Contrast Enhanced Ultrasound in Pediatric Oncology

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Disclosures

• I receive product support from GE Healthcare and royalties from Elsevier and Springer
Objectives

• Discuss current clinical applications of CEUS in a pediatric oncology practice
• Discuss potential role of CEUS in assessing tumor response to therapy
Indications for CEUS at St. Jude

- Tumor vs. post-op change
- Malignant effusion
- Assessing blood flow in the liver
- Focal liver lesions
Adrenal Tumor vs. Hemorrhage

Pre-operative

Post-operative

Hematoma
Follow-up
16 yo Boy with Metastatic Osteosarcoma

Grey-Scale
Contrast Instilled Through Chest Tube
After TPA and Drainage of 750 mL
9 yo Girl Two Weeks After Bone Marrow Transplant for Relapsed AML

August 4th

August 6th
Complicating Issues

• Portal vein thrombus would require intravascular TPA
  – Bleeding risk (thrombocytopenia, coagulopathy)
• Need to confirm thrombus
  – Renal insufficiency
    • Computed tomography angiography contraindicated
    • Patient in ICU not a good candidate for MRA
• Ideal candidate for contrast enhanced ultrasound
Focal Liver Lesions (FLL)

• Commonly encountered “incidentalomas”
  – 7.2% – 33% on computed tomography
  – 10.2% – 34.5% on MRI
  – 2.3% – 6.2% on screening ultrasound
  – 20% – 50% (benign lesions) on autopsy

• Probability FLL is benign
  – Healthy person: > 95%
  – History of malignancy/chronic liver disease: 65% if lesion < 1.5 cm
• Follow-up imaging 273 solid tumor patients
  – 17% (46/273) developed new liver lesion
    • 30% (14/46) focal nodular hyperplasia
      – 86% (12/44) had multiple lesions
    • 15% (7/46) metastases
      – 57% (4/7) had multiple lesions
    • 54% (24/46) had other lesions

Smith et al. AJR (2012); 199:186-191
Management of FLLs in Pediatric Oncology

• Leads to further investigations
  – Detailed medical history
  – Review of prior imaging
  – Size, number, morphology of FLLs
• Often requires additional imaging
• Adds cost, time, anxiety
• Work-up should be:
  – Prompt
  – Effective
  – Non-invasive
  – Preferably avoids radiation and sedation

CEUS of Focal Liver Lesions

Figure 5. Algorithm used to diagnose a liver mass.

CEUS of Focal Liver Lesions

Figure 5. Algorithm used to diagnose a liver mass.
Phases of Enhancement

• Arterial: 10-35 seconds
• Portal venous: 30-120 seconds
• Late phase 2-5 minutes (intermittent scanning)
13 yo Boy, Treated for Stage 4 Neuroblastoma. FLL Found on Imaging Obtained for Bowel Obstruction
Arterial Phase
Hyper-Enhancing

Centrifugal enhancement
Portal Venous Phase
Hyper-Enhancing

“Lightbulb” appearance

Portal vein

Delayed Phase
Iso-Enhancing

Delayed Phase Iso-Enhancing Focal Nodular Hyperplasia

7 yo Girl Treated for Neuroblastoma at Age 13 Months.
FLL Found on CT for Abdominal Pain
Arterial Phase
Iso-Enhancing
Portal Venous Phase
Iso-Enhancing
Delayed Phase
Iso-Enhancing
Delayed Phase
Iso-Enhancing

Regenerative Nodule
25 yo Woman Treated for AML at Age 16 Years

Visible on Grey Scale

TRANS LIVER

Arterial Phase
Hyper-Enhancing

Early arterial

Late arterial
Portal-Venous Phase
Iso-enhancing
Delayed Phase
Iso-Enhancing
Delayed Phase
Iso-Enhancing

Adenomatosis
3 mo with Liver Mass Found on US for Pyloric Stenosis
Arterial Phase
Peripheral Hyper-Enhancement
Portal Venous Phase
Central Filling/Iso-Enhancing
Delayed Phase
Central Filling/Hyper-Enhancing

Infantile Hemangioma
12 yo Girl
Newly Diagnosed Wilms Tumor

Gray-Scale

Early Arterial Phase
Iso-Enhancing
Late-Arterial Phase
Washout
Portal-Venous Phase
Washout
Delayed Phase
Washout

Metastasis
16 yo Boy with Liver Mass
Arterial Phase
Hyper-Enhancing
Portal Venous Phase
Washout
Delayed Phase Washout

Fibrolamellar Hepatocellular Carcinoma
Work-up of FLLs at St. Jude

• Most found incidentally on CT or MRI
• Recommend CEUS
  – Usually done the same day or next day
  – Provides immediate feedback
  – Avoids additional imaging procedures/early follow-up imaging
• When CEUS equivocal, MRI is suggested
Future Directions
Assessing Tumor Response to Therapy
21 mo Girl
Recurrent Rhabdoid Tumor
Peak Enhancement (dB)  
Non-Responder  

Baseline  
33.5 dB  

Day 7  
30.6 dB  

8.7% Reduction  

Time to Progression = 22 days  

16 yo Girl
Synovial Sarcoma
Peak Enhancement
Responder

Time to Progression = 242 days

Baseline
28.9 dB

Day 7
2.0 dB

93% Reduction

Conclusions

• CEUS is uniquely suited for pediatric imaging

• Clinical indications in pediatric oncology
  – Distinguishing tumor from abscess, hematoma, other benign process
  – Assessing fluid collections
  – To guide biopsy
  – Characterizing focal liver lesions
    • Recommend MRI for equivocal findings

• May provide an early method of assessing tumor response to therapy
Thank-you!
On CEUS the most important feature to distinguish a benign from malignant liver lesion is?

- A. Early arterial flow
- B. The size of the lesion
- C. The location within the liver
- D. Whether or not the lesion washes out on delayed phase imaging

References:
1. Chiorean L et al., World J Gastroenterol (2015);21(28):8541-8561
2. Jang et al., Clinical and Molecular Hepatology (2013);19:1-16
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