MRI OF COMMON PEDIATRIC LIVER LESIONS

Prakash Mohan Masand MD
Division Chief, Cardiovascular Imaging
Pediatric Radiology, Texas Children’s Hospital
Associate Professor, Baylor College of Medicine
Houston, Texas
Disclosures

- Toshiba Medical Systems Speaker Bureau
- Consultant: Vital Images
- Consultant: Daiichi Sankyo (Venous thromboembolism in pediatric patients charter)
- Grants
  - Cystic Fibrosis Liver disease Foundation
  - NASH-CRN study: Site PI
  - Pilot grant from Texas Children’s Hospital: Shearwave Elastography for Hepatic Veno-occlusive disease in pediatric patients
Objectives

• Introduce the common liver lesions (age group directed)
• Clinical perspectives
• MR imaging features (images galore !)
• Take home points
Focal fat

- Commonest lesions
  - Focal fat sparing
  - Focal fatty infiltration

- In and opposed phase images
Biloma

- Intrahepatic biloma
- Biloma shows hyperintense T1 and T2 signal with no enhancement
- Hepatocyte specific contrast pooling within the biloma
Hematoma

- Subcapsular hematoma
- Hyperintense T1 signal
- Heterogeneously hyperintense T2 signal
- No enhancement
Abscess
0-3 yrs

**Benign:** Hemangioma, Mesenchymal hamartoma

**Malignant:** Hepatoblastoma

3-10 yrs

**Benign:** Hemangioma, Adenoma

**Malignant:** Undifferentiated embryonal sarcoma

>10 yrs

**Benign:** Hepatic adenoma, Focal nodular hyperplasia

**Malignant:** Hepatocellular CA
Tumor marker: AFP

• Alpha fetoprotein (AFP) as a tumor marker is elevated in hepatoblastoma, hepatocellular carcinoma and even infantile hepatic hemangioma

• AFP is normally elevated in the neonate

• Treatment response
Common benign masses

- In a series of 716 hepatic tumors in patients under the age of 21 years from the AFIP, the most common benign tumors in decreasing order of frequency
  - infantile hemangioma,
  - focal nodular hyperplasia (FNH),
  - mesenchymal hamartoma,
  - nodular regenerative hyperplasia (NRH), and
  - hepatocellular adenoma
Infantile hemangioma

- Develops between 2-8 weeks of life
- Proliferate for 6-12 months followed by slow involution
- 90% regress by age 9 years
- GLUT-1 (glucose-1 transporter protein) positive
- Focal, multifocal and diffuse
Infantile hemangioma
Infantile hemangioma
Congenital Hemangioma

- History of prenatal presence
- Rapidly involuting (RICH) and Non-involuting (NICH)
- GLUT-1 (glucose-1 transporter protein) negative
- RICH tumors regress by 18-24 months
- D’ont need tissue sampling, unless atypical features
Congenital Hemangioma
Congenital hemangioma
## Congenital and Infantile hemangioma

<table>
<thead>
<tr>
<th>Congenital hemangioma</th>
<th>Infantile hemangioma</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less common (30%)</td>
<td>More common (70%)</td>
</tr>
<tr>
<td>Present at birth</td>
<td>Develops between</td>
</tr>
<tr>
<td></td>
<td>2-8 weeks of age</td>
</tr>
<tr>
<td>Equal male and female prevalence</td>
<td>Female prevalence (5:1)</td>
</tr>
<tr>
<td>Growth is complete at birth or grows proportionately with the child’s growth</td>
<td>Grows rapidly for approximately 6-12 months</td>
</tr>
<tr>
<td>Rapid involution (within 12-18 months) or no involution</td>
<td>Slow involution</td>
</tr>
<tr>
<td></td>
<td>(over 5-9 years)</td>
</tr>
<tr>
<td>GLUT-1 negative</td>
<td>GLUT-1 positive</td>
</tr>
</tbody>
</table>

GLUT: Glucose transporter
Mesenchymal hamartoma

- Benign lesion presenting under 1 year of age
- Solid, cystic (80%) and mixed type
- Malignant counterpart is undifferentiated embryonal sarcoma
- Great mimicker
- Surgical resection
Cystic mesenchymal hamartoma
Solid mesenchymal hamartoma
Undifferentiated embryonal sarcoma
Focal nodular hyperplasia

