

# THROMBOSIS IN PEDIATRIC CANCER PATIENTS

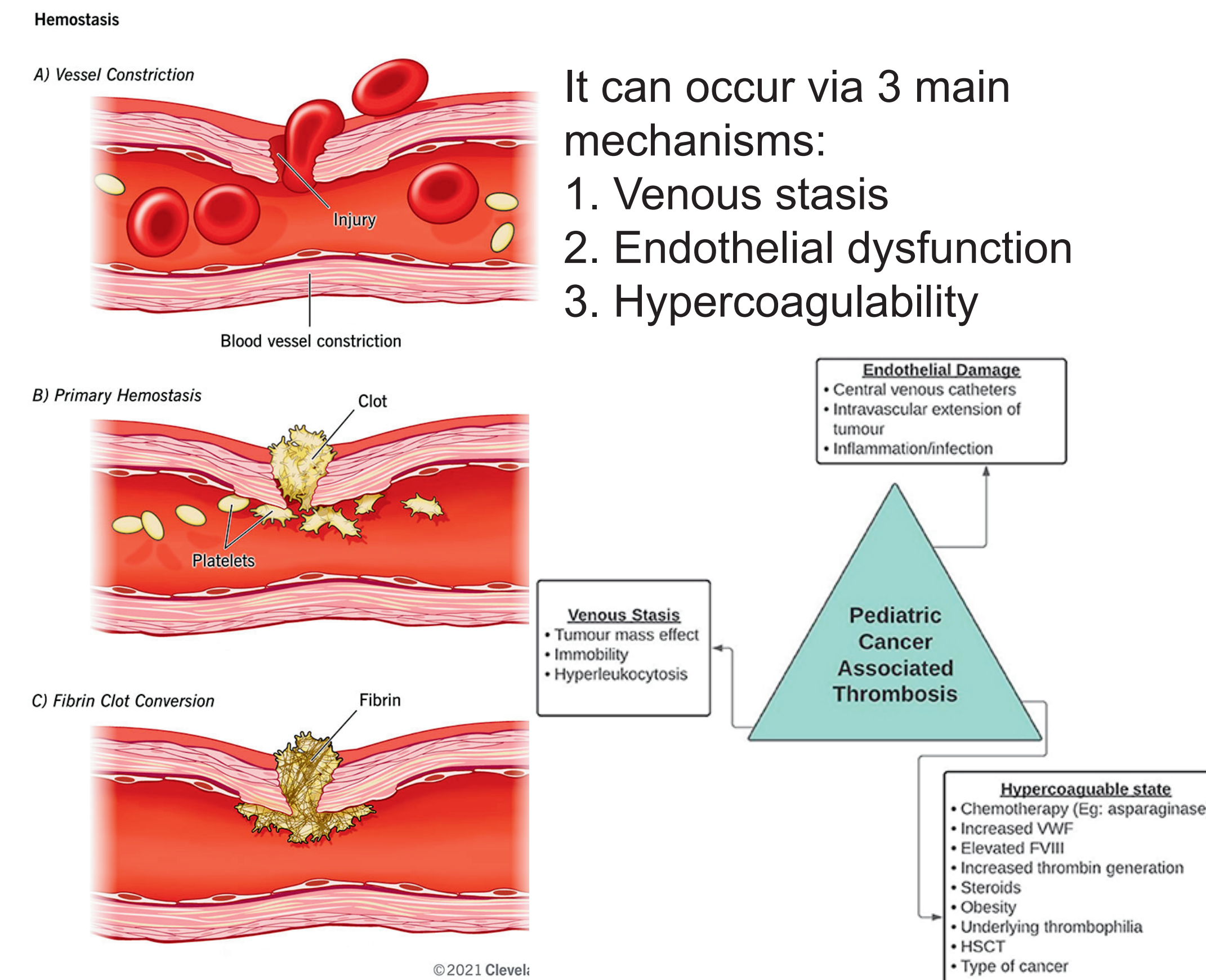
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## ABSTRACT

