GUNDERSEN LUTHERAN NUCLEAR MEDICINE DEPARTMENT PROTOCOL MANUAL

PROCEDURE: **HEPATOBILIARY IMAGING**

I. HIDA *with* EF
II. HIDA *without* EF
III. ACUTE CHOLECYSTITIS
IV. BILE LEAKS
V. SPHINCTER OF ODDI DISFUNCTION
VI. BILIARY ATRESIA, NEONATAL HEPATITIS & OTHER CONGENITAL ANOMALIES OF BILIARY TRACT

SECTION: **GASTROINTESTINAL 4.2**

ORIGINAL DATE: **4 - 27 - 00**

DATE REVISED: **5 – 25 - 21**

REVIEWED: **ANNUAL**

Associated documents:

Imaging RN HIDA Scan Workflow
Pyxis – How to remove morphine
Imag-0800

Indications	Diagnosis of acute cholecystitis Evaluation of extrahepatic biliary tract obstruction Evaluation of the post-surgical biliary tract Evaluation of gallbladder (GB) ejection fraction Detection of bile leaks Diagnosis of biliary atresia and other congenital anomalies of the biliary tract
Contraindications	*Oral narcotics should be stopped 4 hrs prior to exam. (See list below including but not limited to these oral narcotics). Notify Radiologist if this is not possible. Please notify Radiologist if any of the following medications have been given. Note amount of drug given and time of administration. Approximate duration of affect: IV / PO Fentanyl Patch: 3-5 day / --- Fentanyl P.C.A: 6 hrs / --- Hydrocodone: --- / 3.5hrs Oxycodone: --- / 3-4hrs Oxycotin (Oxycodone CR-control release): ---- / 10-12 hrs Lortab (hydrocodone): --- / 3.5hrs Vicodin (hydrocodone): --- / 3.5hrs Percocet (oxycodone): --- / 3-4hrs Percodan (oxycodone): --- / 3-4hrs Dilaudid (hydromorphone): 4-5hrs / 3.6hrs Methadone: .03-24hrs / 2-10hrs Morphine *CCK is contraindicated in patients hypersensitive to sincalide and in patients with intestinal irritation or obstruction. *If needed, pretreatment of CCK can start the last 30 min of the delays listed above. *Regarding patients with multiple exams (i.e. CT w/ contrast -oral/iv), HIDA should be done first, due to NPO status and concern with possible contrast caused attenuation.
Patient Preparation	*Patient should have fasted between 4 and 24 hours. (If a patient has had **only water or nothing for 24 hours or greater then** we will **pre-treat the patient with CCK** otherwise we can go ahead and start our procedure as usual). *Document date and time of last meal eaten by patient, along with what type and amount. *Document abdominal symptoms patient may be experiencing before and during exam. Use Wong-Baker Pain Rating Scale scale to document discomfort level (Gladiator/Patient Educ. /Select Pain Management (left menu) / Scroll to Pain Scale). *Set intermittent IV *Obtain patient's weight
RRx & Dose	Radiopharmaceutical: 99mTc-Lidofenin (Choletec) Dose: Adult 4 mCi; Pediatric 0.05 mCi/kg (Dosing Range 0.5 – 3.7 mCi) CCK dose to pre-treat patient: 0.02 mcg/kg infuse over 5 minutes slow IV push. CCK dose EF study, after 60 min Gall Bladder visualization images: 0.02 mcg/kg infuse over 44 minutes.
Administration Technique	Standard intravenous injection through IV for Choletec **CCK**: use pump device to IV infuse Cholecystokinin (CCK) over 44 minutes. Imaging will begin 1 min before CCK infusion. (45 min total acquisition) **ENSURE PLUS**: To be used when KINEVAC (CCK) unavailable. Patient drinks 8 oz (11.4 gm fat) bottle contents. Start 2nd imaging sequence to run for 60 minutes: 60 sec/frame, 128 x 128.

STATIC ACQUISITION PARAMETERS

Time interval between tracer injection & imaging	None
Collimator	LEHR
Patient position	Supine
Energy	140 keV
Matrix	128 x 128
Time /View	Basic acquisition parameters: FLOW: 5 sec/frame, total 80 seconds 1 HR DYNAMIC: 60 sec/frame, total 60 min CCK DYNAMIC: 60 sec/frame, total 45 min Look for GB activity: *If activity in ducts, bowel & GB study may be stopped (non-EF study). *For GB EF study proceed to the EF acquisition. If GB is full prior to 60 min check with Rad if you can go right into EF acquisition. *If GB is not visualized proceed to 'Acute Cholecystitis' protocol
Images taken	ANTERIOR, upper abdomen to include liver
Screen caps to make	Images: flow & 1 hr composites GB Emptying data with graph
Send to FUJI	Screencaps

