

Venous Thromboembolism in Children

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KEYWORDS

- Children • Venous • Thromboembolism • Anticoagulation
- Post-thrombotic syndrome

With improved pediatric survival from serious underlying illnesses, greater use of invasive vascular procedures and devices, and a growing (albeit still suboptimal) awareness that vascular events do occur among the young, venous thromboembolism (VTE) increasingly is recognized as a critical pediatric concern. The focus of this review is on providing background on etiology and epidemiology in this disorder, followed by an in-depth discussion of approaches to the clinical characterization, diagnostic evaluation, and management of pediatric VTE. Prognostic indicators and long-term outcomes are considered, with emphasis placed on available evidence underlying present knowledge and key questions for further investigation.

CHARACTERIZATION

VTE is classified clinically by various relevant descriptors, including first episode versus recurrent, symptomatic versus asymptomatic, acute versus chronic (a distinction that can be difficult at times), veno-occlusive versus nonocclusive, and idiopathic versus risk associated. This last category includes clinical prothrombotic risk factors (eg, exogenous estrogen administration, indwelling central venous catheter, and reduced mobility) and blood-based thrombophilic conditions (eg, transient or persistent antiphospholipid antibodies [APAs], acquired or congenital anticoagulant deficiencies, and factor V Leiden or prothrombin G20210A mutations); the latter are discussed in greater detail later. Because of the frequency of indwelling central venous

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catheters as a major clinical risk factor for VTE in children, VTE also may be classified as catheter-related thromboembolism (CRT) versus non-CRT. VTEs also are distinguished anatomically by vascular type (ie, venous versus arterial); vascular distribution (eg, distal lower extremity versus proximal lower extremity versus central or superficial versus deep vasculature); and organ system affected, if applicable (eg, cerebral sino-venous thrombosis [CSVT] or pulmonary embolism). The use of systematic nomenclature and precise descriptors for VTE assists in optimizing clinical care and in evaluating clinical research evidence in the field.

EPIDEMIOLOGY

Several years ago, registry data revealed an estimated cumulative incidence of 0.07 per 10,000 (5.3 per 10,000 hospitalizations) for extremity deep venous thrombosis (DVT) or pulmonary embolism (PE) among non-neonatal Canadian children¹ and an incidence rate of 0.14 per 10,000 Dutch children per year for VTE in general.² More recently, an evaluation of the National Hospital Discharge Survey and census data for VTE in the United States disclosed an overall incidence rate of 0.49 per 10,000 per year.³

Epidemiologic data have revealed that the age distribution of the incidence rate for VTE in children is bimodal, with peak rates in the neonatal period and adolescence. The Dutch registry, for example, indicated a VTE incidence rate of 14.5 per 10,000 per year in the neonatal period, approximately 100 times greater than the overall rate in childhood,² whereas the VTE-specific incidence rate in the United States among adolescents 15 to 17 years of age was determined as 1.1 per 10,000 per year, a rate nearly threefold that observed overall in children.³

ETIOLOGY

The pathogenesis of VTE readily can be appreciated by considering the Virchow triad, consisting of venous stasis, endothelial damage, and the hypercoagulable state. In children, greater than 90% of VTEs are risk associated^{2,4,5} (compared with approximately 60% in adults), with risk factors often disclosed from more than one component of this triad. Specific examples of VTE risk factors in children are shown in (Fig. 1). One of the most common clinical prothrombotic risk factors in childhood is an indwelling central venous catheter. More than 50% of cases of DVT in children and more than 80% of cases in newborns occur in association with central venous

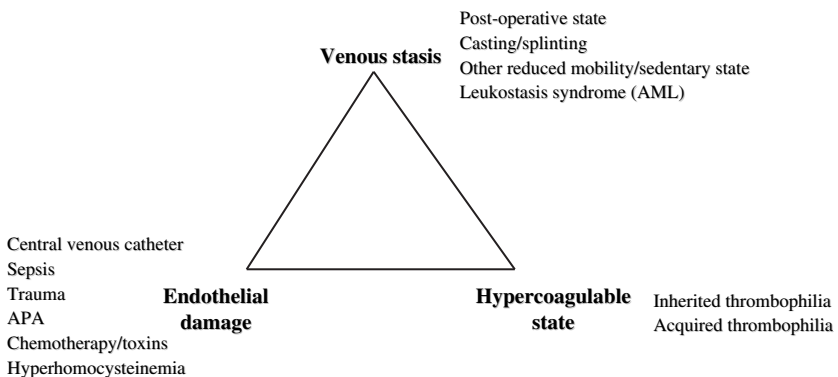


Fig. 1. Clinical prothrombotic risk factors: the Virchow triad applied to VTE in children.

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