- Benign lesions with female preponderance
- Adolescent age group
- Multiple lesions occur as a late complication post chemotherapy
- Classic MR imaging features with gadoxetate disodium
- Rarely surgically resected
Focal nodular hyperplasia
Nodular regenerative hyperplasia
Hepatic adenoma

- Benign tumor with potential for malignant transformation
- Young women with h/o oral contraceptive pill use
- Hepatic adenomatosis (more than 10)
- Various subtypes (Inflammatory, Beta-catenin mutation, HNF-1 alpha mutated, unclassified)
- Surgical resection if 5cm or larger
Hepatic adenoma
Hepatoblastoma
Hepatoblastoma

- Commonest liver malignancy, typically presents in children < 3 years
- Elevated serum AFP levels (100,000-300,000 mcg/ml)
- Low birth weight and Beckwith-Wiedemann syndrome
- Various subtypes (Teratoid, fetal, epithelial, mixed mesenchymal, NOS)
- Multifocal, vascular invasion and distant metastases
Hepatoblastoma

Pretext (pretreatment extent of disease) towards surgical planning

- Intrahepatic tumor extent
- IVC, hepatic and portal vein involvement (encasement, occlusion or definite invasion and not just extrinsic compression)
- Tumor focality, caudate lobe involvement
- Intraperitoneal hemorrhage or spread
- Lymph node and distant metastases
Hepatoblastoma

• PRETEXT stage 1
  Tumor involves only one quadrant; three adjoining liver quadrants are free of tumor

• PRETEXT stage 2
  Tumor involves one or two quadrants; two adjoining quadrants are free of tumor

• PRETEXT stage 3
  Tumor involves three quadrants and one quadrant is free of tumor or tumor involves two quadrants and two nonadjoining quadrants are free of tumor

• PRETEXT stage 4
  Tumor involves all four quadrants; there is no quadrant free of tumor
# Metastases

<table>
<thead>
<tr>
<th>Primary malignancy</th>
<th>Metastatic disease at diagnosis</th>
<th>Hepatic metastatic disease</th>
<th>Treatment options</th>
</tr>
</thead>
<tbody>
<tr>
<td>NB</td>
<td>50%-60%</td>
<td>20%-30%</td>
<td>Surgery, chemotherapy and radiation therapy</td>
</tr>
<tr>
<td>WT</td>
<td>10%-20%</td>
<td>10%-15%</td>
<td>Surgery, chemotherapy and radiation therapy</td>
</tr>
<tr>
<td>GCT</td>
<td>20%-30%</td>
<td>15%-20%</td>
<td>Surgery and chemotherapy</td>
</tr>
<tr>
<td>GIST</td>
<td>30%-40%</td>
<td>15%-20%</td>
<td>Surgery and imatinib</td>
</tr>
<tr>
<td>OS</td>
<td>15%-20%</td>
<td>1%-3%</td>
<td>Surgery</td>
</tr>
<tr>
<td>DSRCT</td>
<td>30%-50%</td>
<td>30%-40%</td>
<td>HIPEC and surgery</td>
</tr>
<tr>
<td>NET</td>
<td>30%-45%</td>
<td>30%-45%</td>
<td>Surgery, HAE, cryoablation, radiofrequency ablation, liver transplant and radionuclides therapy</td>
</tr>
</tbody>
</table>

Metastases
Common pediatric liver lesions

**Benign**
- Hemangioma
- Focal nodular hyperplasia
- Adenoma
- Mesenchymal hamartoma

**Malignant**
- Hepatoblastoma
- Hepatocellular Ca
- Undifferentiated Embryonal Sarcoma
- Metastases
Take home points

• Reviewed the MR imaging features of the pediatric liver masses (benign and malignant)

• Hemangioma is the most common benign lesion

• Hepatoblastoma is the most common malignant lesion

• Metastases are commonly from neuroblastoma

• Hepatocyte specific contrast is essential
THANK YOU