Pediatric Gastrointestinal Transit Scintigraphy:
Update and Review

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Objectives

- Provide an overview of some of the clinical applications and technical aspects of gastrointestinal transit scintigraphy in children

- Discuss some of the imaging pitfalls and diagnostic challenges encountered in children
Introduction

Gastrointestinal Transit Imaging Studies

- Sophisticated, systematic techniques
- Allow anatomic and functional imaging of the esophagus and stomach
Gastrointestinal Transit Imaging Studies

- Usually more sensitive than fluoroscopic studies:
  - Dynamic, uninterrupted imaging can be performed
  - Image longer periods of time
  - Less radiation exposure

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Gastrointestinal Transit Imaging Studies

- GE reflux
  - Secondary pulmonary aspiration
- Gastric emptying
- Primary pulmonary aspiration (salivagram)
- Esophageal transit
- Colonic transit

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Gastrointestinal Transit Imaging Studies

- GE reflux
- Gastric emptying
Gastrointestinal Transit Imaging Studies

- GE reflux
- Gastric emptying
Infants:
- Occurs in healthy infants - “physiologic”
  - Asymptomatic

- Produces symptoms in others
  - Recurrent vomiting
  - Respiratory complications; apnea, “ALTE”
  - Recurrent pneumonia
  - Reactive airway disease
  - Chronic cough
  - Stridor
  - Esophagitis
  - Anorexia/oral aversion
  - Failure to thrive
GE Reflux - Clinical Manifestations

- Pre-school children:
  - Intermittent vomiting

- Older children:
  - Dysphagia
  - Globus - “food stuck in chest”
  - Hematemesis
  - Anemia
  - Esophagitis
  - Strictures
GE Reflux - Associated Disorders

- Prevalent in children with
  - Reactive airway disease
  - Asthma
    - Gastric acid in esophagus → hyper-responsive bronchial walls

- Aspiration pneumonitis
  - Neurologically impaired children
Advantages (vs pH probe/impedance probe)

- Detect and quantify gastroesophageal reflux
- Detect pulmonary aspiration
- Detect non-acidic GER
- Less invasive than pH probe
Advantages (vs UGI)

- Achieve greater sensitivity & specificity than with conventional barium UGI fluoroscopy
  - monitored continuously
  - without additional radiation exposure

<table>
<thead>
<tr>
<th></th>
<th>SENSITIVITY</th>
<th>SPECIFICITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>UGI</td>
<td>30 - 86%</td>
<td>20 - 83%</td>
</tr>
<tr>
<td>GER SCINTIGRAPHY</td>
<td>60 - 90%</td>
<td>&gt; 90%</td>
</tr>
</tbody>
</table>
**Disadvantages:**

- Lack of resolution provided by conventional radiography
- Cannot evaluate anatomic abnormalities
  - Hypertrophic pyloric stenosis
  - Hiatal hernia
  - Antral web
  - Malrotation with midgut volvulus
Disadvantages:

- Does not evaluate reflux causing silent aspiration at night - only post-prandial
GE Reflux Scintigraphy

- Techniques vary widely
- Little standardization

- My institution
- Other techniques
GE Reflux Scintigraphy: How We Do It

- **Patient preparation**

- **INFANTS**
  - Replace regularly scheduled feeding with radiolabeled meal
  - Similar volume to that used for regular feeds (or calculated for BSA)
  - Infant formula or saved breast milk

- **OLDER CHILDREN**
  - Fasting for 2-4 hours
  - Age-appropriate volume given
  - Whole milk or whole chocolate milk or Pediasure
GE Reflux Scintigraphy: How We Do It

- **Patient preparation**

- Verify position of NG tube

- *Continuous feeds stopped 2-4 hours prior to exam*

- Check for residual barium – prior GI imaging studies
GE Reflux Scintigraphy: How We Do It

