Gastrointestinal tract
Colloidal liver-spleen imaging

Presented by: Jehad Felemban
Introduction:
- To obtain better anatomic display of liver and spleen architecture, we use (CT – Ultrasound).
- (Radionuclide liver-spleen imaging) used for confirmation or evaluation of:
  1) Hepatomegaly
  2) Hepatocellular disease
  3) Space-occupying lesions

Radiopharmaceuticals:
- Radionuclide colloid imaging capitalizes on a function common to both, liver and spleen (Phagocytosis).
- The most commonly used agents are:

<table>
<thead>
<tr>
<th></th>
<th>(Tc 99m) sulfur colloid</th>
<th>(Tc 99m) albumin colloid</th>
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</thead>
<tbody>
<tr>
<td>Particle size</td>
<td>(0.3) to (1.0) micrometer</td>
<td>(0.4) to (2.0) micrometer</td>
</tr>
<tr>
<td>Preparation</td>
<td>Needs to be boiled</td>
<td>Does not need to be boiled</td>
</tr>
<tr>
<td>Other</td>
<td>Not expensive</td>
<td>Expensive</td>
</tr>
<tr>
<td>Administered activity</td>
<td>For (planer imaging): 4 to 6 mCi (148 to 222 MBq)</td>
<td>For (SPECT): 8 to 10 mCi (296 to 370 MBq)</td>
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- The (uptake) and (distribution) of (Tc 99m) colloid in the liver reflect both:
  1) The distribution of functioning reticuloendothelial cells.
  2) The distribution of hepatic perfusion.
To make (simultaneous imaging), the particles of (Tc 99m) colloid must accumulated rapidly by the (phagocytosis) of both, the liver and the spleen.

The localization of particles of (Tc 99m) colloid are:
- 90% localize in the (liver).
- 10% localize in the (spleen).
- Small percentage localize in the (bone marrow).

There is some correlation between particle size and organ avidity for colloid:
- Larger particles are favored by the spleen.
- Smaller particles go to the liver.
- Smallest particles are sequestered by the bony marrow.

**Technique**

**Planer Imaging:**
- Accumulation of (Tc 99m) sulfur colloid requires about:
  - (5 to 10 min) in normal patient.
  - (20 to 30 min) in patients with:
    - Compromised hepatic function.
    - Portal hypertension.
- Each (gamma camera images) are:
  - Obtained for (500 to 1000 k counts).
  - Using a (low-energy, parallel-hole) collimator.
- Occasionally, we use (SPECT) scanning of the liver to add additional information.
In (abdominal perfusion study), we assess the (hepatic perfusion) by using:

(Rapid-sequence images): (1) Image (2 to 3) seconds for (30 to 60) seconds.

(SPECT) imaging using to evaluate and assess of:

- Focal or multifocal space-occupying disease.
- (Kupffer cell) distribution.
- Liver hemangiomas, by using: (Tc 99m) red blood cell.

(SPECT) sensitivity and accuracy of localization have been shown to be superior to planer imaging.

Normal scan: fig. (1)

In (normal scan), the evaluation of a (liver-spleen scan) should include:

- The (size - shape - position) of the liver and spleen.
- The (homogeneity) of activity within the organs.
- The presence of any (focal defects) in activity.
- The distribution of colloid among the (liver - spleen - bone marrow).

Abnormal scan:

In abnormal scan, the (radionuclide imaging) presence the (size - location) of lesions of the liver.
By using (gamma camera):
- (8mm) lesions: may be identified.
- (2 to 2.5 cm) lesions: routinely imaged.

The nearer (lesions) are to the (organ) surface nearer to (camera collimator) surface more readily they may be detected.

In (equivocal liver scan findings), we should use (Ultrasound - CT).

(Inclusion part of the liver): It is the part that resulting from (radiation therapy). It maybe produced (decreased activity area) in the liver. We can recognize it by its sharp linear edges, which correspond to the sides of the treatment portal.

(Colloid shift): Increased radiocolloid concentration by the (spleen – bone marrow) compared with the (liver).

