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Pediatric Imaging & Updates FOMA 2026

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Objectives

- New technology & techniques in pediatrics
 - Photon Counting Detector CT
 - AI & MRI
- Progress in new pathway for imaging volvulus
 - Types & natural course
 - When to image
 - Which modality-US, MR, CT
 - Alarming hemangiomas



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State of the art Imaging



Alpha Naetom Photon Counting CT (Siemens)

- Reductions of 40% or more in radiation dose
- Improved resolution
- Fast scans
- Reduce metal artifact



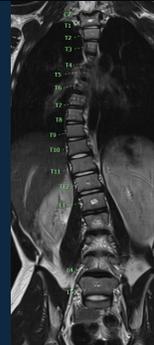
MRI Upgraded

Siemens Deep Resolve Boost:

- imaging time decreased by 1/3 time or more
- AI applied to image reconstruction
- Improves image resolution
- Combined with other techniques can result in scan times >70% boost in speed

3

AI & MRI DEEP RESOLVE TOTAL SPINE in practice:




HUGE TIME SAVINGS

DECREASE SEDATION TIME & MOTION

TOTAL SCAN TIME: 50MIN CUT IN 1/2 FROM 1.5HRs
 AXIALS: 1/3 time to acquire. 15MIN TO 5 MIN.

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Deep Resolve: MRI Brain w/o 25min vs 45 min



Non contrast MR Brain 16 min vs 30 min

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NAETOM ALPHA PHOTON COUNTING DETECTOR CT (PCD CT)

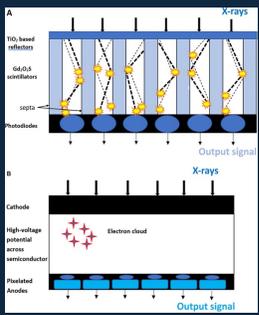


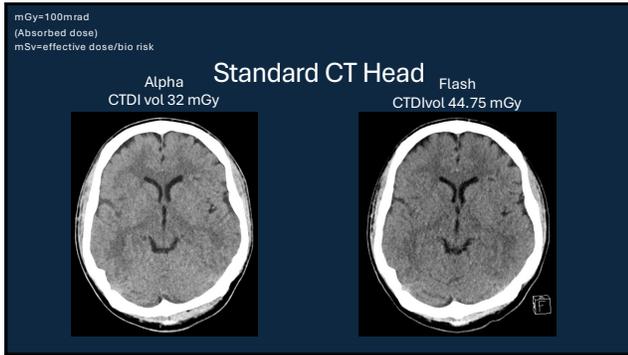
Figure 1:

(A) Schematic of an energy-integrating detector (EID). A scintillator is used to produce visible light when an x-ray photon strikes it; this light is then converted to electrical signal by a photodiode. Reflective strips are positioned between detector elements to minimize the spread of light to adjacent detector elements. Cs₂O, S = gadolinium oxysulfide, TiO₂ = titanium dioxide.

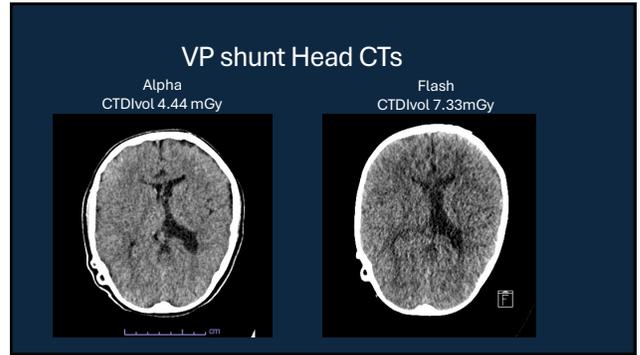
(B) Schematic of a photon-counting detector (PCD). PCD CT directly generates charge pairs (electrons and holes) using a semiconductor, with the charges traveling across a potential difference to induce an electrical signal at the pixelated anodes.

Novati KB. Published Online: May 21, 2024
<https://doi.org/10.1155/2024/2517241>

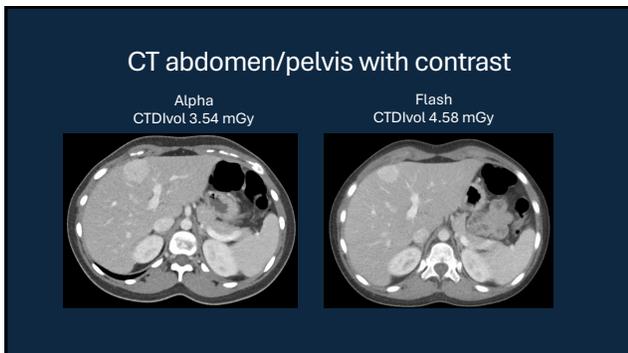
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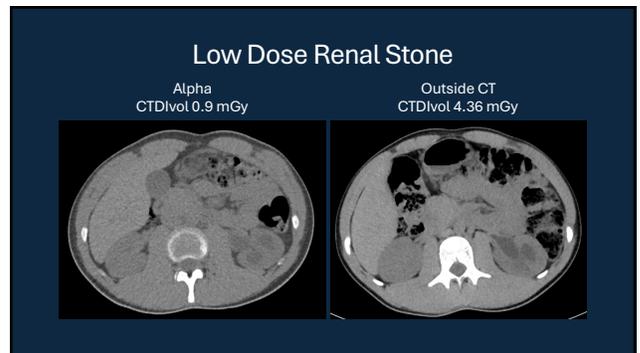
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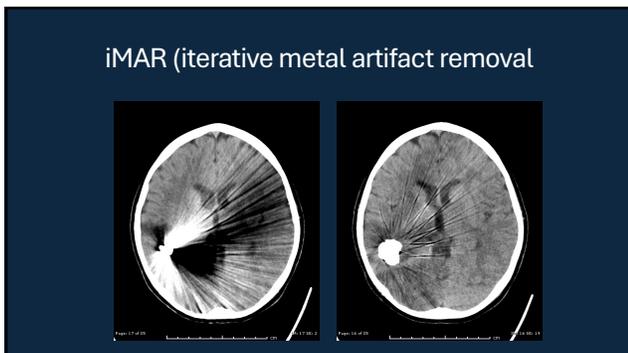
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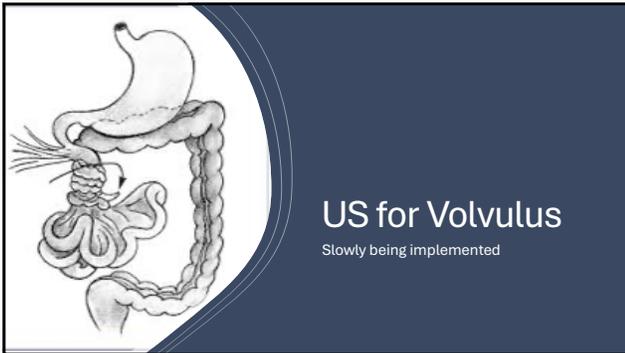
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US for Volvulus