- **Radiopharmaceutical Administration**

  - Radiopharmaceutical: $^{99m}$Tc sulfur colloid
  - Child Dose: 0.5 mCi
  - Route: oral, NG tube, gastrostomy tube
    - NG tube:
      - Verify position - PF/fluoroscopy
      - Inject tube
      - Remove tube
      - Arrange for tube reinsertion p-study
  - Follow radiolabeled liquid with tracer-free liquid
  - Infants: Burp infant after feeding, prior to imaging

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GE Reflux Scintigraphy: How We Do It

- **Machine Set-up**
  - LEHR collimator
  - Photopeak, window: $^{99m}$ Tc (140 keV, 15-20%)
  - Preset time for dynamic 60sec/frame for 15 minutes
GE Reflux Scintigraphy: How We Do It

**Imaging**

- Child placed supine
- Immediate computer acquisition
  - DYNAMIC - 60 seconds per frame for 15 minutes x 2
    - 15 minutes supine - ANT - followed by:
      - 15 minutes prone position - POST (if tolerated)
    - 3-4 hour delayed image -- to evaluate for pulmonary aspiration

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GE Reflux Scintigraphy: How We Do It

- Imaging

- Alternative:
  - Radionuclide esophagram 5 sec/frame, 2-3 min
  - (Esophageal motility)
Normal study

- Radiopharmaceutical in the stomach
- No activity in the esophagus or lungs
Abnormal study

- New identification of radiopharmaceutical in esophagus
- Number of episodes is counted over the entire imaging period
- Proximal extent noted
3 year old male with Nissen fundoplication, still spitting up
0.520 nCi TcSC in 104 ml formula via G-tube
Tech: AG/LH
AGE: 3 y/o male

R Shoulder Markers L

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Potential Pitfalls & Challenges

- Images equivocal for GE Reflux

**SOLUTION:**
- Manipulate image intensity on computer screen
- Cinematic replay of dynamic images
- Inspect dynamic images for patient motion
- Place marker at level of shoulders - at least one image
Potential Pitfalls & Challenges

- Residual radiopharmaceutical in esophagus may suggest GE reflux

**SOLUTION:**
- Calculate volume
- Divide formula or milk in half - label half - feed child
- Give tracer-free second half to clear esophagus of tracer
Secondary Pulmonary Aspiration Scintigraphy: How We Do It

- Performed following GE Reflux study:
  - Obtain 3-4 hour delay image over lungs
  - External shoulder markers - anatomic reference
  - Shield abdominal activity
  - Obtain image of the chest with a transmission scan - useful to detect pulmonary aspiration
0.520 nCi TcSC in 104 ml formula via G-tube
Tech: AR/LH
AGE: 3 y/o male

R Shoulder Markers L
Gastrointestinal Tract Imaging Studies

- GE reflux
- Gastric emptying
Gastric Emptying Scintigraphy - Clinical Indications

(1) Delayed gastric emptying:
- nausea
- vomiting
- early satiety
- bloating
- abdominal pain
(2) Accelerated gastric emptying:
   - diarrhea
   - “dumping syndrome”

(3) Pre-op assessment for Nissen, G-tube
Gastric Emptying Scintigraphy

**Advantages:**

- Physiologic - uses “real” food, rather than barium
- Can be performed with liquid or solid meal
- Can get quantitative information
- Considered gold standard
**Disadvantages:**

- Lack of standardization
  - Meal content
  - Volume
  - Imaging technique
- Lack of normal GE values for children
  - not readily established
  - ethical considerations of studying normal children
  - most data from children → reflux
Test Meal:
- Standardized
- Standard alternative available
- Stable, reliable label
Gastric Emptying Scintigraphy

**Test Meal:**
- Standardized
  - Any variation in GE rate is due to physiologic variation, not protocol variation
- Standard alternative available
  - In case of allergies, food intolerance
- Stable, reliable label
  - Resistant to gastric juice
  - Limited absorption by gastric mucosa
Gastric Emptying Scintigraphy

Test Meal:
- Liquid
- Casein-containing liquid
- Semi-solid
- Solid
Gastric Emptying Scintigraphy