I. HIDA with EF using Kinevac:

A. Follow Basic acquisition parameters above.

B. Image Workflow

1. For GB EF study proceed to the EF acquisition.
   Protocol will que CCK DYNAMIC
2. If GB is not visualized proceed to 'III. Acute Cholecystitis' protocol

C. Data Processing:

1. Highlight pt. name, make sure all datasets are there.

2. Process 'FLOW and 1 HR DYN'
   a. Click "Favorite Applications" tab; Select GB_REFRAME container.
   b. Adjust intensity on both 5-second frames (top ½ of screen) and 5-minute frames (bottom ½ of screen) using the COLOR MAP tab and the sliding scale.
   c. Annotate as needed, create SCREEN CAPTURE by clicking the drop down next to printer icon. Click More button.
      Database Study 1024 color (User template)
      Destination: Database Study 1024 color
      Color mode: inverse
   d. Click Print button and Save. Exit out. Click "File" and "Quit" to complete.

3. Process CCK DYNAMIC
   a. Select GBEF series (if study was ended early may need to modify end time for reframe. For the five-minute composites will need to adjust times to be a multiple of 300 (and initial 80).
   b. Click "Favorite Applications" tab. Select and click "GL GBEF" container to start processing.
   c. Follow processing prompts.
      1). Modify ROI's as necessary to include Gallbladder and exclude gut and ducts.
      2) Adjust intensity on all 3 sections of screen image.
      3) Prior to screen capture annotate image orientation.
      4) If acceptable create Screen capture by clicking on Printer icon and click 'Save' button.
      Database study 1024 color (User template)
      Destination: Database Study 1024 color
      Color mode: inverse
   d. Click Print button and Save. Exit out. Click "File" and "Quit" to complete.
   EF of less than 40% is abnormal.

Using ENSURE PLUS in place of KINEVAC:

Alternative procedure, supplement-stimulated cholescintigraphy:

HIDA with Ensure Plus (Abbott Laboratories): Literature states at least 10 gm of fat are necessary to cause gallbladder contraction. The low range of normal for GBEF with Ensure Plus protocol is 33%.

Taken from JNM: Vol44, No8; pp1263-1266. Cholecystokinin Cholescintigraphy: Methodolgy and Normal Values Using a Lactose-Free Fatty-Meal Food Supplement, Ziessman, et al.

(Call Nutrition Therapy for Ensure Plus if stat need)

Process as "HIDA with EF", but will need to use full 60 min for EF calculations.

II. HIDA *without* EF:

A. Follow Basic acquisition parameters above.

1. If activity in ducts, bowel & GB study may be stopped (non-EF study).
    a. Continue with Data Processing.
2. If GB is not visualized proceed to 'Acute Cholecystitis' protocol

B. Data Processing:

1. Highlight pt. name, make sure all datasets are there.
2. Process 'FLOW and 1 HR DYN'
    a. Click "Favorite Applications" tab; Select GB_REFRAME container.
    b. Adjust intensity on both 5-second frames (top ½ of screen) and 5-minute frames (bottom ½ of screen) using the COLOR MAP tab and the sliding scale.
    c. Annotate as needed, create SCREEN CAPTURE by clicking the drop down next to printer icon. Click More button.
        Database Study 1024 color (User template)
        Destination: Database Study 1024 color
        Color mode: inverse
    d. Click Print button and Save. Exit out. Click "File" and "Quit" to complete.

III. ACUTE CHOLECYSTITIS:

A. Follow Basic acquisition parameters above.

*For Acute cholecystitis (NO EF), there is no need to hold narcotics.

- If CCK PRETREAT is needed, administer per protocol. Wait the 1hr then bring patient down.
- IF no CCK PRETREAT, just bring the patient down, no delay needed. No need to wait for narcotic to wear off.

1. If GB non-visualized at 60 min p.i continue with 30 MIN dynamic: 60 sec/frame
    a. If after 60 minutes the activity remaining in the liver is not enough to visualize the gallbladder, then 2 mCi of Tc-Choletec may be administered. Imaging should begin 15 minutes post injection.

B. For patients ***without*** a driver: Delayed Imaging

1. If GB not visualized at 90 minutes, continue imaging GB region every 30 minutes until the GB is visualized or the exam is at 4 hours post injection.
    a. If GB visualized, a GB EF study is not necessary for the indication of Acute vs. Chronic Cholecystitis.
2. Refer to Reading Radiologist to confirm study is complete.

C. For patients ***with*** a driver/Inpatient: Morphine Augmentation

1. If GB not visualized at 90 minutes, morphine may be given to hasten visualization of the gallbladder. Morphine causes contraction of ampulla and speeds up gallbladder visualization. You only need to take images out to 30-60 min post Morphine injection to see whether gallbladder visualizes. Morphine eliminates the need to take delayed films out to 4 hours or until only minimal liver and bile duct activity remains.

