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FOREWORD

“Vascular and Interventional Radiology handbooks have been around since I was fortunate to discover this field four decades ago. But the information contained in this current volume bears little resemblance to the copy I first carried around with me. Each edition is invaluable to the student, however. In the early days handbooks contained a plethora of information on how to make a good film, full of diagnostic information. MA and KVP techniques for different body parts, filming rates to keep down the cost of silver based film, and contrast injection rates and volumes were paramount. Advances in imaging technology greatly simplified this process (still important) and allowed later handbooks to concentrate on technical aspects of procedures such as balloon inflation times, tips and tricks for the newest procedures, and small but important difference in materials used to construct the latest devices.

The current handbook takes us to the next stage, long imagined and sought after by all those in the field: true incorporation of total clinical involvement. This volume will direct the student of Interventional Radiology in the art of providing full patient care, not just being a highly skilled operator. Although this handbook is specific to the Medical University of South Carolina, the majority of information it imparts can be used anywhere in the world to establish a better VIR practice. Other organizations looking to develop similar materials would do well to use this as a guide. Dr. Guimaraes and his team
have done an excellent job of preparing a VIR handbook for the 21st century.”

J. Bayne Selby Jr., MD FSIR
Professor, Former Director
Vascular & Interventional Radiology, MUSC

“Vascular and Interventional radiology is intimately involved in patient care throughout all medical specialties. Minimally invasive therapies are evolving so quickly that traditional textbooks soon become outdated. This up to date introductory handbook to VIR emphasizes a team approach to safe patient centered care. The authors are to be commended in their efforts to enhance patient safety and outcomes through these remarkable medical advances. Congratulations.”

Phil Costello, MD FACR
Chairman
Department of Radiology and Radiological Sciences
“As the radiology residency program director, it is often difficult and confusing for residents to understand what is required in a subspecialty when on a rotation, especially one as complex as interventional radiology. This handbook hopefully will guide residents efficiently into accessing knowledge about Vascular Interventional Radiology practices and procedures and serve as a concise and useful introduction and tool. I am sure it will be a manageable resource to guide residents as they master the specialty. Hopefully over time they will become very familiar with commonly encountered procedures and the way they are managed by the MUSC Vascular Interventional Radiology Division. When they graduate from the program, they will continue to refer to this valuable resource.”

Leonie Gordon, MD
Program Director, Radiology Residency
Department of Radiology and Radiological Sciences
INTRODUCTION

The goal of this handbook is to provide medical students, visitors, residents, fellows, nurses, CT technologists and angiography specialists with some basic information about the most frequently performed Vascular & Interventional Radiology (VIR) procedures. Also, information is presented on how to obtain an adequate informed consent, to deal with the most common procedure complications, to perform appropriate pre-procedure evaluation and preparation, to manage post-procedure care, to perform airway evaluation (Mallampati score), amongst other things.

VIR is a very dynamic and modern specialty. It is in constant change, which requires reinvention and frequent updates in imaging, clinical, and surgical knowledge. In the last decade, VIR has refocused in “best patient care value” and in “patient centered operations”, which has resulted in the creation and expansion of clinical activities such as the admission of patients post procedures, the evaluation and management of patients in outpatient clinics and the consultation service for inpatients.

Recently, the American Medical Association recognized VIR as a medical specialty. Specific VIR board certification is now offered in conjunction with Diagnostic Radiology certification (dual certification). A new IR/DR
residency program has been defined and MUSC will soon match its first group of IR/DR residents.

There will be several challenges in the future, but VIR never has been in a stronger situation to position itself as a medical specialty capable of providing the best minimally invasive procedures, under safe and cost-effective conditions.

There is much new information included in this updated version. The VIR division has made the transition to a full consult service and has integrated this service with EPIC. These advancements were not without their challenges, but these changes will ultimately make for improved patient care and more well-rounded clinical training. There is much new information about the navigating the EPIC chart and maintaining the consult service. We have also included a “Resident Check List” to better delineate resident duties when on service.

Special thanks are in order for the contributions of several people for this updated version. In addition to all of those who made prior editions possible, Dr. Nima Golchin gave helpful updates to the Epic section. Also input from our procedure nurses and technologists were strong additions to the 3rd edition- specifically Linda Poulos, Jenny Hazel, and Lori Rager Dr. Patrick Gilbert compiled and edited the new sections and provided new and updated information based on his fellowship experience and feedback from the previous editions of the VIR Handbook.
Hopefully, this handbook will provide general guidelines and basic knowledge to enhance the learning experience, facilitate exceptional patient care and consequently increasing patients’ safety and satisfaction.

Marcelo Guimaraes, MD FSIR
Director
Vascular & Interventional Radiology
June 2016
RESIDENT GOALS AND OBJECTIVES IN VASCULAR AND INTERVENTIONAL RADIOLOGY ROTATION

If at the main hospital, you should report to the Vascular and Interventional Radiology Division located on the 5th floor of the Children’s hospital. Take the Children’s hospital elevators (F) to the 5th floor. The Division VIR is behind the security protected double doors (use your ID to enter).

If at ART, the VIR Division is on the 3rd floor through the security doors, take a left all the way down the hall, then a right will get you to the VIR suites.

Rotation 1

Patient Care

• Learn layout of the department, including patient flow.
• Learn how to evaluate a patient EMR, with particular attention to the indications and contraindications for the particular procedure requested.
• Learn how to order appropriate labs and imaging studies in the pre-procedural, procedural, and post-procedural care of a patient
• Learn how to obtain a medically legal and ethical informed consent from a patient or a patient's power of attorney for the common procedures done in VIR.
• Learn how to properly document the informed consent in the EMR (pre-procedure note).
• Learn how to do a directed physical exam tailored to the specific procedure, including assessing risk for moderate sedation.

Medical Knowledge
• Learn the techniques, indications, and contraindications to the common IR procedures.
• Read a basic textbook (Requisites) on VIR and learn to use the handbook.
• Learn sterile technique, including pre-procedure scrub and patient preparation and dressing.
• Learn radiation protection of self, co-workers, and patients.
• Learn how to operate the basic functions of the equipment.
• Learn basic techniques of guidewire and catheter handling, including anti-clot measures such as wire-wiping and catheter flushing.
• Participate as first assistant for a variety of the more basic interventional procedures.
• Learn arterial access techniques and hemostasis with manual compression techniques and the use of arterial closure devices.
• Learn technique of ultrasound guidance.
• Learn how to place a PICC line.
• Learn how to place a venous central line.
• Learn how to perform CT guided procedures as the primary operator.
• Learn how to dictate VIR procedures on Talk system.
• Begin reviewing non-invasive vascular studies (CTA/V, MRA/V) with attending IR.

Practice Based Learning and Improvement
• Learn how to evaluate the patient’s previous imaging studies, including mastery of the PACS system, as well as loading and viewing images from outside sources (CD).
• Review any complications or poor outcomes that occurred in IR during the rotation to learn the root cause of the problem and develop and implement mechanisms to avoid the complications or poor outcomes in the future.

Interpersonal and Communication
• Learn how to properly document the results of a study, both in the EMR (procedure note) and verbally (to referring physician).
• Begin role as teacher by inviting medical students on the rotation to observe and teach them anatomy.

Professionalism
• Introduce yourself (or be introduced) to the VIR team (doctors, nurses, techs).
Systems Based Practice

- Maintain procedure log of all procedures in which you participated in the performance, interpretation, and reporting of the procedure for accreditation, credentialing, evaluation and possible program improvement. Record the medical record number, date, type of procedure, supervising radiology attending, and any complications.

Rotation 2

Medical Knowledge

- Learn the shapes, properties and indications for use of the most common vascular catheters.
- Learn the properties and indications for use of the most common guidewires.
- Learn proper guidewire and catheter manipulation techniques during cases.
- Read selected chapters from comprehensive IR textbook (e.g. Castaneda-Zuniga) pertinent to next day procedures of interest.
- Scrub in as primary operator on more basic cases, and scrub in as first assistant on complex cases.
- On all cases, the resident is to learn the indications, contraindications and techniques involved in the performance of the procedure.
• Learn the basics of CT guidance in the performance of complex procedures.
• Performing supervised CT guided procedures such as biopsies and drainages.
• Perform initial evaluation of non-invasive vascular cases (US Doppler, CTA/V, MRA/V) with subsequent review with VIR attending followed by dictation of the cases. (See important information on reading CTA/MRA on call in the section “VIR CT protocols”).

Interpersonal and Communication
• Dictate all cases that the resident scrubbed.

Practice Based Learning and Improvement
• Continue role as teacher by discussing cases with medical students, nurses and techs, to increase their fund of knowledge.

Systems Based Practice
• Review and continue to improve upon the goals and Objectives for the first rotation.
Rotation 3

Medical Knowledge
- Scrub in as primary operator on all types of cases, including vascular, non-vascular, US, and CT-guided.
- Attain a deeper knowledge regarding the clinical and pathophysiologic understanding of the diseases that are being treated.
- Review all major cases with an attending physician (even those not performed by resident) and dictate these cases after review.
- Continue reading selected chapters from comprehensive VIR textbook, as well as relevant articles found in radiology journals (Radiology, AJR) and subspecialty journals (JVIR).
- Learn about catheter maintenance and follow-up care (including dressing care, flushing, input and output).

Interpersonal and Communication
- Take an active role in triaging patients for procedures, working with the VIR nursing staff.
- Continue role of teacher by instructing more junior residents, as well as continuing to teach medical students, nurses and techs.

Practice Based Learning and Improvement
- Review and continue to improve upon the goals and objectives of the first two rotations.
FELLOW GOALS AND OBJECTIVES IN VASCULAR AND INTERVENTIONAL RADIOLOGY (4th and 5th YEARS)

FIRST HALF 4th Year:

The fellow should gain:

1. Theoretical information about vascular diseases GI, Urologic and thoracic diseases, treatable by Interventional Radiology
2. Knowledge of patient preparation, pre and post procedure care
3. Knowledge about informed consent specific for Interventional Radiology procedures
4. Knowledge of specific interpretation and dictation of interventional procedures
5. Familiarity with correct indications, contraindications, risks and complications of Interventional Radiology procedures
6. Familiarity with the on call cases, assisted by the attending
7. Familiarity with the relevant literature of Interventional Radiology

SECOND HALF 4th YEAR:

The fellow should gain:

1. Familiarity with access techniques
2. Techniques of selective catheterization
3. Primary operator skills in diagnostic and therapeutic procedures
4. Knowledge of pharmacology applied to Interventional Radiology procedures
5. Skills to be on call as primary operator, under supervision

**FIRST HALF 5TH YEAR:**

The fellow should:

1. Participate in all diagnostic and therapeutic procedures as primary operator, assisted by an attending
2. Be active in the admission, pre, trans and post procedure care of the patients under supervision of the attending
3. Be on call as primary operator, under supervision of the attending

**SECOND HALF 5TH YEAR:**

The fellow should:

1. Be competent as primary operator in the majority of the Interventional Radiology procedures in the Department
2. Be competent in independent decision making
3. Develop the curiosity about new techniques, procedures, devices and modalities
RESIDENT CHECK LIST

FIRST THING IN THE MORNING, CHECK:

- Imaging Protocol list and assure it is up to date
- PACS for diagnostic imaging from overnight/weekend
- Consult list for outstanding consults.
- Confer with fellows/Advanced Practice Provider (APP) about responsibilities for seeing consults
- Review info and imaging on the day’s scheduled cases, especially for CT cases which are a primary responsibility of the residents rotating in VIR

THROUGHOUT THE DAY

- Work up outpatients including placing H&P on EPIC and obtaining Informed Consent at bedside
- Monitor Consult list and keep communication with the VIR APP and fellows
- Review and work up new inpatients including placing Consult note and Orders in EPIC and obtaining Consent
- Scrub into as many cases as you can
- Post-procedure orders in EPIC right after your cases
- Monitor PACS for VIR diagnostic studies to be dictated (MRAs, CTAs, oncology follow-up CTs)
BEFORE LEAVING FOR THE DAY

- All dictations including diagnostic studies and procedures must be complete in the same day
- Review cases for next day including clinical info/imaging
- Place orders in EPIC for the next day’s outpatients if necessary
PATIENT WORKUP

- Consults/History & Physical exam (EPIC)
- Airway evaluation (EPIC)
- Informed Consent (paper for now)
- Pre-procedure labs (EPIC)
- Medications (EPIC)
- Post-procedure bed rest (EPIC)

Please see the dedicated EPIC help section (pg 149) for more help with entering the data from your patient encounters, particularly placing H&P/Consult notes and Orders.

CONSULTS/HISTORY & PHYSICAL EXAM

General Information

Communication between fellows/residents and the APP on the service is key to avoid duplication of work (e.g. two people working on the same consult) and doing unnecessary work (e.g. working up a consult for a non-indicated procedure).

All patients require an H&P/Consult note, a procedure order placed in EPIC, and an Informed Consent before a procedure can be scheduled. Assuring each patient has these three documents will minimize delays in posting the case. Templates for the consults are available.
If a fellow or resident plans to participate in a case, he/she should know the pertinent clinical information/imaging and have a plan in mind for the case. This includes access, the devices, potential complications, what outcomes to expect, endpoint to consider stopping the case previously discussed with the VIR Attending. Use common sense.

The VIR fellows and radiology residents should be aware of the following information ideally before meeting any patient prior to a procedure: name/type of requested intervention, the indication of the procedure, list of current medications, check the patient’s symptoms if any and review the history of drug allergies. If any of this essential information is not available in the online chart or procedure request, the information should be obtained directly from the patient or from the referring physician before the patient encounter.

The procedure indication should match clinical needs. If there is unclear indication or any concern, it should be discussed with the VIR fellow or Attending.

The list of current medications must be reviewed in order to detect if a medication that should have been stopped was really stopped and when (e.g. Coumadin). Also, check for chronic use of medications such as opioids for pain control, which may lead to difficult analgesia during the moderate sedation with Versed and Fentanyl due to opioid tolerance. Alternative analgesics such as non-steroid anti-inflammatory drugs (e.g. Toradol) or even
general anesthesia should be discussed (especially for procedures in which moderate to severe pain is anticipated, e.g. fresh gastrostomy placement, percutaneous biliary/ nephrostomy tube placement, and TIPS procedures). For additional information, please see the moderate sedation pharmacology section in the appendix.

The history of drug allergies should be reviewed and, if positive, what happened during the “patient’s allergic reaction” should be investigated. It is not unusual for some patients to misinterpret adverse drug reactions (e.g. nausea, vomiting, bad taste in the mouth) to allergic reaction (itching, hives, shortness of breath).

A targeted physical exam should be performed. Lungs and heart auscultation, airway assessment (Mallampati) and evaluation of the procedure access site are minimal requirements during the physical exam. Evaluate the patient for relevant issues regarding the planned procedure (e.g. shortness of breath may contraindicate the patient to lay flat during the procedure or the moderate sedation due to respiratory depression in a patient with poor respiratory reserve or access issues).
INPATIENT CONSULT WORKFLOW:

The VIR Advanced Practice Providers (Nurse Practitioner or Physician Assistant) will be the primary responders to the VIR inpatient consults during work hours M-F 7:30-15:30. The expectation is that the APP and the fellows will communicate first thing every morning and the APP will coordinate the distribution of consultation workload among the APP, VIR fellows and the radiology residents rotating in VIR.

The APP should be the primary person managing the consultation service until 15:30. After that, the VIR fellows need to make sure that the same level of service is provided smoothly until the end of the day.

Consults should be discussed with the attending responsible for the modality (CT or fluoro cases) to assure appropriate indication, workup and preparation.

An APP is expected to have a collaborative attitude and a patient-centric mindset. After the first batch of consultations gets managed adequately, additional consultation posted during the day should be responded to within 90 minutes (consult note in Epic within this time-frame). Currently, the APP will be stationed at the busier hospital, leaving residents and fellows responsible for the less busy location.
PROCESS:

1. Patient is seen and assessed including review of history, systems, films and labs to determine if patient is appropriate for requested procedure. Consent should be obtained at this time.
2. A consult note should be completed in EPIC. The VIR fellows can share notes templates.
3. Pre-procedure orders are placed in EPIC; including any necessary laboratory exams and NPO status.
4. An order for the appropriate procedure must be placed in EPIC before it can be scheduled.
5. Referring team and patient are notified once patient has been scheduled for procedure.

OUTPATIENT PROCEDURE WORKFLOW:

Patients are scheduled for procedure by calling the scheduling line at 792-9271

1. Pre-procedure orders should be placed in the afternoon for the next day’s outpatient procedures to avoid delays upon arrival. (The patient will already have an order for the procedure.)
2. On the day of the procedure, the patient should be consented and have an H&P placed in EPIC. Any possible problems with the patient should be discussed with either an attending of fellow prior to rolling back.
Ideally, the same fellow, resident or APP who obtained the H&P and informed consent should fill out the pre-procedure orders to have continuity of care. The review of the patient’s procedure, indication and H&P will provide enough information to fill out the pre-procedure form regarding of the need for access preparation (e.g. femoral versus radial), I.V. hydration, vesical drain placement (Foley catheter), pre-procedure medications (analgesic, anxiolytic, antibiotic), ordering chemotherapeutic agent from the pharmacy (typically for liver chemoembolization), and in case of allergic reaction to iodine, the prescription of medications. Specific discussion on protocols for I.V. hydration, allergic reaction prevention, pre-procedure blood tests and antibiotic prophylaxis are available in subsequent sections of this handbook. Consult the appendix for possible antibiotic prophylaxis, depending on procedure.

Residents are not responsible for cases done at East Cooper. In some cases, if a patient has been seen in clinic by an attending at East Cooper, they may have been already appropriately worked up. In this case, and H&P update is all that is necessary to document if there has been any change since the last encounter.
AIRWAY EVALUATION AND ASA CLASSIFICATIONS

Anesthesia Guidelines with ASA and Mallampati Classification

Please note that all Mallampati scores of IV should require evaluation by anesthesiology. This is often a rate-limiting step, so mention it to the VIR attending and consult anesthesia promptly.
Notes regarding anesthesia:

1. Most pediatric cases generally require GA, and cannot be guaranteed to be performed the same day. Discuss the case with the patient and family and VIR attending. Some older pediatric cases may not need GA depending on the procedure.

2. Majority of left ventricular assist device (LVAD) cases require GA. Discuss this with the VIR attending.

3. Fresh G tubes often require GA.

4. Fresh biliary drains often require GA.

5. RF ablations often require GA.

6. RF wire cases require GA.

7. Mallampati IV requires anesthesia consult (they will not necessarily need GA for the case, but must be evaluated prior to proceeding).

If the patient is to undergo General Anesthesia, it should be arranged and scheduled by the board runner. A separate informed consent must be obtained from the Anesthesiology team.
Consider Foley catheter placement for the following:

1. The case will be of a long duration (>2 hrs).
2. The pelvic vasculature is the focus of the exam (e.g. Uterine Fibroid Embolization)
3. Initiating lytic therapy. The patient will be on strict bedrest while TPA is being administered in an ICU. Catheter placement after initiating TPA could result in GU hemorrhage.

Make sure to discontinue the catheter as soon as possible following the procedure.
INFORMED CONSENT

General Information

Informed consent must be obtained for all interventional procedures. The steps of the procedure should be explained to the patient using colloquial terms as well as special considerations for the procedure when appropriate. Indication/benefits, risks, potential complications and alternatives for the procedure should be discussed.

All consents require a witness and should ideally be obtained from a person that witnessed the consent and conversation about the procedure.

In general, all interventional procedures carry risk of bleeding, infection, and pain. Damage to surrounding structures is also a risk, depending on where the target lesion is located. There is also always a possibility that the procedure will fail to yield the diagnostic or therapeutic benefits expected. Please refer to the subsequent section for specific risk associated with each procedure.

Contrast-induced nephropathy (CIN) and contrast allergic reaction should be discussed if iodinated contrast will be used. Alternatively, negative contrast such as CO2 (carbon dioxide) could be considered and discussed with the VIR attending. It is especially important to prevent CIN in patients with Diabetes Mellitus, Multiple Myeloma and borderline kidney function (Creatinine > 1.5). Hydration and reduction in the amount of iodine contrast should be
discussed with the VIR Fellow/Attending. Special attention should be paid to patients with history of cardiac failure. End-stage renal disease (ESRD) patients with chronically elevated creatinine do not need hydration protocol.

For complex cases that may require extended fluoroscopy, the patient should be made aware of the small possibility of radiation exposure complications (see appendix for cutaneous injury threshold doses).