- **Liquid**
  - infant formula

- **Casein-containing liquid**
  - milk, formula

- **Semi-solid**
  - cereal and milk
  - pudding

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Gastric Emptying Scintigraphy

- Clear liquids empty faster than opaque liquids
- Casein-based formulas empty slower than whey-based formulas
- Cow’s milk empties slower than human milk
- Solids are formed in stomach during milk digestion

→ varied rates of emptying not attributable to physiologic factors
Gastric Emptying Scintigraphy

- **Solid**
  - Chicken livers*
  - Scrambled eggs*
  - Scrambled egg whites*
  - Oatmeal
  - Peanut butter and toast
  - Mashed potatoes - instant
  - Cheddar cheese - melted
  - “Technecrispy” cakes

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"Technecrispy" cakes*

- Evaluated “palatability” of 7 test meals
- Children’s favorite: chocolate “crispy cake”
  - milk chocolate, Rice Krispies, golden syrup, semi-skimmed milk
- Determined standard meal volume: 30 g
- Combined meal with $^{99m}$Tc bound to ion exchange resin:
  - non-absorbable, inert, high binding stability
- Established normal GE values in healthy children
  - (N: 24; Age: 5-10 years)

Cheese Alternative*

- Evaluated labeling stability of several alternative meals:
  - oatmeal, mashed potatoes, peanut butter and bread, cheddar cheese
- Meals mixed with gastric juice, analyzed after 1 hr & 4hr
- Activity assayed in dose calibrator
- Percent activity remaining in solid meal calculated

### Cheese Alternative*

<table>
<thead>
<tr>
<th>Food</th>
<th>1 Hour</th>
<th>4 Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egg whites</td>
<td>98.2 ± 1.9</td>
<td>98.5 ± 1.0</td>
</tr>
<tr>
<td>Cheese</td>
<td>95.6 ± 1.0</td>
<td>95.8 ± 2.6</td>
</tr>
<tr>
<td>Oatmeal</td>
<td>62.1 ± 1.7</td>
<td>77.2 ± 6.8</td>
</tr>
<tr>
<td>Mashed potatoes</td>
<td>41.8 ± 0.6</td>
<td>55.5 ± 3.4</td>
</tr>
<tr>
<td>Peanut butter</td>
<td>74.5 ± 3.8</td>
<td>40.2 ± 22.1</td>
</tr>
</tbody>
</table>


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Cheese Alternative*

- Cheddar cheese - alternative meal for solid GE in children
  - comparable to egg whites
- Oatmeal & mashed potatoes
  - low, variable labeling stability

- Suggested cheese meals:
  - Melted topping on pizza
  - Melted with macaroni

GE Scintigraphy - Liquid: How We Do It

- **Patient preparation**

  - Same as for GE Reflux
Radiopharmaceutical Administration

- Radiopharmaceutical: $^{99m}$ Tc sulfur colloid
- Child Dose: 0.5 mCi
GE Scintigraphy - Liquid: How We Do It

Radiopharmaceutical Administration

- Oral route:
  - Meal should be introduced into stomach quickly
    - (ACR Guidelines: ~ 10 min)
- NG tube:
  - Verify position - PF/ fluoroscopy
  - Inject tube, remove tube, arrange for tube reinsertion p-study
- G Tube:
  - Connector tubing - remove prior to imaging; residual activity could skew calculations

- Split meal in half in case child cannot consume total volume
- Infants: Burp infant after feeding, prior to imaging

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Machine Set-up

- LEHR collimator
- Photopeak, window: $^{99m}$Tc (140 keV, 15-20%)
- Preset time for static images 60sec/image

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**GE Scintigraphy - Liquid: How We Do It**

**Imaging**
- Child placed supine
- Immediate computer acquisition
- Dual head camera
  - STATIC - 60 seconds per image

- ANT & POST images immediately - then:
- Every 10 minutes up to 120 minutes
- - until reach T1/2 for 2 hour limit

