

Rhode Island Hospital
COMPUTED TOMOGRAPHY 2006-2007

William W. Mayo-Smith, MD
Professor of Radiology, Brown Medical School
Director of Computed Tomography,
Rhode Island Hospital

Table of Contents

- I. [General Description of CT Division at Rhode Island Hospital](#)
- II. [Educational Goals and Objectives by Core Competency](#)
- III. [Resident Evaluation](#)
- IV. [Reference Sources](#)

I. General Description

There are currently six helical CT scanners at Rhode Island Hospital which perform in excess of 74,000 examinations per year. The Main CT section has a 64 detector row scanner which performs diagnostic and cardiac imaging and a single detector row scanner with CT fluoroscopy for CT guided interventional procedures. There are two multidetector scanners in the ER (4 and 16 detector rows). The Medical Office Center (MOC) and the Pediatric Imaging Center each have a 16 detector row scanner. The department uses dual phase power injectors for every contrast enhanced examination.

Resident and fellow exposure to CT occurs in the Meehan Building, Emergency Room, at the MOC and pediatrics. Computerized tomography is used within all subspecialties of Radiology and this section will refer to the general daily operation of residents rotating through the Meehan Building. Reference will be made to neuroimaging, thoracic imaging and abdominal, pelvic and musculoskeletal imaging. Pediatric scans are performed in the Meehan Building and interpreted in via our Picture Archiving System (PACs) by the pediatric radiologists. Emergency CT scans are interpreted in the Emergency Department.

CT Rotation

The rotation in CT through the Meehan Building begins with rounding on patients in the hospital who have had tubes placed by the CT/US radiologists. Any resident or fellow that has placed a tube in an inpatient, should round on the patient to learn about follow-up catheter management. We are hiring 2 physician assistants who will be working in the CT/US division starting in 2006. At 7:30 a.m. the resident/fellow reports to the CT area and pulls cases from the CT requisition bin adjacent to the door. Tube rounds take place at 8 a.m. to manage inpatients with catheters. The day concludes at 5:30 p.m. or when the work is completed, whichever is later. Readout of CT scans in the Meehan area is divided between the residents rotating in the section and the cross-sectional imaging fellow.

The resident/fellow should review relevant prior exams on PACs to help with accurate interpretation of the current exam. The resident/fellow should review prior discharge dictations and relevant pathology and surgical reports from the Lifelinks computer system. All residents and fellows are expected to have activated Lifelinks account which are activated through the IT help desk (4-6381). The resident/fellow should then review the films and form their own impressions. If you have a question about what is going on with a patient, look up the history in Lifelinks and prior reports! The more history we have, the better our interpretation will be. At this point, all cases will be reviewed with the attending. At mid-day and at the conclusion of the day the resident/fellow should review and sign all of their reports, making sure their queue is empty on the computer system before leaving work. Any unexpected or emergent findings should be

communicated to the referring physician during the course of the day. All studies should be dictated within 24 hours of the exam.

Second through fourth year residents are expected to be able to form basic interpretations of neurological, thoracic, abdominal and pelvic examinations. These residents are expected to help referring physicians interpret studies performed at Rhode Island Hospital when they come to the CT section. When residents are having difficulty interpreting these cases, the attending or fellow in the CT section should be consulted immediately.

Protocolling Cases

There is a comprehensive protocol book for CT examinations performed at Rhode Island Hospital. These are also on line at the department web site or can be seen at www.brownct.org. Residents/fellows should read through the Rhode Island Hospital protocols and be able to describe them in detail to the attending in the section. First year residents should not protocol CT examinations. Please note that there is increasing scrutiny about how radiological examinations are performed and there will need to be careful attention to protocolling CT examinations. For example, if the history given is "liver disease" then the appropriate examination is a three phase liver CT not an abdominal CT. Likewise, if an abdominal CT is ordered, it does not necessarily mean a pelvic CT should also be performed. If we perform a pelvic CT in this circumstance, we will not be reimbursed for that study and in fact could be found guilty of over-billing Medicare with a possible \$10,000.00 per incident penalty.

The resident and fellow should protocol all upcoming cases in the morning and in the evening before leaving for the day. All electively scheduled cases should be protocollod at least 24 hours in advance.

When protocolling a case, the clinical history and prior findings of earlier radiology reports should be acknowledged. The relevant results of prior study should be entered in the appropriate portion of the CT protocolling sheet. On Friday, the resident should protocol all cases for the upcoming weekend and Monday. If abnormalities are found in the examination requested and prior studies, the referring physician should be called to confirm the area of interest to be scanned. The resident/fellow should print their name **legibly** at the appropriate position on the protocolling sheet so they can be contacted if further information on the patient is needed.

Contrast Administration

We routinely use low osmolar intravenous contrast agents at a concentration of 350mgI/cc in adults and the technologist notes the appropriate ICD9 code indication on the paper requisition and on the PACs screen in the lower left corner. Dictations on patients should include the appropriate reason (ICD-9) the agent was administered.

American college of Radiology indications for utilization of low osmolar intravenous contrast are listed below:

Indications for the Use of Low-Osmolar Contrast Media

Previous reaction to contrast medium
History of asthma or allergy
History of cardiac disease or dysfunction
Generalized debilitation
Blood dyscrasia
Risk of aspiration
Age less than 1 year
Other^a

^aSituations in which the supervising radiologist believes that the patient would benefit from low-osmolar contrast media. Such cases might include patients with poor communication skills, severe anxiety, or a patient preference for low-osmolar contrast media. Modified from the Manual on Iodinated Contrast Media, ©1991, American College of Radiology

Residents and fellows should be familiar with adverse contrast reactions and be able to treat the patient appropriately. A set of guidelines for treatment of contrast reaction (Appendix 1) is included at the end of the CT section.