Patients who are Spanish speakers must sign an Informed Consent in Spanish. The consent may be obtained by an authorized Spanish speaking M.D. (from VIR Dr. Schonholz and Dr. Guimaraes) or by an official interpreter.

On a practical note, this can be printed out from the URL https://www.musc.edu/cce/ORDFRMS/. Search for surgical consent, and a blank form may be filled in and printed off. Alternatively, whoever is running the desk at either hospital can print off a specific, pre-filled in consent form. Lastly, make sure to get consent witnessed by the patient’s nurse if obtained before the patient gets to the VIR unit.

NOTES:

Efforts are being made to convert Informed Consent to an electronic process, however, at present, we are still using the paper consents
MUSC Health

AUTHORIZED FOR ADMINISTRATION OF ANESTHESIA AND FOR PERFORMANCE OF OPERATIONS AND OTHER PROCEDURES

Page 1 of 2

Form Origination Date: 1/00
Version: 7
Version Date: 07/07

1. I authorize the performance upon (Myself or name of patient) of the following operation / procedure:

   (Description of operation or procedure)

   (Physician's language / Medical description of operation or procedure)

   for the preoperative diagnosis of

   (Specify diagnosis)

   to be performed under the direction of Dr(s):

   (Name of attending physician)

   and / or such associates, partners, assistants, or designees as may be selected by him to perform such operation / procedure. I understand that the individuals participating in my operation / procedure are physicians who are in approved medical residency training programs or are nonphysician skill-based care providers. All individuals participating in my operation / procedure are under the direction of Dr(s):

   (Names of participating physicians)

   I understand that my primary physician for this operation / procedure will decide who should participate and in what manner at the time of my operation / procedure and that this decision will be based upon my condition and needs at the time of the operation / procedure and who is available to meet those needs. Other individuals may perform important parts of the operation / procedure such as opening and closing, harvesting grafts, dissecting or removing tissue, suturing tissue, or implanting devices.

2. I recognize that during the course of the operation / procedure, unforeseen conditions may necessitate additional or different procedures or services than those set forth above, and I further authorize and request that the above-named surgeon and / or his / her associates, partners, assistants, or designees perform such procedures that are, in his / her (or their) professional judgment, necessary and desirable.

3. I consent to the disposal by hospital authorities of any tissue or members, which may be removed during the course of the operation. I further give my consent for the hospital authorities, at their discretion, to save for research and educational purposes all or part of the tissue or specimens normally thrown away. I understand that the tissue or specimens saved will not be linked to my name or any other identifier that could be traced to me. If you do not give permission for any removed tissue or specimens to be saved, strike through this paragraph and initial to the left of the paragraph.

4. For the purpose of advancing medical knowledge, I consent to the admittance of medical students and other observers, in accordance with ordinary practices of this medical facility, to the use of closed-circuit television, the taking of photographs (including motion pictures) and the preparation of drawings and similar illustrative graphic material. I also consent to the use of such photographs and other materials for scientific purposes.

5. The nature, proposed and possible consequences of the operation / procedure, possible alternative methods of treatment, the risks involved and the possibility of complications including those listed below, and the potential problems that might occur during recuperation have been fully explained to me. Although we have discussed the potential likelihood of success, no guarantees or assurances have been made or given by anyone as to the results that may be obtained.

   (List of risks, complications, and potential problems)

Patient initials / Physician initials

all_consent_surgeryconsent

OTE 700024 Rev. 07/07
6. I understand and consent to blood transfusion and / or blood products if needed before, during and after my surgery until discharge. I acknowledge that my doctor's explanation included the reasonable benefit and potential risks that I have been told can occur with transfusion of blood and / or blood products such as hepatitis, AIDS, cytomegalovirus (CMV), hemolytic reactions, and fluid overload. ☒ N/A

7. I consent to the administration of such anesthetics as may be considered necessary or advisable by the Anesthesiologists, Certified Registered Nurse Anesthetists (CRNA), and others assisting with the anesthesia process. Prior to the procedure I will have the opportunity to discuss my plan of anesthesia care in detail with the Anesthesia care provider of such service with the exception of ________________________________ (State exception or write “none”)

8. The nature, proposed and possible consequences of the anesthesia / moderate sedation, possible alternative methods of treatment, the risks involved and the possibility of complications have been fully explained to me. No guarantees or assurances have been made or given by anyone as to the results that may be obtained.

I, THE UNDERSIGNED, HAVE HAD THIS FORM EXPLAINED TO ME AND FULLY UNDERSTAND THE CONTENTS OF THIS AUTHORIZATION.

Witness ___________________________ Patient or authorized person ___________________________

Witness for telephone consent ___________________________ Pager ID ___________________________

Physician obtaining consent ___________________________ Relationship ___________________________

Date __________ Time __________ A.M./P.M.

all_consent_surgicalconsent ___________________________ OTE 700034 Rev. 07/07
**PRE-PROCEDURE LABS**

All blood work must be from within **30 days** of procedure. VIR attending may waive labs depending on the clinical situation and procedure. Labs may be ordered depending on the clinical scenario even if recent labs are present. However, consistency and common sense should prevail.

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<th>PROCEDURE</th>
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<th>Cr</th>
<th>CBC</th>
<th>*K+</th>
<th>CMP</th>
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<tbody>
<tr>
<td>Abscess/collections Drain placement</td>
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<td>Angiogram/ Angioplasty (non-dialysis)</td>
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<tr>
<td>Biliary Drainage/ Tube Placement</td>
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<tr>
<td>Biopsies CT</td>
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<tr>
<td>CT guided liver, kidney, lung ablations</td>
<td>X</td>
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<td>Chemoembolization</td>
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<td>Dialysis Catheter Placement</td>
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<td>Dialysis Graft Thrombectomy</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
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<td>Embolization procedures</td>
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<td>PROCEDURE</td>
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<td>Cr</td>
<td>CBC</td>
<td>*K+</td>
<td>CMP</td>
<td>N</td>
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<td>Fistulagram</td>
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<tr>
<td>G/J Tube Placement</td>
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<td>X</td>
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<tr>
<td>G/J Tube Replacement</td>
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<tr>
<td>IVC Filter Placement</td>
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<td>Kypho-Vertebroplasty</td>
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<td></td>
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<tr>
<td>Nephrostogram / tube exchange*</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Nephrostomy Tube Placement</td>
<td>X</td>
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<td>Paracentesis</td>
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<tr>
<td>Port Placement</td>
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<tr>
<td>PICC</td>
<td></td>
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<td>X</td>
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<tr>
<td>Non-tunneled catheters</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>X</td>
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<tr>
<td>Tunneled catheters</td>
<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>Chest Tube Placement</td>
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<td>Port Check</td>
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<tr>
<td>Port Removal (Coumadin)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>SIRS work-up and infusion</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
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<tr>
<td>Tunneled catheter Removal/exchange (No Coumadin)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
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<tr>
<td>Thoracentesis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>TIPS</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TJ Liver Biopsy</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**PROCEDURE** | Plat/INR | Cr | CBC | *K+ | CMP | **NONE**  
---|---|---|---|---|---|---  
Ureteral Stent Placement | | | | | | X  
Uterine Fibroid Embolization ** | X | X | | | |  
Venogram (Arm or Leg) | | | | X | |  
Venous sampling | X | | | | |  

* Recent TBili and Cr levels should be documented prior to biliary drain and nephrostomy tube removals.

** Pregnancy test must be ordered and checked for all UFE cases and on all women of child bearing age.

*** Y90 cases MUST have CMP drawn the DAY of treatment.

**NOTES:**

For PICC lines, non-tunneled central lines, some tunneled lines, and tube exchanges, labs are not always necessary upon review of patient history.

Notify the VIR attending if platelets <50, INR<1.5. In some cases we still may proceed with interventions.

Other abnormal lab values should be noted, especially elevated creatinine in a case that will require contrast, and elevated bilirubin in liver directed therapies.

Check Urine Pregnancy Test on all women of child bearing age.
POST-PROCEDURE CARE

POST PROCEDURE BED REST PROTOCOLS

FEMORAL ACCESS

After Arterial access:

- 2 hours of bed rest with punctured leg immobile if a closure device is used without complication

- 6 hours of bedrest often necessary if hemostasis obtained with manual compression

After Venous access:

- 2 hours of bed rest with punctured leg immobile following most femoral vein access
RADIAL ACCESS

- 2 hours of bedrest with TR band in place, deflated per TR band protocol.

Post-Procedural Catheterization Care using the TR Band:
1. The TR Band is placed and inflated with 15ml of air.
2. The sheath is removed, and then air is removed until a flash of blood is seen and 2ml of air is replaced in the TR Band.
3. May make small adjustments in inflation/deflation based on the waveform.
4. Patent hemostasis is the goal.

Care of the patient after the TR Band is removed:
1. Following radial access, the TR Band is removed after 2 hours (first hour of observation, band deflation during the 2nd hour).
2. Attach pulse oximetry on left index finger to help assess perfusion of the hand.
3. After the first hour of observation, deflate the balloon of the TR band as follows: Remove 3ml of air every 15 minutes until fully deflated, assessing pulse, bleeding and access site closely. Inflate band if bleeding occurs.
4. Leave band on for additional 15 min once fully deflated and then remove it.
5. Cover with Tegaderm dressing.
6. Give patient “Radial Artery Discharge Instruction Sheet”.

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We are currently working to decrease the time of the TR band removal protocol, and the above procedure may change in the future. More radial access info is located in the appendix.

**LUNG BIOPSY**

- CXRs obtained at 1 and 3 hours post procedure.
- These patients should be recovered in the prep and recovery area, even if they are inpatient.
- Typically, the patient has the NPO released if the 1 h chest X-ray is normal. Patient may be discharged if there is no pneumothorax at the 3 h CXR.

**MOST OTHER PROCEDURES**

- 2 hours post-procedure monitoring is usually sufficient to watch for possible complications and to allow sedation to wear off. Fellows and residents should round their patients (briefly) to check immediate post procedure complications - make sure that access site and the vital signs are OK before the patient is discharged.

**NOTES:**
POST PROCEDURE ORDERS

Following a procedure, all **outpatients and inpatients** will need post procedure orders. The VIR order sets should be used pre and post interventions. There is one standing orders set, one generic pre-procedure orders set, and 8 procedure specific post-procedure orders set. Outpatients should be monitored in the recovery area until their sedation has subsided. As a new policy, inpatients are also to be monitored in the prep and recovery area following any procedure that requires sedation.

Orders are necessary to remove the peripheral IV, monitor vital signs, resume regular/especial diet, and to be discharged. Most patients need some pain control depending on the procedure. Bed rest per protocol should be followed. Any special instructions regarding post procedure care should also be communicated to the patient and to the referring clinician. Placing orders immediately following the procedure (however inconvenient) will avoid phone calls and pages from the recovery nurses and will improve efficiency.

**NOTES:**
ADmits

Generally, the fellows (or resident if managing the case) will be responsible for either directly admitting or coordinating admits to another service. Communication with the admitting team (if not VIR) is necessary to relay important clinical and procedural information.

If directly admitting to VIR, admit orders including home medications, vital checks, appropriate diet, and prn medications (e.g. for pain, nausea, hypertension, itching, sliding scale insulin for diabetics) are advised for patient comfort and to avoid numerous phone calls on admits. Next morning, all admitted patients (regardless the admitting team) should be rounded on in before starting to perform VIR cases, by the APP, resident, or fellow. Make sure to communicate with the VIR attending the patient status and discuss an action plan (e.g. discharge, transfer to Hospitalists, order images or laboratory exams, etc). Make sure to document the visit either in the Epic progress note or in the discharge summary.

These cases requiring an inpatient stay should be discussed with the fellow on call, as he/she will be handling calls overnight on admits.

NOTES:
RESIDENT DUTIES ON CALL

When on call, the radiology resident will often be asked questions regarding VIR procedures, and how to get an emergent procedure performed after hours. Often, the consulting physician will directly contact the VIR fellow personally; however, it is important to know what information regarding the case is available, and what may be needed in order for the case to be performed.

Also, there are often CTA studies that will be read by the overnight resident that will need the attention of the VIR fellow and attending.

RESIDENT DUTIES FOR “ON CALL” VIR CASES

The consulting service should contact the VIR fellow on call directly regarding a possible emergent case overnight or on the weekend. However, if the on call resident fields a call related to a VIR consult, it is helpful to obtain the following information, which should be passed on to the on call VIR fellow: (This information should be obtained on all inpatient consults seen by VIR prior to posting a procedure.)

1. Patient name and MRN
2. Referring physician and service
3. Determine procedure to be performed
   a. Have requesting MD write an order for VIR consult in EPIC
   b. Gather basic relevant clinical information
   c. Are there other imaging studies available for review from MUSC or elsewhere (for example, in MIES)?
4. Patient location
5. Patient weight (weight limit is 440lbs for Angio tables)
6. Laboratory (abnormal results do not preclude the case from happening, but they must be discussed with the VIR attending).
   a. Platelet (ideally >50K)
   b. Creatinine (ideally <1.5)
   c. INR (ideally <1.5)
7. History of allergies: medications, iodine contrast?
8. Consent
   a. Is the patient consentable? If not, who will give consent? (Acquire telephone # if phone consent needs to be obtained from a family member)
   b. If patient cannot give consent and there is not a family member to contact, have requesting service write emergent note in chart with 2 different MD’s signature
9. Is patient on ventilator? Hemodynamically stable?
10. NPO status?

NOTES:
POLICY FOR RADIOLOGY RESIDENTS ABOUT READING CTAs OVER THE WEEKEND

On call, there will be studies that VIR is responsible for-CTA’s of the extremities, abdomen, pelvis, chest, including trauma (please see below for list of studies and protocol information). As with all call studies, results should be communicated with the referring physician as soon as possible and the impression should be placed in the ibox.

If an overnight study is completely negative and the resident is comfortable calling the study negative, the VIR attending on call should be notified via page in the morning before the call resident leaves. If the CTA is read during the day (on the weekend), page the VIR attending soon after the case is pre-dictated.

If there are positive findings at night, a call should be made to the referring physician right away. If these findings would require VIR intervention, page the on call fellow as well. If you are uncertain, page the VIR fellow at any time. Document that the VIR fellow has been paged in the ibox. If the VIR fellow does not respond STAT, it may be because he/she is scrubbed in an on call case. The radiology resident should review and discuss all the positive studies with the VIR fellow immediately or soon after the VIR fellow is available.

If there are positive findings during the day, the radiology resident should page the VIR attending directly soon after
the case is pre-dictated, so both can discuss the findings and the report can be signed off by the VIR attending in a timely fashion.

If there are emergent findings during the day or at the night that would require immediate intervention, call the referring clinician and page the VIR fellow on call STAT. As always, the VIR fellow should return the page to discuss the case ASAP. If the fellow does not return the page within 5 minutes, page the VIR attending on call.

This workflow will allow the overnight/weekend CTAs being reviewed and signed off by the VIR attending in a timely fashion. All these reports can be signed off the same day or the next day in the morning.

There will be CTA’s without clear indication on who should read it (VIR, Body, Cardiac, Thoracic), use the best judgment about whether VIR would be reading the study. If there is any doubt, err on the side of notifying the VIR fellow. The VIR fellows are aware they will be contacted about these studies.

NOTES:
DIAGNOSTIC IMAGING

There will be an assigned VIR attending responsible for checking out diagnostic studies each day. These studies should be dictated and signed out with that attending. The VIR attending schedule can be found here: http://academicdepartments.musc.edu/radiology/divisions/pdf/intrad-call-schedule.pdf

The senior resident is ultimately responsible for interpretation of the CTAs, MRAs, and interventional oncology patient abdominal studies. The junior resident should help with reading diagnostic studies. The senior resident should set clear expectations with junior resident(s) in regards to sharing the diagnostic workload.

During the regular work hours, the diagnostic studies should be signed off by a VIR attending before the end of the day. The resident should contact the VIR attending responsible for the diagnostic studies to check them out as soon as time permits, particularly if the attending is at a different site. Checkout will vary based on the attending. Do not leave the VIR diagnostic studies to be read late in the afternoon or at the end of the day.

If there are no senior residents on rotation, the residents should decide amongst themselves who will be responsible for the studies and let the VIR attending know.
COMPUTED TOMOGRAPHY VIR PROTOCOLS

The senior resident is responsible for protocoling diagnostic imaging. This should be done a month out and monitored first thing daily for new studies.

- **Pre/Post Endovascular Abdominal Aorta Aneurysm Repair (EVAR)**

  **Pre EVAR:** Low dose non-contrast and arterial phases from diaphragm to femoral neck.
  **Post EVAR:** Low dose non-contrast, arterial, and delayed phases from diaphragm to femoral neck
  All 1.5 mm slices, with MPR and 3D reconstructions

- **Pre/Post Thoracic Endovascular Aorta Aneurysm/Dissection/Intimal tear Repair (TEVAR)**

  **Pre TEVAR:** Low dose non-contrast and arterial phases. Scan from the base of the neck to the femoral heads.
  **Post TEVAR:** Low dose non-contrast, arterial and delayed phases.
  Scan the Chest: from the base of the neck to the diaphragm.
  All 1.5 mm slices, with MPR and 3D reconstructions

- **Pre/Post Central Venous Recanalization/ RF wire technique**

  Phases: Low dose non-contrast, Arterial, Venous – all 3 mm slices
  Scan Chest: from the base of the neck to the diaphragm
  MPR reconstructions
• Abdominal CTA for flap construction DIEP (Deep Inferior Epigastric Perforators)

Phases: Arterial
Scan Abdomen and Pelvis: from the diaphragm to the femoral neck
1.5 mm slices, with MPR / MIP reconstructions

• Lower extremities Run-off

Phases: Low dose non-contrast and Arterial
Scan Pelvis and lower extremities:
- **Peripheral arterial disease**: scan from the diaphragm to the toes
- **Pre-op for fibular flaps**: scan from the crest to the toes
All 1.5 mm slices with MPR and 3D reconstructions

• Mesenteric CTA (Unless ordered by ED for mesenteric ischemia)

Phases: Low dose, 5 mm non-contrast and 1.5mm Arterial. Abdomen and Pelvis: scan from the diaphragm to the pubic symphysis
Provide MPR reconstructions

• Renal CTA (Unless living renal donor protocol)

Phases: Low dose non-contrast and Arterial
Abdomen: scan from the diaphragm to crest
All 1.5 mm slices MPR reconstructions
- Liver CT (pre/4 weeks post TACE and RFA procedures, VIR clinic patients)

4 Phases: Low dose non-contrast, Arterial, Venous, Delayed
Abdomen: scan from the diaphragm to crest
All 3 mm slices with MPR reconstructions
Delayed imaging will be obtained in certain cases

General comments on CTAs:

- All contrast volumes and flow rates determined by patient weight and scan duration.
- Best scanned with Dual Energy. If single source scanner, use 100 kV what is best for any arterial work.
- Omnipaque 350 is used for all CTAs.
- 20-gauge peripheral I.V. access in the upper extremities, unless evaluating the aortic arch vessels in which case, lower extremity injection may be preferable.
- In case of known central venous occlusion, access should be obtained preferably on the contra-lateral side of the occlusion.
- VIR should read any complex CTA that may fall into a “gray area” or that is not read by other Divisions.
- Please confirm that the listed indication on the study is factual and appropriate for the exam. Double check reports to minimize errors and typos.
ASEPTIC TECHNIQUE-GUIDELINES FOR VIR

All VIR staff and any visitors entering the suites should follow these recommendations. These guidelines have been derived from the Aseptic Technique guidelines from MUSC, and adapted to fit the VIR working area. These guidelines will be amended as indicated by current practice trends.

- All VIR staff should wear head covers, mask, gown and gloves when setting up a sterile field.
- All medical staff and visitors should wear head covers and mask when entering a procedure room that has an open sterile field. Protective gear should be worn until the procedure is completed or a dressing is in place.
- All procedure trays should be set up as close as reasonably possible to the beginning of the case and/or covered to minimize the risk of contamination.
- An inspection of all pre-packaged sterile trays should take place prior to setting up each case. Integrity of the sterile procedure tray is to be confirmed and maintained by the Angio Specialist (Radiology Technologist) setting up the tray.
- VIR staff and visitors are required to dress in scrub attire when in the procedure rooms. Scrub attire is
defined as clothing that is non-shedding and made of cotton fabric. Loose fitting coats and shirts are discouraged.