Thrombosis is a life-threatening complication that can occur in pediatric cancer patients. Cancer treatment, such as chemo- and radiation therapy, increases the risk of thrombosis in pediatric patients with cancer. Early diagnosis and management of thrombosis in these patients is crucial to minimize the associated morbidity and mortality. Pediatric cancer patients are at an increased risk of developing thrombosis due to the cancer and its treatment modalities. The pathophysiology of thrombosis in pediatric cancer patients is multifactorial. Cancer cells release procoagulant factors, which promote clot formation. Cancer treatment modalities, such as chemotherapy and radiation therapy, can damage the endothelium and increase the risk of thrombosis. The diagnosis of thrombosis in pediatric cancer patients can be challenging due to their underlying medical conditions. Imaging studies such as ultrasound, CT scan, and MRI are used to confirm the diagnosis of thrombosis. Blood tests, such as D-dimer levels and coagulation profiles, can also aid in the diagnosis. The management of thrombosis in pediatric cancer patients involves a multidisciplinary approach. Anticoagulation therapy is the primary treatment modality, and its duration is based on the risk of recurrence and bleeding. Interventional procedures such as catheter-directed thrombolysis may be used in select cases.

## MECHANISMS OF THROMBOSIS

Thrombosis is an aberrant activation of coagulation pathways designed to repair vessel injury.



These pathologic mechanisms are often activated by both the cancer itself as well as associated diagnostic interventions and treatments.

## DIAGNOSIS OF VTE IN PEDIATRIC CANCER PATIENTS

- Accurate and timely diagnosis of VTE is crucial in pediatric cancer patients to initiate prompt treatment and prevent potential complications.
- The diagnosis of VTE in this population requires a multimodal approach, involving both clinical assessment, laboratory workup, and diagnostic imaging techniques.

### Clinical Assessment:



- Common presenting symptoms include localized pain, swelling, and erythema in the affected limb.
- Atypical or nonspecific symptoms such as tachycardia, respiratory distress, or altered mental status should also raise clinical suspicion.

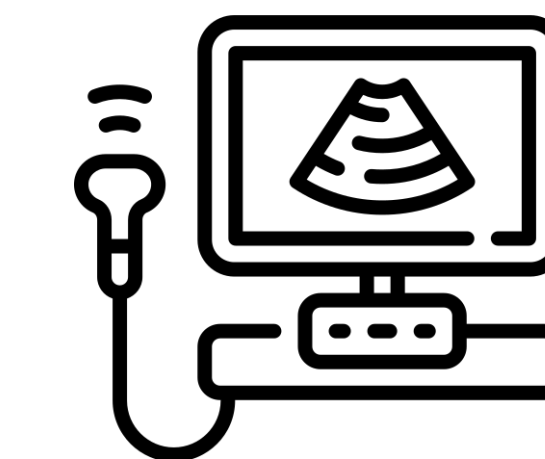
### Laboratory Workup:



- Clinicians should first obtain blood tests including a complete blood count (CBC), a comprehensive metabolic panel (CMP), and coagulation studies (PT and PTT).
- Tests such as a d-Dimer level, which measures presence of ongoing clot formation and lysis and can raise clinical suspicion of VTE, must be performed.