If a patient has a history of a serious contrast reaction and is scheduled for a CT scan with contrast, then an alternative exam should be attempted (noncontrast CT, ultrasound or MR). If contrast is required and there is a strong clinical indication, then the premedication regimen recommended by the American College of Radiology should be followed. **Methylprednisolone (Medrol) 32 mg. p.o. 12 hours and 2 hours before the contrast injection.** In addition, the patient should receive low osmolar contrast material. In general, H₂ blockers (cimetidine) are not recommended. The above assumes the patient does not have a contraindication to steroids (pediatric, pregnant, fungal infection, diabetes, immunocompromised patients, lymphoma, leukemia, peptic ulcer).

Metformin (Glucophage) is an oral hypoglycemic for which precautions should be taken when giving intravenous contrast. Our protocol for administering intravenous contrast in patients on Glucophage is approved by the ACR and is as follows: 1) patients undergoing intravenous contrast agents should stop taking Glucophage either before or at the time of the contrast examination. 2) Patients should remain off Glucophage for 48 hours after their contrast study and then have a serum creatinine drawn. If the creatinine is normal, the patient can resume medication. In the CT section, we will fill out a lab slip for creatinine to be drawn with the results to be sent to the patient's referring internist. The patient will be instructed to call their internist one day after the blood test to decide whether the medication can be restarted. This will save a step for the patient and the internist as the decision to restart the medication can be made by phone call rather than a

visit. 3) Patients with elevated creatinine (greater than 1.5) and on Glucophage should have the contrast administered only if there is a high diagnostic yield to be obtained from the contrast. 4) Note the patients do not need to be off Glucophage for 48 hours before the contrast examination is started.

Evaluation of Serum Creatinine before IV contrast Administration.

It is the policy of the Rhode Island Hospital CT Scan Department to check the creatinine on all inpatients. The Patient Screening/Consent Form is completed for all patients with the assistance of a technologist. All creatinine levels above 2.0 mg% will be referred to the Radiologists.

All out patients must fill out the Patient Screening/Consent form. A serum creatinine level is not needed for outpatients.

All Emergency Patients will be treated as outpatients; hence, a screening serum creatinine is not necessary for the performance of a contrast CT study. If the Ordering Physician is concerned that the patient has renal failure, s/he should wait until the appropriate screening blood work has been returned from the laboratory before ordering the CT.

Women and Infants inpatients that are accompanied by the patient's chart will have the creatinine level checked and Patient Screening/Consent form completed. Patients from Women and Infants Emergency Room are treated as outpatients.

Visipaque is a nonionic dimer shown to reduce the incidence of contrast nephropathy in high-risk patients. In patients with a serum creatinine of greater than 2.0 and in whom CT with contrast must be performed as an emergency (usually pulmonary CTA) Visipaque may be used. In other patients with elevated creatinine and less urgent indications for CT it should be possible to perform a noncontrast CT or an alternative study such as ultrasound or MRI. Visipaque may be used in individual cases with the approval of the attending or if requested by the referring clinician. Note that Visipaque is of no benefit in prevention of idiosyncratic contrast reactions, and does not reduce the incidence of renal failure in patients who do not have an elevated creatinine.

Intravenous Catheter Sizes, Location and Flow Rates

1. IV size and injection rates with 350mgI/cc contrast agents: 20 gauge antecubital IV maximum injection rate is 4cc/sec. 18 gauge antecubital 5cc/sec.
2. CTA (incl. CTPE) intravenous policy: Must have 20gauge or larger IV in an antecubital vein to perform a CTA study (e.g. cannot use a hand IV). Exceptions can be made at the discretion of the radiologist, but only after the radiologist documents **IN WRITING** that there is to be a deviation from this policy.
3. We can use power injectors with triple lumen central venous catheters at a maximum rate of 3 cc/second.

4. We can never use power injectors with regular PICC lines or swann-ganz catheters as the pressure will rupture the catheter. There are purple picc lines which can take power injections up to x cc/second.

Contrast Extravasation

Our policy for contrast extravasation follows ACR guidelines.

A staff physician (fellow or attending) should evaluate all extravasations. Evaluation should include a neurological exam of the affected extremity, documentation of presence or lack of capillary refill and skin ulceration and documentation of presence of distal pulses and presence of pain. The patient should be observed in the CT suite for 2-4 hours after the extravasation with the arm maintained in an elevated position above the heart. The patient should be instructed to apply dry warm packs to the site of extravasation and to keep the arm elevated overnight. For large volume extravasations (>50) the patient should return to the Radiology suite the following day to the same physician.

If there were some findings at the time of the exam (increased pain or swelling), decreased capillary refill, change in sensation or skin ulceration, a plastic surgery consult should be obtained at the time of extravasation. If the extremity looks particularly ominous and needs immediate attention, consult with the Emergency Department is necessary.

As a courtesy, the patient's referring physician should be informed of the extravasation and our management. The extravasation, physical exam and steps taken in management should be dictated in the reports. An addendum can be dictated the following day when the patient is seen in follow-up. If contrast extravasation does occur in the evening (from 5-11PM) when the resident is covering, the findings on physical exam and actions taken should be written on the patients requisition and the details related IN PERSON to the CT attending at 8 AM the following morning.

General Protocol Information:

We are routinely performing 5mm coronal reconstructions for neck, chest and abdomen on all MDCT exams. This offers more diagnostic information from routine scans without need to use the 3D workstation or archive large data sets.

All abdomen/pelvis non trauma CT's now have a dual phase injection protocol of 30 cc contrast followed by 100cc saline. This is followed by a 5 minute delay, then injection of 100cc contrast and image at a fixed delay of 80 seconds. The rationale is to opacify the ureters and bladder with contrast (30cc up front, flush, 5 min delay), without obscuring liver lesions (only 40 cc up front and 100cc contrast given dynamically). This protocol avoids the duplicate delayed scans through the kidneys and bladder and thereby reduces radiation dose.