- IV fluid lines should be set up on every patient in the procedure suite. IV solution order per protocol (see appendix). Nurses should utilize the side arm port of the fluid line to administer medications. Manipulation of the sterile drape should be avoided at all times.

- VIR staff that is going to scrub into a case should perform surgical hand scrub. All other staff should follow hospital guidelines for handwashing after each contact with a patient. Scrubbed staff should not travel from procedure room to procedure room. Scrub attire must be changed if a staff member enters another procedure room to assist with a case. Avagard may be used between cases if a surgical scrub has been previously performed.

All of the interventional staff practicing in the VIR working area is responsible for following these guidelines and providing their team members with constructive feedback when they observe breaks in aseptic techniques. Breaks in the guidelines should be corrected at the time of the incident.

NOTES:
CT GUIDED PROCEDURES

The radiology resident is primarily responsible for the CT-guided procedures. The majority of these are biopsies, but there will be also drain placements/checks and solid organ (liver, kidney, lung, etc) ablations using microwave, radiofrequency, or cryoablation. It is important to preview prior imaging if available to plan the approach for the percutaneous CT guided intervention and how to position patient for best approach. Consideration should be given to critical surrounding structures (thermal protective techniques are needed?) and respiratory motion (especially lung and liver).

The expectation is that the resident should proactively review the requested case, discuss the indication, patient’s position, site for access and devices. Need of general anesthesia (GA) should be considered. As a general rule, all the pediatric patients will require GA. Coagulation status of the patient should be discussed with the VIR attending and corrected as needed.

Regarding percutaneous biopsies and drainages procedures, keep in mind that, depending on the clinical question, samples of the target area may need to be sent not only to pathology, but also to microbiology and biochemistry.
<table>
<thead>
<tr>
<th>Procedure</th>
<th>CT Guided Biopsy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indication</td>
<td>To obtain tissue for pathologic/microbiologic diagnosis</td>
</tr>
<tr>
<td>Consent/Complications</td>
<td>Bleeding (Category 1-superficial; Category 2- abdominal, lung, retroperitoneal, liver; Category 3-renal), infection, bruising, damage to adjacent organs, tumor cell seeding in the needle tract. Lung biopsy – hemoptysis and pneumothorax (which may require a chest drain and overnight admission). If hemoptysis occurs, use oral aspirative cannula to help drainage of blood, check O2 levels, BP and keep the bleeding side down (lateral decubitus)</td>
</tr>
<tr>
<td>Contraindications</td>
<td>INR &gt;1.5, Platelets &lt;50K, discuss with VIR attending about blood products.</td>
</tr>
<tr>
<td>Alternatives</td>
<td>No biopsy, Surgical biopsy Treatment without diagnosis</td>
</tr>
<tr>
<td>Medication</td>
<td>1% Lidocaine</td>
</tr>
<tr>
<td></td>
<td>Moderate sedation (Versed/Fentanyl)</td>
</tr>
<tr>
<td>Equipment</td>
<td>CORE: Biopsy Temno kit (general rule: lung and lymph nodes 20G. Liver and kidney mass 18G. Kidney cortex 16G) FNA: Franseen needle, 20 or 22G. 22G is the most commonly used.</td>
</tr>
<tr>
<td>How to perform</td>
<td>1. Position grid on skin, perpendicular to the CT scan slice. Scan an mark the entry site</td>
</tr>
<tr>
<td></td>
<td>2. Prep and drape overlying skin</td>
</tr>
</tbody>
</table>
3. Local anesthesia with Lidocaine.
4. Scan through region with the numbing needle through the skin to confirm safe approach
5. Skin nick with blade #11.
6. Advance the guide needle into lesion, reimage to assure safe needle position
7. FNA usually obtained first for pathology to check tissue origin
8. 2-3 core Temno needle biopsies are obtained and the specimens kept in formalin and sent to pathology. Consider additional core for “flow study” if Lymphoma is suspected. In infection is in the differential, consider getting a sample for culture and cytology.
9. Gelfoam “torpedoes” may be used in certain cases (renal, liver) for hemostasis at the end of the case through the guide needle.

**Follow up**

Lung biopsy requires Chest x-ray (CXR) at 1h and 3h post procedure that should be checked by the rad resident or VIR fellow. If the control 1h CXR is normal, the patient may eat. If the 3 h CXR is unchanged, then the patient may be discharged home. Keep bandaged and dry for 24 hours. No strenuous activity for 24 hours. If there is chest pain and/or shortness
of breath after being discharged, the patient should be sent to the closest ED in order to rule-out late pneumothorax; tension pneumothorax must be managed STAT.

**NOTES:**

Please note that the post procedure chest x-rays for lung biopsies are included in the initial exam and do not have to be ordered separately in EPIC (otherwise the patient will be charged twice).

Occasionally, a blood patch will be used in lung biopsy, which will require approximately 5 cc of autologous blood drawn from the patient’s peripheral IV.

Pathology- Required to be present for all targeted biopsies. FNA will be reviewed prior to obtaining core samples. Most specimens are placed in formalin unless otherwise specified.

Cultures will be placed in sterile specimen cup, and the cultures should be ordered in Epic (aerobic, anaerobic cultures on all, fungal and mycobacterial cultures if indicated also).
<table>
<thead>
<tr>
<th>Procedure</th>
<th>CT Guided Drain Placement (any fluid collection/ cholecystostomy tube)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indication</td>
<td>Placement of percutaneous drain in a fluid collection (usually abscess) under CT guidance</td>
</tr>
<tr>
<td>Consent/Complications</td>
<td>Bleeding, spread of infection/sepsis, damage to adjacent organs (e.g. bowel perforation)</td>
</tr>
<tr>
<td>Contraindications</td>
<td>Collection too small to leave a drain. Consider aspiration biopsy. Unsafe approach- bowel, vascular structures, etc. (hydro-dissection may be attempted to move bowel out of the way), consider Hawkins needle. If INR &gt;1.5, Platelets &lt;50K, discuss with VIR attending about blood products.</td>
</tr>
<tr>
<td>Alternatives</td>
<td>Do nothing, Surgical biopsy Medical treatment</td>
</tr>
<tr>
<td>Meds</td>
<td>1% Lidocaine Moderate sedation(Versed/Fentanyl) Antibiotics- Ancef or Cipro depending on indication</td>
</tr>
<tr>
<td>Equipment</td>
<td>Drain kit, 8-12Fr APDL drains</td>
</tr>
<tr>
<td>How to perform</td>
<td>1. Position grid on skin, perpendicular to the CT scan slices. Scan and mark the patient’s skin. 2. Prep and Drape the overlying skin. 3. Local anesthesia with Lidocaine 1% and skin nick #11 blade 4. Trocar 18-gauge needle is advanced into the fluid collection,</td>
</tr>
</tbody>
</table>
5. Trocar needle is exchanged over the 0.035” stiff guide wire for a dilator (typically max. dilator French size matches the drain French catheter size).
6. Thread an all-purpose (e.g. APDL)catheter over a 0.035” stiff guide wire into collection
7. Drain immediately the max amount of fluid. If blood is seen, stop aspiration, avoid sepsis.
8. Send a sample for culture studies. Consider cytology and fungal culture in the appropriate clinical setting.
9. Final CT scan and then secure drain with stitch 2.0 Silk. Put a bandage appropriately, and connect the drain to bag. All patients with a new drain get admitted overnight.
10. CHOLECYSTOSTOMY: approach the gallbladder through the right hepatic lobe parenchyma

| Follow up | Bandage and keep dry for 24 hours. No strenuous activity for 24 hours. Drain care: keep clean and dry, monitor skin site, record output, and flush 10 cc on normal saline bid if fluid is viscous. Drain check: Limited non- |
contrasted CT scan to evaluate the fluid collection.

Criteria to remove a drain:
1. Less than 10cc output in 24h
2. No fever or abdominal pain
3. No or minimal fluid around the drain tip in CT scan
4. If WBC count is available, check if there is trend to infection resolution.
5. Cholecystostomy tube should not be removed until tract has had time to mature (at least 4 weeks)

**NOTES:**

Be sure to place flushing orders for drains if deemed appropriate by the attending for both inpatients and outpatients.
<table>
<thead>
<tr>
<th><strong>Procedure</strong></th>
<th><strong>Percutaneous Ablation</strong> <em>(Radiofrequency, Cryoablation, Microwave)</em></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Indication</strong></td>
<td>Tumor treatment</td>
</tr>
<tr>
<td><strong>Consent/ Complications</strong></td>
<td>Bleeding, infection, shoulder pain, thermal damage of adjacent organs or liver structures: gallbladder, bile ducts, bowel, stomach, diaphragm, pancreas, kidney (depends on the tumor location).</td>
</tr>
<tr>
<td><strong>Adverse reaction</strong></td>
<td>Post-ablation syndrome: “flu-like” symptoms (fatigue, lack of appetite), nausea/vomiting, abdominal distention, fever, increase in WBC count, abdominal pain. It does not mean that there is infection if they are present in the first 2-3 days and the patient improves clinically in the following days.</td>
</tr>
<tr>
<td><strong>Contraindications</strong></td>
<td>If INR &gt;1.5, Platelets &lt;50K, discuss with VIR attending about blood products.</td>
</tr>
<tr>
<td><strong>Alternatives</strong></td>
<td>Do nothing, Surgical excision Medical treatment</td>
</tr>
<tr>
<td><strong>Meds</strong></td>
<td>1% Lidocaine GA usually required. Cipro 400 mg</td>
</tr>
<tr>
<td><strong>Equipment</strong></td>
<td>RFA, Microwave and Cryoablation needles. Consider thermal protective techniques is some challenging cases</td>
</tr>
</tbody>
</table>
| **How to perform** | 1. Position grid on skin, perpendicular to the CT scan slices. Scan and mark the patient’s skin.  
2. Prep/Drape  
3. Local anesthesia, skin nick #11 blade |
4. Numbing needle(s) in the skin toward the lesion, reimaging to assure safe approach

5. If needed, thermal protective may be considered to cool off (e.g. gallbladder) or to move adjacent organs out of the way (bowel, kidney)

6. Insert 1-3 ablation needles into the lesion. Always consider a 1cm surgical margin around the lesion.

7. Activate RFA, Cryoablation, Microwave machine. If unipolar RFA is used, then 4 ground pads MUST BE placed, 2 on each thigh

8. Perform cauterization of the needle track after the ablation is terminated

9. Remove needle(s), re-scan.

10. Clean site and sterile bandage

11. Patient is discharged home after 3hs of observation

Follow up

Bandage and keep dry for 24 hours

No strenuous activity for 24 hours

NOTES:
FLUOROSCOPIC GUIDED / ANGIOGRAPHIC PROCEDURES

The fellows are primarily responsible for all angiographic procedures. Residents are encouraged to assist and sometimes perform these procedures along with the fellow. Residents can help by performing the informed consents, ensuring the appropriate labs are ordered and reviewing prior images with the VIR Fellow or Attending before the case.

As with CT guided cases, it is important to preview prior imaging if available to plan the approach for the intervention and how to position patient for best approach. Consideration should be given to critical surrounding structures and possible access difficulties or challenges to selective catheterization.

The expectation is that the resident should proactively review the requested case, discuss the indication, patient’s position, site for access and devices.

Need of general anesthesia (GA) should be considered. Coagulation status of the patient should be discussed with the VIR attending and corrected as needed.
<table>
<thead>
<tr>
<th>Procedure</th>
<th>General Vascular Access (Seldinger Technique)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indication</td>
<td>Vascular accesses for diagnostic or therapeutic interventions</td>
</tr>
<tr>
<td>Consent/Complications</td>
<td>Puncture site- bleeding, hematoma, pseudoaneurysm, infection, distal embolization, direct vessel injury (dissection)</td>
</tr>
<tr>
<td>Contraindications</td>
<td>If INR &gt;1.5, Platelets &lt;50K, discuss with VIR attending about blood products.</td>
</tr>
<tr>
<td>Alternatives</td>
<td>Open surgical access or no action</td>
</tr>
<tr>
<td>Meds</td>
<td>1% Lidocaine</td>
</tr>
<tr>
<td>Equipment</td>
<td>Micropuncture kit</td>
</tr>
</tbody>
</table>
| How to perform     | 1. Identify the target vessel - Direct palpation or US guidance.  
2. Advance micropuncture needle (21 gauge) or regular access needle (18 gauge) into the vessel lumen until there is blood return. Ideally, arterial puncture site should have no calcifications. Preferably use micropuncture kits in coagulopathic patients  
3. Thread small guidewire (.018” in micropuncture kit, others use .035” wire) through needle into the vessel lumen  
4. Remove needle while pressure is held in the puncture site and the guidewire is kept in place  
5. Insert the introducer sheath over the wire. The type of intervention and |
necessary devices should dictate its size.

6. At the termination of the intervention, remove the sheath and consider holding manual compression (venous and brachial/femoral punctures), closure devices (femoral) and TR band (for radial)

| Follow up          | Bed rest per protocol  
|                   | Bandage and keep dry for 24 hours  
|                   | No strenuous activity for 48 hours 
|                   | Keep clean and dry               |

**NOTES:**
Seldinger Technique

The above illustration depicts a double wall puncture technique. However a single anterior wall puncture technique is more desirable.

All access should be performed with US guidance.

NOTES:

Micropuncture kit- 21-gauge micropuncture needle, 0.018” guidewire, and a sheath (usually 4-Fr). It may be converted to a 0.035” platform after the 4-Fr sheath is intra-vascular.

Regular access - 18-gauge Trocar needle, 0.035” guidewire, and a sheath (usually 5-Fr). Sheath sizes available: 4-18 Fr.
Femoral Artery Puncture- Aim for the disease-free anterior wall of the common femoral artery (CFA) at the level of the femoral head, below inguinal ligament and above femoral artery bifurcation. Femoral head should be visualized under fluoroscopy and a mark can be done at the skin level to prevent high punctures above the inguinal ligament that could lead to retroperitoneal hematoma or low punctures that could lead to access the SFA or DFA with the potential risk of pseudoaneurysm and/or AVF. It is important for the puncture to be at the level of the femoral head for effective manual compression and to minimize bleeding complications. The access level should be confirmed by US guidance to prevent puncture of the femoral artery in an area where calcifications are present.
Radial Artery Access (see also section in appendix) -
Preoperative assessment is paramount for uncomplicated radial access. Workup includes Allen’s Test and Barbeau’s Test as well as sonographic evaluation of the artery. This should be done prior to patient arrival to the angio suite. A 1.8 mm (if the Slender sheath is used) or greater radial artery diameter must be documented with ultrasound. Please see appendix for further explanation of the Allen’s and Barbeau’s Tests. If an oximetry pulse monitoring system is available, then give preference to the Barbeau’s test, as it is more sensitive than the Allen’s test. Barbeau’s is obligatory in all patients. Allen’s may be used in clinic or when there is no oximetry pulse available.

During a radial access case, we will administer intra-arterial nitroglycerin via the sheath in the radial artery. It is important to assure that systolic blood pressure is greater than 100 mmHg prior to administration. A saline bolus may be initiated if the patient is running slightly hypotensive. Typically, we will administer 200mcg/1mL after securing access and again before removing the sheath.

Systemic heparin will be administered following secure access (usually 2000-3000 units, possibly redosed if the case runs long).
<table>
<thead>
<tr>
<th>Procedure</th>
<th>Adrenal Vein Sampling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indication</td>
<td>To localize aldosterone-secreting adenomas and for distinguishing adenomas from bilateral adrenal hyperplasia in patients with primary hyperaldosteronism</td>
</tr>
<tr>
<td>Consent/Complications</td>
<td>Puncture site- bleeding, hematoma, pseudoaneurysm, infection, damage to vessel. Damage to the adrenal gland during venogram, especially of the right adrenal gland.</td>
</tr>
<tr>
<td>Contraindications</td>
<td>If INR &gt;1.5, Platelets &lt;50K, discuss with VIR attending about blood products.</td>
</tr>
<tr>
<td>Alternatives</td>
<td>Do nothing</td>
</tr>
<tr>
<td>Meds</td>
<td>1% Lidocaine Moderate sedation Cosyntropin</td>
</tr>
<tr>
<td>Equipment</td>
<td>Regular needle for access, guidewires/catheters</td>
</tr>
<tr>
<td>How to perform</td>
<td>1. Review coronal abdominal CT with contrast in order to detect the level of the right adrenal vein(s). 2. Before starting, 9 vials correctly labeled must be ready for blood sample. At least 4 cc of blood is needed in each vial according to MUSC lab. 3. Create side holes (hole puncture device) at the tip of the Mikaelson/Cobra for the right and Simmons 2 or 3 for the left adrenal vein.</td>
</tr>
</tbody>
</table>
4. Prep and drape femoral vein
5. Local anesthesia with Lidocaine
6. Venograms of the right and left adrenal glands are performed with gentle hand injection. The left adrenal gland vein(s) is typically more challenging to be identified. An accessory hepatic vein can be easily misinterpreted as the right adrenal vein.
7. Draw a blood sample from the IVC for baseline plasma cortisol and aldosterone
8. Start infusion of ACTH analogue (Cosyntropin) at 1ug/min (24 cc/hr)
9. At 15 min and 30 min into infusion draw samples from left, right adrenal veins and IVC for cortisol and aldosterone
10. 9 blood samples are required

| Follow up | Bed rest per protocol  
|           | Bandage and keep dry for 24 hours  
|           | No strenuous activity for 24 hours  
|           | Keep clean and dry |

**NOTES:**

There is a binder with intraprocedure guidelines for the procedure RN. Please consult this prior to beginning case.
<table>
<thead>
<tr>
<th>Procedure</th>
<th>Arterial and Venous Angiography/ Angioplasty/ Thrombolysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indication</td>
<td>Evaluation and treatment of acute, chronic, or acute on chronic arterial/venous occlusive disease that includes: balloon angioplasty, stent placement, mechanical thrombectomy, infusion of lytic therapy (thrombolysis)</td>
</tr>
<tr>
<td>Consent/ Complications</td>
<td>Puncture site- bleeding, infection, hematoma, pseudoaneurysm, pain or discomfort at puncture site, damage to adjacent vessels, abrupt vessel closure, bruising, distal embolization, failure to relieve stenosis/ occlusion, rethrombosis/ re-stenosis necessitating further intervention, PE, stroke (hemorrhagic or ischemic), heart attack, possible death</td>
</tr>
<tr>
<td>Contraindications</td>
<td>If INR &gt;1.5, Platelets &lt;50K, discuss with VIR attending about blood products.</td>
</tr>
<tr>
<td>Alternatives</td>
<td>CTA for diagnosis, but no intervention. Open surgical repair, medical therapy, no action</td>
</tr>
<tr>
<td>Meds</td>
<td>1% Lidocaine, Moderate sedation Heparin if plan on treating any lesion</td>
</tr>
<tr>
<td>Equipment</td>
<td>Micropuncture kit or regular needle. US guidance may help for access. Several guidewires/catheters- often vessel/procedure specific. Balloons, stents with multiple diameters and lengths</td>
</tr>
<tr>
<td>Angiojet for mechanical thrombectomy (MT) Multi side holes infusion catheter (MIC) for thrombolytic tPA infusion IV Contrast, alternatively CO2/IVUS</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td></td>
</tr>
<tr>
<td>How to perform</td>
<td></td>
</tr>
<tr>
<td>1. Review CTA, MRA, prior angiographies, history of prior interventions, surgeries if available.</td>
<td></td>
</tr>
<tr>
<td>2. Prep and drape <strong>both</strong> groins</td>
<td></td>
</tr>
<tr>
<td>3. Vascular Access (see Seldinger technique)</td>
<td></td>
</tr>
<tr>
<td>4. Catheter advanced to the target vessel</td>
<td></td>
</tr>
<tr>
<td>5. Diagnostic angiogram. Consider pressure measuring across the anastomosis in case there is a questionable stenosis and pre and post PE MT</td>
<td></td>
</tr>
<tr>
<td>6. Balloon angioplasty, stent, MT, MIC</td>
<td></td>
</tr>
<tr>
<td>7. Completion angiogram</td>
<td></td>
</tr>
<tr>
<td>8. Sheath removal. Check ACT if heparin was given before removing the sheath</td>
<td></td>
</tr>
<tr>
<td>9. Closure device or hold pressure (will dependent on the femoral art puncture site)</td>
<td></td>
</tr>
<tr>
<td>10. Clean site and sterile bandage</td>
<td></td>
</tr>
<tr>
<td>11. In case of MT: Angiojet may cause significant bradycardia especially in MT of the Pulmonary arteries. Have atropine (0.5-1 mg I.V) available.</td>
<td></td>
</tr>
</tbody>
</table>
12. In case of thrombolysis: Label the infusions/catheters to avoid confusion. Suture the sheath in the groin. Cover the sheath and infusion catheter with Opsite dressing to prevent infection and catheter dislodgment. Follow protocol for infusion of lytics. Admit patient in the ICU for close observation. Recheck with angiography in 6-12 h.

| Follow up                  | Bed Rest per protocol  
|                           | Evaluate puncture site  
|                           | Evaluate for distal embolization, rethrombosis/ occlusion |

**NOTES ON ANGIOPLASTY AND STENTING:**

Heparin (weight based, 50 IU / kg) should be administered after access is secured, but prior to crossing a stenotic lesion.

