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**SURVIVAL MANUAL**

**FOR**

**ANGIOGRAPHY / INTERVENTIONAL RADIOLOGY**

Dartmouth-Hitchcock Medical Center

Spring 2009

# GENERAL OUTLINE OF THIS MANUAL:

The manual is divided into 12 chapters:

1) Arterial Diagnosis

2) Vascular Intervention

 3) Venous Diagnosis - including pulmonary angiography

4) Venous Access and Intervention

5) GI Intervention

6) Biliary Intervention, & GU Intervention

8) Non-vascular Tube Change

 9) Drainages and Aspirations

10) CT Biopsies

11) Pharmacology

12) Lab Tests

In each section the following information is outlined for all of the typical procedures we do:

1. indications for the procedure,
2. contraindications to the procedure [key point: almost all contraindications listed are relative, not absolute!],
3. steps to the pre-procedure work up of the patient,
4. information to use in obtaining consent,
5. pre-procedure orders,
6. post-procedure orders and (where applicable) post-procedure actions.

Use these guidelines during your clinical rotation on the Angio-Interventional Radiology service. The manual is intended to provide a framework for developing an understanding of the clinical practice of Interventional Radiology and to help streamline the clinical service.

# GENERAL CONSIDERATIONS

CONTRAST ALLERGY**:**

 **Allergy prophylaxis for iodinated contrast injections** — 50 mg. Prednisone P.O. 13, 7, and 1 hr prior to angio. We will supplement this with 50 mg IV Benadryl immediately prior to the exam. For emergency cases, give 100 mg IV Hydrocortisone immediately prior to the Angio in lieu of the PO Prednisone. For emergency cases in persons with a severe allergy history, consider arranging for anesthesia standby - consult with angio staff.

INSULIN**:**

 If at all possible, we should do diabetic patients in AM. Write to cut AM insulin dose in half.

METFORMIN (Glucophage):

Please follow the department procedure for the patients on treatment with Metformin.

BORDERLINE/MILD RENAL INSUFFICIENCY:

 **Discuss with staff**

 Hydrate the patient well. Start IV fluids in the morning. Instructions for NPO should be followed by IV fluid, rate and type.

 Consider bicarbonate infusion; 3ml/kg/hr one hour before study and 1ml/kg/hr for 6 hours after last contrast injection.

 Consider mucomyst 600mg PO the evening before, the morning of, the evening after and morning after. (Advise them to dissolve it in 30cc ginger ale….the medication tastes quite bad and is best tolerated this way).

ANTICOAGULATION REVERSAL:

 D/C Heparin 2 hours prior to Angio. It is not necessary to repeat PTT. Discuss any other orders regarding correction of coags (i.e. for FFP, cryoprecipitate, platelets, vit K, etc.) with staff & the referring House Officer to make sure you have a shared plan. Discuss plan with angio faculty. It is best not to schedule cases requiring complex management of coagulation status for first thing in the AM.

CONSCIOUS SEDATION:

 Patients receive Versed and Fentanyl during the procedure. Anesthesia requirements restrict any food for 6 hours prior to procedure, and any fluids 2 hours prior to procedures for Versed only. If patients have eaten they *can* have Fentanyl. There may be some patients in whom bypassing Versed is acceptable. This needs to be determined on a case to case basis in conjunction with the nursing staff and the Attending physician. Anxiolytics NOT requiring NPO status include Haldol, Ativan, Xanax etc and can be used in place of Versed. If Fentanyl cannot be used due to allergy or some other reason, patient should be offered any other narcotic (Dilaudid, Morphine, etc). This will need to be discussed with the nursing staff.

#  CHAPTER 1: ARTERIAL DIAGNOSIS: ARTERIOGRAPHY

INDICATIONS (typical; not exhaustive)

|  |  |
| --- | --- |
| Abdominal Aorta | PVOD, aneurysm work up, dissection, trauma emboli, tumor, arteritis, coarctation |
| Thoracic Aorta | Aneurysm work up, dissection, coarctation hemoptysis, AVM, Parathyroid search, sequestration of lung |
| Upper Extremity | Vasculitis, ischemia, trauma, AVM, anatomy for free flap (donor) |
| Visceral | GI hemorrhage, tumor work up, portal hypertension work up, mesenteric ischemia, trauma, Vasculitis, pre-HACP, venous sampling with IA stimulation, Anatomy for operatively placed chemotherapy pump |
| Renal | Hypertension, renal donor work up, polyarteritis nodosa, unexplained hematuria, trauma, equivocal mass on cross-sectional imaging |
| Pelvis | PVOD, hemorrhage, mass, trauma, impotence, AVM |
| Lower Extremity | PVOD, AVM, pre-free flap (donor) |
| Miscellaneous | Pre-Interventional procedure, post-operative evaluation of vascular anastomosis (most commonly renal revascularization and liver transplantation) |

CONTRAINDICATIONS: (Note: All contraindications are relative. In the case of an emergency procedure, contraindications may be disregarded.

* PT > 18 for **femoral** artery puncturePT > 13 for **brachial** artery puncture
* Platelets < 50,000
* see coag guidelines
* Ongoing heparinization:
* Heparin should be discontinued at least 2 hours prior to any arterial puncture.
* Severe contrast allergy
* Uncontrolled Hypertension
* Renal failure (Creatinine >1.5 consider CO2 Angio, hydration with NaHCO3, use of mucomyst, Cr> 2.0)

WORK UP

**Identify the diagnostic question** to be answered or clinical problem to be addressed by the procedure. Sources of information include: requisition, chart, referring physician, angio attending staff, and the patient

**Learn the pertinent history:**  current clinical problem, surgical history, contrast history, allergy history, current medications, rule out pregnancy, history of renal disease, etc. Get details of previous surgery, site of anastomosis, type and size of graft etc.

**Perform physical exam:** Document state of femoral and foot pulses. If femoral pulses are absent or if brachial access is planned, document axillary, brachial, radial and ulnar pulses.

 **Know the labs: PT, PTT, platelets, Creatinine**

General Guidelines:

* + - PT/PTT, Creatinine within 30 days for most patients except:
* PT/PTT within 24 hours for persons who have been on Coumadin or Heparin
* Platelet count within 24 hours if there is a history of bone marrow suppression, history of previous thrombocytopenia, or if the patient is on medication that can cause thrombocytopenia.

 Red flags **indicating need to correct coags prior to procedure:**

* + - PT > 18 for **femoral** artery puncture
		- PT > 13 for **brachial** artery puncture
		- Plts < 50,000
		- Ongoing heparinization - heparin should be discontinued at least 2 hours prior to any arterial puncture.
			* A repeat PTT after discontinuing the heparin is not necessary.

Key Concept**:** On occasion, (including trauma, dire emergencies and elective studies on healthy outpatients) arteriography is performed despite the absence of recent laboratory data. This is done at the discretion of the attending angio physician. Draw blood for stat coags after obtaining the vascular access.

**Review Relevant Imaging Studies:** This includes previous angiographic examinations as well as cross sectional studies.

**Obtain Consent**

**Write Pre-ProcedureOrders *(inpatients only)*:** See following page. Standing orders exist for outpatients and are followed by the nursing personnel.

**Document all of the above relevant information in your pre-procedure work up form (in CIS). If there are any problems or red flags, make a plan (i.e. contrast allergy; specifically indicate whether or not a steroid prep is being given).** The purpose of the pre-procedure note is to be a check list for you and to ensure adequate communication in the angio suite. This is particularly critical if you have already done a lot of work on the case but are not available to do the procedure.

CONSENT for arteriography:

Benefits of arteriography:

* Provides diagnostic pre- and post-operative road map of vascular anatomy (e.g. renal donor, revascularization procedures)Provides possibility of definitive diagnosis when it can't be made by less invasive means (e.g. GI hemorrhage, angiodysplasia, vasculitis)
* Gold standard for diagnosis (e.g. pulmonary angiography)
* As preparation for planned percutaneous or surgical intervention (e.g. - arterial portography before TIPSS, Arterial pump placement)

Risks of arteriography:

* Overall risk of complication for femoral access is <2% and axillary puncture is <4%. Risk of death 3 in 10,000 mostly from aortic dissection, rupture or cardiac complications.
* Contrast Reaction - 1/500

 Usually mild, but:

* May prolong hospitalization – (1/1000)
* May require mechanical ventilation and ICU
* Death rare (1/10,000)
* Hematoma (usually a mild annoyance) Groin - 1%, Axillary – 3%
* Arterial injury at the puncture site or at the catheter tip site that could require operative repair (<1%).
* Renal damage (for Cr > 1.5 consider CO2, MRA)

Usually mild, but:

* + - Can require temporary dialysis
		- Rarely can lead to permanent renal failure
		- Rare if the patient has no significant risk factors such as diabetes
* Brachial sheath hematoma (can cause significant nerve damage
* For brachial punctures only
* Stroke (for catheterizations above the diaphragm only) 0.5% for diagnostic cerebral angiography
* Puncture site infection (rare)

PRE-PROCEDURE ORDERS for arteriography:

|  |  |
| --- | --- |
| **NPO** | Except medications with sips of water:* after midnight for AM cases
* after a clear liquid breakfast for PM cases
 |
| **IV** | Place peripheral IV evening before exam — Hydrate the patients well before the exam to minimize contrast induced nephrotoxicity. Typical solution is D5.45 NaCl @ 75cc/hr to 120cc an hour. Consult clinical service when necessary. |
| **Antibiotics** | 1 dose of IV ATB on-call to Angio should be given if person has a prosthetic vascular graft or heart valve. Discuss ATB of choice with clinical service. |
| **Endocarditis Prophylaxis** | Recommended for known congenital heart disease, previous history of endocarditis, MVP *with* mitral regurgitation. |
| **Foley catheter** | Request catheter placement for all patients undergoing major interventional procedures such as TIPSS, Aortoiliac interventions, iliac stent placement, pelvic arteriogram, uterine embolization and thrombolytic therapy. |

POST-PROCEDURE ORDERS for arteriography: Pre-printed orders are available. All you need to do is fill in the blanks. The main variable is immobilization time for the puncture site: typical times are 4 hours following femoral puncture, and 6 hours with arm in a sling for patients following axillary puncture. Use of anticoagulation and closure devices will affect immobilization time. Consult with the attending.

CUSTOMIZING THE BASIC PRE-ARTERIOGRAM WORK UP

* **Aortagram and lower extremity angiogram**
* Consent for possible stent, PTA and thrombolysis
* Review the results of non-invasive vascular studies, old films and reports if available.
* **Visceral Arteriogram**
* Review all imaging studies especially the CT and MR.
* Make sure that patient had not received oral contrast for GI or CT studies in the preceding 48hrs. Scout film of the abdomen may be necessary before the patient is called for Angiogram if the patient received oral contrast. Recommend cleansing enemas if residual contrast is noted in the bowel.
* If applicable, Consent for emboliztion, risk of non-target embolization and ischemia.

# CHAPTER 2: VASCULAR INTERVENTION

## 1. THROMBOLYTIC THERAPY

INDICATIONS: Acute or subacute occlusion of native artery, vascular graft (arterial or dialysis), or central vein. Lytic therapy can restore blood flow and reveal an underlying correctable lesion as the cause of the thrombosis.

CONTRAINDICATIONS: Contraindications are ongoing hemorrhage, recent stroke (<2 mo); recent major trauma, recent major surgery (<2 mo); presence of a known CNS tumor, aneurysm, or AVM, known duodenal ulcer, recent CPR, and known hypersensitivity to the agent. Relative contraindications are being postpartum, uncontrolled hypertension; recent trauma or GI hemorrhage, known hemorrhagic retinopathy; and left sided intracardiac thrombus.

WORK UP: As for an arteriogram. Consult with staff regarding need to correct coagulation abnormalities. A high PT is associated with increased risk of intracranial hemorrhage, so we occasionally give FFP while proceeding. Sometimes we proceed despite ongoing heparinization, because risk of reversing anticoagulation outweighs risks associated with doing the procedure in the face of anticoagulation. Review of previous angiograms is critical because many of these patients are repeat players.