Dictations

Dictations should be performed and signed at the end of the day. Dictations in CT should include the relevant patient history, pertinent other studies and the CT technique. The CT dictation should include the reason that low osmolar contrast was administered. The body of the report should include the pertinent positive and negative findings given the clinical history. The conclusion should be short and have a new sentence for each important impression. Due to legal issues and appropriate reimbursement, multiple CT examinations in one patient should be dictated in separate paragraphs. For accuracy of communicating the aggregate results, the conclusion of the dictation should contain the results of all the CT examinations performed. Thus for a chest, abdomen and pelvis CT to follow-up for lymphoma the dictation should read as follows:

“The patient is a 35-year-old male with lymphoma treated with chemotherapy, question recurrent disease. Helical scanning using multidetector row CT was performed from the lung apices through the pelvis after dynamic administration of low osmolar contrast material. Low osmolar contrast was given due to a history of asthma (ICD9 code: 493.0-9). Comparison is made with prior CT from 5/15/02.

CHEST: The lungs are clear. There is no evidence of hilar or mediastinal adenopathy. The heart and bones are normal

ABDOMEN: The liver, gallbladder, pancreas, kidneys and adrenal glands are normal. The spleen remains enlarged measuring 20 cm in cranial-caudal dimension. There is no evidence of retroperitoneal adenopathy. The bowel within the abdomen is normal.

PELVIS: There is new left iliac adenopathy with the largest node measuring 3 cm. The bowel, bladder and bones are normal.

Dr. _____ has reviewed the report and all images related to this patient encounter.

IMPRESSION:

1. Normal Chest CT
2. Stable splenomegally
3. New left pelvic adenopathy since prior exam suggesting recurrent lymphoma

Important or unexpected clinical findings should be called to the referring physician at the time of the dictation.

Regulations put forth by CMS (Center for Medicare/Medicaid Services) require that residents and fellows attest to the participation of attendings in the work product. For

diagnostic imaging that product is the report. Thus please add the following sentence at the end of the findings (NOT the conclusion) of every report. “Dr. _____ has reviewed the report and all images related to this patient encounter.”

CT GUIDED PROCEDURES

The residents and fellows will be responsible for performing interventional procedures in Ultrasound and CT. Interventional procedures include lung, abdominal, and bone biopsies, abscess drainages and tumor ablations. General guidelines for performing procedures follows. We require referring physicians call directly to book procedures so there is accurate transmission of clinical information. Procedure booking sheets (see end of this document) should be filled out for all patients when taking the request, and the person filling out the sheet should print their name legibly. First year residents should not book procedures. RIH films can be reviewed on PACs and RIMI and Shields exams can now be accessed via the web on a computer in CT. If the images are from outside, have the CT secretary call that institution to fax the report at the time of the booking. Outside films reviewed for upcoming cases are kept in the biopsy bin area in CT and ultrasound. The plan for the procedure (patient position, side of lesion, area to be scanned and can be entered onto the new procedure sheet. When the procedure sheet is completed, it is brought to the CT secretary who then books the case and can call either the patient or the booking doctor’s office with the time. Patient procedure information sheets are kept in referring physicians offices and should be given to the patient so they know what to expect in advance. If the referring doctor is seeing the patient in his/her office, they can be given a patient information sheet at the time of the booking.

Two days before the procedure, the secretary in the radiology recovery room calls all patients at home to confirm the date and time of their exam to minimize no-shows.

On the evening before the procedure, the fellow and resident should review upcoming cases for the following day to assure that all films and laboratories are in order. If the relevant films are not present, they can be retrieved or restored. Good residents will look at all procedures for the upcoming week to know what is happening, rather than have a “surprise” each morning at 7:30.

On the morning of the procedure, the cases will be reviewed with the attending to decide the appropriate approach to a lesion. The plan for the procedure (patient position, side of lesion, area to be scanned and collimation) should then be entered into the biopsy book which is kept near the interventional CT console. This information should then be reviewed with the charge technologist so s/he can plan the day. When the patient arrives in the CT section, the secretary will stamp a procedure packet and the resident/ fellow will obtain informed consent from the patient. Informed consent includes 1) an explanation of the procedure, 2) expected benefits of the procedure, 3) risks of the procedure and 4) alternatives to the procedure. These all need to be documented. Pre-procedure assessments should be completed by the senior resident or fellow and the

appropriate documentation completed in the Radiology holding area before the procedure. That assessment should include review of the indications for the procedure, relevant blood work and a brief physical exam.

All procedures are performed with the attending present. After the procedure, outpatients are observed in the holding area and inpatients are returned to the floor. A procedure note should be left in the chart.

The format for a radiology procedure note should be as follows:

Date: **Radiology Procedure Note**

Procedure:

Operators:

Medications:

Findings:

Complications:

Orders for monitoring of vital signs and catheter irrigation should be entered on inpatient order sheets. Biopsy specimens for pathology should be hand delivered by the residents/fellow to the surgical Pathology Department which is located on the 3d floor of the bridge building (accessed from the first floor by the ER.) Cytology specimens should be hand delivered to the cytology department (APC 12th floor.) Specimens for microbiology should be placed in a sterilized red top tube. This tube can be used for aerobic cultures, anaerobic cultures and gram stains. Blood culture bottles should not routinely be used for cultures of aspiration specimens.

Dictations of procedures should include a brief history and indication for the procedure, the findings on the localizing CT images, the type and amount of anesthesia used and note of the follow-up period in the radiology holding area. In addition the dictation should include that the patient was discharged home in the care of his/her wife, family member etc with printed discharge instructions. Each procedure CT should include a brief diagnostic portion of the exam with imaging findings. The size and number of lesions, the type and gauge of needle (or catheter) and number of passes made should be included in the dictation. The resident should dictate that the attending radiologist was present during the entire procedure for all interventional cases. All interventional procedure are dictated at the conclusion of the procedure, these should never be dictated on the following day. **There is an interventional database sheet (see end of this document) which should be filled out for every CT guided procedure and placed in the green interventional database binder kept in the interpretation room.**

Pre-operative blood work is not necessary or essential in most cases. A routine bleeding history should be obtained from the referring physician and from the patient. Has the patient had any difficulty with bleeding in the past, with dental extractions or prior surgery? If the patient is on any anticoagulants or drugs which could effect coagulation, this should be noted. When blood work is deemed necessary because of an underlying bleeding history or drug history, baseline INR and platelet count should be obtained.