It is important to measure vessel diameter and lesion length to insure appropriate balloon and stent selection.

Balloon expandable stents are desirable when precise deployment is necessary. Self-expandable stents are often better for tortuous anatomy and where the stent could easily be compressed by external force (Carotid and SFA).
Discuss with attending prior to case to ensure you have the appropriate devices available.

Larger diameter balloons require larger sheaths to accommodate them. This is important to think about the compatibility among different materials when planning the case.

NOTES ON LYSIS:

Alteplase (tPA) should be ordered prior to the procedure. A phone call to pharmacy is often helpful to get the appropriate concentrations. tPA infusion requires ICU admission for close monitoring.

tPA infusion is typically initiated at 1 mg/hr through the infusion catheter, which has been previously positioned within the clot. Often, we may use 2 infusion catheters for bilateral DVT in the lower extremities and bilateral pulmonary arteries lysis; in this case, 0.5 mg/hr tPA infusion is performed through each catheter (this makes a total of 1 mg/hr). 500 IU/hr heparin is infused through the sheath.

Dr. Adams protocol- tPA at 0.75 mg/hr through the catheter and 0.25 mg/hr through sheath, 500 IU/hr heparin peripherally.

When using EKOS system, additional saline infusion is necessary to keep the US unit from overheating.
Fibrinogen should be monitored q 6 hours- If the level is <200, tPA infusion is halved; if the level is <100, infusion should be discontinued.

**NOTES ON CONTRAST INJECTION:**

*Contrast administered e.g. “5 for 30”, means injection rate of 5 cc/sec of contrast for a total of 30 cc of contrast volume (this would be a 6 second injection).

Contrast injection rate will roughly correspond with the vessel diameter (e.g. a 5 mm celiac artery will often use a 5cc/sec rate; a 2 cm aorta may need up to a 20cc/sec rate.

Rates and pressures differ between catheters; it is important to specify if a power injection will be performed through a microcatheter to use appropriate pressures and rates during a power injection.

- Standard pressure limits range from 900-1000psi
- Microcatheter pressure limits from 700-800psi
- Microcatheters range from 3-4 cc per second

Siemens rooms have several options for administration of contrast with the power injector. Make sure the toggle switch is in the RED off position on the MEDRAD injector for the injection to work via the table hand switch/acquisition foot pedal. A hand switch is also available in the control room.

In the GE rooms, make sure that the auto inject button is on to deliver contrast through the injector.
<table>
<thead>
<tr>
<th>AREA</th>
<th>CC/SECOND</th>
<th>TOTAL CC</th>
<th>PSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>THORACIC ARCH</td>
<td>15</td>
<td>30</td>
<td>1000</td>
</tr>
<tr>
<td>ABDOMINAL AORTA</td>
<td>15</td>
<td>30</td>
<td>1000</td>
</tr>
<tr>
<td>PELVIS</td>
<td>10</td>
<td>20</td>
<td>700</td>
</tr>
<tr>
<td>CELIAC ARTERY</td>
<td>5</td>
<td>30</td>
<td>400</td>
</tr>
<tr>
<td>HEPATIC ARTERY</td>
<td>3</td>
<td>15</td>
<td>700</td>
</tr>
<tr>
<td>RENAL ARTERY</td>
<td>3</td>
<td>12</td>
<td>400</td>
</tr>
<tr>
<td>SMA</td>
<td>5</td>
<td>30</td>
<td>400</td>
</tr>
<tr>
<td>IMA</td>
<td>3</td>
<td>18</td>
<td>400</td>
</tr>
<tr>
<td>SFA</td>
<td>3</td>
<td>12</td>
<td>500</td>
</tr>
<tr>
<td>IVC GRAM</td>
<td>10</td>
<td>20</td>
<td>1000</td>
</tr>
<tr>
<td>PULMONARY ARTERY*</td>
<td>15</td>
<td>30</td>
<td>1000</td>
</tr>
<tr>
<td>CAROTID ARTERY</td>
<td>3</td>
<td>12</td>
<td>700</td>
</tr>
<tr>
<td>SUBCLAVIAN ARTERY</td>
<td>3</td>
<td>12</td>
<td>700</td>
</tr>
</tbody>
</table>

*Take care with pulmonary artery injections in the setting of increased R heart pressures- large volumes may precipitate R heart failure and arrhythmia*
<table>
<thead>
<tr>
<th><strong>Procedure</strong></th>
<th><strong>Central Venous Access (Nontunneled)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Indication</strong></td>
<td>Temporary dialysis catheter, medication administration</td>
</tr>
<tr>
<td><strong>Consent/Complications</strong></td>
<td>Bleeding, infection, damage to vessel, nerve, pneumothorax, abnormal heart rhythm, arterial puncture</td>
</tr>
<tr>
<td><strong>Contraindications</strong></td>
<td>If INR &gt;1.5, Platelets &lt;50K, discuss with VIR attending about blood products.</td>
</tr>
<tr>
<td><strong>Alternatives</strong></td>
<td>Do nothing, Peripheral IVs</td>
</tr>
<tr>
<td><strong>Meds</strong></td>
<td>1% Lidocaine Moderate sedation if possible, but not always necessary</td>
</tr>
<tr>
<td><strong>Equipment</strong></td>
<td>Central line kit</td>
</tr>
</tbody>
</table>
| **How to perform** | 1. Check with US if the target vein is open (usually internal jugular) Check if there is any history of previous central venous occlusion  
2. Prep and drape  
3. Local anesthesia and skin nick  
4. Seldinger technique – guidewire, dilator and temp catheter are advanced under fluoroscopic guidance  
5. Check the catheter tip and if there is adequate flow.  
6. Suture into place  
7. Clean site and sterile bandage |
| **Follow up** | Bandage and keep dry for 24 hours  
No strenuous activity for 24 hours  
Keep clean and dry  
Patients with Temporary central line cannot be discharged home |
<table>
<thead>
<tr>
<th>Procedure</th>
<th>Central Venous Access (Tunneled) - (port, dialysis catheter, etc)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indication</td>
<td>Long term access for medications or dialysis</td>
</tr>
<tr>
<td>Consent/ Complications</td>
<td>Bleeding, infection, damage to vessel, damage to nerve, pneumothorax, abnormal heart rhythm, arterial puncture</td>
</tr>
<tr>
<td>Contraindications</td>
<td>If INR &gt;1.5, Platelets &lt;50K, discuss with VIR attending about blood products.</td>
</tr>
<tr>
<td>Alternatives</td>
<td>Do nothing, working fistula, surgical access?</td>
</tr>
<tr>
<td>Meds</td>
<td>1% Lidocaine</td>
</tr>
<tr>
<td></td>
<td>Ancef 1g if placing port of cuffed line.</td>
</tr>
<tr>
<td>Equipment</td>
<td>Tunneled port or dialysis catheter kit</td>
</tr>
<tr>
<td></td>
<td>Port tray</td>
</tr>
<tr>
<td>How to perform</td>
<td>1. Check with US if the target vein is open (usually internal jugular). Check if there is any history of previous central venous occlusion</td>
</tr>
<tr>
<td></td>
<td>2. Prep and drape</td>
</tr>
<tr>
<td></td>
<td>3. Local anesthesia and skin nick in neck</td>
</tr>
<tr>
<td></td>
<td>4. Seldinger technique – guidewire advanced ideally to the IVC</td>
</tr>
<tr>
<td></td>
<td>5. Measure approximately 3 fingers width inferior to the ipsilateral clavicle (end point above the nipple) and administer local anesthesia, second nick in the chest (tunnel track)</td>
</tr>
<tr>
<td></td>
<td>6. Catheter introduced through the subcutaneous tunnel</td>
</tr>
<tr>
<td></td>
<td>7. Dilator and peel-away are advanced</td>
</tr>
</tbody>
</table>
over the wire under fluoroscopic guidance
8. Check the tip of the catheter and if there is adequate flow.
9. Suture the catheter in place
10. Clean site and sterile bandage

Chest Port placement
1. Similar technique to the above including the 3 fingers distance from the clavicle where a 3 cm incision is performed for dissection of the subcutaneous tissues and pocket creation
2. Using the sharp tissue dissector with attached catheter, tunnel towards the neck incision slowly
3. Place catheter through the peel-away sheath into appropriate position under fluoroscopic control
4. Connect the port to the catheter and sew the port down into the subcutaneous tissues within the pocket created. Check the flow.
5. Look for catheter kinks under fluoro. Fill up the lumen with heparin
6. Sew incision with 3.0 Vicryl subcuticularly
7. Dermabond the skin nick at the neck if necessary
8. Clean sites and sterile bandages
<table>
<thead>
<tr>
<th><strong>Arm port placement</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Check with US if the target vein is open (usually basilic/ brachial vein). Check if there is any history of previous central venous occlusion</td>
</tr>
<tr>
<td>2. Prep and drape</td>
</tr>
<tr>
<td>3. Local anesthesia w/ Lidocaine</td>
</tr>
<tr>
<td>4. Under US guidance and Seldinger technique – micropuncture kit is used to obtain venous access</td>
</tr>
<tr>
<td>5. Incision of ~ 2 cm is performed in where the .021” micro guidewire is. Dissection for a small subcutaneous pocket creation to accommodate the port. No tunneling in arm ports</td>
</tr>
<tr>
<td>6. Port catheter introduced over a hydrophilic wire through a 7-Fr sheath under fluoroscopic control</td>
</tr>
<tr>
<td>7. Check the tip of the catheter, connect it to the chamber, check if there is adequate flow. Heparinization of the catheter lumen.</td>
</tr>
<tr>
<td>8. Sew the chamber in the pocket and the skin with 3.0 Vicryl subcuticularly</td>
</tr>
<tr>
<td>9. Clean site and sterile bandage</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Follow up</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bandage and keep dry for 24 hours</td>
</tr>
<tr>
<td>No strenuous activity for 24 hours</td>
</tr>
<tr>
<td>Keep clean and dry</td>
</tr>
</tbody>
</table>
NOTES:

We are frequently asked to place tunneled, non-cuffed, central venous lines (tunneled PICCs) for patients with renal dysfunction and difficult access (to preserve arm veins for possible future dialysis). No antibiotics are required.

A Hawkins needle may be used to tunnel the PICC to the chest from the internal jugular vein. Also a single puncture with a modified curved needle can be useful in these situations.

Ports and catheters should be loaded with the appropriate heparinized solution and labeled. Adult HD catheters should be loaded with 1,000 IU/mL heparinized saline (appropriate volume based on the catheter placed).

Ports should be loaded with heparin solution (5cc/lumen) - 10 IU/mL if leaving accessed, 100 IU/mL if not accessed.
<table>
<thead>
<tr>
<th><strong>Procedure</strong></th>
<th><strong>Chemoembolization-Liver (TACE)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Indication</strong></td>
<td>Tumor control, alleviate pain, palliative</td>
</tr>
<tr>
<td><strong>Consent/Complications</strong></td>
<td>Make sure the patient is not drinking alcohol. Complications: Puncture site-bleeding, hematoma, pseudoaneurysm, infection; damage to vessel or adjacent organs, non-target embolization- may result in gastric or duodenal necrosis/ulceration, contrast allergy/nephropathy, reaction to chemotherapy Mitomycin (bone marrow suppression is rare, no alopecia), liver injury, rigors, GI bleeding.</td>
</tr>
<tr>
<td><strong>Adverse reaction</strong></td>
<td>Post-TACE syndrome is expected in ~ 40% of patients: “flu-like” symptoms (fatigue, lack of appetite), nausea/vomiting, abdominal distention, fever, increase in WBC count, abdominal pain. It does not mean that there is infection if they are present in the first 2-3 days and the patient improves clinically in the following days.</td>
</tr>
<tr>
<td><strong>Contraindications</strong></td>
<td>If INR &gt;1.5, Platelets &lt;50K, discuss with VIR attending about blood products. Also, discuss w/ Attending if TGO/TPG and total Bilirubin are elevated</td>
</tr>
<tr>
<td><strong>Alternatives</strong></td>
<td>Do nothing (tendency for the lesion(s) to grow), Surgery, Transplant, Systemic chemotherapy</td>
</tr>
</tbody>
</table>
| **Meds**                      | Moderate sedation  
Cipro 400 mg  
Nitro, Heparin for radial access |
<table>
<thead>
<tr>
<th>Equipment</th>
<th>Femoral or radial access kits Mikaelson / Jackie catheters, microcatheter coaxially PVA micro-particles, lipiodol chemotherapeutic agent</th>
</tr>
</thead>
</table>
| How to perform                                 | 1. Prep and drape  
2. Femoral or radial access (femoral/radial) via Seldinger technique  
3. Angiograms, check portal vein phase  
4. Cannulate hepatic arteries, as super selective as possible  
5. Infuse chemo agent and micro-particles  
6. Completion angiogram  
7. Remove catheters  
8. Clean site and sterile bandage  
9. Patient gets admitted overnight for observation |
| Follow up                                      | Bed Rest per protocol  
Evaluate puncture site  
Keep clean and dry |

**NOTES:**

Embolization mixture: 10 cc saline, 10 cc contrast, 5 cc Lipiodol, 10 cc chemotherapy agent is placed in each of 2 cups. One of the mixtures will have a vial of 300 microns PVA to it.
In the case of bland embolization the above mixture will be the same, but without the chemotherapy.

Chemotherapy agent should be ordered in advance and will be picked up by the procedure nurse prior to case.

Consult the VIR attending for access preference- femoral v radial prior to case. Patients who are taller than 6’ 4” should have the 150 cm microcatheter for any liver directed therapy.

Patients will be admitted overnight for pain and nausea control.

**Discharge scripts for ALL chemoembolization patients:**

1) Cipro 500 PO BID for 1 week
2) 30 tabs of Zofran or Phenergan q8 h PRN
3) 40 tabs of Oxycodone 5 mg tabs, 1-2 tabs q6 h PRN
4) Senna or Colace over the counter daily for opiate constipation
<table>
<thead>
<tr>
<th>Procedure</th>
<th>Embolization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indication</td>
<td>Internal bleeding – trauma, GI bleed, renal, etc.</td>
</tr>
<tr>
<td>Consent/Complications</td>
<td>Puncture site- bleeding, hematoma, pseudoaneurysm, infection, non-target embolization – damage to healthy adjacent organs, ischemia- need for surgical procedure, contrast allergy/nephropathy.</td>
</tr>
<tr>
<td>Adverse reaction</td>
<td>Post-embolization syndrome- fever, pain, leukocytosis, nausea, vomiting</td>
</tr>
<tr>
<td>Contraindications</td>
<td>If INR &gt;1.5, Platelets &lt;50K, discuss with VIR attending about blood products.</td>
</tr>
<tr>
<td>Alternatives</td>
<td>Open surgical repair, correction of coagulopathy if any</td>
</tr>
<tr>
<td>Meds</td>
<td>1% Lidocaine Moderate sedation Antibiotics may be necessary (solid organ embolization)</td>
</tr>
<tr>
<td>Equipment</td>
<td>Regular needle or micropuncture kits guidewires/ diagnostic and micro catheters- often vessel/procedure specific Embolization agent – gelfoam, coils, PVA, glue, Onyx, Vascular plug, etc.</td>
</tr>
<tr>
<td>How to perform</td>
<td>1. Prep and drape 2. Local anesthesia and skin nick 3. Seldinger technique – guidewire, sheath, place catheter into appropriate vessel 4. Angiogram to visualize target vessel 5. Microcatheters may be used to</td>
</tr>
<tr>
<td>Step</td>
<td>Actions</td>
</tr>
<tr>
<td>------</td>
<td>---------</td>
</tr>
<tr>
<td>6.</td>
<td>Deploy appropriate embolization agent</td>
</tr>
<tr>
<td>7.</td>
<td>Post embolization angiogram</td>
</tr>
<tr>
<td>8.</td>
<td>Remove catheters, obtain hemostasis (femoral: closure device, hold pressure/radial: TR band)</td>
</tr>
<tr>
<td>9.</td>
<td>Clean site and sterile bandage</td>
</tr>
</tbody>
</table>

**Follow up**
- Bed Rest per protocol
- Evaluate puncture site
- Keep clean and dry

**NOTES:**

There are multiple embolization agents that are used in VIR, and each case will have a preferred agent, given the scenario. These agents include Gelfoam, coils, glue/Onyx, and PVA. Discuss with attending the pros and cons of each agent for a given scenario.
<table>
<thead>
<tr>
<th><strong>Procedure</strong></th>
<th><strong>Endovascular Aortic Repair (TEVAR, EVAR)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Indication</strong></td>
<td>Aneurysm, aortic dissection or intimal tear</td>
</tr>
<tr>
<td><strong>Consent/Complications</strong></td>
<td>Puncture site- bleeding, infection, hematoma, pseudoaneurysm, pain or discomfort at puncture site, damage to vessel and organs (bowel/renal ischemia), bruising, stroke, heart attack, possible death. Thoracic specific: paraplegia</td>
</tr>
<tr>
<td><strong>Contraindications</strong></td>
<td>If creatinine abnormal or INR &gt;1.5, Platelets &lt;50K, discuss with VIR attending about contrast nephropathy prevention (hydration, CO2, IVUS) blood products.</td>
</tr>
<tr>
<td><strong>Alternatives</strong></td>
<td>Open surgical repair No action</td>
</tr>
<tr>
<td><strong>Meds</strong></td>
<td>General Anesthesia Ancef. I.V. Heparin after access is obtained</td>
</tr>
<tr>
<td><strong>Equipment</strong></td>
<td>Regular needles, 8-Fr sheath, regular/stiff guidewires/ pigtail/Mikaelson catheters, 2 Perclose device, stent-graft (body + limb+ extension if needed), trilobe or Coda balloons,</td>
</tr>
<tr>
<td><strong>How to perform</strong></td>
<td>1. Prep and drape both groins and the abdomen (in case of conversion) 2. Bilateral Percutaneous vascular access 3. Pre deployment in “X” fashion of the Perclose (closure device) in the percutaneous access (2 Perclose)</td>
</tr>
<tr>
<td>Step</td>
<td>Procedure</td>
</tr>
<tr>
<td>------</td>
<td>-----------</td>
</tr>
<tr>
<td>1.</td>
<td>Devices on the intervention access, 1 on the diagnostic access</td>
</tr>
<tr>
<td>2.</td>
<td>8 Fr sheath and pigtail catheter inserted on the diagnostic side</td>
</tr>
<tr>
<td>3.</td>
<td>Abdominal Angiogram</td>
</tr>
<tr>
<td>4.</td>
<td>20-24 Fr sheath placed over Lunderquerquist wire on intervention side</td>
</tr>
<tr>
<td>5.</td>
<td>Main body and limb stent-graft placement</td>
</tr>
<tr>
<td>6.</td>
<td>Post stent-graft deployment balloon angioplasty</td>
</tr>
<tr>
<td>7.</td>
<td>Completion angiogram</td>
</tr>
<tr>
<td>8.</td>
<td>Sheaths removal, access hemostasis with Perclose.</td>
</tr>
<tr>
<td>9.</td>
<td>Clean site and sterile bandage</td>
</tr>
</tbody>
</table>

| Follow up | Post-surgical procedures recovery area  
Before discharge: evaluate puncture site, kidney function  
Post: the same + Evaluate for stent-graft migration, occlusion, endoleaks (see appendix for types) |