CONSENT: We frequently begin lytic therapy immediately following a diagnostic arteriogram. Therefore if the patient's history makes lytic therapy likely, include it (and angioplasty/stent) in the consent for the diagnostic study. Benefits of lytic therapy include avoidance of surgery, ability to identify and possibly correct an underlying lesion, and limb salvage. Additional risks of lytic therapy include allergy to the lytic agent, hemorrhage at the arterial and venous puncture sites, hemorrhage at any other remote location such as retroperitoneum, intracranial etc., infection, embolization, and failure to improve the problem. If the brachial artery is chosen as access site, complications include brachial sheath hematoma with median nerve palsy which can be permanent. Include death in the consent.

PRE-PROCEDURE ORDERS: Same as angiography

POST-PROCEDURE ORDERS(WHEN THROMBOLYSIS IS TO BE CONTINUED):

* Transfer to ICU.
* Foley catheter
* NPO till further orders
* Absolute bed rest with the accessed extremity FLAT
* No IM or SC injections
* Stat Hematocrit, PT, PTT, Fibrinogen on arrival to ICU
* Repeat PT. PTT, Fibrinogen every 8 hrs.
* Notify VIR if Fibrinogen is <150 mg. (If Fibrinogen is <150mg, decrease thrombolytic dose by ½.. If < 100 mg, stop infusion of thrombolytic agent and infuse only NS at a rate of 30 ml/hr through the catheter.)
* Check vital signs and puncture site(s) for bleeding or hematoma every 15 minutes x 4 then every 30 minutes x 4 then every hour. In case of bleeding, apply direct pressure, and notify VIR. (If ooze or small hematoma is noted from the groin access site consider pressure dressing or mechanical compression device. If moderate to large groin hematoma is noted stop infusion of the thrombolytic agent. Discuss with attending.)
* Neuro check with VS. (If remote bleeding is suspected stop infusion of the thrombolytic agent and start NS until further evaluation. Notify attending)
* Write for t-PA (Define concentration and infusion rate. Explain the tip location of each of the infusion ports to the ICU staff and in the procedure note. Label all the ports before transfer)

*(Standard infusion rates for rt-PA are 0.5 to 1 mg/hr. rt-PA(Alteplase) is reconstituted in sterile water supplied to a concentration of 1mg/ml. Further dilution with normal saline to 0.2mg/ml is acceptable. However dilution with more than 4 times the volume of saline may result in precipitation of the agent and hence should be avoided.)*

Heparin is given with thrombolytic infusions to maintain PTT around 1.5 times control.

Patient to return to angio at (**XX:XX**) hours for follow-up.

POST-PROCEDURE ORDERS: (AT TERMINATION OF INFUSION)

* Bedrest with puncture site limb(s) immobile for 6 hours.
* VS q 15 min x 1 hr, q 30 min x 1 hr, q 1 hr x 2 hr..
* Check puncture site for bleeding or hematoma with each VS check.
* Check pulses in treated area with each VS check.
* Plan to restart Heparin, if indicated, 2 hours following catheter removal. Consult with attending because risk-benefit ratio of continued anticoagulation varies with each case.

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## 2. VASCULAR INTERVENTION: PTA and / or STENT

INDICATIONS: Symptomatic arterial stenosis and short segment occlusions of the renal, iliac or femoral vessels. Stent placement is likely if the lesion is at the orifice, a complete occlusion or if the stenosis is heavily calcified, eccentric and long. Typical venous lesions are central vein occlusions and stenosis not responding to PTA. Unusual lesions to dilate and or stent include transplant arteries, infrapopliteal lesions, SVC stenosis, IVC stenosis, and aortic stenosis, occlusion, or dissection.

CONTRAINDICATIONS:As for arteriography.

WORK UP: As for arteriography.

CONSENT: As for arteriography. Discuss with attending staff, if intervention is likely, be sure to include possible angioplasty/stent/lysis in the consent for the angiogram. Benefits of angioplasty include avoidance of major surgery and its risks. Complications of angioplasty include: vessel dissection, thrombosis, and rupture; technical failure; clinical failure; as well as all of the complications of angiography. Benefits of stent placement include: avoidance of major revascularization procedure; salvage of failed angioplasty; and possible prolongation of vessel patency beyond what is possible with angioplasty alone. Complications of stent placement include all those for angiography and angioplasty as well as acute stent migration necessitating further stent placement and possibly surgery.

PRE-PROCEDURE ORDERS: As for arteriography

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## 3. VASCULAR INTERVENTION: EMBOLIZATION

INDICATIONS: Indications include control of hemorrhage (GI, bronchial, hepatic, splenic, pancreatic, renal, pelvic, extremity), control of symptoms of hormonally active tumors, chemoembolization for tumor treatment, preoperative for tumor resection, tumor ablation, hypertension control, priapism, redirection of blood flow for hepatic artery chemotherapy infusion, and treatment of symptoms or complications of congenital arteriovenous malformations.

CONTRAINDICATIONS:

 As for arteriography. Each type of embolization also has unique contraindications depending on the site to be embolized and the agent to be used. For example, pre-existing portal vein occlusion is a relative contraindication to arterial embolization of liver metastatic disease because of the increased risk of global hepatic ischemia. **Seek guidance from staff.**

CONSENT for embolization: **Seek guidance from staff.** As for arteriography. Specific benefits and risks will vary. In general, the major benefit of embolization is to achieve a therapeutic goal when surgery is not possible, is unlikely to be curative (i.e. for chronic GI bleeding) or is likely to cause excessive morbidity or death. Risks of percutaneous embolization include technical failure; migration of the embolic material to an unintended and undesirable location - possibly requiring surgery to correct; tissue necrosis; post embolization syndrome (fever, nausea, pain); stroke (pulmonary AVM and arch vessels only); death. This list is not exhaustive. Consult with staff regarding specific risks in each case.

PRE-PROCEDURE ORDERS: As for arteriography. Also a single dose of antibiotic should be ordered on call to Angio prior to any embolization procedure.

 If a pelvic embolization is being performed, consider placing a foley catheter.

POST-PROCEDURE ORDERS: As for arteriography. Consider PCA for pain control. Special orders are necessary for uterine artery embolization and chemoembolization procedures.

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## 4. UTERINE ARTERY EMBOLIZATION

INDICATIONS: Uterine artery embolization is indicated for relief of menorrhagia and bulk

 related symptoms of uterine fibroids.

CONTRAINDICATIONS: Patients with desire to maintain fertility, uterine prolapse, stress

 incontinence, pelvic inflammatory disease, contrast allergy, diabetes and patients with

 other pelvic surgical lesions including prior pelvic radiation are generally excluded from

 transcatheter therapy.

CONSENT: Inform the patient of possible complications related to arterial catheterization,

 contrast related complications, post procedural pain, nontarget embolization, infection,

premature ovarian failure, possibility of hysterectomy (0.7%) and infection.

WORK-UP: (In addition to the routine pre-angio work up protocol)

* All patients require pelvic US or MRI before the procedure, in addition to clinical evaluation by gynecologist.
* The procedure is performed as admit to follow; make sure that arrangements for admission after the procedure have been made.
* IV access and a Foley catheter are placed in the holding area.
* If a recent pregnancy test is not done repeat in holding area.
* Ancef 1Gm Ivis administered prior to embolization.
* Toradol 60mg IV (potent NSAID and analgesic) before transfer to Angio.

POST-PROCEDURE ORDERS: As per routine post angio

* PCA pump (template for PCA order form in burgundy binder at desk)
* Motrin 800mg PO on arrival to floor and 600mg q6h.
* Decadron 6 mg IV q6h prn nausea
* Zofran 4mg IV q6h prn nausea
* Diet as tolerated

DISCHARGE ORDERS:

* Motrin 600mg po q6h x 1wk
* Vicodin 1-2 prn q 4-6 h
* Peri-colace (casanthranol 30 mg and 100mg of colace) 1 cap BID

FOLLOW-UP:

* Periodic assessment of pain control during the first 24 hrs of the procedure.
* Examine the patient before discharge for procedure related complications such as groin hematomas and peripheral pulses.
* Assess the severity of the pain before discharge, convert to oral pain meds by am of day of discharge.
* Call the patient in 48 hours for assessment of pain related to embolization

# CHAPTER 3: VENOUS DIAGNOSIS

## 1. VENOGRAPHY

PROCEDURES: upper extremity venography, lower extremity venography, pre-dialysis access evaluation.

INDICATIONS: Rule out upper or lower extremity DVT; evaluate for incompetent perforating vein as a cause for lower extremity venous stasis ulcer; evaluation of extremity venous system prior to dialysis access placement; evaluation of non functioning or malfunctioning dialysis access; evaluation of subclavian vein prior to AICD or other permanent central transvenous device; r/o pericatheter subclavian thrombus; r/o SVC stenosis or occlusion.

*Note: for DVT evaluation, lower extremity venography is reserved for cases where US and/or MRA are equivocal, and for cases where symptoms are limited to the calf*.

CONTRAINDICATIONS: Coagulopathy is not a contraindication unless a positive venographic study will lead to a more complex procedure (i.e. acute lower extremity DVT leading to IVC filter placement.**)**

WORK UP:

**Identify the diagnostic question:** this can be the hardest part of the work up.

**Learn the pertinent history:**  Contrast history, allergy history, symptoms, surgical history.

**Perform physical exam:**  Location and extent of swelling, location of venous stasis ulcers (mark with radio-opaque marker for films)

**Know labs:** Creatinine is the most important value. PT, PTT, platelets not necessary unless a procedure requiring central access is planned after diagnostic study.

**Review relevant imaging studies**: PREVIOUS VENOGRAMS!!! PREVIOUS FISTULOGRAMS!!!

**Obtain consent**

**Write pre-procedure note:** Clear description of the point of the study is key

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## 2. PULMONARY ANGIOGRAPHY

INDICATIONS: Rule out pulmonary embolus, AVM evaluation, pulmonary

 thromboembolectomy.

CONTRAINDICATIONS:

* Contrast allergyPregnancy
* Renal failure (Creatinine > 2.0)
* Left bundle branch block: (for pulmonary angiography only). Consider transvenous pacer placement prior to study, or at least having one available for placement during the study if necessary
* Correction of coagulopathy usually not necessary
* Pulmonary hypertension: relative contraindication; measure pulmonary artery pressures and LVED pressures during the case

WORK UP: as for arteriography

**Identify the diagnostic question**

**Learn the pertinent history**

**Perform physical exam**

**Know labs:** PT, PTT, Cr +/- plts.

**Review relevant imaging studies**: in particular review studies and results that document status of femoral and iliac veins and IVC prior to filter placement as occlusion of a segment may affect choice of access site

**Obtain consent**

**Write pre-procedure orders**

**Fill out angio work-up form**

CONSENT:

***Benefits: Gold standard for diagnosingpulmonary embolism***

***Risks:***

* **General:** Bleeding, hematoma, or infection at puncture site; contrast allergy; renal dysfunction
* **Specific for pulmonary arteriography:** Cardiac arrhythmia; right heart failure; death
* **For jugular access:** pneumothorax; neck/mediastinal hematoma

PRE-PROCEDURE ORDERS ***for pulmonary arteriography****:*

* **Heparin** - D/C Heparin 1 hours prior to Angio (see exceptions to this). It is not necessary to repeat PTT.
* Discuss any other orders regarding correction of coags (i.e. for FFP, cryoprecipitate, platelets, vit K, etc.) with the referring House Officer to make sure you have a shared plan. Discuss plan with angio faculty.

##

* POST-PROCEDURE ORDERS:Main variable is immobilization time for the puncture site: typical times are 4 hours for inpatients following femoral vein puncture, 2 hours for outpatients following femoral vein puncture.
* Venography from the jugular approach requires 4 hours bedrest with head of bed elevated 45 degrees or more.

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## 3. RENAL VEIN RENIN, ADRENAL VEIN CORTISOL, ALDOSTERONE SAMPLING:

INDICATIONS: evaluation of possible renovascular hypertension, hyperaldosteronemia,

cushings. All patients should have had peripheral lab results concordant with these diagnoses. Role of sampling is to localize side.

CONTRAINDICATIONS: as for central venography

WORK UP:

**Identify the diagnostic question**: Particularly which kidney or adrenal is suspect and whether or not segmental renins should be obtained. Hyperaldosteronemia vs hypercortisolemia.