- If reach T1/2 earlier than 2 hours: STOP
- If T1/2 > 2 hours, can interpolate

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GE Scintigraphy - Liquid: How We Do It

- **Computer Processing:**
  - ROI drawn over the stomach for each image
  - Time-activity curve - decay corrected - is plotted
    - using geometric mean* of anterior and posterior counts
  - Half time calculated as time initial counts decrease by 50%
  - Percent of initial activity remaining in stomach, calculated at:
    - 90 minutes
    - 120 minutes
  * May not be needed in infants and small children

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GE Scintigraphy - Liquid: How We Do It

- **Computer Processing**

- **MULTIPLE WAYS TO EXPRESS GASTRIC EMPTYING:**
  - % of initial activity remaining in stomach at specific time point
  - % emptied from the stomach by a particular time point
  - Time for half the initial activity to empty ($T_{1/2}$)
10 year old male with epigastric pain, emesis, not tolerating NG feeds
Pediasure via NG tube

53% remaining @ 88 min

$T_{\frac{1}{2}} = 93 \text{ min}$

(NI: 30-120)
**Potential Pitfalls & Challenges**

- **Gastric and duodenal activity overlap**

**SOLUTION:**
- Extend acquisition to allow clearance from duodenum
Gastric Emptying Scintigraphy

Potential Pitfalls & Challenges

- Child cannot finish entire liquid meal - concern for inadequate total activity consumed

**SOLUTION:**
- Calculate volume
- Divide formula or milk in half - label half - feed child radiolabeled half first
- Give tracer-free second half - if tolerated
Gastric Emptying Scintigraphy

Potential Pitfalls & Challenges
- Stomach empties immediately after feeding

SOLUTION:
- Draw ROI around stomach and bowel on first image; compare to stomach ROI on final image
**Patient preparation**
- Confirm no residual barium from prior x-ray exams

**OLDER CHILDREN**
- Fasting for 4-6 hours
- Single egg scrambled
  - 8 Oz water provided
  - Clear all egg from mouth during swallows
- Alternative: oatmeal
Radiopharmaceutical Administration

- Same as for Liquid study
GE Scintigraphy - Solid: How We Do It

- **Imaging**
  - Immediate computer acquisition
  - Dual head camera:
    - Patient stands for images, sits between images - if able
  - Single head camera:
    - Child placed LAO - if patient cannot stand
    - No geometric mean
  - Image acquisition same as for Liquid gastric emptying
11 year old male with chronic abdominal pain, nausea, acute on chronic vomiting
0.516 mCi TcSC in eggs (po)
Tech: ES/LH
AGE: 11 y/o
male

R

L

ANT 1 MIN
18:09:51.6

ANT 10 MIN
18:10:09.3

ANT 20 MIN
18:30:11.6

ANT 30 MIN
18:41:01.6

ANT 40 MIN
19:00:26.6

ANT 60 MIN
19:02:46.0

ANT 60 MIN
19:12:46.0

ANT 70 MIN
19:22:22.0

ANT 80 MIN
19:34:50.6

ANT 90 MIN
19:46:53.5

ANT 2HR
20:11:16.5

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0.516 mCi Tc-99m in eggs (po)
Tech: ES/LH
AGE: 11 y/o male

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Scrambled egg

50% remaining @ 123 min

$T_{1/2} = 129$ (NI: 30-120 min)
Which of the following is true about the Gastric Emptying time-activity curve in children?

A. Emptying may be intermittent
B. Emptying may be delayed at 1 hour and normal at 2 hours
C. Emptying may show a plateau pattern
D. Emptying may show a diphasic pattern
E. All of the above
Which of the following is true about the Gastric Emptying time-activity curve in children?