Patients with a history suggesting the potential for coagulopathy such as those with liver disease, sepsis, or poor nutritional status should be screened.

The department policy on use of anticoagulants and indications for transfusion have recently been modified and are outlined below

Guidelines for Hematologic Values and Medication Usage Prior to Invasive Diagnostic Procedures

Procedure	PT	INR	Rx	Notes
Thoracentesis or Paracentesis procedure	< 20 sec	< 2.5	No FFP	Order 4 hrs before
	20-24 sec	2.5-4	FFP10 mls/Kg	
	> 24	> 4	FFP 15mls/Kg	Order 6 hrs before procedure
Liver, Renal or Lung Biopsy	< 16 sec	< 1.8	No FFP	Order 4 hrs before procedure
	16-20 sec	1.8-2.5	FFP10 mls/Kg	
	> 20	> 2.5	FFP 15mls/Kg	Order 6 hrs before procedure
Lumbar or other CNS Puncture	< 14 sec	< 1.4	No FFP	Order 4 hrs before procedure
	14-16 sec	1.4-1.8	FFP10 mls/Kg	
	> 16	> 1.8	FFP 15mls/Kg	Order 6 hrs before procedure

Aspirin (Excedrin, Bufferin) should be withheld for 36 hours before the procedure (not 7 days)

NSAIDs (Advil, Motrin, Ibuprofen, Naprosyn, Aleve, Indomethacin) should be withheld for 24 hours before the procedure

ADP receptor antagonists (clopidogrel or Plavix) should be withheld for 10 days before the procedure

Selective Cox 2 inhibitors (Celebrex, Robecoxib) do NOT need to be discontinued before a procedure.

In general we do not perform biopsies in patients with $<50,000$ platelets. Avoid platelet transfusions prophylactically but if there is a bleed in a thrombocytopenic patient, give 5 units of platelets promptly.

Joseph Sweeny, M.D. Director of Lifespan Blood bank 6/02 (jm, wm-s)

As the regulatory world becomes more complex, we need to fill out several forms when performing interventional procedures in CT and ultrasound. The following is a summary on these procedures from Marie Kelley RN, nursing director of the radiology recovery area:

When doing invasive procedures in all areas of diagnostic imaging, the following documentation is required:

1. A pre-procedure note indicating the planned procedure, diagnosis/indication for study, allergies and current meds
2. Patient history
3. Review of systems
4. Physical exam
5. Documentation of pre-procedure “time out”
6. Post procedure note
7. Signed procedure orders
8. Discharge instructions

Pre procedure notes and history and physical must be either documented in the patient’s chart or filled out on page 1 of the “sedation, invasive procedure & monitoring record.” Post procedure notes are either documented in the patient’s chart or on page 2 of the “ambulatory surgery record”.

For all procedures or exams requiring sedation the following information **must** be documented on the lower portion of page 1 of the “sedation, invasive procedure & monitoring record.”

1. ASA class
2. History of complications with sedation
3. Sedation plan and sedation meds intended
4. Mallampati airway class
5. Verification of NPO status
6. Consent received for administration of sedation
7. Availability of resuscitative equipment

Documentation compliance is reported monthly to the DI and RIH QA committees.

An outline of specific CT Guided interventional procedures follows.

1. Abscess Drainage:

Abscess drainages should be performed with antibiotic coverage. If it is desirable to hold antibiotics until a specimen is aspirated, antibiotics should be initiated immediately following the procedure. It is the recommendation of the Infectious Diseases Division that 3 grams of Unasyn be given intravenously for broad spectrum coverage of abdominal abscess drainages. Alternatively, 1 gram of Ancef and 80 mg. of Gentamicin may be given intravenously at the time of procedure. Outpatients undergoing an abscess drainage generally should be admitted for overnight observation as all patients have a transient bacteremia from the procedure and may have an episode of hypotension.

Inpatients and outpatients who have tubes placed in CT/US are followed by the residents, fellows and attendings in the CT /US area. A bulletin board in the CT/US area has a list of patient name, location, tube type, date of tube, referring MD and plan. When a procedure is done, the patient data is entered on the bulletin board by the resident/fellow who performed the procedure.

Each morning a resident and or fellow will round on all patients and gather information on 1. overall patient status, 2. fever 3. white count, 4. tube drainage and 5. Irrigation. Residents and fellows will irrigate the tubes on the floor themselves if there is not drainage. A radiology progress note should be written in the chart. At 8 in the morning, we will have "tube rounds" with the residents, fellows and either the CT or US attending to decide on a plan. The person coordinating who will see each patient is the CT fellow (as this fellow is in the CT/US area for a week, unlike the US fellow, residents and attendings). Who sees which patient should be set up the afternoon before. Decisions on patient management, tube pulling, flushing, changing etc. will be made during tube rounds and communicated in the chart and with the appropriate referring service.

2. Renal Biopsies - Benign Disease:

Renal biopsies for benign disease require an 18 gauge automated biopsy needle, i.e. Biopsy gun. They still are considered a high risk procedure, and at this institution are admitted the day of the biopsy. No patient can be on aspirin, and routine blood work is mandatory. In addition, they must have a type and cross match. The Quality Assurance Committee has necessitated that a pre-biopsy form, which is available in CT Scan be filled out on each of these patients and attached to the medical record. There also is a post-biopsy order sheet which has been endorsed by the Quality Assurance Committee. It is therefore necessary that you be sure both of these forms are filled out and attached to the record before the patient leaves the department. A copy of these forms is included at the end of this manual. In general, these procedures are now performed under ultrasound guidance.