Some patients require medication to suppress adrenal function in the days prior to the study…this varies depending on what we are sampling for! Discuss with staff and referring endocrinologist.

**Learn the pertinent history.**

**Perform physical exam.**

**Know labs:** PT, PTT, Cr +/- plts.

**Review relevant imaging studies:** in particular review renal studies, such as angios, nuc med studies, CT, or MR.

**Obtain consent.**

**Write pre-procedure orders.**

CONSENT:

**Benefits:** Unequivocal evidence that ischemic kidney is a cause of hypertension - this

increases the likelihood that intervention (such as surgery, embolization or PTA) will help symptoms. Localize potential source of autonomous hormone production for surgical planning.

**Procedural Risks:** Bleeding, hematoma, or infection at puncture site; contrast allergy; renal dysfunction. Equivocal test result is possible. Laboratory error requiring repeat procedure can occur but is rare.

PRE-PROCEDURE ORDERS: ***for renal vein renin sampling***

* Low sodium diet (< ?? mEq/d) for 3 days prior to sampling if patient is not taking diuretics.
* Discontinue antihypertensive medications except for diuretic x 3 days. Guidelines for this:
	+ - DC proproanolol and alpha-methyldopa if possible.
		- Hydralazine is acceptable because it is a renin stimulant.
		- ACE inhibitors are +/-
* Supine position for at least one hour prior to sampling. Patient must be transported on a stretcher.

POST-PROCEDURE ORDERS: ***as for venography from the femoral approach.***

# CHAPTER 4: VENOUS ACCESS AND INTERVENTION

## 1. TUNNELED CATHETER PLACEMENT

INDICATIONS: Long-term venous access - typically for chemotherapy or access following bone marrow transplantation. Single, dual, and triple lumen catheters are available. Indication for translumbar placement is SVC or bilateral subclavian vein occlusion.

CONTRAINDICATIONS:

* Uncorrectable coagulopathy. General coag guidelines are as follows…**consult with staff regarding abnormal coags**
	+ - PT < 18
		- PTT: normal or patient off Heparin for at least 4 hours
		- Platelets >50,000
		- Immunosuppression with WBC <1000
* Central venous occlusion (remember to review previous venous studies!!!)
* Inability of the patient to cooperate with line maintenance: Hickman catheters require a fair amount of maintenance and are potential sources of sepsis.
* Ongoing infection: must be afebrile x 24 hours to placement. Must wait 48 hours before placing a new Hickman if an infected one has just been removed, or have a negative blood culture.

WORK UP:

**Identify the indication**: for placement and the requested site and side of insertion.

**Learn the pertinent history**: particularly sites of previous line placements.

**Perform physical exam**: evidence of arm swelling.

**Know labs**: Platelets, PT, PTT, and Creatinine.

**Review relevant imaging studies**: in particular review studies and results that document status of IJ subclavian veins, brachiocephalic veins and SVC as occlusion of a segment may affect choice of access site.

**Obtain consent**

**Write pre-procedure note**

CONSENT:

**Benefits:** permanent access decreasing the need for peripheral needle punctures; central access decreasing the risks of infusion of substances irritating to endothelium; fluoroscopic guidance provides added benefit of decreasing procedural risks when compared with blind surgical placement.

**Procedural Risks:** technical failure, contrast allergy, renal dysfunction, infection, arm swelling due to venous thrombosis, catheter malfunction requiring future intervention, pneumothorax, hemothorax,and mediastinal hematoma.

**Long Term Issues:** Requires daily maintenance; delayed infection may require removal; and catheter fragmentation may lead to cardiac arrhythmia and would require foreign body retrieval.

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## 2. VENOUS ACCESS: SUBCUTANEOUS PORT PLACEMENT

INDICATIONS: Long term venous access where need for access is intermittent and long lasting,
 high volume infusions are not needed. Typical indication is chemotherapy. Use for
 antibiotic administration is controversial - because of placing an implantable device in
 someone with ongoing infection. Not generally used for TPN due to risk of infection.

CONTRAINDICATIONS: as for tunneled catheter placement.

WORK UP:

**Learn the pertinent history**: particularly sites of previous line placements.

**Perform physical exam**: evidence of arm swelling.

**Know labs**: Platelets, PT, PTT, and Creatinine.

History of breast surgery, subclavian occlusion, or other factors making access from one side more favorable than from the other. In general, we prefer to use the nondominant arm. Contraindications to that site are: mastectomy, history of subclavian or axillary vein thrombosis, history of other operation for injury for predisposing to venous thrombosis.

**Review prior imaging studies**: which may show patency of central veins

**Identify the indication for placement** and the requested site and side of insertion. Write pre-procedure note. 1 gm Ancef is given in angiography1.

**Obtain consent**

**Write pre-procedure note**

CONSENT: written consent is required

**Benefits, Risks, and Long Term Issues:**  are the same as those for tunneled Catheter placement except that, following initial healing of the wound, ports do not require daily care (a significant advantage over other types of access).

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## 3. VENOUS INTERVENTION: IVC FILTER PLACEMENT

INDICATIONS: DVT +/- PE with failure of anticoagulation, contraindication to
 anticoagulation, free-floating thrombus above the inguinal ligament. Massive PE
 with limited pulmonary reserve. Pre-pulmonary embolectomy. Pre-lytic therapy
 of femoral, iliac or IVC thrombus. Prophylaxis in trauma patients at high risk for
 development of DVT (pelvic or lower extremity fracture, or cord injury).

*DVT or PE in and of itself is not an indication for IVC filter placement*

Potential indications for suprarenal filter is include 1) Women that are pregnant or likely to have pregnancy in future 2) Free floating IVC Clot extending to renal veins 3) Clots extending from the nose of a infrarenal IVC filter with clinical evidence of PE 4) Recurrent PE of lower extremity origin in the presence of an infrarenal IVC filter 5) Large AAA 6) Duplication of cava, and 7) large circumaortic renal vein.

CONTRAINDICATIONS: Infra Renal IVC occlusion. Discuss with attending.

WORK UP: as for arteriography

**Clearly identify the indication**

Identify if a permanent or removable filter is most appropriate

Check coags and platelets; we are liberal with abnormal values, as it is a venous stick and via IJ approach, patient can sit upright to aid in hemostasis

**Obtain consent**

**Review previous imaging studies:** vascular lab studies to see location of DVT, A/P CT scan to assess for venous anomalies and caval diameter

**Write pre-procedure note:** indicate where access is planned, femoral or IJ

In the setting of contrast allergy or renal insufficiency, CO2 may be used for the inferior vena cavagram

CONSENT: Risks of IVC filter placement include:

* allergy to contrast,
* bleeding,
* hematoma,
* contrast nephropathy,
* recurrent PE (3-5%),
* chronic leg swelling (5%)
* and over the long term, IVC occlusion

POST-PROCEDURE ORDERS:

* Femoral access: bedrest supine for 4 hours unless patient is morbidly obese. If patient is morbidly obese, may want longer period of bedrest.
* Jugular access: bedrest with head of bed elevated at least 30 degrees for 4 hours.
* Wait at least 4 hours to restart heparin.

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## 4. VENOUS INTERVENTION: TRANSJUGULAR INTRAHEPATIC PORTOSYSTEMIC SHUNT (TIPSS)

INDICATIONS: Portal hypertension with recurrent variceal hemorrhage despite sclerotherapy;
 portal hypertension with ongoing exsanguinating hemorrhage; refractory ascitis,
 refractory hepatic hydrothorax. (refractory to optimal medical management).

CONTRAINDICATIONS: Relative contraindications are chronically occluded portal vein or hepatic vein, allergy to contrast, renal failure, acute liver failure, uncorrectable coagulopathy. Child's class A or "good" class B patients do well with conventional surgically constructed portosystemic shunts, which have a lower restenosis rate than TIPS. Therefore, in these patients, consider a surgical consult before we accept them for a TIPS, in case the surgeons would rather shunt them.

WORK UP: As for arteriography.

**Make sure you carefully review previous imaging studies for evidence of portal vein patency (CT, US, MR, Angio)**

**Check labs**

**Write pre-procedure note**: include discussion of pre procedure imaging

**Obtain consent**

**DISCUSS CASE WITH STAFF OR FELLOW BEFORE GETTING CONSENT OR WRITING NOTE**: make sure indications are appropriate and no potential problems

 **TIPSS** are typically performed under general anesthesia; make sure that this process has been initiated

CONSENT: Risks include contrast allergy, contrast nephropathy, technical failure, hemorrhage (mediastinal, intraperitoneal), hepatic artery injury (possibly requiring percutaneous embolization), sepsis, biliary fistula, stent migration, acute intra-stent or portal vein thrombosis, and encephalopathy (20%: 15% manageable with diet and meds, 5% symptomatic despite medical management), death. Patients and families should be aware that up to 50% of patients require re intervention within 18 months of first TIPSS procedure. The usual reason for delayed problems is restenosis at the hepatic venous end of the stent.

PRE-PROCEDURE ORDERS:

* As for arteriography except the following
* Correct coagulopathy as much as possible but we frequently do the procedure with ongoing coagulopathy. (see coag guidelines for guidelines for use of FFP.)
* Type and Screen
* Unasyn 1 gm IVPB on call to Angio

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## 5. VENOUS INTERVENTION: SAPHENOUS VEIN ABLATION

INDICATIONS: Symptomatic reflux; pain or other symptoms associated with documented
 venous reflux. Heaviness, itching, pain with standing which worsens throughout the day.
 The vein ablation patients typically will have been seen in clinic prior to arriving for their
 procedure and will have had Ultrasound either in clinic or through the Vascular Lab.
 Ablation is typically a Greater Saphenous Vein or possibly an anterior thigh vein with
 occasional other vessels such as incompetent perforating veins. They are typically
 relatively healthy patients being treated for the discomfort associated with venous reflux.

CONTRAINDICATIONS: None. If they don’t have symptoms, then it is cosmetic and an out of
 pocket cost.

WORK UP:

**Make sure you carefully review previous imaging studies, vascular ultrasound obtained**

**Check labs**

**Write pre-procedure note**: include discussion of pre procedure imaging and office evaluation, symptoms

**Obtain consent**

CONSENT:

Technical failure, recurrent venous congestion or leg swelling which could require the procedure to be repeated. DVT which could require long term anticoagulation. Skin burn (RARE)

PRE-PROCEDURE ORDERS:

 Ancef 1 gm iv

POST-PROCEDURE ORDERS:

* Recovery for one hour for sedation used.
* Patient to receive post procedure information sheet
* The upper thigh is ACE wrapped and we ask the patient to wear the ACE wrap for 24 hours if possible. Typically patients are seen for follow up at 1 week and one month post-ablation to check that the target vessel is closed and that there is no evidence of DVT (reported at 2% in the literature).

# CHAPTER 5: GI INTERVENTION

## 1. PERCUTANEOUS GASTROSTOMY TUBE PLACEMENT

INDICATIONS: Inability to eat due to CNS disease, peripheral neurologic or neuromuscular disease, or obstructing cancer of the pharynx or esophagus; tracheo-esophageal fistula; inability to maintain adequate nutrition with po intake due to general malaise associated with cancer or due to swallowing dysfunction; excessive caloric needs due to cystic fibrosis. G tubes are also occasionally placed to palliate gastric outlet or small bowel obstruction in preterminal cancer patients.

CONTRAINDICATIONS: The absolute contraindications are severe coagulopathy, Total or subtotal gastrectomy, gastrojejunostomy, ongoing peritoneal dialysis, severe portal hypertension or splenic vein thrombosis with gastric varices, gastric and perigastric carcinomatosis. The relative contraindications are ascites, large hiatal hernia/intrathoracic stomach, presence of a ventriculoperitoneal shunt less than 3 months old; presence of a Laveen shunt and general combativeness and ongoing infection or fever of unknown etiology. When placing G-tubes in patients with ventriculoperitoneal shunts, leave a safety margin and select a site 2 Cm from the shunt. Patients with significant delay in gastric emptying, GE reflux, and/or aspiration pneumonia, should be fed past the ligament of Treitz via a percutaneous GJ tube (see next section).

