter-related thrombosis requires a structured vascular access stewardship model that is shared between physicians and nursing staff. In many European healthcare systems, including Italy, surveillance of catheter-related complications remains fragmented: nurses are often responsible for catheter care and early recognition of complications, yet therapeutic decisions and medication administration depend on medical prescriptions. This disconnect may delay timely interventions and limit proactive risk mitigation.

In contrast, integrated surveillance models increasingly adopted in the United States leverage digital health tools and artificial intelligence–driven monitoring systems to enable real-time assessment of catheter dwell time, infusion characteristics, and complication signals. Such systems facilitate early alerts, support multidisciplinary decision-making, and

promote standardized responses to emerging risks. The implementation of similar technology-assisted stewardship pathways in European settings represents a critical unmet need and a promising direction for improving patient safety.

## Research Gaps and Future Directions

The most important limitation in the literature is the lack of randomized trials specifically addressing catheter-provoked UESVT, particularly trials that stratify by thrombus length, proximity to deep veins, and cancer status. The Cochrane review focused on upper-extremity superficial infusion thrombophlebitis emphasized the insufficiency of evidence for defining optimal therapy.<sup>4</sup> Observational data suggest that a large proportion of patients may not need anticoagulation, while a smaller subset, particularly cancer patients and those with proximal or extensive thrombosis, may benefit from anticoagulant strategies. Future research should therefore prioritize pragmatic trials comparing conservative management to prophylactic-dose anticoagulation in ultrasound-confirmed UESVT, with clinically meaningful outcomes including extension to deep veins, need for new vascular access, symptom resolution, bleeding, and treatment delays.

Implementation research is also needed. Comparative studies of midlines versus PICCs, and investigations of catheter-to-vein ratio protocols, may yield substantial benefits because device selection and insertion practices are modifiable at scale. These prevention-focused interventions may ultimately have greater clinical impact than fine-tuning anticoagulant choice in the relatively small proportion of cases requiring escalation.

## Conclusions

Catheter-related superficial venous thrombosis of the upper extremity should no longer be viewed as a uniformly benign complication. Rather, it is best understood within an anatomy-based and patient-centred risk continuum, ranging from limited self-limited distal thrombophlebitis to clinically relevant disease close to the deep venous system or associated with major host-level risk factors such as cancer, infection, and ongoing catheter dependence. In this context, duplex ultrasonography is pivotal not only for diagnosis, but also for management stratification.

Ultimately, the future of catheter-related thrombosis prevention lies not only in pharmacological strategies, but in the development of shared, technology-supported vascular access stewardship programs that align medical and nursing competencies and enable continuous, data-driven surveillance.

The main clinical contribution of this review is the proposal of a pragmatic anatomy-based, risk-adapted framework in which treatment intensity is guided by thrombus extent, proximity to the deep venous axis, progression, and patient-specific thrombotic and hemorrhagic risk.

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## Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, literature acquisition, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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