## DIAGNOSIS OF VTE IN PEDIATRIC CANCER PATIENTS

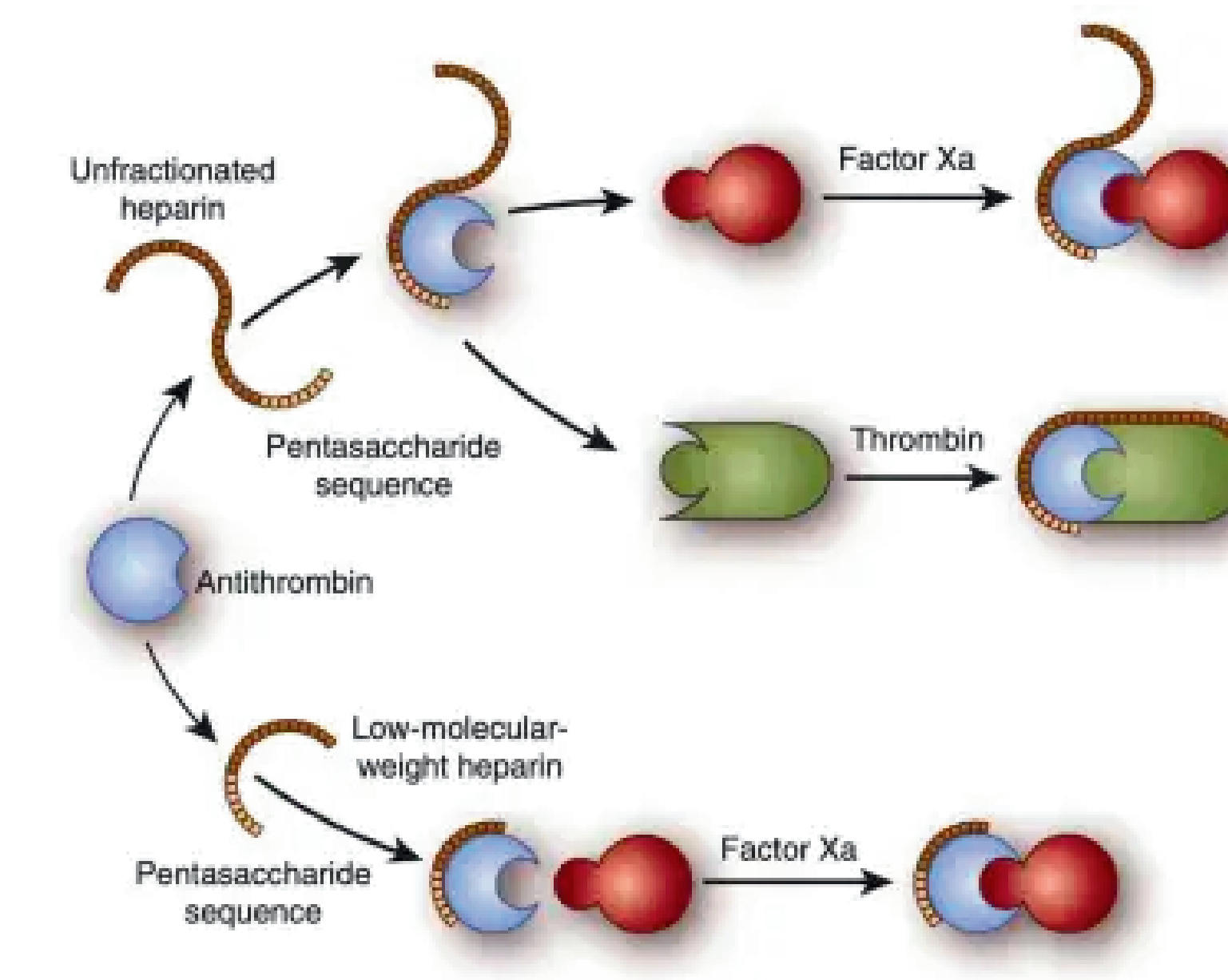
### Diagnostic Imaging:



- Integration of laboratory testing and imaging with clinical assessment facilitates accurate diagnosis and appropriate treatment decisions to optimize patient care.

## MANAGEMENT AND PROPHYLAXIS

- VTE diagnosis requires careful consideration of the pediatric patient's demographic factors, concurrent medical conditions, active treatments, location of thrombus, and family preferences.
- Before administering any therapy, it is also important to assess risk of bleeding and possible allergic reactions.
- Low-molecular-weight heparin (LMWH) is the recommended anticoagulant therapy for these patients due to its ease of administration, predictable response, and reduced risk of heparin-induced thrombocytopenia compared to unfractionated heparin.
- In select cases of severe thrombosis, such as extensive iliofemoral DVT or CVST, thrombolysis or thrombectomy may be considered.
- These interventions are typically reserved for situations where there is a high risk of organ or limb compromise and are performed in specialized centers with expertise in pediatric thrombosis management.