A. Emptying may be intermittent
B. Emptying may be delayed at 1 hour and normal at 2 hours
C. Emptying may show a plateau pattern
D. Emptying may show a diphasic pattern
E. All of the above
Gastric Emptying Scintigraphy

A. Emptying may be intermittent

B. Emptying may be delayed at 1 hour and normal at 2 hours
   
   If delay @ 1 hour, important to image for at least 2 hours or longer (serial statics)

C. Emptying may show a plateau pattern
   
   Consistent with intermittent gastric outlet obstruction

D. Emptying may show a diphasic pattern
   
   Consistent with swallowed air

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Techniques vary considerably....
Esophagogram + GE Reflux + Gastric Emptying + Primary & Secondary Aspiration - Combined

- Admin dose: 5 uCi/ml administered liquid
- Liquid meal: Milk
- Feed supine, camera under table

**RADIONUCLIDE ESOPHAGOGRAM & PRIMARY ASPIRATION:**
- Obtain 30 dynamic 5-sec POST images (2.5min)
- Evaluate passage through esophagus and possible tracheobronchial aspiration
- Feed remainder of radiolabeled milk - burp baby

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Esophagogram + GE Reflux + Gastric Emptying + Primary & Secondary Aspiration - Combined

- **GE REFLUX STUDY:**
  - Obtain dynamic 10-sec POST images for 60 min (360 images)

- **GASTRIC EMPTYING STUDY:**
  - Obtain static ANT image of chest and abdomen - 1 hour calculation of GE
  - Obtain static ANT image of chest and abdomen - 3 hour

- **SECONDARY ASPIRATION:**
  - Obtain POST image of chest (2-3min), (mark shoulders with external marker) - 3 hour

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Esophagogram + GE Reflux + Gastric Emptying +
Primary & Secondary Aspiration - Combined

- ADVANTAGES OF COMBINED STUDY:
  - Single radiopharmaceutical dose
  - Maximize information:
    - Primary aspiration
    - GE Reflux
    - Secondary aspiration
    - Gastric Emptying

  GER + GE combo: important - related

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GE Reflux + GE Scintigraphy: How We Do It

- Images obtained with a dual head camera
  - ANT and POST projections
  - supine position only

- GER: Dynamic images @ 60 sec/frame every minute - 30 frames
- GE: Static images every 10 minutes for 60 - 120 minutes
  - until much of the gastric activity has emptied
  - child may move between images, but walking around is discouraged
13 month old infant with failure to thrive
0.520mCi Tc-99m PO in 30 ml formula
R shoulder markers L
13 m/o female
Tech:ES
2nd 10 min dynamic combo study
8.129mCi Tc99m Pd in 30mLs formula
R shoulder markers L

13 m/o Female
Tech:ES

3rd 10 min dynamic combo study

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0.520mCi Tc - 99m
90 ml formula
10 m/o female
Tech: ES

Posterior
Immediate

15 min

30 min

45 min

60 min

75 min

90 min

2hr

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Formula

Total imaging time: 120 min

GR: 68% remaining @120 min

\[ T_{\frac{1}{2}}: \ 183 \ \text{min} \]
What is your diagnosis?

- A. Normal gastric emptying
- B. Delayed gastric emptying
- C. Unsure
What is your diagnosis?

- A. Normal gastric emptying
- B. Delayed gastric emptying
- C. Unsure
Gastric Emptying

How do you know?
Gastric Emptying Scintigraphy

- Normal study:
  - Radiotracer in the stomach on the initial images
  - Progressive emptying of the stomach
  - Gradual decline of TAC

- What are normal quantitative values?

- Age-appropriate normal values from large group of normal controls not readily established
  - Some studies - children evaluated for reflux
# Gastric Emptying Scintigraphy - Reported Normal Values