Slowly being implemented

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Transition to US as 1st line

- Well studied UGI sensitivity for volvulus ranges 54-89% (Midgut malrotation 93-100%)
- US higher sensitivity & similar specificity for Midgut volvulus:
 - Sensitivity: 83-96%
 - Specificity: 89-100%
- Benefits to adopt US as first line imaging
 - Improved sensitivity
 - Portability (can evaluate at outpatient center)
 - No oral contrast (important in vomiting child)
 - No radiation
 - Accessibility, US more available in middle of night than fluoro. Important at outpatient sites.
 - Avoid delays in diagnosis while awaiting fluoro study.
 - may take an hour-2hrs to perform UGI including transfer patient, calling in rad, procedure prep.
 - If US positive, patient could go straight to surgery.
 - Ensure no delays to performing UGI by creating dual order set online US and UGI.

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12 day M old pyloric US with vomiting: Midgut volvulus

Reversal of sma/smv relationship
D3 intraperitoneal course
hypoplastic pancreatic uncinate process

Long Pylorus AREA

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US: Advantages & Disadvantages

follow up UGI shows obstruction. Real time images showed to & fro motion in duodenum with reflux back into stomach

- Advantages**
 - Portable
 - No rad needed on site
 - High sensitivity & specificity
 - Low cost
- Disadvantages**
 - Tech dependent
 - Bowel gas artifact

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Infant for evaluation intussusception: Volvulus & Swirl Sign

- Twisting of the mesentery
- Clockwise swirl of SMV around bowel loops & SMA
- Surgery consulted immediately & care expedited

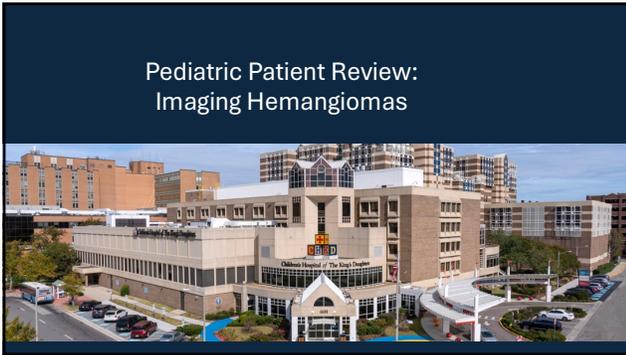
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UGI: advantages and disadvantages

SAME PATIENT:
Follow up UGI confirms volvulus
Straight to OR surgery already set

- Advantage**
 - Familiar
 - Can convert to enema or SBS if equivocal
- Disadvantage**
 - Not portable
 - Requires radiologist on site
 - Operator dependent
 - False + if obstructed or redundant duodenum, low DJJ
 - Spiraling bowel of malrotation may be misinterpreted for volvulus

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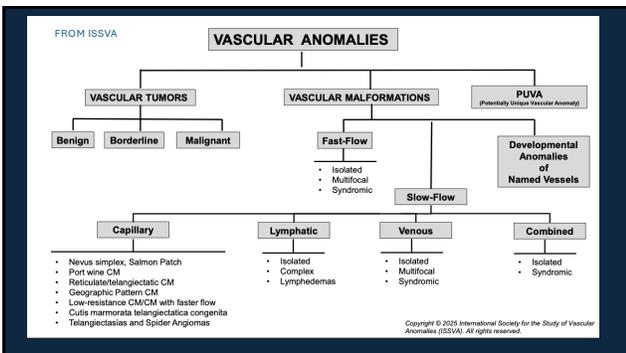
Pediatric Patient Review:
Imaging Hemangiomas

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International Society For The Study Of Vascular Malformations' Classification Of Vascular Anomalies^{1,2}

<p>VASCULAR TUMORS</p> <p>Benign:</p> <ul style="list-style-type: none"> • Infantile hemangioma (IH) • Congenital hemangioma: <ul style="list-style-type: none"> • Rapidly involuting congenital hemangioma (RICH) • Non-involuting congenital hemangioma (NICH) • Tufted angioma • Cherry angioma • Pyogenic granuloma • Spindle cell hemangioma <p>Borderline:</p> <ul style="list-style-type: none"> • Kaposiform hemangioendothelioma <p>Malignant:</p> <ul style="list-style-type: none"> • Angiosarcoma • Epitheloid hemangioendothelioma 	<p>VASCULAR MALFORMATIONS</p> <ul style="list-style-type: none"> • Slow Flow <ul style="list-style-type: none"> ▪ Venous ▪ Lymphatic ▪ Capillary • High Flow/complex <ul style="list-style-type: none"> ▪ Arteriovenous fistula ▪ Arteriovenous malformation ▪ Any other combination <p>SYNDROMES ASSOCIATED W VENOUS MALFORMATIONS (NOT WITH HEMANGIOMAS)</p> <ul style="list-style-type: none"> • Klippel Trenaunay • Proteus • Maffucci's • Gorham-Stout • Blue-rubber bleb nevus • Bockenheimer's
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Hemangiomas: types and clinical course