WORK UP:(note the work up is very similar to basic angio work up)

**History:**

* Establish what kind of tube the patient needs: *G tube, single lumen GJ (for transgastric feeding into the jejunum, or dual lumen GJ (for gastric drainage and jejunal feeding)*.
* Record any abdominal surgical history.
* Ancillary studies that might be warranted prior to tube placement are:
* esophageal pH probe (to document reflux)
* gastric emptying study
* CT, or UGI (for reflux and GI anatomy).
* Consult with angio staff if you think a G tube placement should be postponed for further diagnostic work up.
* Perform a brief physical exam of the abdomen to identify body habitus and scars.

**Check labs**: CBC, platelets, PT, PTT. In order to proceed, labs should be: WBC normal or, for immunosuppressed patients, WBC >1000; platelets > 50,000, INR<1.6

**Review relevant imaging studies**: GI series, gastric emptying study, abdominal or chest CT (review of the latter is especially helpful if the patient has had prior gastric surgery, ascites, or intraperitoneal tubing). We do not need to order a CT if the patient hasn't had one.

**Obtain Consent**: see below for risks.

**Write pre-procedure note**: see below.

CONSENT:

**Benefits of percutaneous G tube placement**: allows long term enteral nutrition; may shorten hospitalization; eliminates need for nasogastric feeding tube or IV hyperalimentation; decreases caretaker time for feeding; in some cases, patients can be fed at night while asleep. Tubes last about 6 - 9 months and can be changed as an outpatient procedure. Alternatives are surgically placed and endoscopically placed G tubes which have similar procedural risks and long term care issues to the fluoroscopically placed ones.

**Procedural Risks of G tube placement**: Allergy to contrast (rare) technical failure due to interposition of the colon between the stomach and abdominal wall (2%), hemorrhage possibly requiring transfusion or endoscopy (2%), infection requiring prolongation of hospitalization and IV antibiotics (3%), infection requiring emergency surgery (<1%). Tell patients and families to expect some abdominal and subdiaphragmatic pain for 24-48 hours.

**Longterm Issues/Risks**: G tubes require daily care and maintenance. They can malfunction, break, become dislodged or become clogged. These events must be recognized promptly and the patient be brought back for tube replacement in a timely fashion. We will provide the patient's caregiver with instructions regarding tube care and emergency contacts prior to patient discharge from the hospital.

PRE-PROCEDURE ORDERS:

* **Coagulation status:**
	+ - Hold subcutaneous heparin until after tube placement
		- Hold IV heparin gtt or coumadin until normal PT and PTT are documented or - correct coags if necessary: **discuss with angio staff**.
		- For lovenox, hold one dose
* **Antibiotics:** Cefazolin 1 gm IVPB on call to Angio. Discuss alternate coverage if patient is allergic to Cephalosporins.

POST-PROCEDURE ORDERS for G tube:

* G tube can be capped
* If GT is used for meds, flush with 10 cc water afterwards.
* Liquid meds only preferred through GT.
* NO carafate or antacids per GT!
* VS q 30 min x 2 hrs, q 1 hr x 2 hr

POST-PROCEDURE ACTIONS FOR INPATIENTS

* Evening of tube placement:
	+ - check patient for signs of bleeding, sepsis, peritonitis
		- write progress note
* Morning after the tube placement:
	+ - check patient for signs of bleeding, sepsis, peritonitis

if you suspect trouble - **contact angio staff**

* + - if all is ok, write for nurses to change dressing every day and write order that graduated feeding schedule may begin
		- notify referring HO of actions.
		- deliver tube care sheet to patient (or to nurse to give to family)

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## 2. PERCUTANEOUS GASTROJEJUNOSTOMY TUBE PLACEMENT

INDICATIONS: as for GT with documented need to feed past the ligament of Treitz. Single lumen tube is preferred. Dual lumen tube is necessary if gastric drainage or venting is needed or if patient is on medication that must be administered into the stomach. Note: you absolutely cannot give crushed pills through a GJ tube - it will tolerate only clear liquid meds.

CONTRAINDICATIONS: as for GT.

WORK UP: as for GT.

CONSENT: as for GT. (Note: GJ tubes are harder to place, harder to get TFs going smoothly, and harder to maintain than G Tubes. Families should know that sometimes (10%) at the initial procedure, we are unable to get a tube through the pylorus. In that situation, we place a GT and convert it to a GJ tube after allowing the tract to mature for 4 weeks. Families should also know that GJ tubes clog easily and may have to be changed as often as every three months.)

PRE-PROCEDURE ORDERS: as for GT.

POST-PROCEDURE ORDERS: as for GT

### ***G-TUBE CARE DISCHARGE INSTRUCTIONS***

***Dressing Changes*** - every day for two weeks

Wash hands thoroughly.

Clean around tube with cotton balls moistened with hydrogen peroxide.

Apply antibiotic ointment (Neosporin or Bacitracin) to skin around tube.

Dress with gauze pads and tape. Position tube so it does not kink.

After two weeks, you may use soap and water to clean tube site.

***Bathing***- for the first two weeks

Showers or sponge baths only. No tub baths.

Before showering, cover dressing with a double layer of plastic wrap (e.g. Saran wrap) and tape edges to skin.

After shower, remove plastic wrap. Change dressing if it has gotten wet.

After 2 weeks, no special bathing instructions.

Activities - no specific restrictions

***Feedings***

For bolus feeding: after each bolus feed, flush tube with 10-20 cc water, then cap tube.

 For drip feeding: flush tube with 10-20 cc water after each drip infusion.

 ***Medications***

 Liquid meds preferred.

 Crush solid meds very fine and dissolve in warm water prior to administration.

 Flush tube with 10-20 cc water after each med administration.

***Problems With The Tube***

If the tube falls out, it must be replaced within 12 hours or the hole in the skin may seal over.

If the tube plugs up, it should be replaced as soon as possible in order to maintain nutrition but it is not an emergency that needs to be done at night.

# CHAPTER 6: BILIARY INTERVENTION

## 1. PERCUTANEOUS TRANSHEPATIC CHOLANGIOGRAPHY (PTC) AND BILIARY DRAINAGE

INDICATIONS: Symptomatic biliary obstruction (jaundice, severe pruritis); biliary leak;, possible cholangitis; possible biliary obstruction; elective access for treatment of known biliary stones or stricture; salvage of unsuccessful ERCP or endoscopically guided biliary stent placement. Usually performed in setting of ERCP failure.

CONTRAINDICATIONS: No absolute contraindications. Relative ones are allergy to contrast; renal failure; uncorrectable coagulopathy (keeping in mind that DIC due to biliary sepsis may best be treated with transhepatic drainage); ascites (if massive should be tapped prior to PTC procedure)

WORK UP:

**Identify the diagnostic question**: establish the criteria for placing a biliary tube rather than stopping after the diagnostic PTC. Has and ERCP been performed? If not, why not? Should it be?

**Learn the pertinent history**: current symptoms; surgical history; contrast history; renal function; and whether the patient is likely to need a right sided tube, a left sided tube or bilateral tubes. (what is the level of obstruction?)

**Perform physical exam**: particularly location of abdominal scars, existing tubes, and obviousness of ascites.

**Know Labs**: In order to proceed, labs should be: INR <1.6, PTT normal, platelets >50,000. check creatinine and LFTs

**Review relevant imaging studies**: ERCP, US, CT. knowing the degree of ductal dilation and the general location of the porta hepatis is helpful in planning access site.

**Obtain consent**: See below for risks.

**Write pre-procedure orders and note**: All of above info should be reflected in the note.

PTCs are typically performed under general anesthesia; make sure that this process has been initiated

CONSENT for PTC and Biliary Drainage:

**Benefits:** The benefit of diagnostic PTC is the ability to diagnose intrabiliary disease when noninvasive methods are equivocal or not possible. The benefits of transhepatic biliary drainage are relief of symptoms of obstruction; treatment of source of sepsis; avoidance of open surgery; and creation of a tract to treat an underlying problem such as stone or stricture without surgery.

**Procedural Risks:** Contrast allergy; technical failure (less than 2% with dilated ducts, greater {up to 30%} with non-dilated ducts, sepsis (post procedure fever is common); and hemorrhage possibly requiring transfusion or surgery (10%). These are the typical complications. Rare complications include colon perforation; pneumothorax; biloma; perihepatic abscess; bile peritonitis; biliary fistula to pleural space possibly requiring chest tube and/or new biliary drainage tube; and hepatic artery damage possibly requiring embolization. I don't always list these in detail but I do say that complications may occur requiring emergency treatment such as surgery, embolization, tube placement, etc. Also, contrast induced renal failure or allergy.

**Long Term Issues and Risks:** If a drainage tube is placed electively, the patient should know it will be in place for at least several months if not longer. He/she should be aware that tubes require routine care and maintenance at home, should be changed prophylactically at 6 - 8 week intervals, and can develop problems such as clogging, breaking, or dislodgement that may require emergency trips to the hospital. They should be warned if it is possible that two tubes will be necessary. These long term issues are less important when the initial procedure is an emergency.

PRE-PROCEDURE ORDERS:

 Unasyn 1.5gm iv on call to Angio.

POST-PROCEDURE ORDERS:

* S/P PTC with transhepatic biliary drainage. Specify tube insertion sites.
* VS q 30 min x 2 hr, q 1 hr x 2 hr, then q 4 hr x 24 hrs.
* Call HO for T > 100.5, P <60 or >100, BP systolic <90 or > 160, RR >30.
* Keep tube(s) to gravity drainage and record output every shift OR cap tube; consult with angio staff
* Flush tube(s) with 5 cc sterile saline every day—inject slowly, do not aspirate.
* Teach patients or caregiver to irrigate tubes and change dressing.

*These orders apply directly to persons who get a biliary drainage tube. If we have performed only a diagnostic PTC and have not left a tube in, the orders change a bit: delete orders referring to the drainage tube.*

##

POST-PROCEDURE ACTIONS following biliary drainage:

* Evening of the procedure: check patient and write progress note.
* Morning after the procedure: check patient and write progress note-if applicable, consult with angio staff regarding capping the tube.
* For all fresh biliary tubes schedule the patient for a follow up tube change appointment in 6-8 weeks, or sooner is stent placement is planned/contemplated. Check with staff.

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## 2. BILIARY INTERVENTION: PTC TUBE CHANGE

INDICATIONS: Routine to prevent tube occlusion, tube leaking, fevers, poor drainage

CONTRAINDICATIONS: No absolute contraindications.

WORK UP:

**Identify why tube change is indicated**.

**Learn the pertinent tube history**: When was PTC originally placed. When has it been changed in past. Is it to chronic internal or external drainage.

**Perform physical exam**

**Know Labs**: In order to proceed, labs should be: INR <1.6, PTT normal, platelets >50,000. Check creatinine and LFTs.

**Review relevant imaging studies**: prior PTC placements or changes

**Obtain consent**

**Write pre-procedure orders and note**: All of above info should be reflected in the note.

CONSENT for PTC and Biliary Drainage:

**Procedural Risks:** Contrast allergy; loss of access which could require a new tube, sepsis These are the typical complications.

PRE-PROCEDURE ORDERS:

Unasyn 1.5gm IV on call to Angio.

POST-PROCEDURE ORDERS:

* Write orders for tube care; capping it vs keeping to gravity drainage
* Flush tube(s) with 5 cc sterile saline every day—inject slowly, do not aspirate
* Make appointment for next tube change, if applicable (these are usually changed every 6-8 weeks)

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## 3. BILIARY INTERVENTION: COMPLEX INTERVENTIONS THRU AN EXISTING PERCUTANEOUS TRACT

PROCEDURES: Procedures include stricture dilatation, stone removal, foreign body retrieval, biopsy, and internal stent placement.

INDICATIONS:Presence of a problem in the biliary tree or GU tract that is best managed without open surgery, or for which there is no good surgical alternative, in a patient who has a percutaneous access route in place. In some settings, the problem was discovered after the tube was placed (i.e. - biliary tube placed for cholangitis and subsequent cholangiogram demonstrated an obstructing stone) while in others the tube was placed specifically as access for percutaneous therapy of a known problem (i.e. - removal of a known stone). Foreign body retrieval is usually for salvage of an iatrogenic misadventure (fragmented guidewire, stent, etc.). Biopsy is typically for diagnosis of a probable cholangiocarcinoma.