**NOTES:**
<table>
<thead>
<tr>
<th><strong>Procedure</strong></th>
<th><strong>Endovenous Laser Therapy (EVLT) of the Greater Saphenous vein (GSV) w/ or without Phlebectomy</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Indication</strong></td>
<td>Varicose veins</td>
</tr>
<tr>
<td><strong>Consent/Complications</strong></td>
<td>Infection, hematoma, pain, post-op bruising/tenderness, thermal damage to adjacent structures (nerves), blood clot that could lead to PE</td>
</tr>
<tr>
<td><strong>Contraindications</strong></td>
<td>If INR &gt;1.5, Platelets &lt;50K, discuss with VIR attending about blood products.</td>
</tr>
<tr>
<td><strong>Alternatives</strong></td>
<td>GSV surgical phlebectomy, do nothing</td>
</tr>
<tr>
<td><strong>Meds</strong></td>
<td>1 % Lidocaine Moderate sedation</td>
</tr>
<tr>
<td><strong>Equipment</strong></td>
<td>EVLT kit, crochet hooks for stripping</td>
</tr>
</tbody>
</table>
| **How to perform** | 1. In case of phlebectomy, make sure the borders of varicose veins were marked in the skin w/ a pen.  
2. EVLT + stripping: Prep and drape from the groin to the ankle. If only EVLT: from the groin to the proximal calf  
3. Administer Lidocaine and under US obtain access to the saphenous vein at the medial aspect of the knee with micropuncture kit.  
4. GSV venogram, wire advanced proximally, laser sheath introduced 1 inch away from the GSV-femoral vein confluence.  
5. Under US guidance, lidocaine solution is injected 360 degrees around the GSV from the GSV-Fem vein junction until the skin entry site (tumescent |
<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.</td>
<td>Use Laser safety glasses (patient and operators)</td>
</tr>
<tr>
<td>7.</td>
<td>Advance the laser probe into the proximal saphenous vein</td>
</tr>
<tr>
<td>8.</td>
<td>Activate laser while retracting slowly (2mm/sec) until the skin entry site.</td>
</tr>
<tr>
<td>9.</td>
<td>PHLEBECTOMY (stripping):</td>
</tr>
<tr>
<td>10.</td>
<td>After local lidocaine, make one/two skin nicks at the pre-procedure areas and use the venous hooks to remove the superficial varicose veins</td>
</tr>
<tr>
<td>11.</td>
<td>Dermabond any skin nicks necessary, clean and bandage</td>
</tr>
<tr>
<td>12.</td>
<td>Compression hose</td>
</tr>
</tbody>
</table>

**Follow up**

20 minutes of ambulation after sedation has worn off. No bed rest but wear compression hose per protocol

**NOTES:**

Will need to get ACE wraps and TED hoses from prep and recovery for placement following the case. Wrap bandage starting at midfoot up to the proximal thigh, then place TED hose over the wrap. Important to educate the patient to maintain the compression hose all the way up to the groin at ALL TIMES.
<table>
<thead>
<tr>
<th>Procedure</th>
<th>Fistulagram/ Balloon Angioplasty/ Stent placement/ Mechanical thrombectomy, Possible temporary dialysis catheter placement if failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indication</td>
<td>Evaluation of dysfunctional fistula Treatment of stenosis/ thrombosis</td>
</tr>
<tr>
<td>Consent/ Complications</td>
<td>Puncture site- bleeding, infection, hematoma, pseudoaneurysm, pain or discomfort at puncture site, damage to vessel, bruising, failure to relieve stenosis/occlusion, distal embolization, hand ischemia, PE, stroke, heart attack, possible death Always consent for placement of a temporary dialysis catheter if the stenosis/occlusion cannot be treated.</td>
</tr>
<tr>
<td>Contraindications</td>
<td>If INR &gt;1.5, Platelets &lt;50K, discuss with VIR attending about blood products.</td>
</tr>
<tr>
<td>Alternatives</td>
<td>Open surgical repair</td>
</tr>
<tr>
<td>Meds</td>
<td>1% Lidocaine Moderate sedation Heparin I.V. by weight.</td>
</tr>
<tr>
<td>Equipment</td>
<td>Micropuncture kit Guidewires/ catheters- often vessel/procedure specific Balloon angioplasty Bare and covered-stents Mechanical thrombectomy (Angiojet)</td>
</tr>
<tr>
<td>How to perform</td>
<td>1. Exam the AVF/AVG. Pulse? Thrill? 2. Prep and drape the puncture site 3. Fistula Access w/ micropuncture kit, sometimes necessary to access</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>clotted graft with 18G needle</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Heparinize after access secured</td>
</tr>
<tr>
<td>5.</td>
<td>Catheters advanced towards the central veins</td>
</tr>
<tr>
<td>6.</td>
<td>Arm venograms until the culprit lesion is identified (typically close to or at the venous anastomosis)</td>
</tr>
<tr>
<td>7.</td>
<td>Balloon angioplasty (preferential)/stent placement (rarely used), and/or mechanical thrombectomy with Angiojet, Fogarty maneuver</td>
</tr>
<tr>
<td>8.</td>
<td>Completion angiogram. Turn the sheath to the arterial side, evaluate arterial inflow in a retrograde fashion by external compression or consider a second access</td>
</tr>
<tr>
<td>9.</td>
<td>Evaluate arterial limb stenosis</td>
</tr>
<tr>
<td>10.</td>
<td>Fogarty maneuver to clear clot from arterial side.</td>
</tr>
<tr>
<td>11.</td>
<td>Completion fistulagram</td>
</tr>
<tr>
<td>12.</td>
<td>Sheath removal, hold pressure or skin suture for hemostasis</td>
</tr>
<tr>
<td>13.</td>
<td>Clean site and sterile bandage</td>
</tr>
</tbody>
</table>

**Follow up**

<table>
<thead>
<tr>
<th></th>
<th>Bed Rest per protocol</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Evaluate puncture site, thrill</td>
</tr>
</tbody>
</table>

**NOTES:**

Bradycardia may be seen during Angiojet thrombectomy-have atropine available.
If the patient has missed their last dialysis, K+ should be checked. Discuss K+ greater than 6.5 with the attending prior to the case, as they may ask for an EKG and potentially place a temporary dialysis catheter for the patient to receive dialysis prior to the procedure.

We are currently working with nephrology to better define the policy relating to K+ values for potential fistulagram/declot.
<table>
<thead>
<tr>
<th>Procedure</th>
<th>IVC Filter Placement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indication</td>
<td>Proximal Floating clot, Iliac-Fem-Pop DVT and contra-indication to anticoagulation, PE despite anticoagulation, prophylaxis in trauma/paraplegia and pre gastric bypass, neuro/orthopedic surgeries</td>
</tr>
<tr>
<td>Consent/ Complications</td>
<td>Bleeding, infection, damage to vessel, filter migration, fracture, tilting Discuss permanent vs temporary filters and importance of retrieving temporary filters</td>
</tr>
<tr>
<td>Contraindications</td>
<td>If INR &gt;1.5, Platelets &lt;50K, discuss with VIR attending about blood products.</td>
</tr>
<tr>
<td>Alternatives</td>
<td>Medical treatment only, no action</td>
</tr>
<tr>
<td>Meds</td>
<td>1% Lidocaine</td>
</tr>
<tr>
<td></td>
<td>Moderate sedation</td>
</tr>
<tr>
<td>Equipment</td>
<td>IVC filter kit</td>
</tr>
<tr>
<td>How to perform</td>
<td>1. Review where the clot (s) is/are. Extension to the femoral?</td>
</tr>
<tr>
<td></td>
<td>2. Consider IJ vs femoral venous access</td>
</tr>
<tr>
<td></td>
<td>3. Prep and drape</td>
</tr>
<tr>
<td></td>
<td>4. Local anesthesia and skin nick</td>
</tr>
<tr>
<td></td>
<td>5. Under US guidance, venous puncture of femoral or IJ veins</td>
</tr>
<tr>
<td></td>
<td>6. Seldinger technique – guidewire, sheath, place catheter</td>
</tr>
<tr>
<td></td>
<td>7. Venogram to check: IVC diameter, duplication, patency and level of renal veins</td>
</tr>
<tr>
<td></td>
<td>8. Deploy IVC filter with cranial tip just inferior to the renal veins ostia</td>
</tr>
<tr>
<td></td>
<td>9. Completion IVC venogram</td>
</tr>
</tbody>
</table>
| | 10. Remove catheter  
11. Clean site and sterile bandage |
| Complications | Puncture site- bleeding, hematoma, pseudoaneurysm, infection, damage to vessel, device migration- possible need for retrieval, IVC thrombosis |
| Follow up | Bed Rest per protocol  
Evaluate puncture site  
Per protocol, remove the filter if anticoagulation can be restarted, resolution of Iliac-fem-pop DVT, improved mobility. |

**NOTES:**

Make sure the patient will receive the IVC filter brochure that contains very important information about the filter retrieval program.

Per retrieval protocol, the program includes a **consultation 90 days** after the IVC was placed in order to evaluate if it is safe to have the filter removed.

Anticoagulation status, ambulation, US Doppler of the Lower extremities to check for residual DVT are among the most important factors to consider filter removal.
<table>
<thead>
<tr>
<th><strong>Procedure</strong></th>
<th><strong>IVC Filter Retrieval</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Indication</td>
<td>Indication in evaluated at the F/U clinic visit. IVC filter in place without continued need (e.g. no longer at high risk for DVT/PE, or no longer contraindicated for anticoagulation), filter migration/displacement</td>
</tr>
<tr>
<td>Consent/Complications</td>
<td>Bleeding, infection, damage to vessel or surrounding structures, inability to remove</td>
</tr>
<tr>
<td>Contraindications</td>
<td>If INR &gt;1.5, Platelets &lt;50K, discuss with VIR attending about blood products.</td>
</tr>
<tr>
<td>Alternatives</td>
<td>Leave filter in place</td>
</tr>
<tr>
<td>Meds</td>
<td>1% Lidocaine Moderate sedation</td>
</tr>
<tr>
<td>Equipment</td>
<td>IVC filter retrieval kit- 15mm snare, braded sheath &gt;9 mm Consider large sheaths and bronchial forceps in difficult cases</td>
</tr>
</tbody>
</table>
one unit
9. Completion IVC venogram
14. Remove venous access
15. Clean site and sterile bandage

<table>
<thead>
<tr>
<th>Complications</th>
<th>Puncture site- bleeding, hematoma, pseudoaneurysm, infection, damage to vessel,</th>
</tr>
</thead>
<tbody>
<tr>
<td>Follow up</td>
<td>Bed Rest per protocol</td>
</tr>
<tr>
<td></td>
<td>Evaluate puncture site</td>
</tr>
</tbody>
</table>

**NOTES:**

1. It is essential to have a recent bilateral lower extremity US Doppler.
2. Need to know: upcoming surgery? Residual thrombus in lower extremity, pelvis or IVC? Able to be anticoagulated? Is patient ambulatory?
3. IS THE FILTER RETRIEVABLE? If don’t know, order abdominal CT to evaluate.
4. How long has the filter been in place? If over 1 year, less likely to be successfully removed.
<table>
<thead>
<tr>
<th>Procedure</th>
<th>Gastrostomy or gastrojejunostomy tube placement</th>
</tr>
</thead>
</table>
| **Indication** | Feeding – malnutrition; esophageal cancer; gastroparesis; failed swallow study  
Venting of stomach in palliative and postsurgical patients |
| **Consent/Complications** | Puncture site- bleeding, hematoma, infection; damage to adjacent organs – pancreas, liver, and large vessels; peritonitis |
| **Contraindications** | If INR >1.5, Platelets <50K, discuss with VIR attending about blood products. Interposed colon between stomach and abdominal wall. Consider CT guidance to obtain access to the stomach |
| **Alternatives** | Endoscopic or surgical placement. |
| **Meds** | 1% Lidocaine  
Moderate sedation v GA  
Ancef 1g |
| **Equipment** | T-fasteners  
Dilators – serial or balloon  
G or GJ tube  
CT guidance used if placing in excluded stomach |
| **How to perform** | **1. Place NG tube**  
**2. Prep and drape epigastric region**  
**Insufflate stomach through NG tube**  
**3. Puncture gastric lumen with 18 Ga needle**  
**4. Place T-fastener(s) through initial puncture or separate punctures** |
depending on VIR attending
5. Insert .035” Amplatz guide wire
6. Serially dilate
7. Place peel away sheath
8. Insert tube through sheath

| Follow up | Bed Rest per protocol  
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Do not use for 24 hours</td>
</tr>
</tbody>
</table>

**NOTES:**

If placing a gastrostomy tube in a patient with prior gastric bypass, typically the access to the excluded stomach will be obtained in CT, as the excluded stomach cannot be insufflated by enteric tube. Once access is confirmed the Amplatz wire and KMP catheter will be is placed through the 18 Ga needle and taped to the sterile abdomen. The patient is then transported to the angio suite to finish the case under fluoro.

Alternatively, the case may be performed in GE room 5 (at the CH) and in GE room 3 (at ART) and used the combination of rotational angiography and fluoro on the same procedure table.
<table>
<thead>
<tr>
<th>Procedure</th>
<th>Nephrostomy +/- Double J stent placement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indication</td>
<td>Obstructive hydronephrosis</td>
</tr>
<tr>
<td>Consent/Complications</td>
<td>Puncture site- bleeding, hematoma, pseudoaneurysm, infection; damage to kidney/adjacent organs, hematuria, rigors, pain, need for surgery</td>
</tr>
<tr>
<td>Contraindications</td>
<td>If INR &gt;1.5, Platelets &lt;50K, discuss with VIR attending about blood products.</td>
</tr>
<tr>
<td>Alternatives</td>
<td>Open surgical decompression, do nothing, double J placement from below</td>
</tr>
<tr>
<td>Meds</td>
<td>1% Lidocaine Moderate sedation Cipro 400 mg</td>
</tr>
<tr>
<td>Equipment</td>
<td>Chiba needle/Accu-stick kit, guidewires, dilator, APDL (all-purpose drain catheter), Double J stent kit</td>
</tr>
<tr>
<td>How to perform</td>
<td>1. Prone position, review axial images if available. 2. Prep and drape the patient the lumbar region and around the tip of the 12th rib 3. Administer local anesthesia 4. Consider using US for puncture guidance 5. From a posterior approach advance the Chiba needle into the renal pelvis – ideally a lower pole calyx 6. Inject contrast until confirmation of renal pelvis access and perform a nephrostogram to identify the obstruction</td>
</tr>
</tbody>
</table>
7. Place a stiff guidewire into the renal pelvis and remove needle.
8. Dilate the track, place an all-purpose drain catheter and suture it to the skin. Dressing. Ensure adequate drainage of urine into a drainage bag.
9. DOUBLE J STENT: once the wire is in the collecting system, use KMP catheter over the wire and advance into urinary bladder past the obstruction. Confirm location with contrast.
10. Ureteral stent kit: Over a stiff wire, advance the distal tip of the double J into the bladder while the proximal is delivered in the pelvis. Do not lose access to the pelvis. Consider using a sheath to secure access or “safety-wire technique”
11. Nephrostomy tube (APDL) is placed in pelvis as described above.

| Follow up | Patient is admitted over night Bed Rest per protocol Evaluate puncture site Keep clean and dry Ensure adequate drainage of urine and connect to a drainage bag. |

**NOTES:**
Minimize manipulation of the collecting system in acute obstruction, as sepsis can occur, and can come on very quickly. Be prepared for this scenario.

Once the acute process has subsided (usually 1-2 weeks), we can then more safely attempt to place a nephroureterostomy or ureteral stent.

Follow up nephrostogram and tube exchanges should be ordered in Epic following the procedure, for a fresh tube or routine exchange. Until a more efficient way to ensure that these follow ups are scheduled, it will be the responsibility of the resident or fellow performing the case to place these orders upon completion of the procedure. Close communication with the RN navigators is essential.

Routine exchanges should be performed every 4-6 weeks to avoid infection.

You may not want to wait the routine 4-6 weeks to schedule follow up; for example, in many cases of acute obstruction, we will see the patient in 1-2 weeks from the initial placement to attempt to place a nephroureterostomy and work towards placing a ureteral stent to then remove the tube. It is often useful to speak with urology or the referring service about the patient.

Although it is easy to mindlessly change tubes over and over, we should try to work towards getting a patient tube free.
<table>
<thead>
<tr>
<th>Procedure</th>
<th>Percutaneous trans-hepatic cholangiogram (PTC)/Percutaneous Biliary Drainage/ Biliary stent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indication</td>
<td>Biliary obstruction</td>
</tr>
<tr>
<td>Consent/Complications</td>
<td>Puncture site- bleeding, hemATOMa, pseudoaneurysm, infection; damage to liver/adjacent organs, bile duct inflammation, rigors, need for surgery</td>
</tr>
<tr>
<td>Contraindications</td>
<td>If INR &gt;1.5, Platelets &lt;50K, discuss with VIR attending about blood products.</td>
</tr>
<tr>
<td>Alternatives</td>
<td>Open surgical repair, do nothing</td>
</tr>
<tr>
<td>Meds</td>
<td>1% Lidocaine Moderate sedation Cipro 400mg</td>
</tr>
<tr>
<td>Equipment</td>
<td>Chiba needle, KMP catheter, hydrophilic and stiff wires, APDL drain</td>
</tr>
</tbody>
</table>
| How to perform | 1. Prep and drape the right upper quadrant and epigastric region  
2. For PTC – from a lateral (right lobe) or anterior (left lobe) approach advance the Chiba needle under fluoroscopic guidance into the liver while intermittently injecting contrast until confirmation of intrahepatic biliary access is made. Perform cholangiogram.  
3. For biliary drainage – through a peripheral bile duct, place a wire through the Chiba needle and advance into the duodenum. Remove needle, dilate and place biliary drainage internal-external |
catheter with the tip in the duodenum. Sometimes a KMP catheter and a hydrophilic/Wholey wire may help crossing an occlusion. Confirm location with contrast. Ensure adequate drainage of bile and connect to a drainage bag. Suture to skin.

4. In case the occlusion can’t be crossed, use similar technique leaving an external drain only and consider re-attempt in 5-10 days. Keep in mind: Internal-external drain in more physiological.

5. BILIARY STENT: typically used for malignancy, once the access to the duodenum is established, place the stent (s) (single in the CBD or two in Y shape configuration to treat occlusion at the confluence), post dilate the stent with balloon(s), and leave a biliary drain in place

| Follow up | Evaluate puncture site  
| Keep clean and dry  
| In stent placement, bring the patient back between 5-7 days to check stent patency and possible pull |

NOTES:

GA should be considered as these can be potentially long and painful procedures.
Minimize manipulation of the biliary system in acute obstruction, as sepsis can occur, and can come on very quickly. Be prepared for this scenario. We may place only an external drain in this setting.

Once the acute process has subsided (usually 1-2 weeks), we can then more safely attempt to place an internal-external drain.

Follow up cholangiograms and tube exchanges should be ordered in Epic following the procedure, for a fresh tube or routine exchange. Until a more efficient way to ensure that these follow ups are scheduled, it will be the responsibility of the resident or fellow performing the case to place these orders upon completion of the procedure.

Routine exchanges should be performed every 4-6 weeks to avoid infection.
<table>
<thead>
<tr>
<th>Procedure</th>
<th>PICC line</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indication</td>
<td>Long term, but temporary IV access, antibiotic, TPN, etc.</td>
</tr>
<tr>
<td>Consent/</td>
<td>Bleeding, infection, damage to vessel, damage to nerve, abnormal heart</td>
</tr>
<tr>
<td>Complications</td>
<td>rhythm, arterial puncture</td>
</tr>
<tr>
<td>Contraindications</td>
<td>If there is coagulopathy, discuss with VIR attending about blood products.</td>
</tr>
<tr>
<td>Alternatives</td>
<td>peripheral IVs (butterfly, jelco needles)</td>
</tr>
<tr>
<td>Meds</td>
<td>1% Lidocaine</td>
</tr>
<tr>
<td>Equipment</td>
<td>PICC line kit</td>
</tr>
<tr>
<td>How to perform</td>
<td>1. Check vein patency with US</td>
</tr>
<tr>
<td></td>
<td>2. Prep and drape the upper part of the non-dominant arm</td>
</tr>
<tr>
<td></td>
<td>3. Place a tourniquet around the upper arm to distend vein</td>
</tr>
<tr>
<td></td>
<td>4. Local anesthesia and skin nick</td>
</tr>
<tr>
<td></td>
<td>5. US guided venous puncture w/ 21g needle and 0.018” wire</td>
</tr>
<tr>
<td></td>
<td>6. Introduce the peel-away over the wire</td>
</tr>
<tr>
<td></td>
<td>7. Tourniquet down</td>
</tr>
<tr>
<td></td>
<td>8. Use guidewire to measure length of PICC line</td>
</tr>
<tr>
<td></td>
<td>9. Trim PICC and thread into the right atrium. Fluoro to confirm tip location. In central venous occlusions, either attempt to recanalize it with balloon angioplasty or leave a short PICC.</td>
</tr>
<tr>
<td></td>
<td>10. Sew the PICC to the skin or use the stat lock.</td>
</tr>
<tr>
<td></td>
<td>11. Clean site and sterile bandage</td>
</tr>
</tbody>
</table>
Follow up | No strenuous activity for 24 hours
| Keep clean and dry

NOTES:

Labs are (almost always) unnecessary for PICC placement.