<p>INFANTILE HEMANGIOMA (IH):</p> <ul style="list-style-type: none"> • Very common • Develop a few weeks after birth. • 30% have precursor lesions at birth. • GLUT 1 positive • Proliferative phase after birth then involute, regress & fibrose • Scar always present after involution 	<p>CONGENITAL HEMANGIOMAS:</p> <ul style="list-style-type: none"> • Rare • Fully developed at birth. • RICH: Rapidly involuting congenital hemangiomas (resolves by 1yr) • NICH: Non involuting congenital hemangiomas • Can have calcification
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GLUT-1:
-Glucose transporter
-Associated placental vessels
-gene expression resembles endothelial cells lining fetal micro vessels in placenta

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Clinical Appearance:

Congenital Hemangioma:

- Soft tissue masses
- purplish with telangiectasias and pale halo.
- Head, face or close to a joint

Infantile Hemangiomas: Segmental & Focal

Segmental: Plaque like, geographic, more extensive

Focal: tumor like & raised, reddish masses

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Hemangioma Treatment : Propranolol hydrochloride

- Antihypertensive drug serendipitously noted to control hemangioma's growth
- FDA approved Hemangeol
- 0.5 mg/kg up to 2 - 3 mg/kg per day
- Therapeutic effect may be rapid with changes noted only after a few hours
- Patients monitored the first 24 hours for cardiorespiratory side effects or hypoglycemia

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Diagnostic imaging: When Should you Image?

- Atypical: deep lesion start with US. Eg. Parotid or breast
- **Alarming Hemangiomas: Get an MRI!**
 - >5cm or Multifocal cutaneous hemangiomatosis(>5-6)
 - High risk visceral disease
 - Orbital
 - Beard distribution
 - Hepatic
 - Fascial (especially the nose or ear)
 - Genitals/perineal
 - Midline hemangiomas
 - Spinal hemangiomas
- CT is rarely used unless airway involvement suspected
- IF imaging &/or clinical is atypical then get a biopsy!



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Infantile Hemangioma: Typical clinical presentation

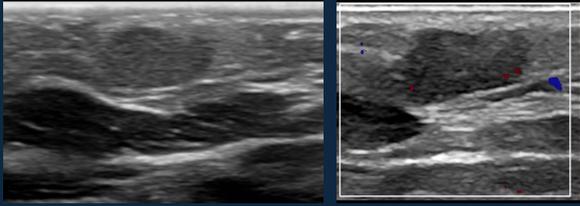
NOTE-not involving the nipple or areola



early precursor lesion <1mo. old Proliferative phase at 4mo.

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US: Precursor. Mass has not declared itself

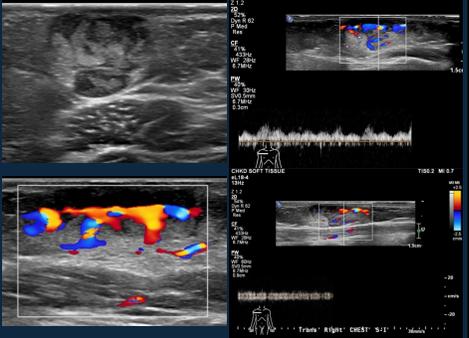


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US: 4mo Follow up

Typical appearance:

- High flow vessels w/low resistance waveforms
- venous drainage
- NO arteriovenous shunting (arterialization of venous flow)



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PHACE SYNDROME & INFANTILE HEMANGIOMA (IH):



Segmental IH of the head/scalp/ear larger than 5 cm in diameter, post fossa abnormality, & sternal defect (2 major criteria)

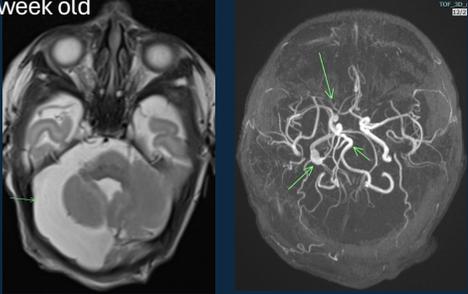
Brain US performed at outside hospital showed enlarged posterior fossa

PHACE syndrome:

- Posterior fossa brain malformations,
- Hemangiomas, IH: fascial segmental (>5cm) & neck
- Arterial cerebrovascular anomalies
- Cardiovascular anomalies,
- Eye anomalies and sternal defects or supraumbilical raphe

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MRI: 1 week old

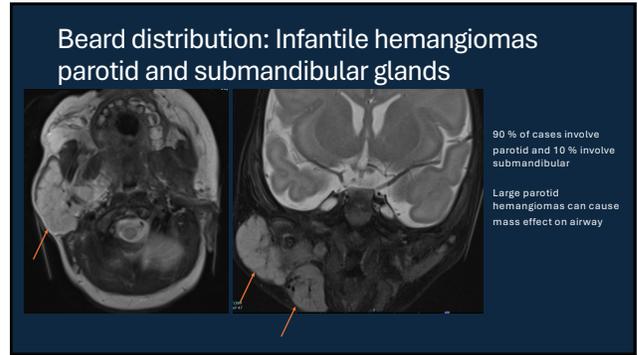


Right Cerebellar hypoplasia Multiple anomalous cerebral arteries at COW & Basilar