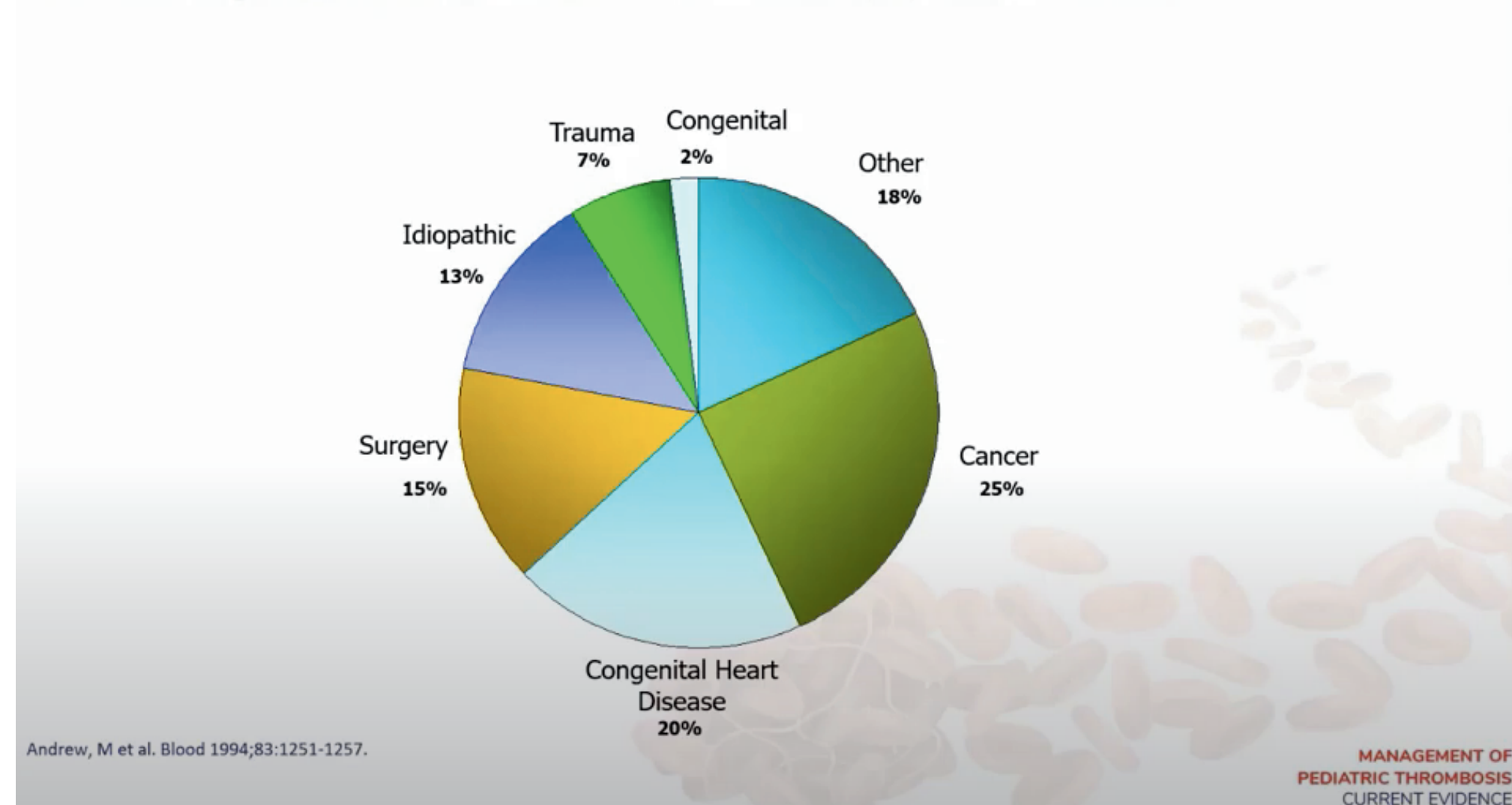
Heparin functions by activating antithrombin-III to bind to serine proteases involved in coagulation, blocking their function (predominantly Factor Xa and Factor IIa a.k.a. thrombin). Low molecular heparin predominantly facilitates inhibition of Xa, whereas unfractionated heparin inhibits Xa and thrombin. This reaction consumes antithrombin-III (which remains permanently stuck to factor Xa and/or thrombin).

## CONCLUSIONS

- Management of VTE in pediatric cancer patients is challenging due to the complex interplay between the underlying cancer, aggressive treatment modalities, and the specific needs of the pediatric population
- The rate of thrombosis in pediatric cancer patients is reported to be between 4-10%, with even higher rates observed in cancers such as leukemia and CNS tumors
- Diagnosis of VTE relies on clinical assessment laboratory studies, and reliable imaging.
- After a diagnosis has been made, timely treatment with anticoagulants such as low molecular weight heparin is necessary to prevent complications such as stroke, pulmonary embolism, and recurrent thrombosis.
- Because of active treatments and poor clinical status of these patients, anticoagulation must be balanced with the risk of severe, life-threatening bleeding.
- Coordinating care amongst various healthcare professionals such as hematologists, oncologists, imaging experts, and supportive healthcare teams is crucial for achieving optimal patient outcomes.

## EPIDEMIOLOGY

### Underlying Conditions in Children with VTE



- While cancer-related thrombosis is well described in the adult population, many areas of uncertainty still remain in understanding the incidence in pediatric patients.
- Estimated rates of a thromboembolic event in pediatric cancer patients have been reported to be between 2.1-16% for symptomatic events, and as high as 40% for asymptomatic events.
- Most common types of cancer in children:
  - Leukemia
  - CNS tumors
  - Lymphomas
- The aggressive nature of these cancers and need for timely intervention increases the risk for adverse events and complications such as venous thromboembolism.

## ACKNOWLEDGEMENTS

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