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From the TSRA Executive Committee 2016-2017

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INTRODUCTION

Welcome to intern year! The year ahead will be filled with new experiences – some exciting, others less so – but all of which will help you grow into your new role as a physician and surgeon. You will begin to develop the clinical knowledge, technical ability, and surgical decision-making that will be honed throughout your training and career. Continual self-reflection and assessment of your strengths and limitations will be critical.

The key to surviving intern year is organization, efficiency, and prioritization. The primary and essential role of an intern is to be the collector of data, communicator of information, and coordinator and doer of tasks. Unlike when you were a medical student, you are also expected to interpret clinical data and appreciate the gravity of a situation. A page for a soft blood pressure may be nothing to worry about – perhaps requiring a small fluid bolus or falling within the patient’s normal range – or it may foreshadow a patient heading south requiring escalation of care. You will learn to distinguish and appreciate the differences between these scenarios throughout the year. Additionally, you will recognize your own limitations and when a situation requires that you call on someone more experienced for help.

While you are responsible for learning about surgical diseases and how to operate, your primary responsibility is to take care of the day-to-day tasks that allow your team to function at its best. The entire team and your patients depend on a solid intern getting his/her work done efficiently and effectively.

This survival guide is not meant to be all-encompassing. It is a culled pool of personal experiences and resources from many residents and residency programs. It is meant to be a starting platform with basic advice and tips from which you can build upon and fill in any remaining gaps in knowledge and skills. We wish you all the best as you embark on your training in cardiothoracic surgery!
YOUR DAILY ROLE

PREPARING FOR ROUNDS

Plan ahead. Before you start a rotation, talk to interns who were on that rotation previously and get a thorough sign out. Familiarize yourself with what you are expected to do, where supplies are kept, and senior resident and attending preferences. Spend time reading about your patients before starting the rotation as well as during the rotation - you should aim to know everything about them. As the intern, you are the eyes and ears of the team. Arrive before rounds with enough time to get sign-out from the night intern and prepare lists for your team. Be aware of the most important/pending issues for each patient to focus your data collection and presentations – this will also help you prioritize your tasks for the day. Generally, the following information is expected for all patients:

1. Vital Signs:
   - Tmax, Tcurrent
   - HR range (rhythm if applicable), BP range
   - RR range, SpO2 (+/- nasal cannula)
   - Current and previous weight trends
2. Intake & Outputs/24 hr and per shift, net fluid balance; (Peds: mL/kg/hr)
3. Labs/micro/rads/path
4. Other – to be aware of and make note of each day but not necessarily to present:
   - IVFs w/ rate, diet
   - Antibiotics
   - Anticoagulation regimen or DVT prophylaxis, include last PTT or INR when appropriate
   - Home and current medications with doses
   - Pain mgt/PCA
   - Access – especially for ICU patients
   - Drains: foley, spinal/lumbar, chest tubes, PEG, A&V wires
5. Dispo and PT status: Is PT recommending acute rehab, subacute rehab, home PT? All of this would need to be coordinated well ahead of time to prevent delays to discharge.

Pro Tips:
Write everything down on rounds but focus on the important details. For complicated patients (and especially ICU patients), it is helpful to adopt a systems-based approach for data collection and presentations to keep your thoughts and plans organized.

Some residents find it useful to make a to-do list for each patient with two check boxes: one for initiating the task (ordering the lab, putting in the consult, etc.), and one after the task is completed. This is a good reminder to follow-up on all labs/imaging studies you order. Other organizational tips to try: color coding to categorize tasks based on level of importance, listing tasks based on timing within the day (i.e., a key PTT due at a certain time).
Just come up with a system that works for you and stick with it. Remember that just because something is ordered does not mean it will get done!

**A word of caution:**
Many institutions have an automatic or computerized system to compile all the vitals/l&Os/labs onto a rounding sheet. Despite the advent of this time-saving tool, it is still important to look over data yourself in a timeline fashion and recognize trends. Static vitals and labs mean nothing, trends are everything. For example, a hemoglobin of 8 means little, but a hemoglobin trend of 13 -> 10 -> 8 over 24 hours should alert you that something is wrong.
DAILY ROUTINE: Maximizing Your Efficiency

Following morning rounds, organize the day by looking at the list of things noted on rounds, consolidating as many as possible, and prioritizing which tasks need to be completed first. As discussed previously, there are a variety of ways to organize and prioritize your task list – just come up with a system that works for you and stick with it.

Tasks that depend on others should be done first such as calling for consults and imaging studies. After that, do all discharges for the day. It is generally not a surprise if a patient is a planned discharge. A great strategy is to get everything ready for the patient to be discharged the day before or on a slow call night (print prescriptions, get narcotic scripts signed by your attending, start discharge summaries, etc.). This way, if the patient looks great in the morning, you can just hit the discharge order and the patient can be on his/her way. Getting people out earlier in the day means rooms can be turned over faster, nurses can be freed up, and new admissions can come in. Discharge summaries can and should usually be delayed until much later in the day (when everything else is taken care of).

Next, take care of any remaining orders and progress notes for the day. Daily progress notes on floor patients should really only take 2-3 minutes; anything more is an inefficient use of your time. Follow-up on anything critical that needs to be done yourself - everything you have been assigned to do is ultimately your responsibility. If it is absolutely critical that a heparin drip be turned off at a certain time, call the nurse in person or physically check that it is done. Similarly, if a PTT is critical, in some hospitals you will need to draw it yourself and take it to the lab. If the results of a particular imaging study would change management immediately, go to the reading room yourself – not only will you get better at reading scans this way, you can also relay the clinical context to the radiologist and relay a focused interpretation of the study to your team. It is even better if you can offer your own opinion if something needs to be done: for example, “the pneumothorax has enlarged and the lung is down 2 more rib spaces, so I am going to place the chest tube back to suction”.