<table>
<thead>
<tr>
<th>Author</th>
<th>Pt. Population</th>
<th>Agent</th>
<th>Meal</th>
<th>Normal Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signer</td>
<td>Normal infants</td>
<td>$^{113m}$ In micro-colloid</td>
<td>Liquid</td>
<td>$T_{1/2}^1$: 87 ± 29 min (GR$_1$: 48-70%)</td>
</tr>
</tbody>
</table>
| Seibert | Children being E/F GER | $^{99m}$Tc sulfur colloid | Milk            | GE$_1$: 32-64% (infants)  
GR$_1$: 36-68%  
GE$_1$: 44-58% (children)  
GR$_1$: 42-56% |
| Rosen   |                        | $^{99m}$Tc sulfur colloid | Dextrose        | GR$_1$: 27-81% (<2 yrs)  
GR$_1$: 11-47% (<2 yrs) |
| DiLorenzo | Children being E/F GER | $^{99m}$Tc sulfur colloid | Milk (<1yr) Pudding | GR$_1$: 44-65% [(-) GER]  
GR$_1$: 25-70% [(+) GER] |
| Singh   | Normal children       | $^{99m}$Tc ion exchange resin | Technecrispy cakes | $T_{1/2}^1$: 107.2 min  
(54.6 - 159.8min) |
| Heyman  |                        | $^{99m}$Tc sulfur colloid |                 | GR$_1$: 48-70% |

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Reported studies complicated

- Solids and liquids empty at different rates
  - Liquids empty from stomach at exponential rate
  - Solids empty at linear rate, lag phase

- Study subjects vary

- Study protocols vary

- Imaging geometry varies

- GE process regulated by variety of factors:
  - osmolality, pH, volume, caloric content, amt of protein, carbohydrate, fat, weight, time of day, position, medications, sex

- GE values reported differently
If there are no standardized techniques or normal values for gastric emptying in children, how are studies performed in reproducible manner?

What are the “Normal values" being reported?
Gastric Emptying Scintigraphy

Surveyed pediatric radiologists & NM physicians in children’s hospitals in North America and Australia:

1. Do you report
   a. gastric residual at a certain time?
   b. gastric activity emptied by the stomach at a certain time?
   c. T₁/₂?

2. How long do you image? (e.g., 90 min, 120 min)

3. What normal values do you report?

4. What is your standard administered activity?
# Liquid Gastric Emptying - Children

<table>
<thead>
<tr>
<th>Institution</th>
<th>Agent</th>
<th>Admin Dose</th>
<th>Total Imaging Time</th>
<th>Normal GE</th>
</tr>
</thead>
<tbody>
<tr>
<td>VCH</td>
<td>99mTc SC</td>
<td>0.5 mCi</td>
<td>90-120 min</td>
<td>“No good standards” T₁/₂ 30-120 min (formula)</td>
</tr>
<tr>
<td>CCHMC</td>
<td>99mTc SC</td>
<td>0.25-0.40 mCi</td>
<td>120 min</td>
<td>51% @ 120 min (Casein)</td>
</tr>
<tr>
<td>CNMC</td>
<td>99mTc SC</td>
<td>5 uCi/ml feeding volume</td>
<td>60 min and 180 min</td>
<td>50% @ 60 min 75% @ 120 min 80% @ 180 min</td>
</tr>
<tr>
<td>SCH</td>
<td>99mTc SC</td>
<td>0.2 mCi</td>
<td>60-120 min</td>
<td>45% @ 60 min 60% @ 90 min</td>
</tr>
<tr>
<td>CHOP</td>
<td>99mTc SC</td>
<td>1.0 mCi</td>
<td>60 min</td>
<td>50-70% residual @ 60 min</td>
</tr>
<tr>
<td>MGH</td>
<td>99mTc SC</td>
<td>12 MBq (0.32 mCi)</td>
<td>90 min</td>
<td>“No consensus”. Some: 31% @ 60 min 76% @ 120 min</td>
</tr>
<tr>
<td>TCHD</td>
<td>99mTc SC</td>
<td>0.5 - 1.0 mCi</td>
<td>60 min</td>
<td>T₁/₂ &lt; 60 min</td>
</tr>
<tr>
<td>PCMC</td>
<td>99mTc SC</td>
<td>0.5 mCi</td>
<td>60 min</td>
<td>50% @ 60 min</td>
</tr>
<tr>
<td>NWMC</td>
<td>99mTc SC</td>
<td>0.05 mCi/kg; min: 0.5; max: 1.0</td>
<td>120 min</td>
<td>“No good standards”. 50% @ 120 min - OK</td>
</tr>
<tr>
<td>CHEO</td>
<td>99mTc SC</td>
<td>18.5 MBq (0.5 mCi)</td>
<td>60 - 120 min</td>
<td>50% @ 60 min (BM) 50% @ 80-90 (other L.) 50% @ 60 min (younger) 50% @ 30 min (older)</td>
</tr>
<tr>
<td>MHC</td>
<td>99mTc SC</td>
<td>0.5 - 1.0 mCi Wt. chart</td>
<td>60-120 min</td>
<td>50% @ 60 min 75% @ 120 min</td>
</tr>
<tr>
<td>RCH</td>
<td>99mTc CaPhytate</td>
<td>40-120 MBq (1.0-3.2 mCi) Wt chart</td>
<td>120 min</td>
<td>T₁/₂ &lt; 50 min Residual activity &lt; 15% @ 120 min</td>
</tr>
<tr>
<td>CHB</td>
<td>99mTc SC</td>
<td>15 uCi/kg</td>
<td>60 min</td>
<td>Residual activity &lt; 50% ± 25% @</td>
</tr>
</tbody>
</table>
Normal Liquid Gastric Emptying - Data Summary