3. Renal Biopsies (Renal Mass)

In this circumstance we follow the same protocol that is used for a liver biopsy. This includes the appropriate lab work (PT, PTT, INR, platelets, hemoglobin, hematocrit, and if necessary, a bleeding time). An intravenous line should be placed prior to the

procedure. These procedures can be performed on an outpatient basis and patients do not need to be admitted.

4. Lung or Mediastinal Biopsy:

CT guided lung biopsies are booked in a standard fashion using the CT booking sheet. It is the responsibility of the fellow and attending performing the procedure to review all relevant films before performing the actual procedure. Occasionally, patients with a lung lesion will have other intra-abdominal lesions such as an adrenal mass that are amenable to image-guided biopsy with fewer complications. In addition, for patients with old films showing a benign lesion which is stable, a biopsy may not be necessary. While the "booking" radiologist will attempt to get as much information as possible, it is the responsibility of the fellow and attending performing the procedure to biopsy the most appropriate area

Management of Pneumothoraces

- In general, if the patient develops a pneumothorax before the lung biopsy is completed on the CT table, we will place a chest tube on the CT table and attach it to the pleurevac to reinflate the lung. There is a Pleurevac within the CT suite at all times specifically for this purpose. After the chest tube has been placed, while the patient is on the CT table, the lung biopsy is then performed. The patient is then brought to the recovery room and if there is no persistent air leak, the chest tube may be placed on straight drain and eventually removed in the recovery room and the patient sent home.
- The literature suggests that up to 15% of patients will have a delayed pneumothorax. Most of these occur within the first hour and a small percentage can be delayed as much as three or four hours. It is necessary, therefore, that the patient be in the department at least for two hours so the absence of a pneumothorax can be re-documented. If a small pneumothorax is detected on the immediate post biopsy CT images, I obtain a chest x-ray (PA only) immediately after the CT and at two hours. This way, I can compare chest x-ray to chest x-ray to assess for interval change. If the patient is asymptomatic, hemodynamically stable, the pneumothorax is stable and the patient is reliable and lives near Rhode Island Hospital, he may be sent home with instructions to return to the CT area the following morning. The patient should be given a stamped requisition, told to have a chest x-ray performed the following morning in the General Radiology area, and to bring the chest x-ray to the CT suite and contact the responsible fellow. In general, if the patient remains asymptomatic the following day and the pneumothorax is stable, the patient does not need follow-up. Obviously if the pneumothorax is bigger or the patient is symptomatic, then a chest tube should be placed.
- For a patient who develops a pneumothorax post-procedure and becomes symptomatic, a chest tube should be placed either in the recovery room or in VIR. If a chest tube is placed in the recovery room, I prefer using a 10 French drainage catheter inserted along the anterior axillary line at the level of the nipples. A chest x-

ray should then be performed to assure resolution of the pneumothorax. If the patient is reliable, asymptomatic and there is no air leak, he may be sent home with a Heimlich valve with instructions to return if symptomatic. As stated above, these patient should be given a chest x-ray requisition and instructed to have a chest x-ray performed in the Main Department and to bring the radiograph to the CT suite.

- For patients with a pneumothorax who are old, unreliable, live far from the hospital or desire to be admitted, admission is generally performed to the radiology service. We do not admit patients for observation if they do not have a chest tube.

Admitting Patients

Patients admitted for overnight observation can be admitted to the Radiology service. Unstable patients with complex medical patients should be admitted to the medical service. It is critical to get the bed assigned early in the day, so that the patient does not remain in the radiology recovery room after 5 p.m. It is responsibility of the fellow/resident who did the procedure to write the admit note and admitting orders.

Tips on how to expedite an admission.

- 1- Do it as early in the day as possible. The later you wait, the more painful it is and the longer it takes.
- 2- DON'T call "admitting". DO call "Bed Control" (x44523)
- 3- Know the admitting diagnosis
- 4- Know patient's name, DOB, MR#
- 5- Know the admitting attending. They can't begin to book a bed without this.
- 6- If the plan is to discharge the patient the next day, make sure you book an "OBSERVATION BED". This costs a lot less than a "general" bed. You can't make the mistake of booking a general bed and try to change it to observation-----they won't allow it. You can, however go the other way (i.e. change from observation to a general bed.)
- 7- Make sure an H&P and Ordered are done ASAP. Use "ADCVANDISL:"

Admitting Orders using the POM System

- ❑ Orders are placed using a computerized system called POM – Physician order management system. There is a link on the lifespan intranet home page under the medical section named POM video training tutorial for physicians, which is a useful guide at the beginning of the rotation to learn about the system.
- ❑ You will need a Lifelinks password. The login ID is the same as the six digit number assigned to you for Radiology dictation system. You will be assigned a password at orientation or you can contact Lifelinks help desk at 46381 to get your password.

- ❑ After logging in click on Rhode Island hospital, and go to the Nurses station census. Pick up the nurses station that the patient is being admitted to, for e.g. JB 3 for Jane Brown third floor. The patient's name should already be on the list of that station. Double click on the patient's name. By default it opens the last lab result page.
- ❑ Click on Write orders/ Post procedure transfer orders. Go to order sets and pick up admit/dsch/order. Alternatively go to New orders and pick Admit orders. It gives you various options like- Admit to Dr, Status observation vs. inpatient. Highlight the option you want by single click on it and hit o.k. tab at the bottom of the screen.
- Remember the basic format of writing orders, which should cover the following points:
 - Admit to Interventional Radiology, Dr Mayo-Smith
 - Condition: Good
 - Activity: ad lib, or ambulate with assistance
 - Nursing: chest tube to wall suction at 20 mm hg. There is a comment box for each order in which you can put the changes you want like - change chest tube to water seal at 4.00 am following admission. WE have written two macro orders sets for routine chest tube and abscess catheter maintenance on inpatients which are being incorporated into the POM system.
 - Diet: Liquids and advance as tolerated
 - Vitals: Routine, or q shift with pulse oximeter
 - IV: Int after po.
 - Meds: you can go to new meds order, which gives a list of common meds to search from and includes the doses. There will be a prompt about frequency, if prn then reason for prn etc. After filling all the fields hit o.k. at the bottom.
 - Tests: Go to Radiology and select CXR. Add in comments – CXR on waterseal and call CT section 444-4123 once it is done (you can check it on PACS).
 - There is a prompt for all these choices and you can select one and further add additional comments as needed.