As cases are completed throughout the day, it is usually the intern’s responsibility to perform post-op checks. These are generally done ~4-6 hours after a patient leaves the OR. Make a note of the patient’s vitals and any post-op labs and imaging. Do a focused exam based on what operation was performed – a thorough abdominal exam if a colectomy, a thorough vascular exam with Doppler after a fem-pop, etc. Any acute issues – unstable vitals, grossly abnormal lab values, inadequate pain control, uncontrollable nausea/vomiting, increased incision site oozing or drainage – should be relayed to your senior. You will get a feel for what a typical post-op course should look like – but there is always patient to patient variability. Check first to determine what type of orders are acceptable for you to place yourself - some services are ok with you putting in orders for narcotic pain control post-op, others may not be. If you have any doubts, notify your senior – better to be overly cautious than miss something important that needs attention and a possible take-back to the OR.
The sooner you complete your daily tasks the sooner you can head to the OR. In general, it is expected that you update your upper level resident on progress and issues as they arise throughout the day. If they are scrubbed in on a case, head to the OR in person and ask if it is a good time to provide an update. If it is clear that you are on top of everything happening on the floor and have completed all assigned tasks, you will usually be invited to scrub in. Be aware of how much and in what manner your senior and the rest of your team wants to be updated. Some may only want to be updated when issues arise; others want to be notified after each task has been completed. Your goal every day should be to tackle your to-do list as efficiently and thoroughly as possible so that you can spend as much time in the OR as possible. There is no other way to learn how to operate.

**SIGNING-OUT PATIENTS**

Being able to sign-out your patients clearly and concisely is a key skill - and absolutely critical for continuity of care in the advent of the 80-hour work week. As with anything, this is a skill that takes practice and lots of feedback. You will get a feel for what type of information is important (and what is less so) when you receive sign-out yourself. Remember that a good sign-out is a two-way street between the person signing-out and the person receiving sign-out. Questions for clarification are expected and encouraged. Thus, it is not always possible but best to do sign-out face-to-face in a quiet space free of distractions.

But do not miss the forest for the trees. When signing out a patient, you should convey a baseline image of the patient. For example, if a patient has baseline delirium, a call for delirium in the middle of the night should still warrant a careful evaluation but would be less worrisome than a patient who is baseline neurologically intact and experiences acute delirium. You should also convey a sense of how “sick” the patient is. If you are particularly worried about someone, make sure to let not only the night intern but also the senior resident on call know so they can pay extra attention to him/her overnight.

In general, a good sign-out should include:

1. Patient’s name, age, location, MRN
2. Brief summary of patient’s pertinent problems/why they are in the hospital
3. Anticipated problems and recommendations
4. Needs for follow-up or things to be checked on during the night
5. Code status, family contact, allergies to be aware of
6. Heads up: is the patient getting sick vs nearing discharge?
PREPARING FOR CASES

Figure out which cases you are expected to cover the day before. Adequate preparation for each case means you know:

1. H&P (know your patient’s age, key comorbidities, and previous surgical interventions especially at the site of surgery, whether it is chest or abdomen)
2. Pertinent labs and imaging – review these yourself
3. Indications and contraindications of the operation
4. Pertinent anatomy
5. Main operative steps

Pre-op tasks:

- introduce yourself to the patient and any family
- mark the patient (must be done by attending at some institutions)
- update H&P
- make sure an updated consent is in the patient’s chart and ensure the correct procedure is listed and that the patient and a physician have signed and dated the consent. For inpatients, this should be done the day before.

Once in the OR:

- be in the OR before the patient is asleep
- introduce yourself to scrubs and circulators – make friends with them and your life will be much easier (e.g., they can respond to pages when you are scrubbed in, sneak you extra suture to practice with, brief you on the steps of a case or an attending’s preferences, hand you the right instruments). Always treat them with respect and listen to them if they say you are doing something wrong; they know more than you do at this point in your training.
- open your gloves and gown
- be helpful (you will win points with the OR staff and speed things up so the case can start on time) – assist with moving the patient, put on SCDs, insert the foley, verify antibiotics and heparin, pad and position, clip hair, position OR lights
- pay close attention to how an attending likes to prep and drape – the more prepared you come across, the more of the case you will likely get to do!
**Post-op tasks:**

- while the patient is getting extubated, save time and take care of their brief op note, orders, and any prescriptions (if it is an ambulatory case)
- help wheel the patient out of the OR, and sign out any pertinent issues to accepting staff or the ICU team
- check at least one set of vitals and make sure the patient is stable before leaving the PACU
- post-op checks should be done ~4-6 hours after completion of an operation; if it is a late case, sign this out to the night team. Document your post-op check with a brief note stating that you have reviewed the vitals/labs/imaging and have performed a pertinent physical exam.
- don’t forget to grab a patient sticker and update your case log

**Pro Tips:**

Take notes on your cases and ask for feedback. Take time to reflect on what went well and what you need to work on for next time. Write down how an attending likes to set up an anastomosis, what kind of suture is used for different steps of an operation, especially if it is one that you will be doing often (i.e. CT cases). It is easy to forget these things, so make a habit of doing this soon after a case, and continue to review your notes and add to them. The more prepared you are for the case, the more you will get to do.
FLUIDS AND ELECTROLYTE MANAGEMENT

FLUIDS

Total Body Water = 2/3 total body weight
2/3 intracellular, 1/3 extracellular (2/3 interstitial, 1/3 plasma)

To monitor fluid status, look at: daily weights, BP, HR, UOP, Bun/Cr ratio, CVP
A good indicator of volume status is UOP.

Plasma Osmolality: (280-295 mosm/kg)
(2xNa) + (glucose/18) + (BUN/2.8)

Volume Replacement (for trauma resuscitation):
4cc/kg/h for 1st 10kg, 2cc/kg/h for 2nd 10kg, 1cc/kg/h after
(e.g., 70kg = 110kg/h)

ELECTROLYTE REPLITION

Replacing electrolytes is most important in patients who are dependent on IVFs, patients with cardiac co-morbidities, and patients with nutritional deficiencies.