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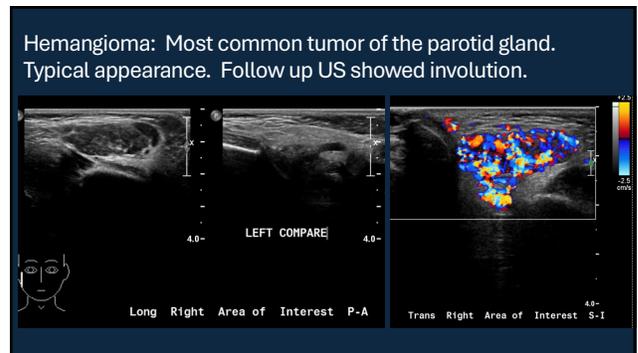
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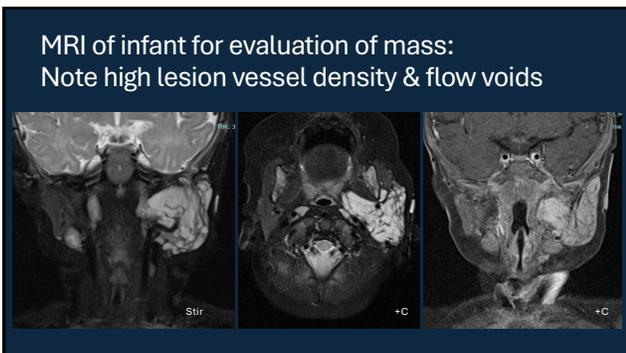
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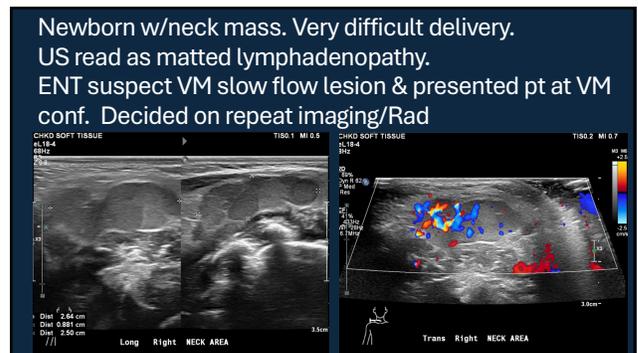
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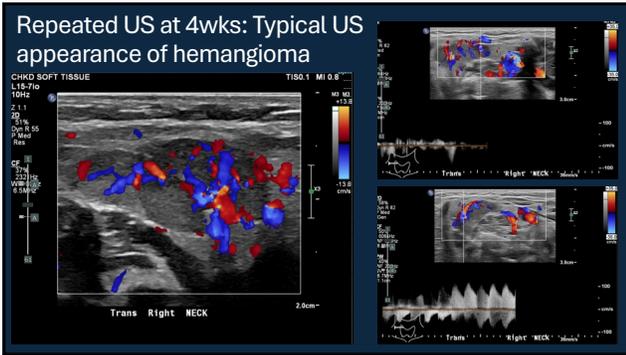
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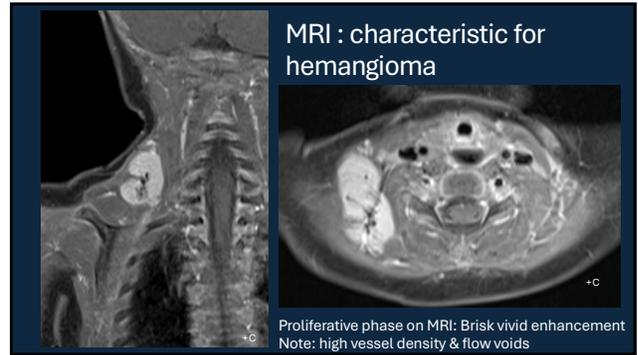
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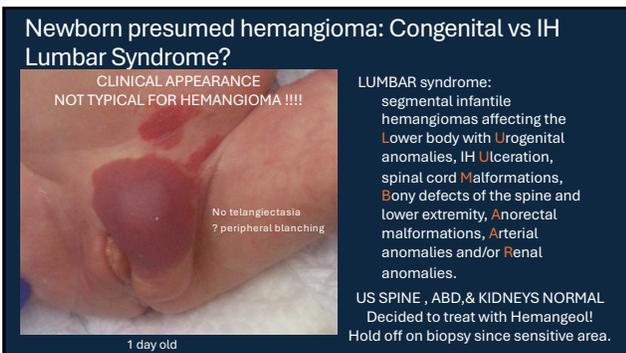
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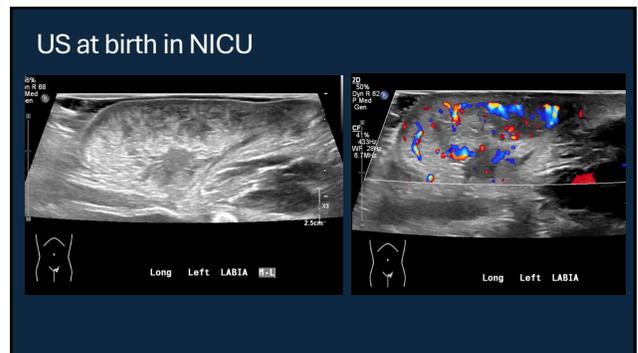
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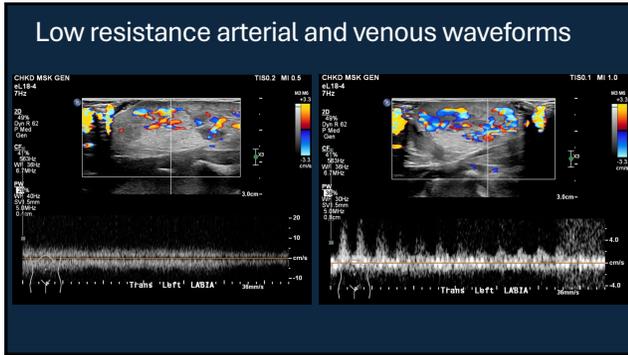
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Lesion rapidly growing in 3 wks No response to hemangeol: Tufted Hemangioma