After you have put in all the orders, click the Sign orders tab, and put in your password in the space provided.

When the patient is DISCHARGED (usually the following day) the resident/fellow should write a brief DISCHARGE NOTE. This is important so that the admitting attending does not get nasty letters from the medical records department about suspension of admitting privileges. Discharge notes are required in all patients who are in the hospital for 48 hours or less. Patients admitted for more than 48 hours require a

discharge dictation. The discharge note should be written in the following format and include the following information:

DATE:	Date of Discharge
TITLE OF NOTE:	“Final Note”
FINAL DISCHARGE DIAGNOSIS:	Whatever the diagnosis is.
SIGN THE NOTE	Sign and print your name

Other General Comments Re Lung Biopsies:

- If the patient has a chest tube placed, it is usually a good idea to check the pathology results to confirm a diagnosis has been made before withdrawing the chest tube. If the findings are nondiagnostic, it is best to re-biopsy the patient with a chest tube still in to obtain an adequate sample. In this scenario a “wet-read” can be performed by the pathology service to assure diagnostic material.
- The above outlines are general procedures and clinical judgment obviously needs to be exercised for each individual case.
- In general, you should strive to perform lung biopsies early in the morning as the patient can be discharged even if a pneumothorax develops if there is adequate observation period in the afternoon. Late lung biopsies in outpatients often require admission to the hospital which could be avoided if the procedure is performed early in the morning. Also, whenever possible it is best to schedule elective lung biopsies Monday through Thursday to avoid admission and rounding of the patients on the weekend.

5. Abdominal Biopsy:

Abdominal biopsies can be performed in either Ultrasound or CT. The patient should be stable for at least two hours.

6. RF Ablation:

Patients undergoing RF Ablation are not routinely admitted. All of these patients have conscious sedation and the specific protocol varies depending on the location to be treated. Consult with the CT attending when booking or performing these procedures.

7. Observation of the Patient:

The patient should be observed in the radiology holding area or on the floor for inpatients. For inpatients, follow-up orders for vital sign monitoring and catheter irrigation should be made. A form regarding the history, physical, procedure and

observation care should be filled out on each patient. A pulse oximeter should be utilized whenever conscious sedation is given and vital signs recorded. The hospital mandate for conscious sedation does indicate that patients must have basic monitoring with pulse oximeter if they are medicated with intravenous sedation.

8. Discharge of Patient:

A discharge form is available in the department that should be given to each patient documenting the instructions you have given them. You should be aware that the Interventional Radiology nurse calls each patient whose name is given to them the next day and verifies that the patient is well.

9. Conscious Sedation:

Following conscious sedation the patient must be alert and awake prior to discharge. Type and amount of sedation administered should be dictated in all interventional cases. The medication used for conscious sedation in adults are listed in appendix at the end of this manual.

10. Needlestick injuries

Should the resident suffer from a needlestick injury, s/he should be evaluated at employee health at Rhode Island Hospital.

PEDIATRIC SEDATION

All pediatric sedation is performed by pediatricians on inpatients and by the pediatric sedation team on pediatric outpatients. All pediatric CT's are protocolled by the pediatric radiologists.

The physicians on the patient's floor sedate all inpatient patients. All patients must be monitored by a floor nurse or doctor who brings the patient to CT.

All outpatient pediatric patients, who need sedation, will be sedated by the Hasbro Sedation Team.

Dr Linda Snelling, MD
Joan Holden, RN CPNP

A pediatric sedation referral must be faxed to the department, before the patient is scheduled for the exam. Once the booking secretaries in each area schedule the patient, Joan Holden will call the parents and give directions according to department guideline.

All pediatric MR and CT scans must be checked by a radiologist at the completion of the study, prior to the patient being moved.

The Hasbro Sedation Team must approve all emergency referrals for outpatients.

Linda Snelling,MD, Director

444-4201

Beeper 350-0355

Joan Holden,RN, CPNP

444-8834

Beeper 350-6379

Fax 444-8816

For booking general anesthesia cases for pediatric interventional procedures, the referring doctor and or radiologist should contact the Anesthesia Department at 444-5142 or 444-6030. Dr. Andrew Triebwasser is in charge of pediatric anesthesia.

EDUCATIONAL GOALS AND OBJECTIVES

First and Second Year Residents:

Medical Knowledge

1. Describe the basic physics of computerized tomography
2. Describe Hounsfield units, window and level settings
3. Describe proper CT protocols for specific disease processes
4. Describe dynamic vs. equilibrium phase imaging and differentiate between these entities
5. Describe normal neuroanatomy of the intracranial fossa and the spine
6. Describe normal thoracic parenchymal, mediastinal and vascular anatomy
7. Describe normal abdominal and pelvic anatomy
8. Describe normal musculoskeletal anatomy
9. State indications for a routine chest CT vs. a high resolution chest CT
10. State indications for aortic dissection CT and the protocol to be followed with this examination
11. Describe the differences between axial CT, helical CT, and MDCT

Patient Care:

1. Become familiar with CT protocols for patients
2. Be able to manage contrast reactions

Practice-based Learning and Improvement:

1. Identify, rectify and learn from personal errors
2. Incorporate feedback into improved performance
3. Efficiently use electronic resources (Lifelinks) to access information
4. Schedule exams appropriately

Communication and Interpersonal Skills:

1. Appropriately obtain informed consent
2. Appropriately communicate and document in the patient record urgent or unexpected radiologic findings
3. Produce radiologic reports that are accurate, concise and grammatically correct
4. Communicate effectively with all members of the health care team

Professionalism:

1. Demonstrate respect for patients and all members of the health care team
2. Serve as a role model for medical students
3. Respect patient confidentiality
4. Present oneself as a professional in appearance and communication.