Potassium  Goal 4.0 mEq/L
- KCl 10mEq IV should raise the serum level by 0.1mEq/L
  - 10mEq of KCl comes in 100cc of fluid (repleting 80mEq of K is 800cc of volume so beware)
  - Max rate in Peripheral IV is 10mEq/hr
  - The amount of K in maintenance fluid can also be adjusted (if K is normal, D5-1/2NS + 20mEq/L, if K is mildly low 3.7-3.9, can increase to 30mEq/L, if K is high, decrease to 10mEq/L).

- PO – KCl 20 mEq PO 2-5x per day:
  - Oral potassium causes significant nausea on an empty stomach
  - Capsule/Tablet – large pills (K-Dur/ Klor-Con)
  - Elixir – tastes bad
  - Powder

Magnesium  Goal 2.0 mEq/L
- IV – Mag Sulfate 1g IV increases serum level by 0.1
- PO: Mag Oxide 800mg PO BID = ~1g elemental magnesium / day
  - Causes diarrhea, but IV takes many hours to administer
Phosphate  Goal level ~3.0
- If K low also, use KPhos. Each 15mmol contains 22mEq K
- If K normal/high, use NaPhos
- Phos 2.5-2.9, give 15mmol IV x1
- Phos 2-2.5, give 30mmol
- Severe hypophosphatemia (<2 or <1.5), can give 45mmol
- PO Options:
  - NeutraPhos 1 packet = 8mmol Phos + 7mmol Na + 7mmol K
  - NeutraPhos-K 1 packet = 8mmol Phos + 7mmol Na + 14mmol K

Calcium
- Rarely needs to be repleted, ask first
- Adjust Ca for albumin (For each 1.0 albumin below 4.0, add 0.8 to the Ca value)
- CaCl only via central line
- Ca Gluconate by peripheral IV
MANAGING COMMON FLOOR ISSUES

RESPIRATORY DISTRESS

One of the most urgent calls you can get. Go see the patient immediately.

Before you even get there, think: place on oxygen and monitor, CXR, EKG, ABG, other labs, call for respiratory for nebs or potential intubation help. As soon as you get there, assess respiratory effort, saturation, and listen to the lungs.

Your job as the first responding intern is to decide what level of care they need. Temporize and think about escalating care. Alert your upper-level prior to pursuing a lengthy workup. (As with everything intern year, you should propose your workup and differential, but patient safety comes first.)

A patient who requires a non-rebreather mask to keep their O2 sat up should not stay on the floor. A non-rebreather is a shorter bridge to recovery or a bridge to intubation/ICU. A patient who is altered and in respiratory distress should not stay on the floor (aspiration risk, may develop hypercapnia 2/2 respiratory failure, or may need emergent intubation).

YOU CAN ALWAYS TRANSFER A PATIENT TO THE ICU if you think they need it. If you cannot manage the patient on the floor, even if you cannot get a hold of an upper level, be safe now and get the patient to the help they need.

Most concerning DDx:
- Pneumothorax
- Aspiration
- Pulmonary Embolism
- MI and CHF
- ARF and CHF
- Hypervolemia and CHF
- Bronchial plugging
- Bronchospasm
- Pneumonia
- COPD exacerbation
- Anaphylaxis

Work-Up:
- Quick history – What was the patient doing when it started?
  - Acute or subacute?
  - Current Meds?
  - On O2?
• Physical exam
  - General: comfortable, diaphoresis, able to talk
  - Neck: +/- JVD
  - Chest: stridor, rales, rhonchi, wheezing, equal breath sounds, diminished or absent breath sounds
  - CV: rhythm, murmur, gallops, pulsus paradoxus
  - Ext: edema (unilateral or bilateral), cyanosis

Treatment:
• Pulse ox, ABG, EKG, portable CXR, chest CT?
• 100% O2 face mask (except COPDers)
• Respiratory therapy
• Wall suction, intubation tray

If you are having trouble getting help, call a code. Call anesthesia early if you fear intubation will be necessary. If the patient is unresponsive and you are not able to intubate, you can always place an oral airway and bag the patient until more help and/or intubation equipment arrives.

Rapid Sequence Induction and Intubation – unlikely you will be the one doing the intubation, but good to know the general steps:

• Preoxygenate with 100% for 3-5 minutes
  - If patient has spontaneous respirations, allow him/her to breathe
  - If not breathing, use bag-valve-mask ventilation
  - Always perform jaw thrust to keep airway open
  - Use oral airway to prevent collapse of tongue
• Sedate
  - Etomidate 0.3mg/kg (NO TIME TO CALCULATE? 30 mg)
  - Monitor BP during administration
• Paralyze (if needed — most acute intubations do not require paralysis)
  - Succinylcholine 1mg/kg IV (NO TIME TO CALCULATE? 100 mg)
    - Onset 0.5-1min, duration 6-10 min
• Intubate
  - DO NOT let go of tube until secured
• Confirm placement – besides watching tube pass under epiglottis
  - Use CO2 detector — should change to yellow after a few breaths
  - Look for condensation in tube
  - Listen for equal bilateral breath sounds, listen to the stomach
  - Check O2 sats
  - Obtain stat CXR
**HYPERTENSION** (usually treat acutely if >170-180 mmHg systolic)

**Etiology:**
Essential hypertension, pain, agitation/anxiety, acute MI, fluid overload

**Initial work-up should include:**
- Quick physical exam, pain control assessment, brief chart review with focus on home medications, h/o asthma
- Good choices for BP control in a patient who is NPO:
  - *Hydralazine* 10mg IV Q4 (watch for tachycardia)
  - *Labetalol* 10mg IV Q6 (patient should be on telemetry, do not give if h/o asthma)
  - *Metoprolol* 5mg IV Q6 (patient should be on telemetry, do not give if h/o asthma)
  - *Clonidine* 0.1mg/24hr transdermal patch Qweek – can titrate to 0.6mg (takes hours – days to work, watch for rebound)

In general, restart home meds when possible and make sure pain is controlled.