- Biopsy: Tufted Hemangioma --neg glut 1, neg D2-40 (lymphatic marker)
- Tx: Sirolimus and steroids if needed
- This patient did not need further treatment just watching no changes in coagulation.
- Unable to perform complete resection.
- Tufted Hemangioendothelioma
 - Less aggressive mild form of KHE

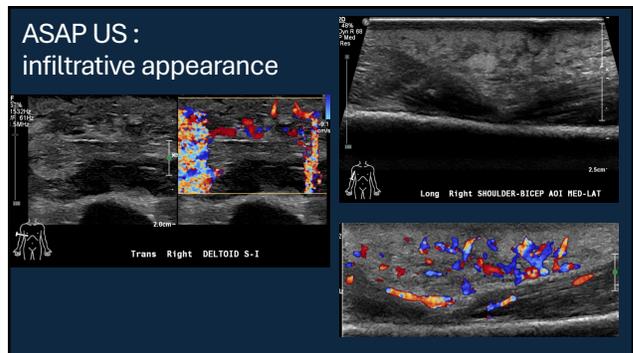
3 weeks old on propranol tx

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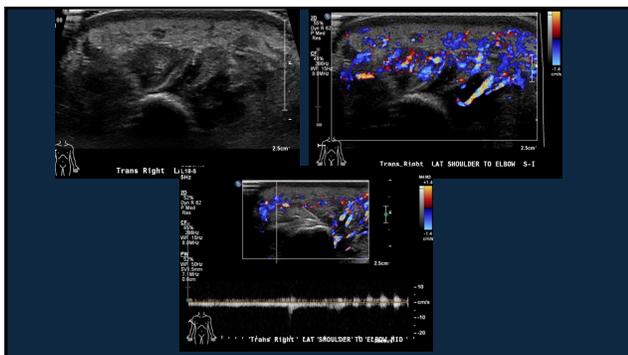
6 wk old with lesion increasing in size since birth

- Features of vascular birthmark but not classic hemangioma or a venous malformation.
- Significant hypertrophy of portion of her arm
- firmness and ill margined border

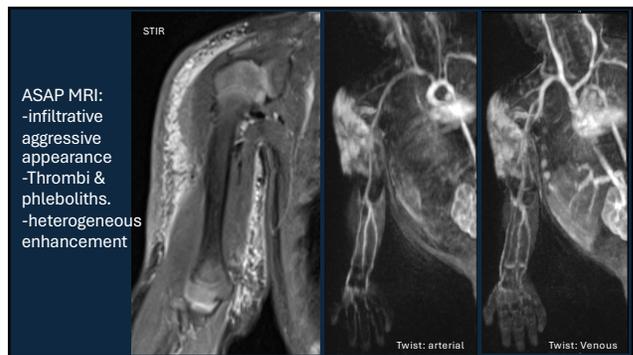
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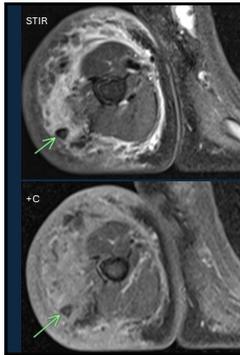
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BIOSPY: Kaposiform hemangioendothelioma (KHE)

- Spindled cell/ vascular lesion with extension into deep subcutaneous tissue and adipose tissue
- gene sequencing were negative
- fairly aggressive lesions, borderline malignant
- can result in severe thrombocytopenia, consumptive coagulopathy (Kasabach-Merritt phenomenon)

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Follow up 2 years later treated with sirolimus



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Follow up MRI: significant contraction



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Newborn: Multiple Hemangiomas

High risk for visceral disease



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Newborn: cardiomegaly & patent foramen ovale
US abdomen for elevated bilirubin

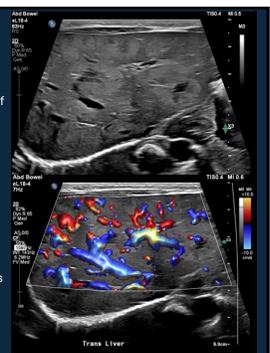


Polyhydramnios, maternal HTN, mild thrombocytopenia which resolved

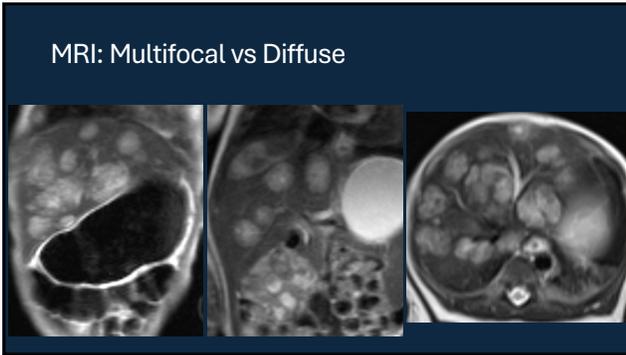
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Hepatic Hemangiomas:

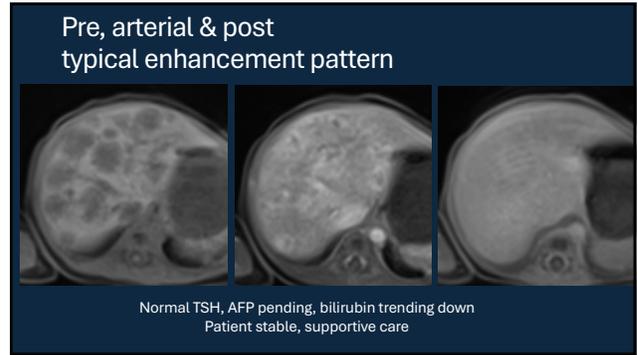
- Focal
 - Thrombocytopenia suspect Kaposiform hemangioendothelioma (KHE)
 - Shunting can cause CHF (may need embolization if high flow shunt)
 - Present at birth
 - Usually GLUT1 neg. RICH type.
 - Large non-enhancing central area
 - Peripheral solid enhancing component
 - May have Ca2++
- Multifocal
 - GLUT 1 +, IH type
 - Centripetal enhancement
- Diffuse
 - Produce type 3 iodothyronine deiodinase, degrades thyroid hormone and causes hypothyroidism
 - GLUT 1 +
 - Massive cardiomegaly can cause compartment syndrome