CONTRAINDICATIONS: None absolute. Coagulopathy is a relative contraindication - particularly if biopsy is planned. Ongoing infection is also a relative contraindication because these procedures are, for the most part, elective. Allergy to contrast and renal failure must be taken into account.

 Before scheduling a procedure, consideration should be given to the age of the tract. Working through an immature tract (less than 4 weeks old) is typical and safe in the kidney. Working through an immature tract in the liver and increases the risk of the procedure because it is easy to lose access across the peritoneal space. Therefore, we follow some general patterns: Biliary stone removal and cholangioplasty are typically performed only after the transhepatic tract has matured for 4 weeks. Biopsy and foreign body retrieval are performed, with care, through fresh tracts. Timing of internal biliary stent placement varies.

WORK UP:

**Learn the pertinent history:** Issues include what the underlying problem is, what kind of tube the patient has, when it was put in, how old the tract is, and whether the patient has fever. Remember to ask about possible contrast allergy. Question the patient regarding pain control during previous tube related experiences. These interventions tend to be lengthy and we have a low threshold of involving anesthesia.

**Perform physical exam:** To inspect tube and identify location of tube insertion site. Is the tube capped, or to external drainage?

**Review labs**

**Review relevant imaging studies:** As with tube change procedures, the single most important and helpful part of the work up for an intervention through an existing tract is to REVIEW REPORTS FROM THE PAST SEVERAL TUBE CHANGES. The next best source of information is the angio faculty followed by the referring attending physician. Review of the films themselves is also useful, but the reports are the key to understanding what is going on.

**Obtain consent**

**Write pre-procedure note.** The most important info to include is what you have learned from your review of old reports!!!

CONSENT:

**Benefits:** Avoidance of open surgery. Lower risk than surgery. (Possible) eventual removal of tube - likelihood of tube removal depends on the underlying problem.

**Procedural Risks:** Technical failure, bleeding and sepsis can occur as can as can perforation of the viscera involved (bile duct, kidney, or ureter). For interventions through fresh biliary tracts, complications can also include loss of access with need for emergency re-access, and bile peritonitis or biloma.

**Long Term Issues/Risks:** Multiple procedures may be necessary to achieve the goal (stone removal, stricture dilation). Long term success with biliary or ureteral stricture dilation is only about 50-60%. Long term drainage or surgery may eventually be necessary. Never promise to remove a patient's tube!!!!

PRE-PROCEDURE ORDERS for complex biliary interventions:

Antibiotics: Unasyn 1.5gm iv

POST PROCEDURE ACTIONS:

Consult with angio staff regarding need for and timing of follow-up procedures.

Visit patient and write progress note in chart on the morning after the procedure.

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## 4. BILIARY INTERVENTION: PERCUTANEOUS CHOLECYSTOSTOMY

INDICATIONS: Acute cholecystitis, or possible cholecystitis in someone for whom surgery is
 contraindicated; fever of unknown etiology with associated signs of gall bladder disease
 (gall bladder distension, wall thickening on US, Murphy's sign, etc.) in someone who is at
 high surgical risk - particularly for ICU patients at high risk for acalculus cholecystitis
 and ICU patients with multiorgan failure. Percutaneous cholecystostomy is also
 occasionally performed electively to provide access to the gallbladder for eventual
 removal of symptomatic stones in persons for whom surgical gall bladder removal is
 contraindicated.

CONTRAINDICATIONS:Shrunken gallbladder; no safe access to gall bladder on US or CT; previous gall bladder removal (not always obvious by history or imaging studies); uncorrectable coagulopathy. Relative contraindications include peritoneal dialysis, ventriculo-peritoneal shunt, Laveen shunt, and ascites.

WORK UP:

**Learn the pertinent history**.

**Perform physical exam.** Make sure we have a window to US and place tube

**Order labs**: CBC, platelets, PT, PTT.Normal coagulation function is mandatory unless the patient is in DIC and the gallbladder is suspected to be the source of sepsis - in that case, aggressive attempts to optimize coags coagulation status must be ongoing during the procedure.

**Review relevant imaging studies:** US and CT are most useful - to establish the size and location of the gallbladder and its relationship to surrounding structures.

**Obtain consent:**  See below.

**Write pre-procedure note:**  documenting all of above

CONSENT for percutaneous cholecystostomy:

**Benefits:** Possible relief of symptoms without major surgery, access for further diagnostic and therapeutic procedures.

**Procedural Risks:** technical failure, sepsis, hemorrhage, bile peritonitis, abscess, vaso-vagal episode possible leading to MI or death. (NOTE: during the procedure, atropine must be immediately available and the angio nurse must be apprised of the risk of vaso-vagal episode)

**Long Term Issues/Risks:** Placement of the tube may not result in improvement of patient's condition. Once the tube has been placed, it cannot be removed until a tract has formed (to prevent bile peritonitis upon removal)- which takes a minimum of two weeks and can take up to six weeks.

PRE-PROCEDURE ORDERS:

* **Coagulation status:**
	+ - Hold antiplatelet/anticoagulation medications..
		- Ensure appropriate PT and PTT are documented; or - correct coags if necessary: **discuss with angio staff.**
* **ATB:** Unasyn 1.5 gm IVPB or cefotetan 1gm on call to Angio.

POST-PROCEDURE ORDERS following cholecystostomy:

Keep tube to gravity drainage and record output every shift.

Flush tube gently with 5 cc of sterile saline q8hrs. Inject, do not aspirate.

POST-PROCEDURE ACTIONS:

Consult with angio staff regarding need for and timing of followup procedures.

Visit patient and write progress note in chart on the morning after the procedure.

### ***BILIARY DRAIN CARE INSTRUCTIONS***

Externally Draining Biliary Tube Care Guidelines

***Dressing Changes*** - every 1-2 days.

 Wash hands thoroughly.

 Clean around tube with cotton balls moistened with hydrogen peroxide.

 Apply antibiotic ointment (Neosporin or Bacitracin) to skin around tube.

 Dress with gauze pads and tape. Position tube so it does not kink.

***Bathing***

 Showers or sponge baths only. No tub baths.

 Before shower, cover dressing with a double layer of plastic wrap (e.g. Saran wrap) and tape edges to skin.

 After shower, remove plastic wrap. Change dressing if it has gotten wet.

***Activities*** - no specific restrictions.

***Signs that the tube is plugged up and needs replacement***:

* + Tube stops draining
	+ Fever
	+ Chills
	+ Leakage around tube
	+ Jaundice (increasingly yellow skin)

***If the tube falls out:***

* + - Cover hole in the skin with gauze pads and tape.
		- Arrange for replacement \*If the tube plugs up or falls out or comes part way out, it must be replaced within 24 hours.

***Internally Draining Biliary Tube Care Guidelines***

***Dressing Changes - every 1-2 days.***

 Wash hands thoroughly.

 Clean around tube with cotton balls moistened with hydrogen peroxide.

 Apply antibiotic ointment (Neosporin or Bacitracin) to skin around tube.

 Dress with gauze pads and tape. Position tube so it does not kink.

***Bathing***

 Showers or sponge baths only. No tub baths.

 Before shower, cover dressing with a double layer of plastic wrap (e.g. Saran wrap) and tape edges to skin.

 After shower, remove plastic wrap. Change dressing if it has gotten wet.

***Activities - no specific restrictions***

***Signs that the tube is plugged up:***

* + Fever
	+ Chills
	+ Jaundice (increasingly yellow skin)
	+ Leakage around tube

***If the tube plugs up:***

* + Uncap tube and connect it to a drainage bag.
	+ Arrange for replacement (see next section)

***If the tube falls out:***

* Cover hole in the skin with gauze pads and tape.
* Arrange for replacement
* If the tube plugs up or falls out or comes part way out, it must be replaced with 24 hours.

# CHAPTER 7: GU INTERVENTION

## 1. PERCUTANEOUS NEPHROSTOMY AND NEPHROURETERAL (UNIVERSAL) STENT PLACEMENT

INDICATIONS: Upper urinary tract obstruction not relieved via retrograde approach; upper
 urinary tract leak; access for stone removal, stricture dilation, endopyelotomy, or other
 intervention; access for performance of a Whitaker test to evaluate possible obstruction or
 degree of partial obstruction; and sepsis or acute renal failure of unknown etiology
 associated with hydronephrosis. Usually at the first sitting we place a nephrostomy
 catheter unless a joint procedure with urology has been prescheduled (stone removal or
 endopyelotomy). Primary placement of a universal stent is indicated if the patient has a
 known and likely permanent source of chronic upper urinary tract obstruction (post-
 operative stricture, tumor) and is likely to tolerate internal drainage (has normal bladder
 capacity and does not have severe prostatic enlargement).

CONTRAINDICATIONS: No absolute contraindication. Relative ones include uncorrectable coagulopathy, contrast allergy, and contraindications to prone positioning (morbid obesity, respiratory compromise, fresh abdominal incision). If these conditions exist, consider general anesthesia.

WORK UP:

**Identify the indication for tube placement.** Was a retrograde approach tried first? Failed?  **Is a PCN tube or a nephroureteral stent needed?**

**Learn the pertinent history:** current symptoms; surgical history; contrast history; renal function; and whether the patient is likely to need a right sided tube, a left sided tube or bilateral tubes.

**Perform physical exam:** particularly to gauge the patient's ability to lie prone.

**Order labs**: CBC, platelets, PT, PTT, Cr.In order to proceed, labs should be: PT < 18, PTT normal, platelets >50,000. Other labs are necessary to have as a baseline. If patient is septic, we will proceed with abnormal coags as long as service is actively trying to optimize coagulation status throughout the procedure.

**Review relevant imaging studies:** IVP, US, CT. Site of entry into collecting system can be critical if access is in preparation for stone removal, endopyelotomy, or intervention in distal ureter.

**Obtain consent:** See below for risks

**Write pre-procedure orders:**  See below

CONSENT

**Benefits:** provides therapy without risks and morbidity of open surgery.

**Procedural Risks:** Typical ones include technical failure (<2%); sepsis; and bleeding possibly requiring transfusion or embolization. Uncommon complications include colon perforation, hepatic or splenic laceration; pneumothorax; hydrothorax; urinoma; and retroperitoneal abscess.

**Long Term Issues and Risks:**  as for biliary drainage tube placement. Typically tubes will need to be changed every 12 weeks.

PRE-PROCEDURE ORDERS:

* **NPO** except meds with sips of water
* **Labs:** CBC, PT, PTT, platelets Cr
* **Coagulation status:**
	+ - Hold antiplatelet/anticoagulation medications..
		- Ensure appropriate PT and PTT are documented; or - correct coags if necessary: **discuss with angio staff**.
* **ATB:** ciprofloxacin 400mg PO or 500 mg IV on call to angio unless patient is already on ATB

POST-PROCEDURE ORDERS:

* S/P percutaneous nephrostomy. Specify tube insertion site(s).
* VS q 30 min x 2 hr, q 1 hr x 2 hrs, q 4 hrs x 24 hrs
* Call VIR for T > 100.5, P <60 or >100, BP systolic <90 or > 160, RR >30, or for leaking around tube or decreased output.
* Keep tube(s) to gravity drainage and record output every shift (or possibly cap tube if neprhoureteral stent or double J stent was placed; consult with staff)
* If procedure was bloody or if collecting system was full of clot at the end, order a CBC for evening of procedure and for the next AM. Also write to “flush tube gently with 5cc sterile saline every 2-4 hours - inject but do not aspirate.”

POST-PROCEDURE ACTIONS FOR INPATIENTS:

* Morning after procedure, check patient and write progress note.
* If further interventions are necessary in the near future, arrange schedule with referring physician. Otherwise, schedule routine tube change in 8-12 weeks.
* If appropriate, arrange for timely tube check and possible capping trial.

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### ***NEPHROSTOMY TUBE CARE GUIDELINES***

***Dressing Changes - every 1-2 days.***

* Wash hands thoroughly.
* Clean around tube with cotton balls moistened with hydrogen peroxide.
* Apply antibiotic ointment (Neosporin or Bacitracin) to skin around tube.
* Dress with gauze pads and tape. Position tube so it does not kink.

***Bathing***

* + - Showers or sponge baths only. No tub baths.
		- Before shower, cover dressing with a double layer of plastic wrap (e.g. Saran wrap) and tape edges to skin.
		- After shower remove plastic wrap. Change dressing if it has gotten wet.