**Quick fixes** in the middle of the night (each hospital has different rules for what you can push on the floor— hydralazine is your safest, most universal bet):
- If NPO:
  - *Metoprolol* 5mg IV x1
  - *Labetalol* 10mg IV x1
  - *Hydralazine* 10mg IV Q3 repeat x2
- If taking PO:
  - *Labetalol* 100mg PO x1 (takes hours to work)
  - *Clonidine* 0.1mg PO x1

**HYPOTENSION** (<100 mmHg systolic)

**Etiology:**
Hypovolemia, bleeding, sepsis, acute MI, medications (antihypertensives, opioids, diuretics, nitrates), arrhythmias, tamponade, tension pneumothorax

**Initial work-up should include:**
- Brief physical exam, focused on new VS (pulse, BP, UOP), quick assessment of orthostatic symptoms and/or mental status changes. *Check to see if new VS differ from baseline (CHF and liver patients are baseline hypotensive).
- Chart review for recent medications given (anti-HTNs, pain meds)
- Elevate legs
- Bolus 1L isotonic fluid (0.9NS, LR)-ONLY IF THEY DO NOT HAVE CHF and/or SEVERE VALVE DISEASE
Notes:
- Usually the cause is hypovolemia, but must be watchful for bleeding, early sepsis, acute MI
- Pulse is often not a good indicator of volume status – UOP is much more helpful
  - If UOP is declining post-op and not responding to IVF, may be bleeding – check CBC
  - If UOP is declining post-op, and patient is tachycardic, hypotensive, febrile, may be sepsis – hydrate aggressively, start antibiotics, call Upper-Level
- If chest pain, tachycardia, hypotensive, may be MI – start MI w/up, call Upper-Level
- If you suspect arrhythmia (A fib w/wo RVR, other), get EKG, call Upper-Level
- Opioids can significantly drop blood pressure – if patient is asymptomatic, assess pain control and decrease dose if possible.

If the patient is not responding to fluids alone, your upper level should have already been made aware, and you will need to transfer the patient to the ICU and consider initiating vasopressors/inotropes (generally an attending-level decision). Which drug to choose and what dose to start are largely attending- and institution-dependent; however, the summary chart below may be helpful to consider.

### VASOPRESSORS/INOTROPES:

<table>
<thead>
<tr>
<th>DRUG</th>
<th>RECEPTOR ACTIVITY</th>
<th>CLINICAL EFFECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Alpha-1</td>
<td>Beta-1</td>
</tr>
<tr>
<td>Phenylephrine</td>
<td>+++</td>
<td>0</td>
</tr>
<tr>
<td>Norepinephrine</td>
<td>+++</td>
<td>++</td>
</tr>
<tr>
<td>Epinephrine</td>
<td>++</td>
<td>+++</td>
</tr>
</tbody>
</table>

**Dopamine (mcg/kg/min)**

<table>
<thead>
<tr>
<th>Dose</th>
<th>“Dopaminergic”</th>
<th>Beta-1</th>
<th>Beta-2</th>
<th>Dopaminergic</th>
<th>CLINICAL EFFECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5-2 “Dopaminergic”</td>
<td>0</td>
<td>+</td>
<td>0</td>
<td>++</td>
<td>May increase urine output and renal blood flow</td>
</tr>
<tr>
<td>5-10 “Beta-1”</td>
<td>+</td>
<td>++</td>
<td>0</td>
<td>++</td>
<td>CO ↑, SVR ↑</td>
</tr>
<tr>
<td>10-20 “Alpha-1”</td>
<td>++</td>
<td>++</td>
<td>0</td>
<td>++</td>
<td>SVR ↑↑</td>
</tr>
<tr>
<td>Dobutamine</td>
<td>0/+</td>
<td>+++</td>
<td>++</td>
<td>0</td>
<td>CO ↑, SVR ↓</td>
</tr>
<tr>
<td>Isoproterenol</td>
<td>0</td>
<td>+++</td>
<td>+++</td>
<td>0</td>
<td>CO ↑, SVR ↓</td>
</tr>
</tbody>
</table>

*Modified from 2016 UpToDate.*

+++: very strong effect; +: moderate effect; +: weak effect; 0: no effect

*Doses between 2 and 5 mcg/kg/min have variable effects.*
TACHYCARDIA

Consider:
Hemorrhage/anemia, hypovolemia, dysrhythmia, ischemia, pain, PE, anxiety, meds, anastomotic leak, pneumonia

*Pain and hypovolemia are the two most common issues with patients on the floor. Bolus the hypovolemic patient. Don’t bolus a patient in Afib (generally).

Tachycardia can be a warning sign for many problems – if none of the above seem to be the cause, there may be something more going on. You will get a sense for what heart rate is “acceptable” in which patient. In addition to the cause, consider effects of this heart rate on increased metabolic demand and potential for cardiac ischemia in an at-risk patient.

Work-up:
Vitals, CV exam, consider EKG (definitely if HR >130)

EKG...
1. Is it regular?
2. QRS narrow or wide? Wide = V-tach!
3. Can I see P waves?
4. Would adenosine help sort things out?
5. If HD unstable or mental status changes -> ACLS algorithm (narrow vs wide complex). It is ok to call a Code MET or Code Blue to get help.