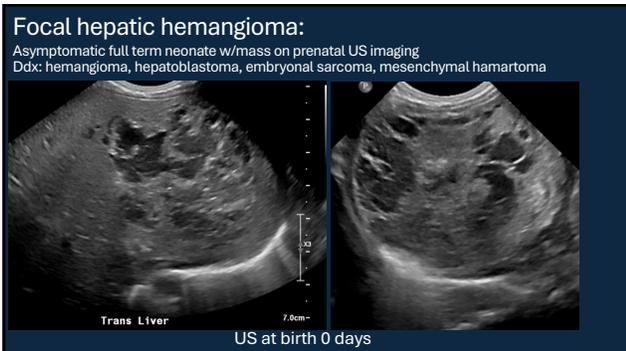
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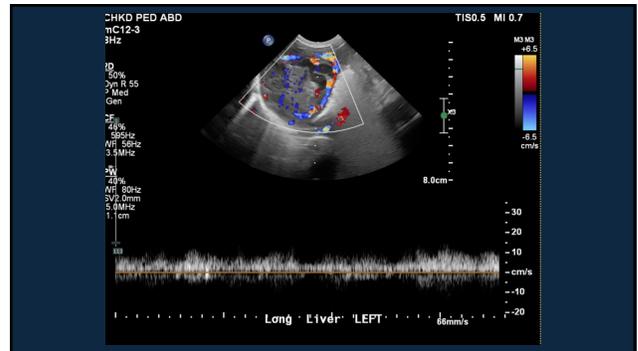
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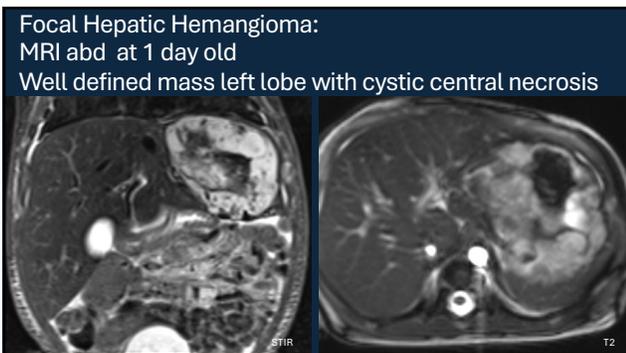
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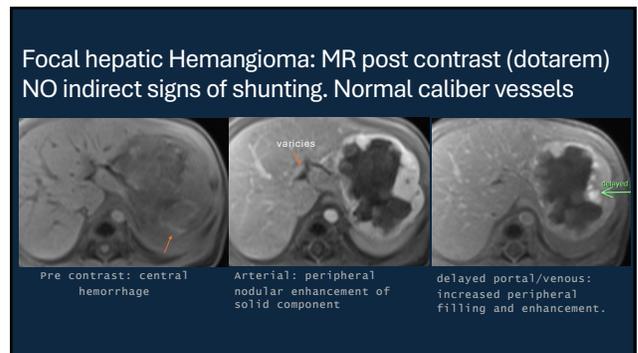
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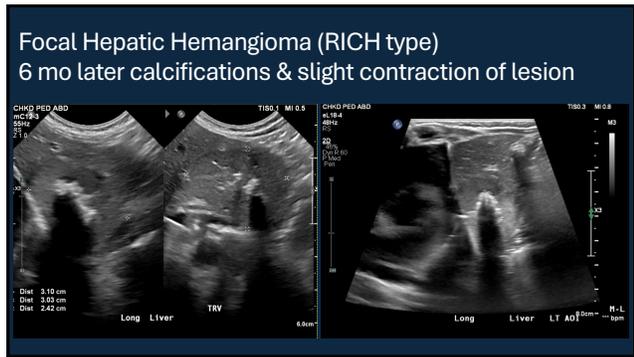
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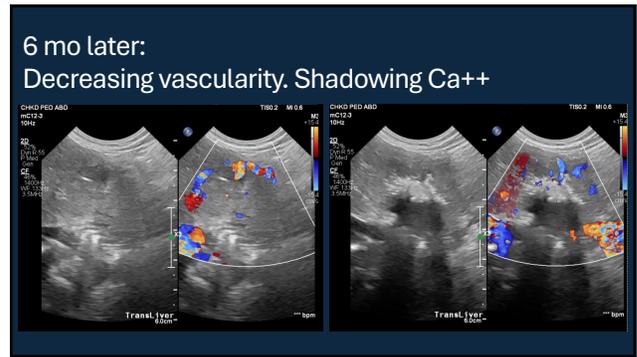
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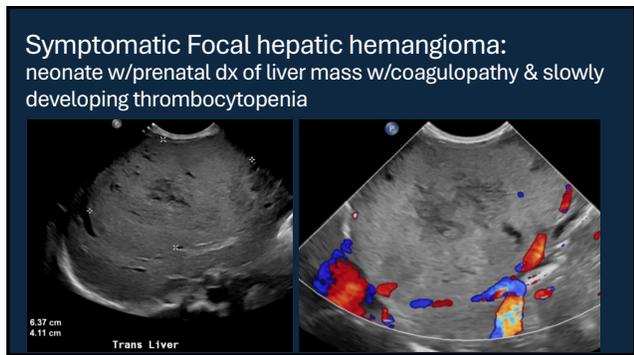
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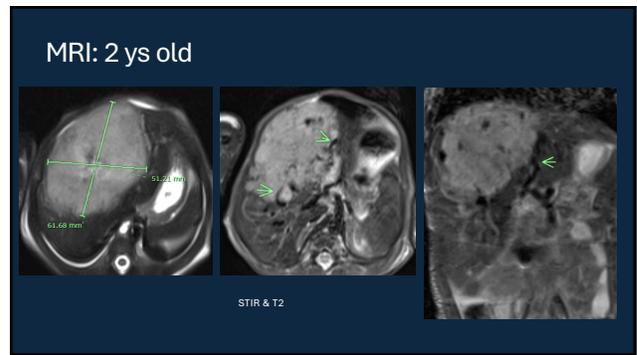
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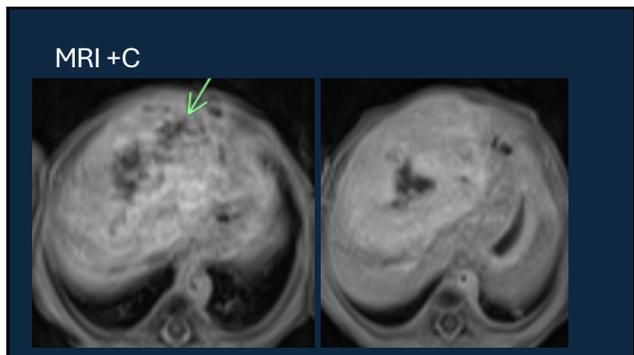
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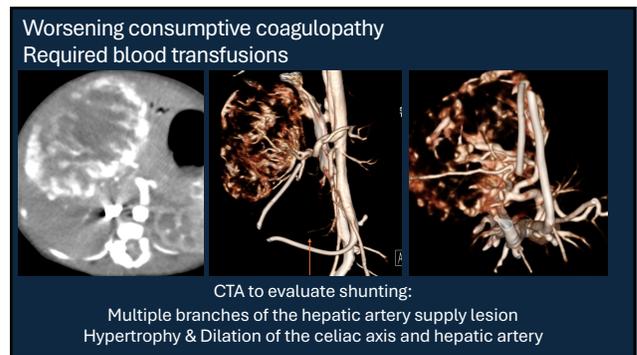
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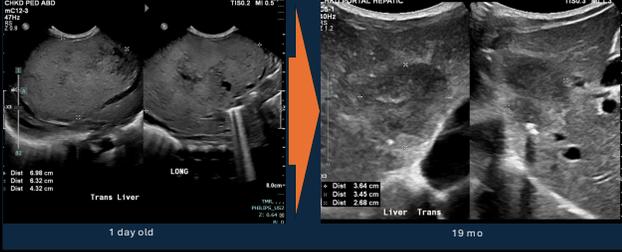