***Activities - no specific restrictions.***

***Signs that the tube is plugged up and needs replacement:***

* Tube stops draining
* Fever
* Chills
* Leakage around tube
* Back pain

 ***If the tube falls out:***

* Cover hole in the skin with gauze pads and tape.
* Arrange for replacement
* If the tube plugs up or falls out it must be replaced within 24 hours\*

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## 2. FALLOPIAN TUBE RECANNALIZATION

 INDICATIONS: Infertility

CONTRAINDICATIONS: Pregnancy

WORK UP:

 **Learn the pertinent history:** With regard to infertility, prior HSG results, side of known or presumed tubal occlusion

 **Perform physical exam:**

 **Review relevant imaging studies:** US or HSGs

 **Obtain consent**

 **Write pre-procedure note**: All of the above info should be reflected in your note

 **Write pre-procedure orders:**  See below

 **Write pre-procedure note**: All of the above info should be reflected in your note

CONSENT: Bleeding, infection, pain, failure to recannalize tube

PRE-PROCEDURE ORDERS:

* The evening before procedure, ibuprofen 800mg PO x 1
* Urine pregnancy test on arrival to angio
* Cefazolin 1gm iv per-procedure
* Prior to iv sedation, consider ketorolac 30mg iv x 1

POST-PROCEDURE ORDERS: (for outpatients; modify for inpatients)

 Doxycycline 100mg PO BID x 5 days

# CHAPTER 8: NON-VASCULAR INTERVENTION: “ROUTINE” TUBE CHANGE (GI, BILIARY, GU)

INDICATIONS: Routine prophylaxis; tube dysfunction; tube breakage; tube dislodgement. Prophylactic tube change schedules are:

1. for G tubes every 6-9 months,
2. for GJ tubes every 3 months,
3. for biliary drainage tubes every 6 - 8 weeks,
4. and for upper urinary catheters every 6-12 weeks.

A routine schedule of prophylactic tube changes can cut down on tube related morbidity, ER visits and costs. When a tube has broken, become clogged, or fallen out, the tube change is an emergency - particularly if the patient is febrile. Tubes that have fallen out must be replaced within 8 to 12 hours to avoid tract closure. Tube changes are almost always done as outpatient procedures.

CONTRAINDICATIONS: none.

WORK UP:

**Learn the pertinent history:** Issues include what kind (and size) of tube the patient has and when and why it was initially placed, when it was last changed, whether the patient has fever, and what has been the big picture for the patient. If the tube has fallen out, how long ago did it happen? If the tube is for feeding or medication administration, has it been dysfunctional long enough for the patient to be dehydrated or to necessitate medication administration. Remember to ask about possible contrast allergy.

**Perform physical exam:** to inspect tube and identify location of tube insertion site.

**Review relevant imaging studies:** The single most important and helpful part of the work up for a tube change is to REVIEW REPORTS FROM THE PAST SEVERAL TUBE CHANGES. The most recent tube change report tells you the style and type of tube that was last placed. Review of the last 3-4 tube related procedure reports will provide a sense of what the big picture is for the patient - is this a tube the patient will have for life, is the patient in between cholangioplasties or ureteroplasties, are we planning to remove the tube soon....etc. Review of the films themselves is also useful, but the reports are the key to understanding what is going on.

**Obtain consent**

**Write pre-procedure note:** All of the above info should be reflected in your note.

**Write pre-procedure orders:** Unasyn 1.5 gm iv on call to Angio for biliary procedures, or 400 mg PO ciprofloxacin for GU procedures. For GI tube changes, antibiotics are not necessary.

CONSENT: Bleeding, infection, damage to kidney/liver/stomach, loss of access which will
 require a new tube to be placed, reaction to medications.

PRE-PROCEDURE ORDERS: See above.

POST-PROCEDURE ORDERS: (for outpatients; modify for inpatients)

* + S/P tube change: <specify tube type>.
	+ Observe in Radiology holding area per nursing protocol.
		- (Note: occasionally, we discharge some of our regulars who live nearby and require no sedation without any observation period.)
	+ VS every 15 minutes x 4, then every 30 minutes x 4, then once an hour x 1, then routine.

**CHAPTER 9: DRAINAGES AND ASPIRATION**

## 1. CHEST TUBE PLACEMENT

INDICATIONS: Pneumothorax, Symptomatic pleural effusion, Symptomatic malignant pleural effusions can be treated by drainage followed by sclerotherapy (pleurodesis).

WORK UP:

**Learn the pertinent history and indication for tube placement**.

**Review relevant imaging studies:** Size and side of effusion; unilateral vs bilateral tubes, fluid (US guided) vs pneumothorax (fluoro or CT guided) access

**Obtain consent**

**Write pre-procedure note**: All of the above info should be reflected in your note.

**Coagulation** parameters similar as for other procedures

PROCEDURE: The patients usually are in hospital or are admitted after the procedure under Oncology service. Sclerotherapy can be performed in IR or by the treating service through the catheter when the drainage through the catheter is <100ml/day. The removal of the tube also is generally performed by the treating service

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## 2. PLEUREX PLACEMENT

INDICATIONS: Recurrent malignant pleural effusion, rarely for other chronic effusions

WORK UP:

**Learn the pertinent history and indication for tube placement.** Have multiple thoracentesis been performed?

**Review relevant imaging studies:** Size and side of effusion.

**Obtain consent**. Ensure patient has home support to drain safely; family member or visiting nurse

**Pre-procedure note.** All of above should be included

POST-PROCEDURE:

Consult with the Nurse Practitioner.

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## 3. ABCESS DRAIN PLACEMENT

INDICATIONS: Fluid collection suspicious for abscess, collection causing pain or mass effect

WORK UP:

**Learn the pertinent history and indication for tube placement**

**Review** **relevant imaging studies**: CT especially helpful-evaluation for site of access

**Coagulation** parameters similar as for other procedures

**Write pre-procedure note**: All of above should be reflected

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## 4. THORACENTESIS/PARACENTESIS

INDICATIONS: Symptomatic or possibly infected pleural or peritoneal fluid.

WORK UP:

**Learn the pertinent history and indication:** What is needed; aspiration only (for diagnosis) or complete drainage?

**Review relevant imaging studies:** Size and side of effusion or volume of ascitis and best site for access.

**Obtain consent**

**Write pre-procedure note**: All of the above info should be reflected in your note.

**Coagulation** parameters similar as for other procedures.

**For large volume paracentesis**: If more than 5 Liters are being removed, generally albumin should be given; 10gm/liter remove IV.

# CHAPTER 10: CT BIOPSIES

## 1. LUNG BIOPSY

INDICATIONS: New lung nodule where tissue diagnosis will determine or change therapy. NOT ALL solitary pulmonary nodules need to be biopsied. Typically we biopsy new solitary lesions in persons who have a history of cancer to determine whether the new lesion is metastatic or represents a new primary malignancy. In select patients, we biopsy for fungal, AFB and/or bacterial culture. \* Not all solitary pulmonary nodules SHOULD be biopsied; if there is high clinical suspicion for cancer, the biopsy results may not change the patients care and therefore should not be biopsied; consult with thoracic surgery when in question.

CONTRAINDICATIONS: None absolute. Relative contraindications include severe COPD, severe pulmonary hypertension, a lesion which cannot be distinguished from central pulmonary vessels, coagulopathy, and inability of the patient to cooperate - either due to mental incapacity or due to physically inability to tolerate the position needed to achieve the biopsy.

WORK UP:

**Learn the pertinent history.** In particular it is necessary to know the patient's pulmonary history, history of bleeding problems or anticoagulation, and general level of anxiety. Also determine what samples are needed from the biopsy (cytology and/or microbiology) – review CIS, discuss with your staff, or call the referring physician if necessary. Make sure patient is not taking anti-platelet agents-these need to be held for 7 days before procedure

**Perform physical exam:** Pay attention to the patient's mental status, and breathing pattern.

**Order labs:** Platelets, PT, PTT, INR

**Review relevant imaging studies:** CXR and chest CT.

**Obtain consent** - Written consent is necessary. See below.

CONSENT for lung biopsy:

**Benefits:** Needle biopsy can establish a diagnosis without the cost, risk, and morbidity of thoracoscopy or thoracotomy.

**Risks:** The major risk is pneumothorax (20%). About 10 % of pneumothoraces require chest tube drainage and admission to the hospital. Other risks include technical failure, and hemoptysis (possibly requiring hospital admission, transfusion or embolization). Patients should also be made aware that an absolute diagnosis may not be possible even if the biopsy is technically successful. In that event, surgical biopsy may be necessary.

POST-PROCEDURE ORDERS:

Order upright PA CXR to be done immediately after the biopsy (if needed, check with your staff) and 2 hrs later.

POST-PROCEDURE ACTIONS:

Check the CXRs. Development of a pneumothorax may require hospital admission. Indications for admission (and chest tube) include: associated symptoms, growing over two hours, large size, decreased mental capacity with poor home supervision. If a pneumothorax is documented, consult with angio faculty regarding management decisions.

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## 2. OTHER SITE BX

INDICATIONS: Mass/lesion, ? cancer, ? infection, ? recurrent cancer. In general want to select the site that would both establish the diagnosis as well as the stage of disease (for example, if have 4cm lung mass and 4cm adrenal mass, generally want to biopsy the adrenal to establish stage 4 disease)

CONTRAINDICATIONS: Uncorrectable coagulopathy. Most others are relative contraindications; consult with staff

WORK UP:

**Learn the pertinent history.** History of bleeding problems or anticoagulation, liver dysfunction. Also determine what samples are needed from the biopsy (cytology, histology, and/or microbiology) - a direct call to the referring physician is the best way to determine this. Make sure patient is not taking anti-platelet agents

**Perform physical exam:**

**Order labs:** CBC, platelets, PT, PTT

**Review relevant imaging studies:** CT or US

**Obtain consent**: Written consent is necessary. See below

**Write pre-procedure note**: Above should be reflected. Include side and site of biopsy; indicate where OSH CT is from and the date

CONSENT:

**Benefits:** Needle biopsy can establish a diagnosis without the cost, risk, and morbidity of surgery. Directs future therapy

**Risks:** Bleeding, infection, damage to adjacent structures. If high liver lesion or adrenal lesion, include risk of pneumothorax. Other risks include technical failure. Patients should also be made aware that an absolute diagnosis may not be possible even if the biopsy is technically successful. In that event, surgical biopsy may be necessary.

POST PROCEDURE ORDERS:

Observe in recovery for minimum of 2 hrs, frequent vital sign checks

# CHAPTER 11: PHARMACOLOGY

## DRUGS COMMONLY USED IN DIAGNOSTIC AND INTERVENTIONAL RADIOLOGY

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## 1. VASODILATORS

### **NITROGLYCERIN (NITRO-BID)**

* MECHANISM OF ACTION
	+ Direct vascular smooth muscle relaxant
	+ Denitrated in cell to nitrous oxide
* INDICATIONS
	+ Vasospasm
	+ Extremity Arteriogram
	+ Angina (IV use)
* DOSAGE
	+ Available in vials of 100 mg
	+ Dilute it in normal saline to provide 20 micro gms/ml
	+ Onset of action - 15 to 30 seconds
	+ For intra arterial use - 100 to 200 mcg. Can be repeated (Total < 500 mcg)
	+ Intravenous infusion: 5 to 10 mcg/min (6 drops/min of 100mcg/ml solution)
* CONTRAINDICATIONS
	+ Hypotension, Tachycardia, hypovolimia
* UNTOWARD EFFECTS AND TREATMENT
	+ Hypotension and reflex tachycardia
	+ Responds to elevation of the legs and IV fluids
* NOTE:
	+ Nitroglycerin readily migrates into plastics and PVC tubing of IV sets. The delivered fraction may be significantly reduced by this absorption during slow infusion. For bolus dose, prepare solutions immediately before use.