<table>
<thead>
<tr>
<th>Dysrhythmia</th>
<th>Rate</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sinus tachycardia</td>
<td>100-160</td>
<td>Response to pain/stress/hypovolemia</td>
</tr>
<tr>
<td>PAT, PSVT</td>
<td>140-220</td>
<td>RR&lt;RP, abnormal P wave, isoelectric PP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Regular rhythm: block with digitalis</td>
</tr>
<tr>
<td>Atrial flutter</td>
<td>250-300</td>
<td>Undulating “Sawtooth” baselines, variable block</td>
</tr>
<tr>
<td>Atrial fibrillation</td>
<td>100-180</td>
<td>No P waves, irregularly irregular</td>
</tr>
<tr>
<td>Junctional tachycardia</td>
<td>140-220</td>
<td>PR&gt;RP, P wave may be hidden by QRS or T, regular, AV dissociation, fusion beats, bizarre QRS</td>
</tr>
</tbody>
</table>

A Fib with RVR:
- Place patient on an in-room telemetry monitor and call upper level
- If HD unstable (hypotensive): sedation + synchronized electrical cardioversion
- If HD stable: your immediate goal is rate control to protect the myocardium
- A rate <100 is generally the goal, can try:
  - Metoprolol 5mg IV x 3 doses, 5 minutes apart or
  - Diltiazem bolus + gtt
  - If refractory, can give amiodarone: 150mg load and 1mg/hr gtt
- Ensure electrolytes corrected (K>4, Mg>2)
BRADYCARDIA

If HD stable and mentating well (asymptomatic), may be physiologic (especially if a young, athletic patient). Check med history (recent beta blocker use?).

If HD unstable, proceed to ACLS bradycardia (Atropine, Epinephrine, pacing if necessary, etc.) Consider MI.

Work up:
- Vitals, CBC, BMP, Troponin
- Stat 12 lead EKG - look for heart block of ischemia

CHEST PAIN

Etiology:
Angina, acute MI, PE, PTX, GERD, costochondritis, trauma

Initial work-up should include:
Focused exam, new vitals, CBC, troponin, ABG, EKG

Characterize the pain: description, location, duration, associated symptoms
- Pleuritic chest pain – think pneumonia, PE, trauma (rib fracture). *If you suspect PE – order stat ABG, turn up oxygen, consider CT per PE protocol, call upper-level. Check creatinine – if >1.5 (unless already on dialysis) cannot get CT scan (will need V/Q scan)
- Pain reproducible by pressing on rib cage – think trauma, costochondritis. *If you suspect costochondritis or rib fracture – can treat with NSAIDS, lidocaine patch.
- Neither, or radiating – think MI. *If you suspect MI – order stat portable EKG, stat cardiac enzymes, put patient on heart monitor, call upper-level. Review chart for cardiac history. Consult cardiology. While waiting, MONAB:
  - May give morphine 2mg IV for pain control – titrate up as needed
  - Turn up oxygen to keep saturation >95%
  - Nitroglycerin (sublingual)
  - ASA 325mg PO x1
  - Beta-blocker
BLEEDING

Etiology:
Post-op bleeding, coagulopathy (anticoagulated, intrinsic heme problem, uremic platelets), thrombocytopenia

Initial work-up should include:
- Check labs (most recent Hgb, coags). If none, order stat CBC, PT/PTT
- Brief physical exam including new VS (is patient stable?) and examination of site of bleeding (take off bandages, examine incision sites)
- Discontinue anticoagulation and antiplatelet agents, consider blood products (if patient not at risk of acutely clotting)

Obtaining hemostasis:
In general, if patient is unstable/recently post-op/hemostasis is not achievable with pressure or AgNO3, call an upper-level.
- Discrete area of bleeding – hold digital pressure for 5 minutes minimum
- Multiple areas of diffuse slow oozing in an open wound – apply AgNO3 sticks to area for 30-60 seconds
- Brisk bleeding (arterial) or expanding hematoma – continue to hold pressure and call upper-level, ask for a stitch and suture-removal kit while you wait.
- Bleeding in a dialysis patient – hold gentle pressure over site, be sure you can still feel a thrill as applying pressure. May need to hold for up to 30 minutes. Do not wrap tightly or you may thrombose the fistula. Consider DDAVP or gelfoam.
- GI Bleeding: ensure 2 large bore PIVs, type and cross for 2+ units of blood, start 1L bolus of crystalloid, consider PPI gtt, call upper level. Consult GI/IR.

FEVER
(Temp > 38.5C)

Etiology:
Post-op atelectasis, infectious causes (UTI, pneumonia, wound infection), PE, cancer, drug fever, central (neurogenic) fever

Initial work-up should include:
- Brief physical exam concentrating on lungs, wound, urinary tract
- Stat portable CXR
- Blood tests – CBC, peripheral blood cultures x2, blood culture from line (if present)
- UA and urine culture – SEND GRAM STAIN ON ALL CULTURES – FASTEST RESULT
- Fluid resuscitation – fever increases insensible losses
Notes:
- In recent post-op patients, examine the wound for signs of necrotizing infection and/or fasciitis (grey colored wound, copious discharge from wound, rapidly spreading erythema, pain out of proportion to exam, hemodynamic instability, mental status changes)
- If fever work up is initially negative, consider occult abscess – get senior resident involved before working up further.

MENTAL STATUS CHANGES

NEVER RESTRAIN OR SEDATE A PATIENT WITHOUT EVALUATING THEM FIRST. RESIST THE TEMPTATION OR NURSING REQUEST TO GIVE SEDATIVES OR ANXIOLYTICS UNTIL YOU RULE OUT MORE SERIOUS CAUSES OF MENTAL STATUS CHANGES!

