Complications of Catheter-Related Thrombosis in Children

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None
Thrombosis
- relatively uncommon in children
- incidence is increasing
- At least half of cases attributed to central catheters
  ⇒ most significant risk factor in children
- Rates highest in critically ill and neonates
Sonography

- Major role in diagnosis of thrombosis

Koksoy C. Clin Radiol 1995;50:687
Sonography - arterial thrombosis
- Direct visualization of thrombus
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- Flow dampened distally, with tardus-parvus waveforms
Diagnosis

Sonography - venous thrombosis
- Direct visualization of thrombus

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- Direct visualization of thrombus
- Incompressibility of the vessel
- Absent or decreased flow velocities on Doppler
- Absent or dampened respiratory phasicity or cardiac pulsatility

Sonography - venous thrombosis
- neonates and infants - catheters may occupy much of lumen
⇒ difficult to assess compressibility and Doppler flow

Andrew ME. Hematology Am Soc Hematol Educ Program 2001:358
Venography
- Imaging of SVC, brachiocephalic and subclavian veins
  ⇒ difficult to fully evaluate by sonography

Smitherman AB. Hosp Pediatr 2015;5:59
Diagnosis

Acute versus residual (aka persistent/chronic) thrombosis
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- Acute thrombus may expand lumen

Murphy TP. Radiology 1990;177:543
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*Murphy TP. Radiology 1990;177:543*
Acute versus residual (aka persistent/chronic) thrombosis
- Thrombus echogenicity
  -> not reliable to discriminate
Complications - central venous catheters

Recurrence of thrombosis

- Up to 19% of patients

Thromboembolism
- Leading cause of excess mortality in adults
- Diagnosed less in children, but incidence is increasing
  ⇒ increase in use of central venous catheters
- CVC - greatest risk factor for PE in children

Faustino EV. Crit Care Med 2011;39:1511 / Thacker PG. AJR 2015;204:1278
Complications - central venous catheters

Thromboembolism
- Seen in up to 15% of peds catheter-related thrombosis
- Segmental pulmonary arteries most often affected
- Central and main arteries in minority of cases

Thacker PG. AJR 2015;204:1278
Complications - central venous catheters

- Thromboembolism - computed tomography angiography
  - modality of choice for evaluation of PE in children

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Thromboembolism - computed tomography angiography
- Acute pulmonary embolus
  - centrally within lumen

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  - centrally within lumen
  - acute margins with vessel wall
  - vessel may be focally dilated

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Thromboembolism - computed tomography angiography
- Acute pulmonary embolus
  - centrally within lumen
  - acute margins with vessel wall
  - vessel may be focally dilated
  - interventricular septum flattening / RV enlargement

Thacker PG. AJR 2015;204:1278
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Thromboembolism - computed tomography angiography

- Chronic pulmonary embolus
  - peripherally within lumen
  - obtuse margins with vessel wall
  - wall may appear focally thickened
  - vessel may be smaller

Thacker PG. AJR 2015;204:1278
Complications - central venous catheters

Thromboembolism - computed tomography angiography
- Chronic pulmonary embolus
  - web or band within lumen

Follow-up

Thacker PG. AJR 2015;204:1278
Complications - central venous catheters

Post-thrombotic syndrome
- chronic venous stasis on a limb following DVT
  - persistent venous occlusion or
  - valvular damage and reflux
- Frequency:
  - up to 25% of patients following DVT
  - more than 50% of patients after venous cardiac cath

Post-thrombotic syndrome
- Clinical manifestations usually mild:
  - limb edema
  - dilated superficial collateral veins
  - chronic limb pain

Complications - central venous catheters

Post-thrombotic syndrome - sonography
- Often normal, even in symptomatic patients

Complications - central venous catheters

Post-thrombotic syndrome - sonography
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Complications - central venous catheters

Post-thrombotic syndrome - sonography
- Residual thrombosis -> wall thickening, luminal narrowing
- Dilated collaterals
- Valvular incompetence: venous reflux > 0.5 seconds

Complications - umbilical venous catheters

Unique spectrum of complications
⇒ catheter course through liver
Portal thrombosis seems common
Most trombi resolve spontaneously
Acute complications are uncommon
⇒ compensatory hepatic arterial flow
Complications - umbilical venous catheters

Left lobe atrophy

Most common long-term complication

⇒ in up to 22% of patients w UVC

- Usually of no clinical significance
Left lobe atrophy

Most common long-term complication

⇒ in up to 22% of patients w UVC

- Usually of no clinical significance
- Relative decrease in size
- Decreased or absent venous flow on Doppler
Complications - umbilical venous catheters

Portal hypertension
- thrombus propagation from left into main portal vein
- Sonographic features:
Complications - umbilical venous catheters

Portal hypertension
- thrombus propagation from left into main portal vein
- Sonographic features:
  - Absent respiratory variations
  - Pulsatile waveforms

Portal hypertension
- thrombus propagation from left into main portal vein
- Sonographic features:
  - Absent respiratory variations
  - Pulsatile waveforms
  - Reversal of flow direction
Complications - umbilical venous catheters

Portal hypertension - sonographic features (cont.)
- Portal replacement by collaterals (cavernous transformation)
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- Portal replacement by collaterals (cavernous transformation)
- Porto-systemic collaterals
Complications - umbilical venous catheters

Portal hypertension - sonographic features (cont.)
- Portal replacement by collaterals (cavernous transformation)
- Porto-systemic collaterals
- Splenomegaly
Complications – umbilical arterial catheters

Most UAC-related thromboses asymptomatic and uncomplicated

Complications - umbilical arterial catheters

Most UAC-related thromboses asymptomatic and uncomplicated

Complications - severe morbidity and mortality
- embolism or direct extension into major branches
  ⇒ hypertension, renal impairment, NEC, limb ischemia

Most UAC-related thromboses asymptomatic and uncomplicated

Complications - severe morbidity and mortality
- embolism or direct extension into major branches
  ⇒ hypertension, renal impairment, NEC, limb ischemia
- Diagnosis - direct thrombus visualization by sonography

Summary

• Thrombosis is uncommon in children, but complications can potentially be devastating
• At least 50% are attributed to central catheters
• Rates are highest in critically ill and in neonates
Summary

- Acute complications due to local obstruction or embolism
- Chronic complications include post-thrombotic syndrome and isolated venous occlusion; often mild.
Summary

- UVC-related thrombosis involve portal system
- Acute complications rare
- Long-term complications:
  - Left hepatic lobe atrophy
  - Portal hypertension
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