System-based Practice:

1. Demonstrate knowledge of how radiologic information is integrated with the other parts of the health care system in the treatment of the patient
2. Demonstrate knowledge of ACR standards and appropriateness criteria
3. Demonstrate knowledge of cost-effective imaging practices

Second and Third Year Residents:

Medical Knowledge:

1. Respond logically and with competence as a CT Radiology consultant.
2. State the indications for all neurological examinations including but not limited to temporal bone imaging, CT myelograms, and CT cisternograms.
3. Prescribe and interpret CT angiography in the head, neck, chest and abdomen.
4. Indications for CT angiography.
5. Describe volume, doses and administration rates of contrast for CT examinations.
6. Provide a differential diagnosis for
 - a) neuro pathology
 - b) thoracic pathology
 - c) abdominal pathology
 - d) vascular pathology
 - e) musculoskeletal pathology
7. Indications for CT-guided chest interventions.
8. Indications for abdominal and pelvic CT interventions
9. Indication and techniques of CT-guided abscess drainages and biopsies.
10. Orient and supervise the proper imaging investigation of a patient or of a specific disease.

Patient Care:

1. Develop a management plan based upon CT findings and clinical information.
2. Demonstrate proper technique in planning and performing CT procedures
3. Know the appropriate indications for CT examinations and alternatives depending on the suspected diagnosis.
4. Appropriately protocol CT cases based upon the indication for the examination
5. Minimize adverse reactions to iodinated contrast through appropriate patient selection and medication.

Practice-based Learning and Improvement:

1. Identify, rectify and learn from personal errors
2. Incorporate feedback into improved performance
3. Efficiently use electronic resources (Lifelinks) to access information
4. Schedule procedures appropriately

Communication and Interpersonal Skills:

1. Appropriately obtain informed consent
2. Appropriately communicate and document in the patient record urgent or unexpected radiologic findings

3. Produce radiologic reports that are accurate, concise and grammatically correct
4. Effectively teach junior residents and medical students
5. Communicate effectively with all members of the health care team

Professionalism:

1. Demonstrate respect for patients and all members of the health care team
2. Serve as a role model for junior residents and medical students
3. Respect patient confidentiality
4. Present oneself as a professional in appearance and communication.
5. Demonstrate a responsible work ethic with regard to work assignments

Systems-based Practice:

1. Demonstrate knowledge of how radiologic information is integrated with the other parts of the health care system in the treatment of the patient
2. Demonstrate knowledge of ACR practice guidelines for CT examinations
3. Demonstrate knowledge of cost-effective imaging practices
4. Understand treatment implicated by findings on CT (e.g. what is the next treatment that should occur based on the CT findings).

III. RESIDENTS' EVALUATION ON CT ROTATION

These are the evaluation mechanisms used to evaluate the resident and determine that the program goals and objectives are met.

Evaluation Forms

Monthly rotation evaluation by faculty

Evaluation by CT technology staff.

Exams

ACR inservice exam

Mock Oral Board exam

Portfolio

Procedure Logs

The residents will also be evaluated on:

1. Attendance during CT rotation.
2. Efficiency during CT rotation.
3. Knowledge of CT protocols.
4. Knowledge of CT anatomy, physiology and pathology.
4. Knowledge of proper prescription of CT examinations.
5. Ability to provide a reasonable differential diagnosis for a CT imaging finding and suggest the next most appropriate step in the work-up of the patient.
7. Ability to appropriately book and perform CT-guided interventions.
8. Efficiency in dictating studies.
9. Quality of dictations.
10. Interactions with referring physicians.
11. Affability with coworkers, CT technologists, secretaries, nursing staff and radiology support staff.

IV. COMPUTED BODY TOMOGRAPHY REFERENCES

1. Computed Body Tomography
Lee, Sagel, Stanley, Heiken
Raven, 1998
2. Computed Tomography and MRI of the Whole Body
Haaga and Lanzieri
Mosby, 1994
3. High Resolution CT of the Lung
Webb, Mueller, Naidich
1992
4. Computed Tomography of the Body 2nd Edition 1992
Moss, Gamsu & Genant
5. Head and Neck Imaging Fourth Edition
Som & Curtin, 2003
6. Neuroradiology: The Requisites 2nd Edition
Robert I. Grossman, David Yousem
Mosby, 2004
7. Atlas of Human Anatomy
Netter
Ciber-Geigy, 1989
8. Textbook of Uroradiology, 2nd Edition
N. Reed Dunnick, Carl M. Sandler, E. Steven Amis, Jeffrey H. Newhouse.
William & Wilkins, 1997
9. Genitourinary Radiology: The Requisites 2nd Edition
Ronald J. Zagoria
Mosby, 2004
10. Synopsis of Diseases of the Chest, 2nd Edition
Fraser, Pare
Saunders, 1994
11. Robbins Pathologic Basis of Disease, 4th Edition
Ramzi S. Cotran, Vinay Kumar, Stanley L. Robbins
W.B Saunders, 1989

Reference to various anatomy texts and atlases will often be necessary.

CT/US Imaging Interventional Procedure Booking/Order Sheet

Rhode Island Hospital, Department of Diagnostic Imaging 6-06

Patient Name: _____ DOB: / /
Patient Location: _____ Patient Home/Cell #: _____
Ordering Physician: _____ MD Page/Back line #: _____

Brief History:

Procedure Requested:

Lab test desired on sample / Special instructions:

Can patient give Consent? Yes No If not, who will give consent? _____ Contact _____

Translator necessary? Yes No Language: _____

Diagnostic Exam From?