Etiology:
Hypotension, HYPOXIA, hypercarbia, NEW ONSET SEPSIS, hypo/hyperglycemia, electrolyte abnormalities, infection, stroke, dementia or “sun downing”, over-sedation/over-analgesia, hepatic encephalopathy, uremia, vitamin deficiencies, underlying psych history

Initial work-up should include:
- Physical exam including new VS, neuro/mental status assessment (orientation & alertness – obtunded, drowsy, arousable). Talk to family if present and/or nurses – has this happened in the past or at home? New onset? Obtain brief psych history (if possible).
- If drowsy, maximize cerebral perfusion/oxygenation (elevate legs, IVF bolus if necessary, increase supplemental O2)
- If focal neuro deficit – consider CVA. Call upper level. Stat CT scan of head w/o contrast.
- Check meds – look for narcotics, sedatives, antihistamines (bad for older patients)
- Find out previous psych meds and restart them if possible (this should be last on your list of things to do)
- Pulse oximetry, finger stick glucose, check electrolytes. Turn up O2, get ABG if markedly hypoxic. Replete electrolytes, blood sugar if needed.
- Calm reassurance & reorientation – if necessary, order a sitter, consider restraints if patient is a danger to self, make NPO if patient is an aspiration risk
- Consider infectious etiology and sepsis workup
- Overdoses – Call upper level
  - Narcotic – *Narcan (Naloxone)* 0.5mg to 1mg IV Q2- 3min PRN
  - Benzodiazepine – *Flumazenil* 0.5mg IV Q30sec (max 3mg)
- If oxygenation/ventilation, electrolytes, serum glucose are normal and patient is agitated, consider sun-downing (especially in elderly demented patients) – best response is gentle re-orientation & sitter. Try to avoid sedation.
- If sedation is unavoidable:
  - *Haloperidol* 5mg IV x1 (may take ~20 minutes for effect)
  - *Lorazepam* 0.5mg IV x1 (acts within 2-5 minutes)

**DECREASED URINE OUTPUT**
*(Minimum normal output ~30cc/hr)*

**Etiology:**
Prerenal (anemia, hypovolemia), renal (ARF from ATN, AIN, or diuretic dependence), postrenal (obstruction – prostate and foley catheter, abdominal compartment syndrome).

*Also think about whether this patient “needs” to make urine. Consider the clinical context. If they are a thoracic patient after a lobectomy, the service may be running them very dry. If the patient has a low volume status, the body will not make much urine (holds onto fluid) and there may be no need for intervention. On the other hand, if the patient was in the OR for a several-hour long open abdomen case and lost some blood, adequate fluid resuscitation and urine output measurement will be critical.*

**Initial work-up should include:**
- Focused history and physical exam concentrating on VS, abdomen (distention, suprapubic tenderness/dullness to percussion), GU system
  - Brief chart review for h/o BPH, diuretic dependence at home.
  - If suspicion is for hypovolemia – isotonic IVF bolus & recheck in 1hr.
  - If no response, place foley for ease of measurement.
  - If no response despite adequate hydration, think occult blood loss – check CBC.

If patient is euvoletic, first think obstruction or mechanical problem, then intrinsic renal problems last.
- Place foley (do not force it – if difficult, try Coude catheter).
- If foley is in place – check for leak, flush catheter.
- If on diuretics at home, resume home dose (unless hypovolemic or in ARF).
- If problem is renal – get UA and renal US (to r/o hydronephrosis).

**Note:**
In general, acute cessation of urine output suggests mechanical obstruction or abdominal compartment syndrome, while slow decline in urine output suggests prerenal causes.

**HEMaturia**

**Etiology:**
Foley catheter trauma, coagulopathy, prostatitis, glomerulonephritis, cystitis, bladder cancer, stones, any disruption in urothelium
*Hematuria may be normal in a patient who received intra-op stent placement.

**Initial work-up should include:**
- Brief history and exam focusing on description of urine (frank blood, presence of clots, red Kool-Aid appearance, pink urine)
- Check INR, PTT, CBC
- Increase IV hydration (to prevent clots)
- Follow serial Hgbs (Q6hr)
- If clots are present, they can obstruct
- Place large multiport foley
- Call Senior Resident and Urology (patient may need bladder irrigation or cystoscopy)

**NAUSEA/VOMITING**

**Etiology:**
Obstruction (gastric outlet, small bowel, etc.), ileus (post-op, hypothyroidism, electrolyte abnormalities), drugs (antibiotics, narcotics, general anesthesia), infection, acute MI, central nervous system/vestibular abnormalities, etc.

**Initial work-up should include:**
- Brief history & physical focusing on abdominal distension, bowel sounds, color & amount of emesis, relation to meals, abdominal pain, flatus, &/or bowel movements
  - If abdomen is distended & patient is obstipated/constipated – think obstruction vs ileus.
  - If associated large volume emesis, place NG tube. Order stat portable Abdominal Series (includes upright CXR and two AXRs). Obstruction will be supported by presence of dilated gastric bubble, multiple air-fluid levels in small bowel and lack of air in rectum.
- Make NPO, start IVFs, check electrolytes

**For symptomatic relief:**
- Antiemetics:
  - Ondansetron 4mg IV Q6hrs PRN
  - Phenergan 25mg IV Q6hr PRN (sedating – watch for mental status changes in elderly)
  - Compazine 10mg IVQ6hr PRN (can produce extrapyramidal side effects)
  - Scopolamine patch (avoid in elderly)
- Promotility Agent: Metoclopramide 10mg IV Q3hr PRN – **DO NOT GIVE IF OBSTRUCTED**
CONSTIPATION

Etiology: Narcotics, fecal impaction, poor PO intake, paraplegia, autonomic dysfunction, chronic laxative use, bowel obstruction, etc.

Initial work-up should include:
- Brief H&P including home laxative use & rectal exam
- KUB to evaluate bowel gas pattern and stool burden

Medical treatment
- Bulking agents:
  - Docusate (Colace) 100mg PO BID
  - Senna 2tabs PO QD
- Cathartics:
  - Bisacodyl (Dulcolax) 10mg tab PO or 10mg suppository PR QD
  - Milk of Magnesia 30mL PO Q6hr PRN (bad taste)
  - Magnesium Citrate 1bottle PO x1 (powerful)
  - Lactulose 30mL PO QD
- Enemas – Fleets, tap water, soap suds (1 PR, repeat PRN)
- Gentle digital disimpaction – often the rectal stimulation is sufficient

HYPERKALEMIA

Normal 3.5-5 mEq/L
Mild 5-6 mEq/L
Moderate 6-7 mEq/L
Severe >7 mEq/L or any EKG changes (peaked T-waves)

Work-Up:
- Get an EKG. Complication: cardiac arrest. Look for peaked T waves, ectopy, widened QRS complex and QT interval, torsades.
- Recheck level STAT if labs seem spurious, if not, repeat after treatment.