Sedation is also often unnecessary, unless a patient is known to have existing central venous occlusion.

All PICC consults should go through the VAIN team prior to being seen by VIR.

VAIN pager number: 18301 (Main); 17092 (ART)

All Pediatric patients should have any PICC line placement attempted in the arm first. In case the vein is too small, tunneled IJ PICC may be considered. Consult with referring service
<table>
<thead>
<tr>
<th>Procedure</th>
<th>Port Removal/Venous access explant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indication</td>
<td>Termination of therapy; line infection</td>
</tr>
<tr>
<td>Consent/Complications</td>
<td>Bleeding, infection, sepsis, damage to vessels, foreign body</td>
</tr>
<tr>
<td>Contraindications</td>
<td>If INR &gt; 1.5, Platelets &lt; 50K, discuss with VIR attending about blood products.</td>
</tr>
<tr>
<td>Alternatives</td>
<td>Do nothing</td>
</tr>
<tr>
<td>Meds</td>
<td>1% Lidocaine</td>
</tr>
<tr>
<td></td>
<td>Moderate sedation (not always needed)</td>
</tr>
<tr>
<td></td>
<td>Ancef if placing. Nothing if removing.</td>
</tr>
<tr>
<td>Equipment</td>
<td>Scalpel, hemostat, scissors, suture</td>
</tr>
<tr>
<td>How to perform</td>
<td><strong>PORT:</strong></td>
</tr>
<tr>
<td></td>
<td>Examine previous incision</td>
</tr>
<tr>
<td></td>
<td>1. Prep and drape</td>
</tr>
<tr>
<td></td>
<td>2. Local anesthesia</td>
</tr>
<tr>
<td></td>
<td>3. With scalpel make incision along existing scar</td>
</tr>
<tr>
<td></td>
<td>4. With hemostat and/or scissors dissect around port</td>
</tr>
<tr>
<td></td>
<td>5. Cut the suture anchoring the port in the subcutaneous tissues</td>
</tr>
<tr>
<td></td>
<td>6. Remove port and the catheter. In case of chest port apply pressure for hemostasis in the ipsilateral IJ area.</td>
</tr>
<tr>
<td></td>
<td>7. Flush the pocket with saline and, if no infection, consider closing the pocket with Vicryl in different planes.</td>
</tr>
<tr>
<td></td>
<td>8. Final subcuticular suture, dressing</td>
</tr>
<tr>
<td></td>
<td>9. Clean site and sterile bandage</td>
</tr>
<tr>
<td></td>
<td>10. If infection, send the port and the catheter tip for culture</td>
</tr>
</tbody>
</table>
**TUNNELED CATHETERS:**

1. Prep and drape
2. Identify how deep the cuff is in the subcutaneous tunnel. It will guide dissection depth.
3. Local anesthesia around the entry site and the cuff.
4. Release the suture from skin
5. With a hemostat, dissect around the cuff. Gentle pull may help visualization of the cuff
6. Remove the catheter and apply pressure for hemostasis in the ipsilateral IJ area.
7. Clean site and sterile bandage
8. Avoid closing the chest wound due to skin bacterial colonization. Increases the chance of abscess in the subcutaneous track. Leave if open, but covered with dressing

| Follow up | Bandage, keep clean and dry
          | No strenuous activity for 24 hours |

**NOTES:**
<table>
<thead>
<tr>
<th><strong>Procedure</strong></th>
<th><strong>Radioembolization (SIRS)– work up and infusion</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Indication</td>
<td>Curative, Palliative therapy</td>
</tr>
<tr>
<td>Consent/Complications</td>
<td>Puncture site (bleeding, hematoma, pseudoaneurysm, infection) non target embolization- may result in gastritis and duodenitis, ulceration and perforation; post-embolization syndrome- fever, pain, leukocytosis; non curative therapy, contrast allergy/nephropathy</td>
</tr>
<tr>
<td>Adverse reaction</td>
<td>Post-radioembolization syndrome: more important are “flu-like” symptoms (lack of appetite, fatigue) and nausea/vomiting. It may also have fever, and abdominal pain.</td>
</tr>
<tr>
<td>Contraindications</td>
<td>If INR &gt;1.5, Platelets &lt;50K, discuss with VIR attending about blood products.</td>
</tr>
<tr>
<td>Alternatives</td>
<td>Surgery, systemic chemotherapy</td>
</tr>
<tr>
<td>Meds</td>
<td>Moderate sedation, Cipro 400mg (for therapy) 2 vials MAA (for workup)</td>
</tr>
<tr>
<td>Equipment</td>
<td>Similar to TACE, except for the Y-90 beads prepared by Rad Oncology</td>
</tr>
</tbody>
</table>
| How to perform | **WORK UP PROCEDURE:**  
  1. Review the abdominal axial images available  
  2. Prep and drape  
  3. Arterial Access (femoral/radial) via Seldinger technique  
  4. Visceral angiogram  
  5. Depending on the tumor location and anatomy of the hepatic arteries, coil |
embolization with microcatheter of the gastro-duodenal; embolization of the right/left gastric, supra-duodenal arteries may be needed.

6. Hepatic arteriogram with the microcatheter tip in the same spot that will be used for the infusion of Y-90 in the following week. Infusion of Technetium 99mTc albumin aggregated (99mTc-MAA) in the right and/or left hepatic arteries. Injectable radiopharmaceutical used for a SPECT of the thorax and abdomen right after the case.

7. Before the patient is discharged, review the SPECT findings (radioactivity distribution and hepatic-pulmonary shunt)

Y-90 INFUSION:

1. Double check the total Bilirubin level from the day of the case.
2. Prep and drape
3. Arterial access (femoral/radial) via Seldinger technique
4. Celiac trunk and selective hepatic angiograms.
5. Microcatheter tip in the same spot where the TC-99 MAA was injected
7. Completion angiogram
8. Remove catheters that should be kept in special container
9. Hemostasis with closure device or manual pressure
10. Clean site and sterile bandage
11. Patient is discharged home after having clearance from radiation safety

Follow up
- Bed Rest per protocol
- Evaluate puncture site
- Keep clean and dry

**NOTES:**

Y-90 workup typically occurs one week before the Y-90 radioembolization infusion.

Nexium 40 mg QD for 7 days prior and 30 days after infusion; Medrol dose pack for non-diabetics

Mandatory to check total bilirubin in the day of infusion

MAA obtained from Nuclear Medicine: 4 mCi of Tc-99
MAA is typically injected into the hepatic artery (2 mCi in each hepatic artery in case of bilateral disease).
<table>
<thead>
<tr>
<th>Procedure</th>
<th>Radiofrequency wire technique for the recanalization of chronically occluded central veins</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indication</td>
<td>Facial, arm, breast swelling, malfunctioning AV fistula/graft</td>
</tr>
<tr>
<td>Consent/Complications</td>
<td>Infection, hematoma, pain, post-op bruising/tenderness, pericardium effusion, hemothorax (both will require drain placement), arteriovenous fistula (that will require covered stent placement), stroke</td>
</tr>
<tr>
<td>Contraindications</td>
<td>If INR &gt;1.5, Platelets &lt;50K, discuss with VIR attending about blood products.</td>
</tr>
<tr>
<td>Alternatives</td>
<td>Conventional endovascular recanalization, surgical venous bypass, do nothing</td>
</tr>
<tr>
<td>Meds</td>
<td>1% Lidocaine general anesthesia Heparin (wt based)</td>
</tr>
<tr>
<td>Equipment</td>
<td>Conventional guidewires/catheters, RF wire and generator. If there is pacemaker/defibrillator, it will require a magnet to turn it off. Have a pericardium drainage tray available</td>
</tr>
</tbody>
</table>
| How to perform | 1. Check if there is defibrillator/pacemaker  
2. Under US guidance, mark the pericardium window in the skin. Leave this area prep and draped.  
3. Prep and drape the upper arm ipsilateral to the occlusion and the groin for dual access |
4. Access vessel intended to treat via the Seldinger technique and US guidance
5. Simultaneous hand injections are done through both accesses for central venograms in PA, RAO and LAO.
6. Semi-curved catheter in one side with the RF wire coaxially
7. 10 mm snare in the other side that will be used as a target
8. Activate the generator crossing the occluded segment
9. 4 mm balloon angioplasty
10. Stent placement and post stent PTA
11. Completion central venogram
12. Remove catheters/sheaths
13. Pressure held to obtain hemostasis
14. Clean site and bandage
15. Patient is discharged home unless if there was a complication or need to go for dialysis

| Follow up | Bed rest per protocol       |
|          | Bandage and keep dry for 24 hours |
|          | No strenuous activity for 24 hours |

NOTES: It is essential to have a chest CT with coronal recons in order to evaluate the occluded segment and surrounding tissues. All cases should be performed under GA and at the ART building.
<table>
<thead>
<tr>
<th>Procedure</th>
<th>TIPS (Transjugular Intrahepatic Portosystemic Shunt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indication</td>
<td>GI bleeding due to portal hypertension, refractory ascites/hydrothorax</td>
</tr>
<tr>
<td>Consent/Complications</td>
<td>Puncture site- bleeding, hematoma, infection; damage to vessel, temporary encephalopathy, anemia, worsening liver function, GI and intra-abdominal bleeding, death</td>
</tr>
<tr>
<td>Contraindications</td>
<td>INR &gt;1.5, Platelets &lt;50K; heart failure, severe tricuspid regurgitation, severe pulmonary hypertension, multiple hepatic cysts, sepsis, unrelieved biliary obstruction, malignancy in the tract of the TIPS</td>
</tr>
<tr>
<td>Alternatives</td>
<td>Medical, endoscopic management</td>
</tr>
<tr>
<td>Meds</td>
<td>1% Lidocaine Moderate sedation. If the patient is actively bleeding, protect the airway w/ETT and GA. Cipro 400mg</td>
</tr>
<tr>
<td>Equipment</td>
<td>TIPS kit (Rosh-Ushida or Ring)</td>
</tr>
</tbody>
</table>
| How to perform | 1. Review abdominal axial images to check the liver size and the anatomy/patency of the right hepatic and right portal veins  
2. Prep and drape the right neck  
3. Access right internal jugular vein via Seldinger technique and US guidance  
4. Record right atrial pressure  
5. MPA catheter is placed into the right hepatic vein for venogram and
<table>
<thead>
<tr>
<th>Step</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.</td>
<td>Occlusion balloon catheter is wedged and used for indirect portal vein pressure (corrected sinusoidal pressure) and for CO2 venogram under balloon insufflation</td>
</tr>
<tr>
<td>7.</td>
<td>Under stiff wire, 10 Fr long sheath is advanced to the right hepatic vein. TIPS kit needle is then advanced through the wall of the right hepatic vein and directed typically in an anterior direction to access the right portal vein. IV contrast is then used to confirm access into the portal vein</td>
</tr>
<tr>
<td>8.</td>
<td>Advance the Bentzon wire through the needle</td>
</tr>
<tr>
<td>9.</td>
<td>Pigtail catheter is advanced through a stiff wire to the main portal vein for portal venogram and pressure measurement</td>
</tr>
<tr>
<td>10.</td>
<td>Pre-stent liver tract balloon dilation is performed, followed by Viatorr covered-stent placement and post stent PTA. The ring of the Viatorr should be anchored against the liver parenchyma</td>
</tr>
<tr>
<td>11.</td>
<td>Perform completion venography and measure right atrial and portal pressures</td>
</tr>
<tr>
<td>12.</td>
<td>Remove catheters, pressure is held in the neck for hemostasis</td>
</tr>
<tr>
<td>13.</td>
<td>Clean site and sterile bandage</td>
</tr>
<tr>
<td>Follow up</td>
<td>Bed Rest per protocol</td>
</tr>
<tr>
<td>--------------</td>
<td>------------------------</td>
</tr>
<tr>
<td></td>
<td>Evaluate puncture site</td>
</tr>
</tbody>
</table>

**NOTES:**

Pressure measurements required: See notes from the TJ liver biopsy section for details
<table>
<thead>
<tr>
<th><strong>Procedure</strong></th>
<th><strong>Transjugular liver biopsy</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Indication</td>
<td>Percutaneous biopsy is contraindicated – bleeding risk; massive ascites</td>
</tr>
<tr>
<td>Consent/Complications</td>
<td>Puncture site- bleeding, hematoma, infection; damage to vessel and to the liver, arrhythmia</td>
</tr>
<tr>
<td>Contraindications</td>
<td>If INR &gt;1.5, Platelets &lt;50K, discuss with VIR attending about blood products.</td>
</tr>
<tr>
<td>Alternatives</td>
<td>percutaneous biopsy, do nothing</td>
</tr>
<tr>
<td>Meds</td>
<td>1% Lidocaine                    Moderate sedation</td>
</tr>
<tr>
<td>Equipment</td>
<td>Transjugular liver biopsy kit</td>
</tr>
<tr>
<td>How to perform</td>
<td>1. Review abdominal axial images to check the liver size and the anatomy/patency of the right hepatic</td>
</tr>
<tr>
<td></td>
<td>2. Prep and drape the right or left neck</td>
</tr>
<tr>
<td></td>
<td>3. Access internal jugular vein via Seldinger technique and US guidance</td>
</tr>
<tr>
<td></td>
<td>4. MPA catheter is placed into the right hepatic vein for venogram</td>
</tr>
<tr>
<td></td>
<td>5. Exchange for occlusion balloon catheter</td>
</tr>
<tr>
<td></td>
<td>6. Measure free hepatic pressure and wedged pressure for indirect portal vein pressure (corrected sinusoidal pressure)</td>
</tr>
<tr>
<td></td>
<td>7. CO2 venogram under balloon insufflation</td>
</tr>
<tr>
<td></td>
<td>8. Exchange occlusion balloon for stiff cannula</td>
</tr>
<tr>
<td></td>
<td>9. Obtain at least 3 quality core biopsies that will be sent in formalin to</td>
</tr>
</tbody>
</table>
pathology
10. Perform completion venography and measure right atrial pressure
11. Remove catheters, pressure is held in the neck for hemostasis.
12. Clean site and sterile bandage

Follow up
Bed Rest per protocol
Evaluate puncture site

NOTES:

Pressure measurement set up: Draw 60cc out of NS bag and connect syringe to pressure transducer (hung on the IV pole). Cap the distal end of syringe with needle. Connect pressure cable and right heart cable together. Make sure syringe is closed to patient. Zero the P wave BEFORE hooking up to patient.

Three pressures would be measured: 1st Free Hepatic, 2nd Wedged, and 3rd Right Atrium. Document pressures in Nurses Notes. If MD wants strips printed, glue strips to progress notes and scan to the patient’s chart.

There are several clinical studies that require extensive pressure measurements. We have handouts that specify which protocol should be followed. Coordinate this with the procedure nurse prior to beginning the case.
<table>
<thead>
<tr>
<th>Procedure</th>
<th>Uterine artery embolization</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Indication</strong></td>
<td>Uncontrollable post-partum hemorrhage; uterine fibroids</td>
</tr>
<tr>
<td><strong>Consent/Complications</strong></td>
<td>Infection, hematoma, pain, post-op bruising/tenderness, damage to vessel, need for surgery</td>
</tr>
<tr>
<td><strong>Contraindications</strong></td>
<td>If INR &gt;1.5, Platelets &lt;50K, discuss with VIR attending about blood products.</td>
</tr>
<tr>
<td><strong>Alternatives</strong></td>
<td>Surgery (hysterectomy/myomectomy) Hormone therapy, do nothing</td>
</tr>
<tr>
<td><strong>Meds</strong></td>
<td>1% Lidocaine Moderate sedation Cipro 400mg</td>
</tr>
<tr>
<td><strong>Equipment</strong></td>
<td>Guidewires/(micro) catheters, particulated (irregular PVA/ spherical beads) embolic agents</td>
</tr>
</tbody>
</table>
| **How to perform**      | 1. Review the Pelvic US or MRI  
2. Prep and drape both groins or left wrist  
3. Access femoral artery via the Seldinger technique  
4. Place sheath, perform a Pelvic angiogram, followed by selective right and left uterine arteriograms  
5. RUC or microcatheter is advanced to the horizontal segment of the both uterine arteries  
6. Embolization until stasis is obtained  
7. Completion angiogram with gentle hand injection  
8. Remove catheters, use closure device or pressure is held to obtain |
<table>
<thead>
<tr>
<th>hemostasis.</th>
</tr>
</thead>
<tbody>
<tr>
<td>9. Clean site and bandage</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Follow up</th>
<th>Bed rest per protocol</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No strenuous activity for 24 hours</td>
</tr>
<tr>
<td></td>
<td>Overnight admission for pain control</td>
</tr>
</tbody>
</table>

**NOTES:**

Patient will be admitted overnight for pain and nausea control, and these patients often have significant pain associated with fibroid degeneration. PCA pump may be necessary.
# APPENDIX

## ACUTE LIMB ISCHEMIA

**SVS/ISCVS CLINICAL CATEGORIES**

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Sensory Loss</th>
<th>Weakness</th>
<th>Arterial Doppler</th>
<th>Venous Doppler</th>
</tr>
</thead>
<tbody>
<tr>
<td>I- Viable</td>
<td>Not immediately threatened</td>
<td>None</td>
<td>None</td>
<td>Audible</td>
<td>Audible</td>
</tr>
<tr>
<td>IIA- Marginally threatened</td>
<td>Salvageable w/ prompt treatment</td>
<td>Min, toes, none</td>
<td>None</td>
<td>Often inaudible</td>
<td>Audible</td>
</tr>
<tr>
<td>IIB- Immediate threat</td>
<td>Salvageable w/immediate revascularization</td>
<td>Mod, rest pain</td>
<td>Mild-mod</td>
<td>Usually inaudible</td>
<td>Audible</td>
</tr>
<tr>
<td>III- Irreversible</td>
<td>Major tissue loss/ nerve damage</td>
<td>Severe</td>
<td>Severe</td>
<td>Inaudible</td>
<td>Inaudible</td>
</tr>
</tbody>
</table>
## ANTIBIOTIC PROPHYLAXIS
### Practice Guidelines for VIR Procedures

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Potential Organisms</th>
<th>Routine Prophylaxis</th>
<th>1st Choice Antibx</th>
</tr>
</thead>
</table>
| Angiography, angioplasty, thrombolysis, arterial closure device placement, stent placement | *S. aureus*  
*S. epidermidis* | No | None |
| Endograft Placement                                                       | *S. aureus*  
*S. epidermidis* | Yes | Cefazolin 1 g IV |
| Superficial Venous Insufficiency                                          | *S. aureus*  
*S. epidermidis* | No | None |
| IVC Filter                                                                | *S. aureus*  
*S. epidermidis* | No | None |
| Tunneled Catheter                                                         | *S. aureus*  
*S. epidermidis* | No consensus | Cefazolin, 1g IV  
Allergy? Use Vanc 1g IV |
| Embolization and chemo-embolization (if intent to create / or high likelihood of infarction) | *S. aureus*  
*S. epidermidis*  
*Streptococcus spp*  
*Corynebacterium spp*, and/or enteric flora (if prior sphincter of Oddi manipulation or bilioenteric surgery) | Yes | No consensus  
Ciprofloxacin 400 mg, IV  
or  
Cefazolin, 1g IV |
| SIR work-up                                                               | | No | No |
| SIR (Y-90)                                                                | *S. aureus*  
*S. epidermidis*  
*Streptococcus spp*  
*Corynebacterium spp*, and/or enteric flora (if prior sphincter of Oddi manipulation or bilioenteric surgery) | Yes | No consensus  
Ciprofloxacin 400 mg, IV  
or  
Cefazolin, 1g IV |
<table>
<thead>
<tr>
<th>Procedure</th>
<th>Potential Organisms</th>
<th>Routine Prophylaxis</th>
<th>1st Choice Antibx</th>
</tr>
</thead>
</table>
| UAE                                       | *S. aureus*  
*S. epidermidis*  
*Streptococcus* spp  
*E. coli*                                        | Yes                 | No consensus  
Ciprofloxacin 400 mg, IV or  
Cefazolin, 1g, IV |
| TIPS creation                             | *S. aureus*  
*S. epidermidis*  
*Corynebacterium* spp  
Biliary pathogens  
Enteric gram neg rods  
Anaerobes  
*Enterococcus* spp                                        | Yes                 | No consensus  
Ciprofloxacin 400 mg, IV or  
Cefazolin 1 g, IV |
| Fluoroscopic guided gastrostomy and gastro-jejunostomy tube placement | *S. aureus*  
*S. epidermidis*  
*Corynebacterium* spp                                        | No consensus       | Cefazolin 1 g, IV - Gastrostomy  
Tube pull – none |
| Liver and biliary interventions           | *Enterococcus* spp  
*Streptococcus* spp  
Aerobic gram-negative organisms (*E. coli, Klebsiella* spp, etc)  
*Clostridium* spp  
*Candida* spp  
Anaerobes                                            | Yes                 | No consensus  
Ciprofloxacin 400mg, IV or  
Cefazolin 1 g, IV |
| GU procedures Percutaneous Nephrostomy Tube Placement/Exchange Ureteral Stents | *E. coli*  
*Proteus*  
*Klebsiella*  
*Enterococcus*                                              | Yes                 | No consensus  
Ciprofloxacin 400mg, I.V or  
Cefazolin 1g, IV |
<table>
<thead>
<tr>
<th>Procedure</th>
<th>Potential Organisms</th>
<th>Routine Prophylaxis</th>
<th>1st Choice Antibx</th>
</tr>
</thead>
</table>
| Tumor ablation                | *S. aureus*  
*S. epidermidis*  
*Streptococcus* spp  
*E. coli*                     | No consensus        | No consensus  
Ciprofloxacin 400mg, IV              |
| Percutaneous abscess drainage | *S. aureus*  
*S. epidermidis*  
*Corynebacterium* spp  
Aerobic gram-neg Anaerobes      | Yes                 | No consensus  
Patients are typically under ATB   |
| Percutaneous biopsy           | Transrectal: bowel flora, mostly Anaerobes and Aerobic gram negative *Streptococcus* spp | Only required for Transrectal biopsy | Non-trans-rectal, none  
Transrectal, Gentamicin 80 mg IV plus 250 mg Ciprofloxacin BID PO x 5d |
| Percutaneous Vertebroplasty   | *S. aureus*  
*S. epidermidis*  
*Corynebacterium* spp | Yes                 | Cefazolin 1 g IV                      |


**NOTES:**
ANTICOAGULATION NOTES:

Even in a patient with low platelets (<50,000), it is sometimes possible to proceed with a procedure, usually after giving infusion of platelets prior to and during the procedure. This should be discussed with the attending.