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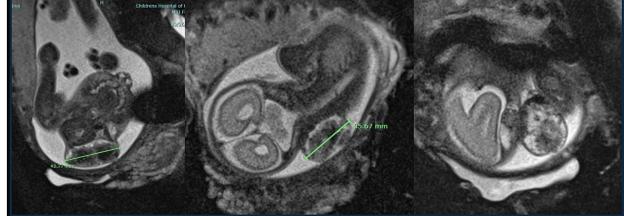
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Embolize? Called Boston Children's for quick consult.
No embolization. Stabilized pt and treated coagulopathy
Now involuting at 19 mo.



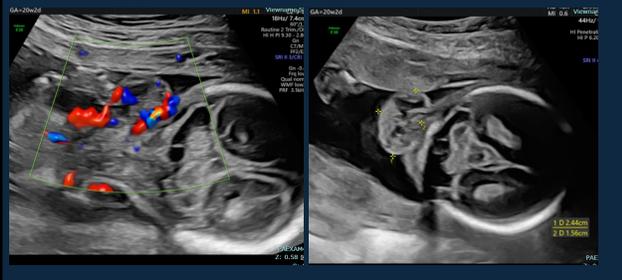
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Congenital hemangioma of neck:
Prenatal MRI to determine exit procedure



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Prenatal US



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At birth: violaceous pulsatile mass with pale halo & central dimple



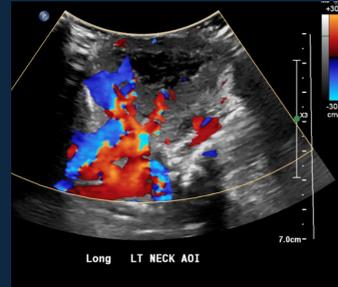
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US at Birth: central necrosis

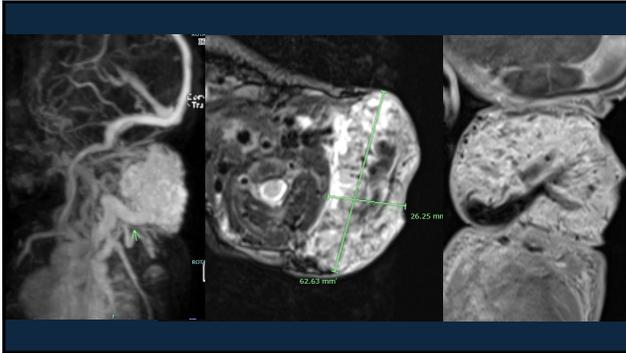


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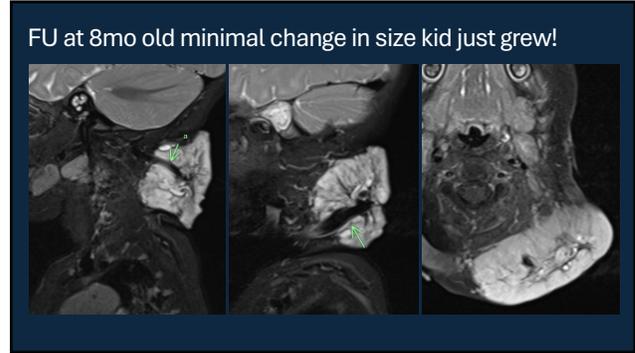
Large feeding vessels –get MRI