Treatment: (Start with EKG, repeat K+ level, Lasix, insulin+D50, Kayexalate, Ca gluconate if EKG changes.)
- Antiarrhythmic:
  - 5-10ml 10% Calcium gluconate (never give CaCl through a peripheral line, Ca++ may precipitate digoxin toxicity). This only briefly stabilizes the myocardium to give you time to treat the hyperkalemia.
- Shift K+ into the cells with acidosis correction and glucose movement:
  - 1 amp HCO3 (+/-)
  - 1 amp D50 + insulin regular 5-10 units IV
Eliminate K+:
- Remove potassium from the IVF
- Kayexalate 15-50 g in 100-200 ml 20% sorbitol solution PO or retention enema, repeating q 3 hr until diarrhea.
- Furosemide 20 mg IV push (+/-)
- Dialysis

Note:
Better than treatment is avoiding the problem in the first place. Make sure renal patients have low potassium diets and IVFs. Remember that ACE-inhibitors and spironolactone cause potassium retention. Periodically monitor potassium in patients receiving K+ supplements.
COMMON MEDICATION DOSAGES

Most of these dosages are for standard adults. Pediatric dosing is generally all weight-based, and you also have to adjust in adults with renal or hepatic dysfunction – use this only as a general guide. Consult your upper level or floor pharmacist for additional specifics on dosing for your patients.

PAIN CONTROL

Equianalgesic Table

<table>
<thead>
<tr>
<th>Oral (PO) /Rectal PR Dose (mg)</th>
<th>Analgesic</th>
<th>Parenteral Dose SC, IM, IV (mg)</th>
<th>Duration of action</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>Morphine</td>
<td>10</td>
<td>3-4 hours</td>
</tr>
<tr>
<td>20</td>
<td>Oxycodone (Oxycontin)</td>
<td>--</td>
<td>3-4 hours</td>
</tr>
<tr>
<td>7.5</td>
<td>Hydromorphone (Dilaudid)</td>
<td>1.5</td>
<td>3-4 hours</td>
</tr>
<tr>
<td>---</td>
<td>Fentanyl</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>Hydrocodone</td>
<td>---</td>
<td>3-4 hours</td>
</tr>
<tr>
<td>20</td>
<td>Methadone</td>
<td>---</td>
<td>8-12 hours</td>
</tr>
<tr>
<td>200</td>
<td>Codeine</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>300</td>
<td>Meperidine</td>
<td>100</td>
<td>2-3 hours</td>
</tr>
</tbody>
</table>

Note: Morphine metabolites can remain in patients with renal failure; both morphine and dilaudid metabolized in liver but morphine has active metabolite.

**Common PO combinations: All narcotics require DEA and/or attending Rx**

- Percocet (Oxycodone/Acetaminophen – 2.5/5/7.5/10/15mg – 325mg)
  - Liquid – Roxicet
- Lortab/Norco (Hydrocodone/Acetaminophen – 2.5/5/7.5/10/15mg – 325mg)
  - Liquid – Lortab elixir
- Vicodin (Hydrocodone/Acetaminophen)
  - Some formulations come with 500mg Tylenol and can quickly reach max daily dose of Tylenol
- Tramadol (Ultram)
  - Can start at 25-50mg q8hr; max dose 100mg q6hr, can schedule
- Transdermal Fentanyl Patch – do not cut patches.
  - Any patient with a Fentanyl patch should be managed by APS. Not recommended for acute pain or pain after an operation. Onset/offset of action is ~12-24 hours; peak effect seen in ~24-48hrs.
**Non-opioid Alternatives**

Topical Lidocaine (Lidoderm) patches
- On for 12 hrs per day, removed for 12 hrs
- Expensive, also available in ointment, which is cheaper (Rx for discharge)

Ketoralac (Toradol) – NSAID
- 15-30mg IV q6-8hrs, often can schedule if normal renal function
- Avoid in older patients and any patients with any renal insufficiency, can also increase bleeding risk, avoid in trauma
- Used extensively in children

**Patient Controlled Analgesia – PCAs typically either Morphine or Dilaudid**

**Common Settings:**

<table>
<thead>
<tr>
<th></th>
<th>Morphine</th>
<th>Hydromorphone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard concentrations</td>
<td>1 mg/ml</td>
<td>0.2 mg/ml</td>
</tr>
<tr>
<td>PCA bolus dose</td>
<td>1 mg</td>
<td>0.2 mg</td>
</tr>
<tr>
<td>Lockout time</td>
<td>6-10 min</td>
<td>6 min</td>
</tr>
<tr>
<td>Usual 1-hr Max Dose</td>
<td>10-12mg</td>
<td>2mg</td>
</tr>
</tbody>
</table>

You can give bolus off of PCA if pain too great (usually 2-3mL).

