Pediatric Hepatobiliary Studies

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Cincinnati, OH
Pediatric Hepatobiliary Studies

- Biliary atresia
- Choledochal cyst
- After Kasai procedure or roux-en-Y
- After liver trauma
- After liver transplantation
- Acute cholecystitis
- Biliary dyskinesia
Pediatric Hepatobiliary Studies
Biliary Atresia

Technique:
- Pre-treat with 3-5 days of phenobarbital
- Administer Tc-99m-mebrofenin or equivalent
- Image intermittently until small bowel activity is seen or up to 7 hr post-injection
- If there is non-visualization of the small bowel at 7 hr, administer a second dosage of radiopharmaceutical, re-image at 18-24 hr
Pediatric Hepatobiliary Studies
Biliary Atresia

Interpretation:

- Visualization of activity in the small bowel excludes biliary atresia
- Early in the disease, there is avid uptake of the radiopharmaceutical by the liver
- Once the liver is injured, liver uptake is reduced and delayed
- Normal renal and bladder activity will be present
Interpretation:

- Neonatal hepatitis classically has reduced and delayed liver uptake, with eventual visualization of the small bowel.
- False positive studies may occur with neonatal cholestasis (often post-hyperalimentation), cystic fibrosis and some cases of Alagille’s syndrome (a congenital syndrome that includes congenital paucity of the bile ducts).
Interpretation:
Without pre-treatment:
• If there is non-visualization of the small bowel, the probability of biliary atresia (i.e., specificity) is **50%**

With pre-treatment (3-5 days of phenobarbital):
• If there is non-visualization of the small bowel, the probability of biliary atresia (specificity) is **85%**
neonate with persistent jaundice
6 wk old with persistent jaundice
1 wk old infant receiving hyperalimentation
Pediatric Hepatobiliary Studies
Choledochal Cyst

- When a cystic structure is diagnosed (usually on ultrasound) in or near the porta hepatitis, hepatobiliary scintigraphy aids in diagnosis by determining if the lesion communicates with the biliary tract.

Technical note:
- Some choledochal cysts fill in slowly so delayed images may be useful at 4, 7 or even 24 hours.
5 yo with sonolucent right upper quadrant mass
Pediatric Hepatobiliary Studies
Carolí’s Disease

- Carolí’s disease (congenital biliary ectasia) is characterized by multiple cystic dilatations of the intrahepatic bile ducts

Interpretation:
- The multiple cystic dilatations of the intrahepatic bile ducts are seen as multiple focal concentrations of the radiopharmaceutical in the liver
From:


Pediatric Hepatobiliary Studies
After Kasai / Roux-en-Y

- Hepatobiliary scintigraphy is a non-invasive way to visualize the proximal roux loop from the liver the anastomosis with the jejunum
Pediatric Hepatobiliary Studies
After Kasai / Roux-en-Y

Interpretation:
Images are assessed visually for:
• promptness and amount of radionuclide excretion
• visualization of the proximal roux loop from the liver to the anastomosis with the jejunum
• anastomotic leakage
• evidence of a dilated loop
• photopenic areas
3 yo with liver transplant and a recent repair of an anastomotic leak (at the site of the proximal roux anastomosis)
Hepatobiliary Imaging
After Liver Trauma

Interpretation:

• Most biliary leaks after injury will demonstrate tracking of RN along the inferior surface of the right lobe of the liver and eventually along the inside of the right body wall

• On a delayed images, activity can sometimes be noted as being around the bowel rather than in the bowel lumen
7 yo involved in motor vehicle accident
Hepatobiliary Imaging After Liver Transplantation

- Promptness of biliary excretion correlates with graft survival
- Increasingly slower hepatic uptake and transit through liver is a non-specific finding (e.g., rejection, viral infection, etc.)
- Useful in evaluating bile leaks
4 yo after liver transplant
4 yo after second liver transplant
16 yo after liver transplant
18 yo after liver transplant
Hepatobiliary Imaging in Acute Cholecystitis

Technique:
- Image as in adults

Interpretation:
- Children and teenagers rapidly recover ability to concentrate $^{99m}$Tc-IDA once the cystic duct is no longer obstructed
- Often hepatobiliary scan is normal despite choledocholithiasis by sonography during recovery from acute cholecystitis
Billary Dyskinesia

Google images attributed to no one in particular

Late middle age white couple with 30+ year history of causing dyspepsia

Google images attributed to MSNBC.com
Late middle age white couple with 30+ year history of causing dyspepsia (in some folks, at least)
Pediatric Biliary Dyskinesia

- Hepatobiliary scintigraphy with CCK
Hepatobiliary Scintigraphy (CCK)  
How we do it

- 4 hour fast
- 3 mCi Tc-99m-IDA IV reduced on a weight basis for children
- 30+ min of sequential images in the anterior projection until the gall bladder is well filled with activity, right lateral and LAO views if needed to separate gallbladder from other structures
Hepatobiliary Scintigraphy (CCK)
How we do it