RIH RIMI (fax report) Shields (fax report) W&I (fax report) Outside (fax report):

Is patient taking anticoagulants/Aspirin/NSAID? No Yes, what medication?: _____

Hold Medications as follows: Aspirin 36 hrs; NSAIDS 24 hrs; Enoxaprin (lovenox) 12 hrs; Plavix (clopidogrel) 7 days
If yes, who will tell patient to stop? _____ When? _____ Hx liver dysfunction/coagulopathy?

Lab Work:

Not necessary Done Date drawn: / / Where? _____

Referring Physician to do Last resort: to be done on admission (have patient arrive 2 hours early)

PT/PTT: / INR: PLATELETS: H/H: /
Type & Cross: _____

Patient Position for Procedure: Supine Prone Decubitus Side of Lesion: R L

For Tumor Ablation: RF: Microwave: Cryo: Other: _____

Scheduled Date: / / Time: _____

Resident & Attending Approving Procedure: _____

Today's Date: / /

Radiology Procedure Data Sheet

Pt. Name: _____ **MR #:** _____

Anesthesia: 1. Local 2. Conscious Sedation 3. General

Patient Location: 1. Inpatient 2. Outpatient 3. W&I

Fellow: 1. Caiati 2. Husain 3. Iafrate 4. Singh 5. Resident _____

Radiologist: 1. Atalay 2. Cronan 3. Dupuy 4. Haas 5. Mayo 6. Murphy 7. Pezz 8. Ridlen
9. Other: _____

CA History: 1. No known primary 2. Lung 3. Breast 4. Colon 5. Pancreas 6. Cervix 7. Ovarian
8. Endometrial 9. Lymphoma 10. Prostate 11. Renal 12. Other: _____

Procedure DATE: ____ / ____ / ____ **CT Fluoro time:** _____ seconds **CT Room
time:** _____ min

I. BIOPSY

Pre Bx Probability of CA: 0 (defin. not) 1 (prob not) 2 (equivocal) 3 (prob malignant) 4 (defin. malignant)

Biopsy Site: 1. Neck 2. Thyroid 3. Lung 4. Mediastinum 5. Liver 6. Adrenal 7. Renal 8. Pancreas
9. Retroperitoneal Node 10. Spine 11. Pelvic Node 12. Bone 13. Other: _____

Lesion Size: <1 cm 1 cm 2 cm 3 cm 4 cm >4 cm

Lesions Present: 1. 2. 3. 4. >4

Needle Type: 1. Franseen 2. Temno (20/18G) 3. Biopsy Gun (18G) 4. Coax Lung (19/21) 5. Ackerman
(14)

BX Needle Size: 14g 16g 18g 19g 20g 21g 22g Other _____

Passes: 1. 2. 3. 4. >4 **Technique:** 1. Coaxial 2. Tandem **On Site Cytopath:** 1. No 2. Yes: + 3. Yes: -

II. DRAINAGE

Procedure type: 1. Aspiration 2. Drainage **Technique:** 1. Trocar 2. Seldinger

Location: 1. Neck 2. Pleural space 3. Lung 4. Liver 5. Pancreas 6. Spleen 7. Renal
8. Diverticula

9. Pelvis 10. Spine 11. Extremities 12. Other:

Etiology: 1. Postop 2. Diverticula 3. Immunocompromised 4. Other:

Catheter Size: 8F 10F 12F 14F 21F Other: _____ Number of
Catheters: 1 2 >2 Aspirate Vol #1: _____ Vol #2: _____ Infection: Yes
No Cavity Collapse: Yes No

III. TUMOR ABLATION (circle type →) **1. RF 2. Cryo 3. Microwave 4. ETOH**

Site: 1. Neck 2. Lung 3. Liver 4. Node 5. Spine 6. Bone 7. Renal 8. Other: _____

Lesions Treated: 1. 2. 3. 4. >4 Max dimension (of each lesion) lesion 1 _____ lesion 2. _____

Probe Type: 1. Single 2. Triple # of Probes: 1 2 3 4 5 6 >6 Tip Length: 1cm 2cm 2.5 cm.(cluster only) 3cm

Treatments per lesion: _____ Avg Imped (ohms) _____ Avg Current (amps) _____ Avg Power (watts) _____

Average T max: _____ Average Treatment Time: _____(min) Thaw Time

(cryo) : _____ Vol. (etoh) _____

IV. OTHER PROCEDURE

Type: _____

V. COMPLICATIONS

1. None 2. PTX (no tube) 3. PTX (+tube) 4. Bleed 5. Patient Admitted 6.

Other: _____

VI.

COMMENTS: _____

_____ 7/05

BROWN UNIVERSITY / RHODE ISLAND HOSPITAL

DEPARTMENT OF RADIOLOGY

POST PROCEDURE INFORMATION SHEET

NAME: _ _ _ _ _

DATE: _ _ _ _ _

You have had a needle biopsy/fluid aspiration of your _____ using CT / Ultrasound guidance today.

You should resume all of your normal medications after this procedure and you may use acetaminophen (Tylenol) as a pain reliever. You may shower 24 hours after the procedure and resume normal activity tomorrow as pain permits. You should contact your referring doctor for the results of this test.

You should have no problems. However, as with any invasive procedure there is always a small risk of complication. If within 24-48 hours you develop increased pain, skin redness, fever or shortness of breath or you have any other concerns, please contact us without delay.

Our daytime telephone number is 401-444-8392 (CT) or 401-444-5309 (Ultrasound). Please ask to speak to the radiologist at this number. If any of these symptoms develop after 5 PM you may call the interventional radiologist through the page operator at (401) 444-5611. You may come directly to the emergency room if you feel more immediate treatment is necessary. Please bring this sheet with you as this is important information to provide to the physician on duty.

Physician Signature

Patient Signature

Date