- \( GE_{30} \): 50% (older children)
- \( GE_{60} \): 31%, 45%, 50%, 50% ± 25%
- \( GE_{60} \): 50% (infants - breast milk)
- \( GE_{80-90} \): 50% (infants - not breast milk)
- \( GE_{90} \): 60%
- \( GE_{120} \): 50%, 51% (casein), 75%, 76%
- \( GE_{180} \): 80%
Normal Liquid Gastric Emptying - Data Summary

- $GR_{60}$: 50-70%
- $GR_{120}$: 15%
- $T_{\frac{1}{2}}$: 30-120 min, <50 min, <60 min
Gastrointestinal Transit Imaging Studies in Children

- Sophisticated, systematic techniques
- Allow anatomic and functional imaging of the esophagus and stomach
- Usually more sensitive than fluoroscopic studies:
  - Dynamic, uninterrupted imaging can be performed
  - Image longer periods of time
  - Less radiation exposure
Gastrointestinal Tract Imaging Studies in Children

- New research on solid test meals:
  - Technecrispy cakes, cheese
- Liquid GE: milk, formula
- Techniques vary widely
- Normal values for GE still vary widely
- Important to establish institution-based standards
  - Test meal
  - Protocol
  - Normal GE
- Guidelines: ACR, SNM, literature

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Objectives

- Provide an overview of some of the clinical applications and technical aspects of gastrointestinal tract scintigraphy in children

- Discuss some of the imaging pitfalls and diagnostic challenges encountered in children
ACR Practice Guideline for the Performance of Gastrointestinal Scintigraphy


References


References


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Thank you!
Formula

Total imaging time: 120min

GR: 68% remaining @ 120 min

$T_{1/2}$: prolonged @ 183 min

(Normal $T_{1/2}$, formula: 30-120 min)

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Gastrointestinal Tract Imaging Studies

- GE reflux
  - Secondary pulmonary aspiration
- Gastric emptying
Secondary Pulmonary Aspiration

**DEFINITION:**

Aspiration of gastric content following episodes of GE reflux
Secondary Pulmonary Aspiration Scintigraphy: How We Do It

- Performed following GE Reflux study:

  - Obtain 3-4 hour delay image over lungs
  - External shoulder markers - anatomic reference
  - Shield abdominal activity
  - Obtain image of the chest with a transmission scan - useful to detect pulmonary aspiration

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10 year old with chronic epigastric pain

Normal UGI
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.530mCi Tc-SC G-Tube in 156mls formula
10 y/o male

R shoulder markers L

ANT 2 hour delay
16:34:33.0

anterior supine

2 hr DELAY TRANS
19:39:54.8

Anterior supine trans. 2 hr delay

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