Note should be made of any anticoagulation that the patient is currently receiving, and it should be discussed with the attending prior to the case. Often, it will still be safe to proceed with the procedure.

If the patient is on a heparin drip, it is usually sufficient to stop the drip 2 hours prior to and following the procedure. Again, discuss this with an attending.

Coumadin should usually be held for 4 days. INR should be drawn prior to the procedure.

Aspirin and Plavix should be held for 7 days.

New oral anticoagulants (Eliquis, Xarelto) generally only need to be held for 2 days.

Anticoagulated patient should be discussed with the attending, as there may be a reason to proceed with the case despite anticoagulation.
BLEEDING RISK GUIDELINES

Category 1 Procedures:
Vascular
- Dialysis access interventions
- Venography
- Central line removal
- IVC filter placement
- PICC placement

Nonvascular
- Drainage catheter exchange (biliary, nephrostomy, abscess catheter)
- Thoracentesis
- Paracentesis
- Superficial aspiration and biopsy (excludes intra-thoracic or intra-abdominal sites): thyroid, superficial lymph node
- Superficial abscess drainage

Management
- INR >2.0: threshold for treatment (i.e., FFP, vitamin K)
- PTT: no consensus
- Platelets: transfusion recommended for counts <50,000/L
- Clopidogrel: withhold for 5 d before procedure
- Aspirin: do not withhold
- LMWH (therapeutic dose): withhold one dose before procedure
Category 2: Procedures with Moderate Risk of Bleeding

Vascular
- Angiography, arterial intervention with access size up to 7 F
- Venous interventions
- Chemoembolization
- Uterine fibroid embolization
- Transjugular liver biopsy
- Tunneled catheters/ports

Nonvascular
- Intra-abdominal, chest wall, or retroperitoneal abscess drainage or biopsy
- Lung biopsy
- Trans-abdominal liver biopsy (core needle)
- Percutaneous cholecystostomy
- Gastrostomy tube: initial placement
- Radiofrequency ablation: straightforward
- Spine procedures (vertebroplasty, kyphoplasty, lumbar puncture, epidural injection, facet block)

Management
- INR: correct to > 1.5
- PTT: no consensus (trend toward correcting for values > 1.5 control)
- Platelets: discuss transfusion for count < 50,000/L
- Hematocrit: no consensus threshold for transfusion
- Clopidogrel: withhold for 5 d before procedure
- Aspirin: do not withhold
- LMWH (therapeutic dose): withhold one dose before procedure
Category 3: Procedures with Significant Risk of Bleeding

Vascular
- TIPS

Nonvascular
- Renal biopsy
- Biliary interventions (new tract)
- Nephrostomy tube placement
- Radiofrequency ablation: complex

Management
- INR: correct to > 1.5
- PTT: stop or reverse heparin for values > 1.5 control
- Platelets < 50,000: transfuse
- Hematocrit: no recommended threshold for transfusion
- Clopidogrel: withhold for 5 d before procedure
- Aspirin: withhold for 5 days
- LMWH: withhold for 24 h or up to two doses
COMPLICATION MANAGEMENT

Bleeding at the arterial/venous access site
- Direct pressure
- Maintain bed rest
- Interrupt anticoagulation if necessary
- Hydration
- Serial CBC’s, transfusion if indicated
- Reimage as necessary
- Suture may control persistent superficial bleeding

Bleeding around venous access site
- Direct pressure
- Suture if superficial bleeding
- Interrupt anticoagulation if necessary
- Hydration,
- Serial CBC’s, transfusion if indicated

Venous access infection
- Remove access, culture tip
- Antibiotics- broad, then focus based on micro

Infection post PTC/ nephrostomy tube placement with or without rigors
- Antibiotics- broad, then focus based on micro
- Supportive

Post-TACE / RFA syndrome
- Important to work up for infection/sepsis as the symptoms overlap
• Mild- supportive; hydration, pain control, antipyretics
• Severe- also supportive; Blood cultures and broad spectrum antibiotics if infection suspected

Post Y-90 syndrome
• Important to work up for infection/sepsis as the symptoms overlap
• Mild- supportive; hydration, pain control, antipyretics
• Severe- also supportive; Blood cultures and broad spectrum antibiotics if infection suspected

Rigors
• Demerol- 25 mg IV. May give q15 minutes up to 100 mg

Nausea/vomiting
• IV hydration, Zofran, Phenergan, NG tube

Seizures
• Supportive
• Benzodiazepines I.V.

Contrast induced nephropathy prevention
• Hydration, hydration, hydration

Drains / venous access / PTC or nephrostomy catheters partially or totally pulled out
• Remove and replace if necessary
Cold foot
- CTA runoff
- Intervention based on CTA findings

“Bloody urine” post mechanical thrombectomy
- Follow labs (Creatinine, H/H)
- Hydration

NOTES:
CONTRAST ALLERGY PREPARATION

Elective cases
13-hour premedication schedule:
Prednisone 50 mg PO x3 doses at 13, 7, and 1 hour prior to procedure
Benadryl 50 mg PO x1 at 1 hour prior to procedure

Emergency cases/Last minute preparation
Only if emergent procedure:
Solu-medrol 125 mg IV x1 dose
Benadryl 50 mg IV x1 dose
Pepcid 20 mg IV x1 dose

NOTES:
CONTRAST REACTION MANAGEMENT IN ADULTS

Urticaria
1. Discontinue injection if not completed
2. No treatment needed in most cases
   If severe or widely disseminated: give alpha-agonist (arteriolar and venous constriction): epinephrine SC (1:1,000) 0.1–0.3 ml (= 0.1–0.3 mg) (if no cardiac contraindications).

Facial or Laryngeal Edema
2. Give alpha agonist (arteriolar and venous constriction): epinephrine SC or IM (1:1,000) 0.1–0.3 ml (= 0.1–0.3 mg) or, especially if hypotension evident, epinephrine (1:10,000) slowly IV –3 ml (= 0.1–0.3 mg).
   Repeat as needed up to a maximum of 1 mg.
   If not responsive to therapy or if there is obvious acute laryngeal edema, seek appropriate assistance (e.g., cardiopulmonary arrest response team).

Bronchospasm
   Monitor: electrocardiogram, O2 saturation (pulse oximeter), and blood pressure.
2. Give beta-agonist inhalers (bronchiolar dilators, such as metaproterenol [Alupent], terbutaline [Brethaire], or albuterol [Proventil or Ventolin]) 2 to 3 puffs; repeat as necessary. If unresponsive to inhalers, use SC, IM, or IV epinephrine.

3. Give epinephrine SC or IM (1:1,000) 0.1–0.3 ml (= 0.1–0.3 mg) or, especially if hypotension evident, epinephrine (1:10,000) slowly IV 1–3 ml (= 0.1–0.3 mg).

Repeat as needed up to a maximum of 1 mg.

Call for assistance (e.g., cardiopulmonary arrest response team) for severe bronchospasm or if O2 saturation <88% persists.

**Hypotension with Tachycardia**

1. Legs elevated 60° or more (preferred) or Trendelenburg position.


4. Rapid intravenous administration of large volumes of Ringer’s lactate or normal saline.

If poorly responsive: epinephrine (1:10,000) slowly IV 1 ml (= 0.1 mg)

Repeat as needed up to a maximum of 1 mg

If still poorly responsive seek appropriate assistance (e.g., cardiopulmonary arrest response team).
**Hypotension with Bradycardia (Vagal Reaction)**

1. Secure airway: give O2 6–10 liters/min (via mask)
2. Monitor vital signs.
3. Legs elevated 60° or more (preferred) or Trendelenburg position.
4. Secure IV access: rapid administration of Ringer’s lactate or normal saline.
5. Give atropine 0.6–1 mg IV slowly if patient does not respond quickly to steps 2–4.
6. Repeat atropine up to a total dose of 0.04 mg/kg (2–3 mg) in adult.
7. Ensure complete resolution of hypotension and bradycardia prior to discharge.

**Hypertension, Severe**

2. Monitor electrocardiogram, pulse oximeter, blood pressure.
3. Give nitroglycerine 0.4-mg tablet, sublingual (may repeat × 3); or, topical 2% ointment, apply 1-inch strip.
4. If no response, consider labetalol 20 mg IV, then 20 to 80 mg IV every 10 minutes up to 300 mg.
5. Transfer to intensive care unit or emergency department.
6. For pheochromocytoma: phentolamine 5 mg IV (may use labetalol if phentolamine is not available).
Seizures or Convulsions

2. Consider diazepam (Valium) 5 mg IV (or more, as appropriate) or midazolam (Versed) 0.5 to 1 mg IV.
3. If longer effect needed, obtain consultation; consider phenytoin (Dilantin) infusion — 15–18 mg/kg at 50 mg/min.
4. Careful monitoring of vital signs required, particularly of pO2 because of risk to respiratory depression with benzodiazepine administration.
5. Consider using cardiopulmonary arrest response team for intubation if needed.

Pulmonary Edema

2. Elevate torso.
3. Give diuretics: furosemide (Lasix) 20–40 mg IV, slow push.
4. Consider giving morphine (1–3 mg IV).
5. Transfer to intensive care unit or emergency department.

Reference: ACR Manual on Contrast Media
CUTANEOUS INJURY GRADING POST RADIATION EXPOSURE

Grade I: > 2 Gy- (2-5 week post exposure) Redness, edema. (6-7 week post exposure) Dry desquamation. Expect complete healing 4-6 weeks following desquamation. Possible permanent skin atrophy

Grade II: > 15 Gy- (1-3 week post exposure) Erythema, edema, skin turns brown. (5-6 week post exposure) subcutaneous edema and blistering, moist desquamation. Healing depends on size of injury. Permanent skin atrophy, possible telangiectasia.

Grade III: > 40 Gy- (1-2 week post exposure) Erythema, blistering, edema, erosions/ ulceration. Ulcerations may take months-years to fully heal. Permanent skin atrophy, depigmentation, telangiectasia formation, lymphatic/ small vessel destruction

Grade IV: > 550 Gy (1-4 day post exposure) Blistering, early ischemia, tissue necrosis by 2 weeks. Treatment via skin graft or amputation if severe. May take many months-years of procedures to correct.

All grades may increase skin cancer risk in the future
DEVICES

It is expected that the Fellow assigned for a case will be the one responsible to select the key materials/devices that will potentially be needed to perform a particular procedure (balloon, sheaths, stents, etc). These materials are stocked in the supply room in each building. The Fellow and the RT should discuss about the devices and have them in the procedure room BEFORE starting the case. The goal is avoid unnecessary waiting or delay during the procedure. Plan the strategy and anticipate issues ahead of the game.

Biopsy Equipment:

- Coaxial systems- Guide introducer needle into lesion and advance biopsy needle through the obturator into lesion.
- Core biopsies typically 18 or 20 gauge. Introducer needle is slightly larger. Systems have multiple lengths to choose from based on lesion depth.
Guidewires:

- Diameter measured in inches, generally 0.018” or 0.035” diameter.
- Length also important when considering catheter exchanges and device usage.
- Different guidewires have different properties, including hydrophilic and hydrophobic types. Wires also vary in stiffness.

Commonly Wires:

Straight Wire- All-purpose 0.035” wire

J Wire- Similar to straight wire, but J tip

Wholey Wire- Very useful 0.035” wire with a floppy, atraumatic tip, and slightly stiff back end; lock extension useful for crossing lesions and exchanges

Glidewire- Hydrophilic wire, available in regular or stiff formats, also in 0.035” or 0.018” sizes; very useful for crossing lesions, but take care to avoid dissection

Advantage Wire- Hydrophilic, floppy tip like a glidewire with a braided back end, useful for crossing and exchanges

Amplatz Wire- Super stiff wire with slightly floppy tip, very useful for catheter exchanges

Rosen Wire- Almost as stiff as Amplatz with a J tip, also a very useful exchange wire

Nitrex Wire- 0.018” wire with a floppy tip, nitinol back end

Fathom Wire- 0.018” wire, floppy, shapeable, hydrophilic tip

Progreat Wire- 0.018” wire, floppy, shapeable, hydrophilic tip
Catheters and Sheaths:

- Diameter measured in French scale (1 FR = 1/3 mm).
- For sheaths, the measurement is the inner diameter, so the outer diameter is slightly larger than the measurement. For example, a 5 Fr sheath will accommodate a 5 Fr catheter inside of it, but the outer diameter of the sheath will actually be slightly larger than 5 Fr to account for the wall thickness.
- Generally use 5 or 6 Fr sheath for routine femoral access angiograms (may use up to 24 Fr for procedures such as TAVRs)
- For catheters, the measurement is the outer diameter, which includes the wall of the catheter.
- Different catheters have different properties - stiffness, hydrophilic coating, tip shape, etc.
- Catheter length is important to consider when planning case to prevent unnecessary exchanges.
- Shuttle sheaths are useful to lend support during interventions

Standard sheaths come in multiple diameters and are 10 cm. Lengths can be longer or shorter. Slender sheaths accommodate catheters with a decreased outer diameter. Ansel or Balkin shuttle sheaths very good for up and over access as well as support for mesenteric work
Mikaelson Catheter- Workhorse reverse curve catheter; useful for selecting mesenteric vessels and up and over access
Cobra Catheter- Workhorse forward facing catheter, not used as much at MUSC due to affinity for the Mikaelson Pigtail Catheter- Multiple side holes for large vessel power injections
KMP/Kumpe, Tegtmeyer, Vert, MPA Catheters- Angled tip catheters; these common in multiple lengths and French sizes
Omniflush Catheter- multiple side holes for large vessel power injections; good for up and over access
Jacky/Sarah Catheter- Radial access catheters; ideal for navigating aortic arch and selecting mesenteric vessels
Simmons Catheters- Reverse curve catheter with a long leg; can be useful to select vessels with difficult angles.
Closure Devices:

- Perclose (suture)- 6 Fr sheath advanced over 0.035” guidewire

- Angioseal (bioabsorbable plug)- 6 and 8-Fr sheath
  Recommended no repuncture in 30 days. Consider puncturing above the previous puncture if really needed.

- Starclose (nitinol clip)- 6 Fr. Sheath
**ENDOLEAK CLASSIFICATION**

Type I- flow originates from ineffective endograft seal at fixation zones
   IA- proximal leak
   IB- distal leak
   IC- iliac occlusion site

Type II- branch vessel retrograde flow (Lumbar, IMA, accessory renal arteries cover by endograft)
   IIA- Simple (single vessel)
   IIB- Complex (two or more vessels creating a Circuit)

Type III- Structural failure of endograft
   IIIA- Junctional failure
   IIIB- Endograft fracture/ hole (major>2mm, minor <2mm)

Type IV- Endograft porosity

Type V- Endotension
HYDRATION PROTOCOL

For Patients Receiving IV or IA Contrast

All Interventional Radiology patients receiving IV or IA iodine-based contrast will be placed on the following hydration protocol unless the patient on dialysis/ESRD or otherwise notified by a physician.

Pre-Procedure Orders

1. Place a 20-gauge (or smaller if necessary) peripheral IV

2. A baseline creatinine should be obtained if no recent value is available.

3. Initiate an infusion of 0.9% normal saline IV at 100cc per hour. End stage renal disease on hemodialysis should have no hydration. Decrease infusion rate in patients with congestive heart failure.

Intra-Procedure Orders

1. 150cc iodinated Omni-300 contrast loaded on the table at the beginning of the procedure. If the patient has creatinine >1.5, Visipaque should be used instead of Omnipaque. Consider using CO2 as a contrast agent in patients with elevated creatinine.

2. Additional contrast to be added in 50cc increments throughout the procedure.
3. Contrast count to be called out by the RT at 150cc and with each additional 50cc of contrast given.

4. Document contrast counts throughout the procedure as they are called out.

5. IV normal saline to continue throughout the procedure at 100 cc per hour.

**Post-Procedure Orders**

10. Post procedure hydration of 250cc normal saline for 2-6 hours unless patient has ESRD or congestive heart failure. In case of congestive heart failure, consult with VIR attending as to how to proceed.

**NOTES:**
MODERATE SEDATION PHARMACOLOGY

All moderate sedation must be monitored by qualified nursing staff

Anxiolytic - Benzodiazepine

• Versed (Midazolam) - 0.5-2.0 mg IV initially (duration 1-2 hours)
  o May repeat doses in 0.5 mg IV increments prn during the procedure for discomfort

Pain control - Local Anesthesia

• 1% Lidocaine - May use ester type anesthetic like Bupivicaine/ Procaine if allergic to Lidocaine (true allergies very rare)

Pain control- Narcotics

• Fentanyl- 25-100 ug IV initially (duration 0.5-1 hour)
  o May repeat doses in 25-50 ug IV increments prn during the procedure for discomfort

MUSCs opioid analgesic comparison chart:
Pain control- Non-steroid anti-inflammatory

- Toradol (Ketoralac)
  - Single dose administration:
    IM: Patients less than 65 years of age: one dose of 60 mg. Patients who are renally impaired, and/or less than 50 kg (110 pounds): one dose of 30 mg.
    IV: Patients less than 65 years of age: one dose of 30 mg. Patients who are renally impaired, and/or less than 50 kg (110 pounds): One dose of 15 mg.