### **PAPAVERINE HCL**

* Opioid, smooth muscle relaxant with negligible CNS effects.
* MECHANISM OF ACTION
	+ Direct smooth muscle relaxant
	+ Muscle is not paralyzed and still responds to drugs
	+ Half life is approx 6 Hrs
	+ Increases Intra cellular cyclic AMP(inhibits phosphodiesterase)
		- (Alkaloid derived from crude opium. Non narcotic)
* INDICATIONS
	+ Pharmaco Cavernousography
	+ Catheter induced vasospasm
* DOSAGE
	+ 30 - 120 mg for intra vascular use
	+ 30 - 60 mg for intracavernous use
	+ Available as 30mg/ml
* CONTRAINDICATIONS
	+ AV heart block, Glaucoma
* UNTOWARD EFFECTS AND TREATMENT
	+ Nausea, hepatic hypersensitivity, jaundice
	+ Drowsiness, Vertigo
	+ Tachycardia, increase in BP, Flushing
* NOTE:
	+ Flush the catheter with normal saline before injection and repeat after injecting papavarine. Admixture with Iodinated contrast, Ringer's lactate and heparin may result in precipitation of the drug.

### **TOLAZOLINE HYDROCHLORIDE (PRISCOLINE)**

* Alpha blocker
* MECHANISM OF ACTION
	+ Vasodilator (alpha adrenergic blocking)
	+ Direct smooth muscle relaxant
	+ Improves flow from arterial to venous vascular bed
	+ Sympathomimetic, parasympathomimetic, histaminergic
	+ Half life is 3 to 12 hrs
* INDICATIONS
	+ Portal or mesenteric venous opacification
	+ Catheter induced vasospasm
	+ Hemodynamic significance of stenotic lesions of iliac arteries
	+ Poor distal filling in the outflow studies
	+ Magnification angiogram of the hand.
* DOSAGE
	+ Available as 100 mg in 4 ml vial. Dilute 2cc in NS to make up 10ml
	+ 40 to 50 mg in 30 sec and flush for intra arterial for arterio portography
	+ 25 mg distal to the stenosis to assess the iliac arterial stenosis
	+ 20 t0 40 mg for other indications
	+ Can be repeated once if necessary when the BP is stable.
	+ Do not exceed 2mg/ Kg / hour
* CONTRAINDICATIONS
	+ Hypersensitivity
	+ Hypotension
	+ Severe coronary disease, Cardiac impairment and arrhythmia.
* UNDESIRABLE EFFECTS AND TREATMENT
	+ Hypotension, Tachycardia, arrhythmia
		- elevate the legs, IV fluids.
			* Administer with caution in patients with mitral stenosis and in patients with Stress ulcers.
* NOTE:
	+ Maximum action is at 30 seconds.
	+ Mix 1 Vial (100 mg in 4ml) with 6ml of saline to make 10 mg /ml.
	+ Inject the required dose fairly rapidly and perform arteriography.

### **PHENTOLAMINE (REGITINE)**

* MECHANISM OF ACTION
	+ Alpha adrenergic blocking agent
	+ Half life is 19 minutes
* INDICATIONS
* CavrnousographyPheocrisisextravasation of norepinephrine injection
* DOSAGE
	+ Intra cavernosal--1 mg
	+ Pheo crisis--1 to 5 mg
* CONTRAINDICATIONS
	+ Hypersensitivity
	+ Hypotension, MI, angina
* UNTOWARD EFFECTS AND TREATMENT
	+ Hypotension, tachycardia and arrhythmias
	+ Responds to Supportive measures

### **NIFEDIPINE (PROCARDIA)**

* Calcium channel blocker, inhibits transmembrane influx of extra cellular calcium ions and inhibits contractility.
* MECHANISM OF ACTION
	+ Relaxes and prevents arterial spasm
* INDICATIONS
	+ Arterial spasm during catheterization and angioplasty
	+ Can be used as a premedication before infra popliteal intervention
* DOSAGE
	+ 10mg PO. Plasma half life is 2 hours.
	+ can also be given sublingual
* CONTRAINDICATIONS
	+ Hypotension
* UNTOWARD EFFECTS AND TREATMENT
	+ Hypotension

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## 2. VASOCONSTRICTORS

### **VASOPRESSIN (PITRESSIN)**

* Posterior pituitary extract. Short acting
* MECHANISM OF ACTION
	+ Contraction of vascular and gut smooth muscle (marked in portal circulation)
	+ Antidiuretic effect
	+ Plasma half life of 10 to 20 mts.
* INDICATIONS
	+ GI bleed
* DOSAGE
	+ Available as Vial containing 20 IU in 1ml.
	+ Mix 100 Units in 500 ml of NS.
	+ IA: 0.2 units/min (60 ml/hr). If no vasoconstriction in 30 mts, 0.4 units/min
	+ Taper over a period of 12 to 24 hrs after treatment.
* CONTRAINDICATIONS
	+ Anaphylaxis or Hypersensitivity
	+ Heart failure
* UNTOWARD EFFECTS AND TREATMENT
	+ Allergy, cramps, nausea, headache, etc respond to conservative trt
* NOTE
	+ Restrict or Closely monitor water intake.
	+ Stop infusion if complications are suspected. GTN for coronary symptoms

## EPINEPHRINE:

* + Sympathomimetic (Catecholamine). Adrenergic receptors of importance in Interventional Radiology:
	+ Alpha-1: Arterioles and veins--constriction
	+ Beta-1: Heart: Stimulation results in increased rate, contractility, conduction etc.,
	+ Beta-2: Trachea and bronchioles-relaxation
* Arterioles and veins (except skin and brain): dilation (delayed)
* MECHANISM OF ACTION
	+ Stimulation of alpha and beta adrenergic receptors
* INDICATIONS
	+ \*Enhanced angiographic demonstration of tumor vascularity by constricting normal arteries with intact smooth muscle.
	+ \*Renal Intra arterial injection to enhance visualization of renal veins.
	+ \*Contrast allergy (most common use)
* As a hemostatic agent with local anesthetic
* DOSAGE:
	+ Intra arterial use: 5 to 7 mcg in 10 ml of NS
	+ Bronchospasm: 1:1000:- 0.1 to 0.3 ml SUB CU, repeat PRN, 10-15mts until 1ml
	+ Cardiac arrest: 1:10000:- 1ml IV slowly over 2-5 mts. Call code.
* CONTRAINDICATIONS
	+ CAD, CHF, Arrhythmias, glaucoma, elderly
	+ Cardiogenic and hemorrhagic shock
* UNTOWARD EFFECTS AND TREATMENT
	+ Anxiety, palpitation, angina, arrhythmias, headache, etc.
* NOTE:
	+ Protect from exposure to light.

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## 3. FIBRINOLYTIC AGENTS

* UROKINASE:
	+ Thrombolytic enzyme produced by kidney and found in urine.
	+ Commercial production is by tissue culture techniques from human kidney cells.
* MECHANISM OF ACTION
	+ Converts plasminogen to Plasmin
	+ Plasmin degrades fibrin clots.
	+ Half life is <20 minutes
		- (Obtained from human kidney cells by tissue culture)
* INDICATIONS
	+ For Thrombolysis
	+ Catheter clearance
	+ Clearing fibrinous adhesions
* LABORATORY TESTS AND MONITORING
	+ Baseline Hematocrit, Platelet,
	+ Base line PT, PTT, Fibrinogen, ?Thrombin time
	+ 12 hourly PT, PTT, Fibrinogen, Fibrin split products
* DOSAGE
	+ Available as lyophilized powder (250,000IU) reconstituted to give 50,000 IU/ml
	+ Pulse spray
		- -250.000 IU Reconstitute With 5 ml sterile water
		- Add 5000 units of heparin in 5ml to make a total of 10ml
		- Each pulse of 0.2 ml/30 sec. yields 5000 IU of UK and 100IU of heparin.
* Additional 250,000 of UK can be repeated without heparin - Infusion
	+ 500,000 in 250cc NS or D5W to give 2000 IU/cc
		- 1000 to 4000 IU/min (30 to 60 cc) according to clinical indication
		- Titrate dose based on clinical indication and coagulation profile
	+ IV catheter clearance
		- 1ml of 5000 IU/ml in a 10cc syringe. Connect the syringe to the occluded hub and apply full suction to create negative pressure in the catheter lumen. Release the plunger slowly to let UK into the catheter lumen which under negative pressure. Repeat suction and release several times. Do not use excessive positive pressure. Aspirate 20 minutes after injection.
		- repeat the same procedure if necessary, cap the catheter for 30 mts.
* CONTRAINDICATIONS for INFUSION AND PULSE SPRAY:
	+ CVA (SAH, AVM, tumor, aneurysm)
	+ Bleeding diathesis and Active internal bleeding
	+ Recent Surgery(10 days),intra cranial surgery(2 Months)
	+ Recent Trauma and CPR, Delivery
	+ Severe uncontrolled Hypertension(relative)
	+ Documented Left heart Thrombus (relative)
* UNTOWARD EFFECTS AND TREATMENT
	+ Bleeding-Stop Infusion, If superficial - Local measures
		- Whole blood, packed red blood cells, cryoprecipitate, FFP
		- ?6 acid locally for puncture site hematoma
	+ Allergy, Fever, Chills - supportive therapy
* NOTE ON USAGE
	+ Avoid IM injections
	+ Do not remove any pre existing vascular catheters
	+ Concurrent Heparin 500 to 750 IU/ hour
	+ Strict laboratory monitoring every 6 hours is essential during UK infusion
	+ Other related complications during UK infusion include worsening of ischemic symptoms due to distal embolization and reperfusion syndrome.

## SUMMARY OF FIBRINOLYSIS

* COAGULATION:
	+ Fibrinogen
	+ (Coagulation cascade) Prothrombin----> Thrombin----->
	+ Fibrin
* FIRINOLYSIS:
	+ Plasminogen--(UK,TPA)-->Plasmin- --------->
		- SK
			* Fibrin split products
* TISSUE PLASMINOGEN ACTIVATOR:

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## 4. COAGULATION

### **HEPARIN**

* PROTAMINE SULFATE
* MECHANISM OF ACTION
	+ Anticoagulant by itself
	+ Forms stable salt with HEPARIN resulting in loss of
	+ anticoagulation properties of both drugs.
	+ Extracted from sperm of salmon and other fish species
	+ Heparin neutralized within 5 minutes.
* INDICATIONS
	+ Heparin overdosage and for Reversal.
* DOSAGE
	+ 10 mg approximately neutralizes 1000 IU of heparin
	+ Do not exceed 100 Mg
* CONTRAINDICATIONS
	+ Drug intolerance, Question Hypersensitivity to fish
* UNTOWARD EFFECTS AND TREATMENT
	+ Hypotension, nausea, anaphylaxis.
* NOTE:
* Monitor dose by ACT, and the heparin given
	+ Half the dosage is enough if heparin is given 30 minutes before

## PLAVIX (Clopidogrel bisulfate)

* MECHANISM OF ACTION
	+ Inhibits ADP induced platelet aggregation
	+ Clopidogrel activates by irreversibly modifying paltelet ADP receptor. Platelets exposed to Clopidogrel are affected for the reminder of their life span.
* INDICATIONS:
	+ Same as for other antiplatelet medications
* DOSAGE
	+ 75 mg/day. Loading dose of 300 mg is recommended after stents.
* CONTRAINDICATIONS:
	+ Peptic ulcer and IC Hemorrhage. Caution recommended for concomitant use of Coumadin.
* UNTOWARD EFFECTS AND TREATMENT
	+ Hemorrhage, occasional agranulocytosis, allergy
* NOTE:
* Action starts about 2 Hrs after single 75 mg dose and peaks in 3 to 5 days.
	+ Action is reversed 5 days after the medication is stopped.

## THROMBIN

* Hemostatic agent of Bovine origin
* Available as Vial containing 5000 IU.
	+ (1 UNIT IS DEFINED AS THE AMOUNT required to clot 1 ml of fibrinogen solution)
* INDICATION:
	+ To be used under supervision of staff Radiologist.
	+ Used for enhancing thrombogenic property of occlusion coils
	+ As an adjunct to other hemostatic agents.