- Infuse sincalide 0.02 mcg/kg as a continuous infusion during the first 20 minutes of a 40 minute dynamic imaging study
- Calculate gallbladder ejection fraction (GBEF) from the maximum and minimum of the time-activity curve obtained from a gallbladder region of interest
- GBEF >= 35% is considered to be normal
Hepatobiliary Scintigraphy (CCK)
How we do it

- Indications for “HIDA-CCK” studies are similar to those in adults
- Most patients who are studied are adolescents
Hepatobiliary Scintigraphy (CCK)
How we do it

Baseline
one frame every 5 min
Hepatobiliary Scintigraphy (CCK)
How we do it

2 min/frame

EF between 1.5 min and 31.5 min = 97%
Hepatobiliary Scintigraphy (CCK)

How we do it

• Indications for “HIDA-CCK” studies are similar to those in adults
• Most patients who are studied are adolescents
Cincinnati Children’s Hospital Experience

- Reviewed first 7 studies at Cincinnati CH
  84% resolution of symptoms
  no local review since that time
- Often re-study adolescents from other hospitals who received rapid CCK infusion with resulting low GBEF;
  almost all repeat studies with slow infusion have been normal
Published Experience

Inclusion criteria – “scintigraphy group”

• 10 or more subjects
• Only CCK infusions used to stimulate gall bladder contraction
• GBEF measured by scintigraphy
## Published Experience

<table>
<thead>
<tr>
<th>Study</th>
<th>GBEF</th>
<th>How CCK Infused</th>
<th>Path-Chronic Cholecystitis</th>
<th>Improved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lugo-Vicente</td>
<td>&gt;=35%</td>
<td>continuous</td>
<td>83%</td>
<td>100%</td>
</tr>
<tr>
<td>n=12 [San Juan, PR]</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Carney</td>
<td>&gt;=15%</td>
<td>not stated</td>
<td>41%</td>
<td>71%</td>
</tr>
<tr>
<td>n=38 [Indianapolis, IN]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Michail</td>
<td>&gt;=35%</td>
<td>not stated</td>
<td>88%</td>
<td>72%</td>
</tr>
<tr>
<td>n=63 [Dayton CMC]</td>
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### Published Experience

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<tr>
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<tr>
<td><strong>Campbell</strong></td>
<td>&gt;=35%</td>
<td>not stated</td>
<td>83%</td>
<td>100%</td>
</tr>
<tr>
<td>n=16 [U of Michigan]</td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Gollin</strong></td>
<td>&gt;=35%</td>
<td>0-60 sec</td>
<td>72%</td>
<td>79%</td>
</tr>
<tr>
<td>n=29 [El Paso, TX]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Al Homaidhi</strong></td>
<td>&gt;=35%</td>
<td>3 min</td>
<td>not stated</td>
<td>100%</td>
</tr>
<tr>
<td>n=10 [CH Michigan, Detroit]</td>
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<td></td>
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<tbody>
<tr>
<td>Siddiqui</td>
<td>&gt;=35%</td>
<td>~93%</td>
<td>94%</td>
</tr>
<tr>
<td>n=102 [Knoxville, TN]</td>
<td>not stated</td>
<td></td>
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Published Experience

Siddiqui

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n=102 [Knoxville, TN]

Published Experience

Inclusion criteria – “mixed group”

- 10 or more subjects
- Some of all patients had fatty meal instead of CCK
- In one article, GBEF measured by scintigrapy or US
## Published Experience

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<tr>
<td><strong>Veganta</strong></td>
<td>&gt;=35%</td>
<td>30 min</td>
<td>~50%</td>
<td>48%</td>
</tr>
<tr>
<td>n=62 [Peoria, IL]</td>
<td></td>
<td>(some fatty meals)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Dumont</strong></td>
<td>&gt;=35%</td>
<td>not stated</td>
<td>48%</td>
<td>97%</td>
</tr>
<tr>
<td>n=42 [Columbus CH]</td>
<td></td>
<td>(some had US)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Hadigan</strong></td>
<td>&gt;=50%</td>
<td>(fatty meals only)</td>
<td>80%</td>
<td>80%</td>
</tr>
<tr>
<td>N=15 [Boston CH]</td>
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Published Experience

Also note this article:

- 2 groups with abdominal pain and biliary dyskinesia (GBEF<=35%)
- 35 operated and 20 not operated
- Selection of surgery was choice of family and surgeon, no randomization
- No difference in results at 2 years
Published Experience

Results (first 6 articles)

- Pathology showed chronic cholecystitis in 41% to 88% of patients
- Symptoms improved or resolved after cholecystectomy in 71% to 100% of patients
Published Experience

Problems with published experience:

- No indication how rapidly CCK was infused in the majority of articles—some GBEF values less than 35% may be due to a too rapid rate of infusion and represent false positive studies
- Subjective reporting of symptoms, no grading scales, except in one article
- Some articles used fatty meals or US emptying measurements
- “Self selection” of surgery in the last article
A Memorable GI Radiology Image