  - Multiple dose administration:
    Patients less than 65 years of age: 30 mg IM or IV every 6 hours as needed. The max daily dose should not exceed 120 mg.
    Patients who are renally impaired, and/or less than 50 kg (110 pounds): 15 mg IM or IV every 6 hours as needed. The maximum dose should not exceed 60 mg.
OVERDOSE REVERSAL:

- **FOR FENTANYL: Use Naloxane (Narcan)**
  - Administer naloxone for significant CNS and/or respiratory depression.
  - Proper airway management is important. This may involve:
    - Breathing support to help maintain proper oxygen levels. It includes assisted bag-valve mask breathing that can be provided until the patient is ventilating adequately.
    - Consider endotracheal intubation
  - The usual dose of administered is between 0.4 and 2 mg in the adult and 0.1 mg/kg in the child or infant. In suspected habituated opiate users, if the situation allows, slowly administer 0.1-0.4 mg of IV aliquots every 1-2 minutes for a more controlled and partial reversal of opiate effect.
  - The onset of effect following IV naloxone administration is 1-3 minutes; maximal effect is observed within 5-10 minutes. A repeat dose is indicated for partial response and can be repeated as often as needed.
FOR VERSED: Use Flumazenil

- The cornerstone of treatment in benzodiazepine overdose is good supportive care and monitoring.
  - Cardiac monitoring
  - Supplemental oxygen and airway support
  - Intravenous (IV) access
  - Rapid glucose determination (finger stick) and administration of D50 if necessary
  - Flumazenil is a competitive BZD receptor antagonist and is the only available specific antidote for BZDs though its use in acute BZD is controversial and its risks usually outweigh any benefit.

  - 0.2 mg IV injection over 15-30 sec
  - If no response: then 0.3 mg over 15-30 sec 1 min later, if no response then again 0.5 mg IV over 15-30 sec to max cumulative dose of 3 mg/hr
  - Rarely patient may require titration up to total dose 5 mg; if no response after 5 min, sedation unlikely to be secondary to benzodiazepines
  - Slow infusion of lowest dose required to decrease adverse events
o Indicated for reversal of benzodiazepine use during procedure, OR known isolated benzodiazepine overdose in patients not taking benzodiazepines chronically.

• FOR HEPARIN: Use Protamine
  o 1mg every 10 Unit of Heparin, or 10 mg of Protamine for every 1,000 Units of Heparin.
  o Slow I.V. infusion (over 5-10 min)
RADIAL ACCESS WORKUP

Allen’s Test

1. The hand is elevated and the patient/person is asked to make a fist.
2. Pressure is applied over the ulnar and the radial arteries so as to occlude both of them.
3. Still elevated, the hand is then opened. It should appear blanched (pallor can be observed at the finger nails).
4. Ulnar pressure is released and the color should return in 7 seconds. This indicates that the patient has complete palmar arch and is safe to have transradial intervention.

Barbeau’s Test

Similar to Allen’s Test. A pulse oximetry is placed on either the thumb or index finger (areas perfused by the radial artery). After occlusion of the radial and ulnar arteries, the pulse oximetry waveform should flat-line. Release the ulnar occlusion and if the palmar arch is complete, you should observe a “normal” waveform (normal variants are A, B and C). Type D waveform is a contraindication to radial access.
Both tests are designed to assure collateral blood flow to the whole hand via the ulnar artery / complete palmar arch. Inadequate perfusion of the 1\textsuperscript{st} and 2\textsuperscript{nd} fingers during radial compression is a contra-indication to transradial interventions.

**US EVALUATION**

The left radial artery should be scanned 1 cm above the styloid process with B-mode US in order to check the AP diameter, measured inner-to-inner wall. Avoid excessive compression of the wrist which would underestimate the radial artery diameter. Minimum 1.8 mm diameter

If there has been prior radial intervention, radial artery should be scanned up to the brachial artery bifurcation.

Make sure there is a printed copy of the radial artery diameter with a patient sticker. Alternatively, make sure the US images are sent to PACS.
RESIDENCY FOR IR/DR (from SIR website)

The total period of training is designed to comply with the normal six-year (combined) requirement for a Diagnostic Radiology residency and IR fellowship training program.

As for the traditional training pathway, a minimum of 12 months of direct patient care in the PGY-1 year is required in an ACGME-approved program in Internal Medicine or its subspecialty areas (i.e. cardiology, nephrology, pulmonary, critical care, gastroenterology, or hematology/oncology); Pediatrics; Surgery (General, Cardiovascular, Pediatric, Thoracic, or Urological); Family Practice; Emergency Medicine; OB-GYN; or a combination of these specialties.

In addition, seven months during PGY-2 to PGY-6 will be dedicated to research and clinical training in areas relevant to the practice of VIR (i.e. consult service for cardiology, nephrology, vascular surgery, oncology, hepatology, gastroenterology or other non-radiology clinical rotations).

Programs may also provide a resident IR clinic to provide the trainees opportunity for managing outpatients and to provide enhanced continuity of care.

DIAGNOSTIC RADIOLOGY TRAINING:

Thirty-two months of full-time radiology is required including 3 months of IR during the PGY-2, PGY-3 and PGY-4 years. Because of the attenuation of the traditional
clinical radiology training, it will be imperative that the Radiology residency and IR Fellowship program directors make annual evaluations regarding the residents’ progress in radiology. This diagnostic radiology training will be obtained during the PGY-2, 3, 4, and 5 years.

**ADDED INTERVENTIONAL RADIOLOGY TRAINING:**

Nine months of subspecialty training in IR will be scheduled during the PGY-5 ("mini-fellowship") year. These nine months could include training in the noninvasive peripheral vascular lab, MRA, CTA, neuroangiography, neurointerventions, cardiac MRI or IR. This is IR fellow-level training that is in addition to the required PGY-6 fellowship year in an ACGME-approved IR fellowship training program.

**RESEARCH/VIR CLINICAL TRAINING:**

Seven months will be dedicated to research and clinical training in areas relevant to the practice of VIR. Of these seven months, the trainee should have a minimum of 3 months dedicated to basic or clinical research activities.

**CALL SERVICE:**

During the IR rotations in the PGY-5 year and non-radiology clinical training rotations during the PGY-2-5 years, call responsibility for the trainee will be determined by the Residency and Fellowship Program Directors.
<table>
<thead>
<tr>
<th>YEAR</th>
<th>Description</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>PGY 1</td>
<td>Transitional-clinical year</td>
<td>12 months</td>
</tr>
<tr>
<td>PGY 2-5</td>
<td>Diagnostic Radiology (*includes 3 months IR during PGY-2, 3 or 4)</td>
<td>32 months</td>
</tr>
<tr>
<td>PGY 2-5</td>
<td>Clinical Training and Research</td>
<td>7 months</td>
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<tr>
<td>PGY 5</td>
<td>Interventional Radiology “mini-fellowship”</td>
<td>9 months</td>
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<tr>
<td>PGY 6</td>
<td>Interventional Radiology Fellowship</td>
<td>12 months</td>
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<tr>
<td>Total Training</td>
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<td>72 months</td>
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</tbody>
</table>

**NOTES:**
VASCULAR & INTERVENTIONAL RADIOLOGY PHONE LIST

Main phone at Children’s Hospital MH VIR 2-7456 (FAX 2-5551)
Main phone at ART VIR 6-5542 (FAX 6-5577)
MH & ART scheduling 2-9271 (FAX 2-2672)
East Cooper Scheduling: 6-8282 (FAX 6-8181)
VIR Admin Assistant Sandra Stringer: 6-5556 (FAX 6-4976)

ATTENDINGS

Dr. Bayne Selby       Office 6-5561       Pager 14135
Dr. Chris Hannegan    Office 6-5560       Pager 14464
Dr. Claudio Schönholz Office 6-5562       Pager 14147
Dr. Marcelo Guimaraes Office 6-5543       Pager 14179
Dr. M. Bret Anderson  Office 6-5557       Pager 14733
Dr. Joshua Adams      Office 6-4854       Pager 14718
Dr. Ricardo Yamada    Office 6-5556       Pager 14865
Dr. Juan Camacho      Office _____        Pager _____

FELLOWS (Academic Room at ART 6-5056, at CH 2-7455)

Dr. ________________        Pager ______
Dr. ________________        Pager ______
Dr. ________________        Pager ______
Dr. ________________        Pager ______
**NURSE PRACTITIONER/PHYSICIANS ASSISTANT**

Maria Hinton    Hospital Mobile 6-5561
                Pager 12300

Brandi Aquino    Hospital Mobile 6-3331
                Pager 12558

**Managers/Directors/Coordinators**

Mike Ricciardone - Director of Radiology
                Office: 2-4030, Pager: 13003

Rob Finch - Radiology Manager
                Office: 2-0559, Pager: 11975

Tracy Robinson – Office/ART 6-5536, Office/ Main 2-3011
                Pager: 12585

Brittany Meibers – Nurse Practice Supervisor
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                Office: 21930 Pager: 13019, FAX: 23472

Corie Lynn/Tina Cooper – Research Coordinators
                Office: 28874 Pager: 13196, FAX: 23472

**Nurse Patient Care Navigators**

Shannon Shuler - Office: 2-8406, FAX: 2-9068
                Pager: 13589

Heather Hartung - Office: 6-5558, FAX: 6-4921
                Pager: 12639

Nicole Wrazin - Office: 2-8996, FAX: 2-9068
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Cormie Lynn- Office 2-8874 Pager 1-3196 Fax 2-3472

Lea DuFour- Office 2-3442 Pager 1-1570

**Holding Areas:**

Main Hosp Prep & Recovery - 2-8955, Fax: 2-5468,
Tube #39
Art Prep & Recovery - 6-5566
Main Hospital (CH) Reception: 2-2083
Ashley River Tower Reception: 6-5709

Private Consult Rooms:
Room 504: 2-2140, Lounge: 2-2212

ANGIO NUMBERS at Children’s Hospital
Reading Room: Room 510D: 2-7456, 2-7455 & 2-0689
Room 1: 6-0315, Control Desk: 2-9153
Room 2: 6-0316, Control Desk: 2-3793
Room 3(CT): 6-0317, Control Desk: 2-3683, Fax: 2-5551
Room 4: 6-0306, Control Desk: 2-6037
Room 5: 6-0307, Control Desk: 2-3706

ANGIO NUMBERS at Ashley River Tower
Main phone: 6-5542
Reading Room: 6-5531, 6-5532, 6-5534
Room 1(CT): 6-5537
Room 2: Control Desk: 6-5540, Fax: 6-5577, Tube #64
Room 3: Control Desk: 6-5538, 6-5539

ANGIO SPECIALISTS
Megan Blake Pager: 11838
Traci Buckingham Pager: 11651
Jim Daniel Pager: 12294
Jill Flint Pager: 13397
Brian Giordano Pager: 13143
Ron Hosey Pager: 12989
Chris Jensen Pager: 11078
Tamara McGougan Pager: 11458
Lori Rager Pager: 13190
Woody Walker Pager: 12779
ANGIO NURSES

Star Austin  Pager 11389
Jamie Brick  Pager 11942
Paula Dixon  Pager 12160
Carla Foust  Pager 12394
Alan Hawes  Pager 11883
Jenny Hazel  Pager 11964
Amanda Lachapelle Pager 11937
Jen Longstreet  Pager 13048
Linda Poulos  Pager 11469
Tom Williams  Pager 13304

Miscellaneous Numbers

Brenda (Financial Serv. HVC):  2-0582
Graylin Nelson:  11369
CCIT Help:  2-9700
Transcription/Nora:  2-4268 / 2-7646
Bernard:  1-3033
Tina Rapstine:  2-7179
Sally Self:  2-4556
Priority Operator:  2-1010
Lunch Line:  2-8713
Radiology I.T.:  6-2525
Alden:  2-9206
Pam Collins:  2-7802
Marlene Mizell:  2-3818, Fax: 2-8948
Paging Operator:  2-2123
June Shi:  2-8030
Lynn Williams - Vascular Access Resource Nurse
Office:  2-1143
EPIC IT:  2-3742
Shon Gladden (Dr. Adams clinic scheduler) – 6-1949
VIR REQUIRED PROCEDURES LOG - THESE PROCEDURES SHOULD ALSO BE LOGGED INTO E-VALUE.

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Min</th>
<th>Max</th>
<th>CPT Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abscess Drainage/ Fluid Aspiration (CT guided)</td>
<td>3</td>
<td>15</td>
<td>75989</td>
</tr>
<tr>
<td>Biopsy (CT guided)</td>
<td>3</td>
<td>15</td>
<td>76360</td>
</tr>
<tr>
<td>Biopsy (Fluoro guided)</td>
<td>3</td>
<td>15</td>
<td>76003</td>
</tr>
<tr>
<td>G tube/ GJ tube placement</td>
<td>3</td>
<td>15</td>
<td>75984</td>
</tr>
<tr>
<td>Procedure</td>
<td>Rate</td>
<td>Temp</td>
<td>Code</td>
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<tr>
<td>------------------------------------------</td>
<td>------</td>
<td>------</td>
<td>-------</td>
</tr>
<tr>
<td>Nephrostomy placement</td>
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<td>15</td>
<td>74485</td>
</tr>
<tr>
<td>Thoracentesis (CT guided)</td>
<td>3</td>
<td>15</td>
<td>76360</td>
</tr>
<tr>
<td>Venous Access</td>
<td>3</td>
<td>15</td>
<td>76942</td>
</tr>
</tbody>
</table>
WEBSITES:

HELPFUL LINKS TO MUSC INTERVENTIONAL RADIOLOGY

http://clinicaldepartments.musc.edu/radiology/interventional

An electronic copy of this document is available on Moodle (password protected) moodle.musc.edu

Diagnostic Radiology Residency Program > Resident Education/ Clinical Rotations > Vascular Interventional Radiology

Electronic copies of many helpful documents can be found here:
https://www.musc.edu/cce/ORDFRMS/Interventradiol/index.html

General Consent
https://www.musc.edu/cce/ORDFRMS/pdf/all_all_consent_surgicalconsent.pdf

CT Guided Post-procedure Orders

Venous Access Device Post-procedure Orders
Cholangiogram /Nephrostogram Post-procedure Orders

Arteriogram Post-procedure Orders

Venogram Post-procedure Orders

CT Guided Procedure Patient Instructions

Drain Placement Patient Instructions

Nephrostogram Patient Instructions
https://www.musc.edu/cce/ORDFRMS/pdf/ah_hvc_intrad_dc_pated_nephdcinstruct.pdf

Cholangiogram/ Biliary Tube Patient Instructions

Fistula Thrombectomy Patient Instructions
Angiography Patient Instructions

EVLT Patient Instructions

OTHER VIR WEBSITES

Society of Interventional Radiology (SIR)
http://www.sirweb.org/

Cardiovascular and Interventional Radiological Society of Europe (CIRSE)
http://www.cirse.org/

Journal of Vascular and Interventional Radiology (JVIR)
http://www.jvir.org/
EPIC NOTES

LOGIN

When logging in for the first time, select a VIR attending. Do not change this for the rest of the rotation as it doesn’t matter if the appropriate attending for that day is selected in any further activities in EPIC.

CHANGING CONTEXT

The first thing that must be done before starting the rotation is changing the context of EPIC. This is performed by clicking the EPIC button in the top left corner of the screen and selecting “Change Context” near the bottom of the menu. Enter one of the VIR attendings under Provider and change the department to RAD VASC MH. This will stay in place for the rest of the month. After your rotation ends, you need to change your context back to your prior setting.

CREATING CONSULT LISTS

You need to create two consult lists to function on service, pending and completed consults. After a consult note is signed, the patient drops off the pending list and joins the completed consults list.
To create these lists, click on the “Patient List Tab”, then click Edit List, then choose Create My List.
1. Name your first list “Pending IR Consults”.

2. Add the following columns from the “Available columns” on the left to your selected columns on the right (you can add more columns if you prefer):
   a. Patient Name/Age/Sex
   b. Unit/Rm/Bed
   c. MRN
   d. Problem
   e. Diagnosis

3. To rearrange the order in which the columns appear within your My List, click the column you want to move and click the **Up** or **Down** arrow.

Repeat this step to create a “Completed IR Consults” list.

Next, expand the “System Lists” folder, then expand “Consults (Pending) – Physician”, and find “Interventional
Radiology” which can then be dragged & dropped into your “Pending IR Consults” list you just created.

Repeat this step under the “Consults (Pending & Completed)” system list by dragging that into your “Completed IR Consults” list you just created.

HOW COPY NOTE TEMPLATES

Click on the EPIC button in the top left, go to the “Tools” Menu, then “SmartTool Editors”, then “SmartPhrase Manager”
Enter the name of the person you will be copying a note template from in the User field (probably an IR Fellow) and click “Go”. You should see a list of their notes.

Select a note you want to copy, then click the “Share” button. Remember the name of each note you are copying.

Enter your name in the Users field and then click Accept.

You can repeat these steps for all the notes you want to copy.

**HOW TO WRITE A NOTE**

Double click a patient, either in the consult or scheduled patients list.

Patient tab will open. Click the notes button on the left.

Then click “New Note”.

![Image of medical software interface showing notes creation process]
The new pop up box will ask for a note type.

- For scheduled outpatients, enter “4” (H&P)
- For inpatient consults, enter “2” (Consult)

For service, enter 266 (or “RAD-VASCULAR”)  

Make sure the “Cosign Required” box is checked.

Enter the name of your attending for the procedure under “Cosigner. See example below.

To insert a note template, click on the body of the note editor, type a period “.” then the name of a note template you have either created or copied. (eg: .IRCONSULTS)

When typing in a consult note template, the F2 button is used to automatically select the next text area that must be filled out and is denoted with “***” or selects the next pull down menu. Please note from the pull down portions of the physical exam, left click is used to highlight and
unhighlight different choices such as “regular rate and rhythm” and using right click enters the highlighted choices into the text of the note.

**CREATE IR OUTPATIENT SCHEDULES**

First, click on the Schedule tab, then click the Create button.
You will need to create 2 lists which will appear under the “My Schedule” Folder. Create a “Rad Vasc Main” and a “Rad Vasc ART” list.

Each time you create a list, a list properties box will appear.

You can change your Selected Columns as below.

Then click on the Configuration Tab and select Search by Provider [All Depts]

Search and add the following providers:

- Main: IN1, IN2, IN3, IN4, IN5
- ART: ANG1, ANG2, ANG3
Now daily schedules can be viewed under the Schedule or Status Board tab just under the big EPIC button.

**INPATIENT WORK FLOW**

Inpatient workflow can be divided into 3 steps

1. Seeing the consult on your “Pending IR Consults” patient list and approving the case.
2. Visit the patients room and obtain consent
3. Complete a **CONSULT** note, making sure to document Mallampati and ASA scores.
4. Placing an order for the procedure as well as making other associated orders (Labs, NPO status).

When you type a consult note, you can check a box that appears that will associate your note with the consult order from the referring physician. This will ensure that the consult drops off the “Pending IR consults” list and moves to the “Completed IR Consults”.

![Image](image-url)
Selecting the Manage Orders Button on the right allows you to place the correct procedure order.

Individual orders can be placed under the Manage Orders Button. Common orders such as NPO status, PT/INR, CBC, and antibiotics are placed here.

Angiographic procedures often begin with “IR”, such as “IR Cholangiogram”.

CT Procedures often begin with “CT”, such as “CT abdomen Drain Placement”.

If you’re not sure, just search for a few key words, such as “IR Biliary” or “CT Drain” and a few relevant options will pop up.
OUTPATIENT WORK FLOW

Scheduled outpatients are seen on the schedule tab explained earlier in this chapter.

Outpatient workflow can be divided in 3 steps.

1. Open the patients chart from the schedule
2. Talk with the patient in the pre-procedure bay and obtain consent
3. Write an **H&P** note. Be sure to document Mallampati and ASA scores.

After the procedure is ordered, you will often have to enter post-procedure orders for outpatients.

This is completed by clicking the Manage Order button and clicking “Go To Order Sets”
Under the Order Sets menu, you can search for pre-made IR order sets by searching for “MUSC VIR POST”. Many IR post-procedure options should appear – choose the one appropriate for the procedure just performed.

Certain things should be selected after every procedure to limit phone calls from Prep & Recovery.

1. VTE prophylaxis – If you don’t need VTE prophylaxis, check the VTE Prophylaxis Contraindicated box and click the Contraindicated Qualifier Value button for both Pharmacological and Mechanical Prophylaxis.
2. Vital Signs
3. Activities
4. Diet – NPO or advance as tolerated
5. Notify physician orders

Other orders such as PRN pain medication and discharge orders can also be entered post-procedure.

OUTPATIENT FOLLOW UP

Nurse coordinators can be reached at extension 2-9271 and are very helpful.

Outpatient prescriptions should be printed from Epic and given to patient (ex chemoembolization patients).

Follow up procedures for nephrostomy and biliary drain changes should be placed in Epic.
These tasks can be accomplished by selecting the Orders Only tab from the Epic dropdown menu. Next, select Meds & Orders from the left hand side menu. You can then enter the appropriate order, whether it is a follow up procedure or a prescription to send home with the patient.

EPIC is a great tool, but can be challenging to navigate in some situations. Some problems may be solved by talking with the current fellows. Others may be solved by calling the EPIC helpline at 2-9700.