2. The morphine order is in the 'HIDA' order set. Once the NM Tech completes order process, the radiologist will need to sign off the order prior to the RN dispensing the morphine dose. This order set and process can be used for both outpatients and inpatients.
    a. Ordering may begin at the end of 1 HR dynamic and GB is non-visualized.
    b. Alert Imaging RN that an order is being placed for Morphine Sulfate.

3. RN (or NMT) will inject 0.04 mg/kg of morphine intravenously over 3 minutes (This is given when bile ducts and bowel activity is seen but the gall bladder does not visualize). Maximum dose is 3 mg.
    a. See Imaging RN HIDA Scan Workflow
    b. Ask the nurses to bring over both the morphine for administration and the vital signs machine. They will do the patients baseline VS, monitor the patient for the first 30 min and take VS every 30 min.

4. Morphine Ordering Process: *Reminder steps for radiologist ordering morphine*
    a. Open "Nuc Med" tab under "My Schedule" in Epic. Double click on patient name to open encounter.
    b. Fill in options
        i. Enter "morphine" in "Search for new order" box
        ii. *Select "morphine 4mg/ml injection"*
        iii. *Double click on 'Order' in right hand column and make appropriate selections*
        iv. *Dose* – (tech will calculate this weight-based dose and give radiologist correct value; max is 3 mg)
        v. *Click "Accept"*

IV. BILE LEAKS:

A. Patient preparation:
    1. Patients do not need to stop narcotics for study per Dr. Manske 12/07.
    2. If you are just looking for a leak, patients do not need to be NPO. These patients typically have had their GB out per Dr. Manske 9/18.

B. Follow Basic acquisition parameters above.

1. If activity in ducts, bowel & GB study may be stopped (non-EF study).

a. Continue with Data Processing.

2. If GB is not visualized proceed to 'Acute Cholecystitis' protocol

C. Data Processing:
    1. Highlight pt. name, make sure all datasets are there.
    2. Process 'FLOW and 1 HR DYN'
        a. Click "Favorite Applications" tab; Select GB_REFRAME container.

B. Additional images: SPECT/CT or ANT images with the patient standing, may be used to help differentiate the gallbladder and bile leaks from the duodenum.

V. Diagnosis of Biliary Atresia, Neonatal Hepatitis, and other Congenital Anomalies of the Biliary Tract

Preparation: **Breast-feeding** infants- NPO 2-hrs prior to exam for both pre/post phenobarbital. **Formula feeding** infants- 3 to 4 hrs NPO.

PEDIATRIC PATIENTS: For patients < 6 months old, ask if they have been pretreated with phenobarbital, and if not why. When differential between biliary atresia and neonatal hepatitis, give **5 mg/kg/d Phenobarbital in 2 divided doses/day over 2 consecutive days prior to exam.**

Phenobarbital induces hepatic microsomal enzymes leading to increased bilirubin conjugation and excretion in patients with a patent extra hepatic biliary system, by priming the liver for better excretion of RRx and therefore earlier identification of a **patent biliary tree.**

1. Supine imaging of the Ant abdomen. Patient may be sedated if unable to lay still for 3-5-minute images. Zoom as needed to visualize liver similar to general hepatic scanning.
2. Acquire 5-minute images consecutively for 1 hour.
    a. Can use' FLOW and 1 HR DYN' if appropriate
3. Delayed imaging at both 4 and 24 hours of the anterior abdomen.
4. Visualization of the tracer in the intestinal tract with or without visualization of the gallbladder indicates patency of the biliary system and excludes biliary atresia.

VI. SPHINCTER OF ODDI DISFUNCTION:

1. Dose: 5 mCi 99mTc Disofenin, 15 minutes post CCK infusion
2. Patient Prep: NPO at least 4 hours prior to exam (Obtain patient weight)
3. Procedure: Place patient supine under camera
4. Infuse CCK at 0.02 ug/Kg over 3 minutes (diluted to 15cc with NaCl) Reconstitute the CCK with 5 ml of Sterile H20 to make the solution a concentration of 1 mcg/ml.
5. 15 min post infusion of CCK inject radiopharmaceutical
6. Time of Imaging:
    a) Flow: Immediate anterior dynamic images for 60 minutes
    b) Use 1 frame/minute, word mode, 128 matrix
    c) Sum images at 3,6,9,15,30,45,60 min for static delays
7. Processing:
    a) 2 ROI's distal CBD and peripheral in right lobe of Liver CBD as distal as possible but avoid bowel.
    b) Measure:
        time to peak activity in CBD
        time to peak activity in Liver
        activity in CBD at 15 minutes
        activity in Liver at 15 minutes
        activity in CBD at 60 minutes
        activity in Liver at 60 minutes
    c) Measure % CBD emptying:
    100 X (peak CBD counts - CBD counts at 60 min)
    peak CBD counts
    Normal is > 50%
    d) Use computer program to draw ROI's and generate curves for CBD and Liver from dynamic data