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## 5. SEDATION AND ANLGESIA

### **MIDAZOLAM (VERSED)**

* + Most commonly used drug for conscious sedation in Radiology
	+ Benzodiazepine 3 to 4 times potent than Valium
* MECHANISM OF ACTION:
	+ CNS depressant active at GABA receptor site
	+ Short acting anxiolytic and hypnotic
	+ Muscle relaxant
	+ Produces antegrade amnesia
* INDICATIONS:
	+ Conscious sedation
* DOSAGE:
	+ To 2.0 mg (0.035mg/Kg) given IV. in 2 to 3 mts.
	+ In elderly patients start at 0.5 - 1.0 mg IV.
	+ Titrate dose to achieve adequate sedation
	+ For conscious sedation limit dose to 10mg IV during the procedure
	+ Reduce dose in renal impairment.
* CONTRAINDICATIONS
	+ Hypersensitivity to the drug
	+ Acute narrow angle glaucoma
	+ Pregnancy
* UNTOWARD EFFECTS AND TREATMENT:
	+ Fluctuations in vital signs, respiratory depression in COPD, apnea
	+ Profound and prolonged amnesia
	+ Treatment of by Flumazenil ( 0.2 to 1.0 mg given at a rate of 0.2/min)
* NOTE:
	+ When given concomitantly with narcotic analgesics reduced doses are given

## FENTANYL (SUBLIMAZE)

* + Short acting synthetic opioid, 50 to 100 times more potent than morphine.
* MECHANISM OF ACTION:
	+ Binds to opioid receptors in CNS. Potent analgesic
		- Increases tolerance to pain and decreases perception of pain
* INDICATIONS:
	+ Analgesia in conscious sedation
	+ Duration of action after a single dose is 30 to 60 mts.
* DOSAGE:
	+ Available as 2ml and 5 ml ampules, 50 micro grams /ml
	+ Loading dose: 50mcg IV over 1 to 2 minutes
	+ Maintenance: 25 - 50 micro gm every 30 minutes or titrate with 50 microgram dose, not exceeding 3 microgram/kg/hr
* CONTRAINDICATIONS
	+ Post operative pain because of risk of hypoventilation
	+ Patients on MAO inhibitors
	+ Use with caution in patients with respiratory problems, elderly and debilitated
* UNTOWARD EFFECTS AND TREATMENT
	+ Respiratory depression in 5 to 15 minutes after the injection
	+ Others: Nausea, dizziness, laryngospasm, bradycardia and muscle rigidity
	+ Reversal: Respiratory support and Naloxone (Narcan) 0.1 to 0.2 mg over 2 to 3 minutes and titrated to get desirable effect.

## DEMEROL (MEPERIDINE)

* + Dose: 0.5 to 1mg/kg. Titrated with additional increments of 10 to 25 mg

## MORPHINE

* + Dose:2 to 4 mg IV slowly. Max 10mg/hour or 0.2mg/kg

## FLUMAZENIL (Romazicon)

* + Benzodiazepine antagonist, Imidazobenzodiazeine structure
* MECHANISM OF ACTION
	+ Competitively inhibits the activity at benzodiazepine recognition site
* INDICATIONS
	+ Reversal of sedative effects of benzodiazepines.
* DOSAGE:
	+ 0.2 to 1mg given IV at 02mg/min. Titrate to achieve desirable reversal.
	+ Once a dose of 3 to 5mg is reached, additional dose may not have any effect
* CONTRAINDICATIONS:
	+ Known hypersensitivity to the drug or other benzodiazepines.
	+ Status epilepticus and Signs of serious cyclic antidepressant overdose.
* UNTOWARD EFFECTS AND TREATMENT:
	+ Convulsions, Fatigue, head ache, agitation etc.,
* NOTE:
	+ Monitor the patient for 2 to 4 hours. The effect of Flumazenil may wear off before the effect of long-acting benzodiazepines are gone. For repeat dose do not exceed 1mg at any time and do not exceed 3 mg in an hour.

## NALOXONE

* Narcotic antagonist
* MECHANISM OF ACTION
	+ Not fully understood
	+ Probably acts by competing for the same receptor sites.
* INDICATIONS
	+ Complete or partial reversal of narcotic depression, including respiratory depression.
* DOSAGE
	+ Supplied as 1mg/ml or 0.4mg/ml
	+ 0.4 to 2mg of Naloxone IV. If the desire degree of counter action and improvement in respiratory function is not obtained the dose may be repeated in 2 to 3 minutes. If no response is observed after 10 mg of Naloxone, the diagnosis of narcotic induced toxicity should be questioned.
* CONTRAINDICATIONS
	+ Hypersensitivity
	+ Cautious administration is recommended in persons suspected to be opioid dependent, to prevent abstinence syndrome
* ADVERSE REACTIONS
	+ Nausea, vomiting, sweating, tachycardia, increased BP, tremulousness, seizures and cardiac arrest.
* NOTE:
	+ Repeated doses may be needed to reverse long acting opioid toxicity

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## 6. Sclerosing agents

### **ETHANOL**

* + 1 TO 20 ML
		- Severe cardiopulmonary collapse and death.
		- steroid preparation needed to prevent local tissue reaction

### **SOTRADECOL**

* + 1% OR 3% SOLUTION
	+ 1.5 TO 10 ML
		- Pain, Vasovagal attacks, and Anaphlaxis are possible

### **ETHANOLAMINE OLEATE**

* + Mild sclerosing agent
	+ 1.5 to 5 ml. Do not exceed 20 ml
		- Anaphylaxis, pyrexiia, local symptoms, renal failure Etc..

### **CHYMOPAPAIN**

* + Proteolytic enzyme L-Cysteinate HCL
	+ Herniated discs
		- Anaphylaxis, Paraplegia, Acute tra.myelitis

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## 7. Miscellaneous agents

**ANTIEMITICS**

* + Prochloperazine (Compazine) 5 - 10 mg
	+ Metoclopropamide (reglan) 5 to 10 mg
	+ Granisetron (Kytril)1mg BID in cancer patients: 1mg BID
	+ Ondansetron (Zofran) .15mg/kg IV, 32 mg max or 8mg BID

### **GLUCAGON**

* MECHANISM OF ACTION
	+ Relaxes smooth muscle of the GI tract
	+ Glycolysis etc.
	+ (Stimulates cyclic AMP synthesis).
	+ Half life is 3 to 6 minutes
* INDICATIONS
	+ GI imaging
	+ GI Interventions
	+ Visceral DSA
* DOSAGE FOR INTERVENTION
	+ 0.25 to 0.5 mg IV (duration of action 9 to 17 minutes)
	+ Can be Given up to 2 mg if needed
		- (onset with in 1 min)
* CONTRAINDICATIONS
	+ Hypersensitivity
	+ Pheochromocytoma
* UNTOWARD EFFECTS AND TREATMENT
	+ Nausea, Vomiting
	+ Generalized allergic reactions

## DIAGNOSTIC AGENTS IN ENDOCRINE TUMORS

### **SECRETIN:**

* + Localization of ZE syndrome
		- 30 Units, Intra arterial Injection, Splenic, GDA/CHA, SMA,
		- Sample from Hepatic Veins at 20, 40, 60, 90, 120 Sec
			* and from pulm Artery at 3 Mts.
		- Gastrin RIA, Significant increase over base level

### **CALCIUM**

* + Localization of Insulinomas
	+ to 0.025 mEq of Ca/ kg IA,in GDA, Splenic, Proper HA, SMA
		- Sample from R and L hepatic veins simultaneously
		- Baseline, 0.5,1, 1.5, 2, and 3 mts after injection.

 fold increase in serum insulin is diagnostic

### **OCTREOTIDE (Somatostatin Analogue)**

* + Metastatic Endocrine tumors to Liver
		- Celiac or CHA, SMA arteriography before and after
			* 100 micro gms Sub CU
		- Evidence of reduced vascularity of tumor in Liver.

### **PENTAGASTRIN**

* + Localization of Medullary carcinoma of the thyroid.
		- 0.5 micrograms/Kg IV
			* Baseline and 1,2,3,5,10,15 mts after inj.
				+ Both Internal Jugular veins, simultaneously
		- Repeat INj, SVC and Right Hepatic Vein

# CHAPTER 12: LAB TESTS

## ACTIVATED COAGULATION TIME

* SYNONYMS: ACT
* INDICATION: Monitoring of heparin effect, protamine sulphate effect.
* SPECIMEN: 3 mL whole blood in a tube containing an activator. (Kaolin activator or Siliceous earth or diatomaceous earthor). Pre warm the tube to 37C.
* NORMAL RANGE: 70 to 120 seconds. Value for adequacy of heparinization is 400 sec approx (Range 300-500)
* LIMITATION/CAUTION: insensitive to Factor VII and some platelet abnormalities. Activators and methods vary from Lab to Lab. Prolonged values may not be exclusively the result of heparin alone.

## FIBRIN BREAK DOWN PRODUCTS

* SYNONYMS: FDP (Fibrin Degradation Products), FSP (Fibrin Split Products).
* INDICATIONS: Lysis and partial lysis of clot, DIC.
* SPECIMEN: 2mL whole blood in a Special tube for FDP.(containing Thrombin and antifibrinolytic agent).
* NORMAL RANGE: <10 mcg/mL. caution needed if >64mcg/mL.
* CAUTION: Indicate the dose of Heparin on the Requisition.

## FIBRINOGEN

* SYNONYM: Factor I
* INDICATION: Monitoring fibrinolytic therapy.
* SPECIMEN: 5mL whole blood in Blue top tube with liquid anti coagulant.
* NORMAL RANGE: 150- 350 mg/ dl. Critical if <100mg/dl

## PROTHROMBIN TIME

* SYNONYM: PT, PROTIME
* INDICATION: simple test for intrinsic system of anticoagulation (Coumarin)
* SPECIMEN: 5 ML whole blood in blue top tube.
* NORMAL RANGE: 10 - 13 SEC, ABNORMAL if >18 SEC
	+ - liver failure, VIT K deficiency, DIC, dysfibrinogenimia, etc.
		- Three times the control in anticoagulated
* LIMITATIONS: prolonged within 2 hrs of heparin administration. A number of drugs also modify the PT.PROLONGED WITH IN 2HRS OF HEPARIN ADMINSTRATION. A NUMBER OF DRUGS ALSO MODIFY THE PT.
* OTHER USEFUL INFORMATION:
	+ - Prolonged in 3 days after a loading dose of 10 – 15 mg.
		- Therapeutic effect without loading dose: 5-7 days.
		- 1.3 TO 1.5 times control (15-18 SEC) for anticoagulation
		- 1.5TO 2.0 times for pts with mechanical valves. TIMES FOR PTS WITH MECHANICAL VALVES.
	+ In the past the goal of oral anti coagulation has been to achieve a PT of 2 times the normal control. Pro thrombin time of 1.25 times the control value generally is believed to provide effective prophylaxis without excessive risk of hemorrhage.

##

## INTERNATIONAL NORMALIZED RATIO (INR)

* Variability of thromboplastin reagents called for a standardized ratio for reporting of results. This ratio is centered on international sensitivity index (ISI). ISI is the responsiveness of athromboplastin to the reduction in VIT K dependent factors. It is derived by calibrating the reagent used with a reference preparation. ISI is provided by the manufacturer of the reagent.
* SYNONYM: INR=(PT ratio)ISI=(patient PT/Mean normal PT) ISI
* INR theoretically gives the PT ratio that would result if the WHO standard reference thromboplastin had been used in performing the test.

## PARTIAL THROMBOPLASTIN TIME

* SYNONYMS: PTT, APTT
* INDICATION: simple test for intrinsic system of anticoagulation
	+ - Heparain therapy, hemophilia, etc.
* SPECIMEN: 5 mL whole blood, in blue top container.
* NORMAL VALUE: 25 - 39 SECONDS. (Within 10 seconds of control)
* ABNORMAL if >70 SECONDS, or 3 times normal value.
* HEPARINIZATION: Maintain dose such that PTT is two times the control or the normal level.

## HYPERCOAGULABLE STATE

* A special note is made with respect to the hypercoagulation to consider Prophylactic heparinization immediately following catheterization in certain high risk patients.
* Primary: Antithrombin III deficiency, protein C, or S deficiency, Factor V leiden mutation, dysfibrinogenemia, dysplasminogenemia, hyperhomocystenemia, antiphosholipid syndrome, etc.
* Secondary: Advanced age, collagen vascular diseases, DM, Hormonal therapy, Hyperlipidemia, Hyperviscosity, Neoplastic disease, Myeloproliferative disease, sepsis, etc.

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