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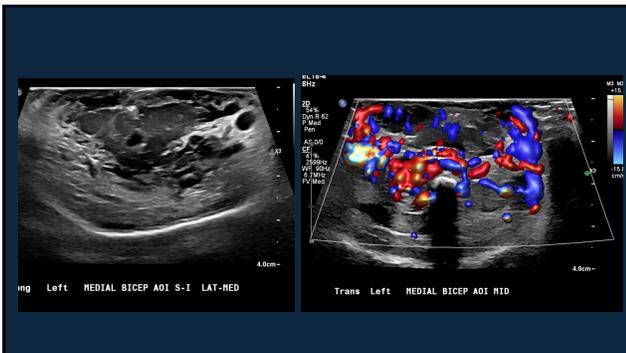
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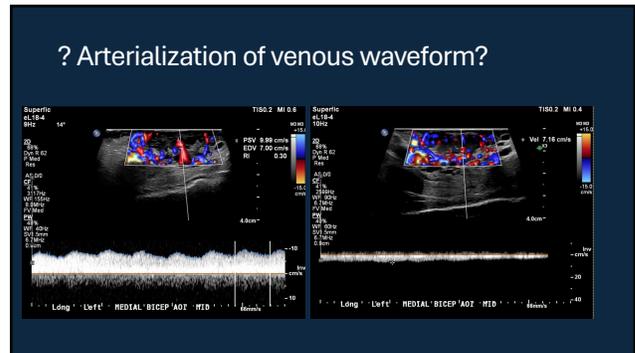
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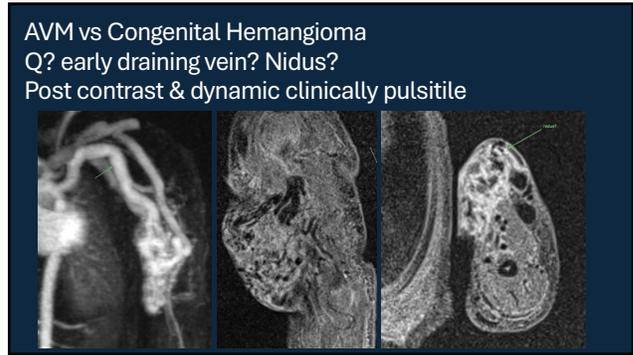
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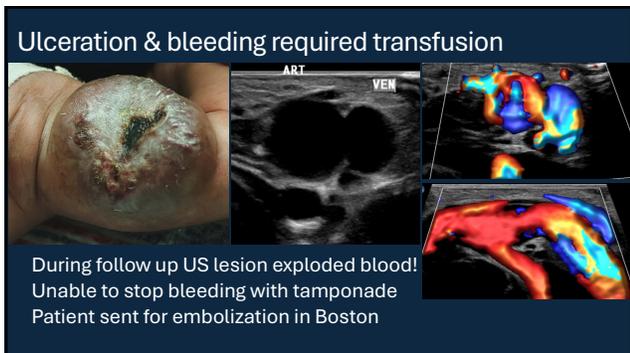
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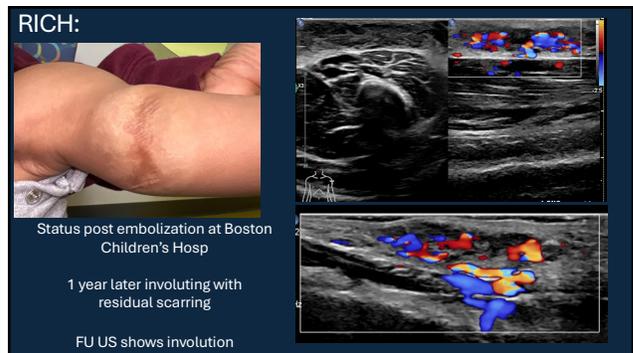
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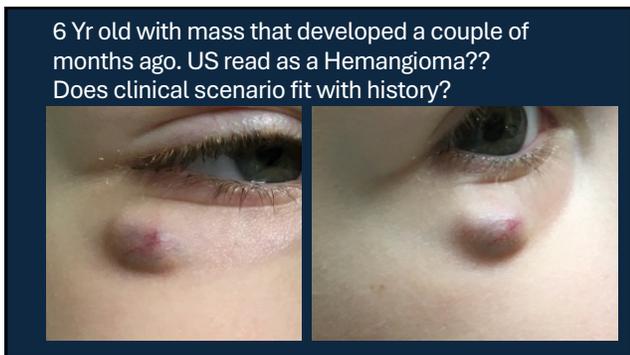
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Key Points: When to Image Hemangiomas

- Alarming Hemangioma?
 - >5cm, ear, nose, orbit, beard, PHACES, LUMBAR, midline, airway
 - Get US, MRI &/or CT
- Deep lesion or Atypical Presentation get US first
- Atypical US characteristics consider biopsy or MRI
- Classical history and presentation no need for imaging



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Thank you! See you next year!



Resources:
 VA: Hemangiomas and Vascular Birthmarks program at CHKD
 Phone: (757) 688-3884
 Wendy Barnes Nurse Coordinator: wendy.barnes@chkd.org

Local: The International Birthmark Institute (TIBI) at
 Nicklaus Children's Hospital.
 Dr. Ana Duarte (Pediatric Dermatologist) 305.669.6555
 Dr. Ricardo Restrepo (Pediatric Interventional Radiology)

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