The mechanisms governing (colloid shift) are:
- Portal hypertension.
- Decrease in the number of (kupffer cells).
(Activity bolus injection): to evaluate (venous obstruction), activity bolus (Technetium sulfur colloid) injected into an (ipsilateral arm vain). This will deliver a large amount of activity to the (liver), causes a (focal hot spot).

Alcoholic liver disease: fig.(8)

- A spectrum of (Tc 99m) colloid scan findings is presented by (alcoholic liver disease).
- In (CT): the (alcoholic liver disease) is seen as (low attenuation area).
- In (xenon ventilation lung): the (alcoholic liver disease) is noted as an (identical finding). This is due to (xenon retention) in the liver.
- **(Colloid shift):** In (alcoholic liver disease) → (hepatocyte function) depressed → (colloid shift) identified on (static images).

- **Metastatic disease:** fig.(9)
- **(CT):** is the initial test for (metastatic disease).
- **(Radionuclide liver-spleen scanning):** detects these as (serendipitous findings)

- In scanning of (metastatic disease):
  - **Tumor:** is present as multiple focal defects.
  - **Lesion:** is present as coarsely inhomogeneous activity.

- **(Scanning sensitivity):**
  - **In (liver - colon - renal cell):** large lesions → sensitivity is greater.
  - **In (breast - lung):** infiltrative lesions → sensitivity is less.

- **(Tc 99m) MAA:**
  - It is performed in (chemotherapy) procedure.
  - It is used for evaluation of:
    - Catheter placement.
    - Distribution of blood flow.
  - The (administered activity): 1 to 4 mCi (37 to 148 MBq)
- **Primary liver neoplasms:** such as:
  - *(Hepatoma)*: fig.(10): to diagnose it, we use Gallium 67 (67 Ga) imaging. Because (hepatomas) are gallium avid.
  - *(Focal nodular hyperplasia)*: fig.(11):
    - It is occurs as (serendipitously lesion) in women.
  - *(Hepatic cell adenomas)*:
    - It occurs as (focal defects) in women's used (birth control pills).
    - (Birth control pills) withheld $\rightarrow$ lesions regress.
    - (Liver-spleen scan) used to monitor (adenomas regression).

- **Miscellaneous focal lesions:**
  - *(Abscess)*: In clinical suspicion, we use:
    - (Gallium) images.
    - (Indium) leukocyte images.
- **(Hemangiomas):**
  - **(Ultrasound):** by using it, we can distinguish between:
    - Cysts: hypoechoic.
    - Hemangiomas: hyperechoic.
  - **(CT):** used to demonstrate characteristic progressive enhancement toward the center of a hemangiomas.

- **(SPECT):** fig. (12):
  - It is used to increase the sensitivity, especially when lesions are deep or less than (5) cm in diameter.
  - The sensitivity of (SPECT) are:
    - 100% for hemangiomas (1.5) cm in diameter.
    - 50% for hemangiomas (1.0) cm in diameter.

- **(Trauma):**
  - **(CT):** is the study of choice for suspected liver trauma.
  - **(Nuclear medicine scans):**
    - More (time-consuming).
    - Less sensitivity.
    - Do not show other potentially traumatized organs.
Patient preparation:
- Fasting (4 hours).
- Infants (below 1 old) may fast for (2 hours).

Protocols:
- Radioagent: 5 mCi (Tc 99m)-HIDA
- Collimator:
  - LEHR
  - Energy: 140 / 20% window
- Method of administration: (I.V.)
- Imaging:
  - Option (1):
    1) Sequential images:
       (32 sec / frames) for 127 frames; (128 x 128); supine; ANT

       Note: fatty meal (2 raw eggs and 1 glass of milk) will be given at 40 minutes PIT.

    2) Delayed static images (if needed):
       (2, 4, 6, 24 hours) PIT; (512 x 512); (300Kcts), supine, ANT and RLAT

    3) Tomogram (if needed):
       (30 sec / frame) for 32 frame; (128 x 128); (180' rotation); supine.