**BOWEL REGIMEN**

Docusate (Colace)
- Pretty much everyone gets this 100mg qDay or BID if on any narcotic pain medication, relatively gentle stool softener

Polyethylene Glycol (Miralax)
- 17gm daily
- An osmotic agent

Bisacodyl (Dulcolax)
- 5-15 mg PO daily OR 10mg PR daily (MAX = 30mg PO when complete evacuation is needed)
- As a PR medication, it will stimulate a BM if stool present

Sennosides (Senna)
- Stimulant laxative

Other high osmotic agents can also have a cathartic effect so be aware: Gastrograffin, kayexalate, lactulose
NAUSEA/VOMITING

Ondansetron (Zofran)
- 4mg/8mg IV q4-8hrs PRN
- PO ODT (oral-dissolving tab) – can be given for occasional nausea at home
- Watch for prolonged QT

Promethazine (Phenergan)
- 12.5-25 mg PO/IM/IV/PR q4-6 hr PRN
- Can make some people a little loopy

Prochlorperazine (Compazine)
- 12.5-25 mg PO/IM/IV/PR q4-6hr PRN

Metoclopramide (Reglan)
- Used for gastroparesis, decreased peristalsis
- 5-10 mg PO/IV/IM up to 4 times a day PRN (20mg doses may be used)

Scopolamine patch

Diphenhydramine (Benadryl) can also have some beneficial anti-nausea effects

ITCHING

Diphenhydramine (Benadryl)
- 12.5-50 mg PO/IV q6hr PRN
- Not to exceed 400 mg/day
- Can also have some anti-nausea effects
- Is sedating, write as a PRN with caution in elderly

Hydroxyzine (Atarax)
- 25-50 mg PO/IM q6hr or q8hr PRN

SLEEP

Benadryl (IV/PO): Be weary in older patients – anti-cholinergic effects can worsen dementia and sun-downing

Ambien: 5-10 mg PO qHS
*In general, do not start unless a home med.
AGITATION

First, ensure that your patient does not have another reason like hypoxia or sepsis causing the “agitated” state. Follow AMS pathway described previously.

Benzodiazepines (Ativan, Versed): need to consider age, renal/hepatic dysfunction, etc. – avoid if possible

Antipsychotics: Haloperidol (Haldol)/Quetiapine (Seroquel)
Get an EKG to check for QT prolongation.

HYPERTENSION

Hydralazine (PO/IV)
  o  Most often 10mg IV q6hr PRN, can go up to 20mg
  o  Can cause reflex tachycardia, often held for HR>100

Labetalol (PO/IV)
  o  Less selective beta-blocker
  o  Quick onset/off with IV
  o  5mg IV q5-10min until effect

Metoprolol (PO/IV)
  o  Selective beta-blocker
  o  5mg IV q4-6hr
  o  Not very good for BP control but relatively safe and good for HR

Clonidine
  o  Will have rebound hypertension – common if stopped suddenly
  o  PO or Transdermal patch

Calcium channel blockers – not typically first line agents but some patients are on these at home and can be very hypertensive until restarted: amlodipine, nifedipine

*Typically avoid ACE inhibitors, ARBs in hospital, generally will see Cr bump with restarting.
COMMON BEDSIDE PROCEDURES

This is meant to serve as a guide for common procedures you may be expected to do at the bedside. The equipment and steps used are recommendations but institutional variation may exist.

NASOGASTRIC TUBE

Indications:
Ileus, SBO, feeding, UGI bleed, gastric outlet obstruction, acute gastric dilation

Contraindications:
Recent esophageal/gastric surgery (check with attending), basilar skull fracture
*Ask about deviated septum, history of trauma to face.

Materials:
NG tube (14-18Fr, larger is easier to place), 60cc syringe, cup of water, lubricant (+/- lidocaine)

Steps:
- Lubricate tube.
- Measure distance – mouth to earlobe and down to anterior abdomen.
- Have patient sit with chin touching chest
- Advance tube aiming straight back, once hits back of the throat, have the patient swallow the tube down as you advance – sips of water can help here.
- Confirm placement by injecting air into port while listening over epigastrium. Have tubing ready for set-up in case there is a large amount of output.
- Secure tube in position with tape.
- Get a KUB to confirm position.

Tube Care:
- If an NG is not working, look for positioning: there are 4 black marks on the NG, you want two inside of the patient’s nose and two outside for the vast majority of patients.
- Remove the sump caps off NGTs–if this becomes wet it becomes a plug and it hinders proper functioning.
- Have 60cc syringe at patient’s bedside. Flush sump (blue) tube with air. Once the sump port gets wet, it will no longer provide the sump function. Flush main port with water and watch for return and/or pull back to see if you meet resistance (should flow freely).

Note:
Feeding tubes (dobhoffs) are usually placed by nursing. They are much thinner, need radiographic confirmation of placement, and should not be used for drainage - only for feeding/meds.
**FOLEY CATHETER**

**Indications:**
Placed for monitoring of resuscitation or bladder drainage. Should place in any case longer than 3-4 hours or any patient with epidural.

**Contraindications:**
Trauma patients with blood at meatus, high riding prostate, urethral damage

**Complications:**
UTI, bleeding

**Materials:**
Sterile gloves, foley kit (16-18F, larger if blood clots) – if having difficulty with insertion, consider Coude catheter

**Technique:**
- Prep urethra opening with betadine swab (in kit), check balloon, lube catheter, insert foley.
- For men: Must hub catheter before inflating balloon (and see urine in tubing). Remember to replace foreskin.
- For women: Inflate balloon once you see urine. Remember urethra is most anterior structure.

**Tricks:** If encountering urethral spasms, inject 10cc of 2% lidocaine jelly into urethra and advance catheter slowly, consider larger (if BPH) or smaller (if stricture) catheter; if still having problems, ask Urology to help.

**ARTERIAL LINE:**

**Indications:**
Monitoring of blood pressure, allows for frequent arterial blood draws

**Sites:**
Radial >> ulnar > femoral > dorsalis pedis > brachial

**Contraindications:**
Positive Allen’s Test

**Materials:**
Sterile field/gown, several A-line kits, lidocaine, suture, needle driver, A-line set-up (nurse)
An ultrasound may also be helpful.
Positioning:
Dorsiflex wrist, place rolled up towel underneath wrist, secure hand and arm to arm board/table with tape.

Steps:
- Prep and drape in sterile fashion after wrist secured.
- Palpate pulse.
- Inject weal of lidocaine over site of pulse.
- Position catheter at a 45-degree angle. Keeping finger over pulse, advance slowly until you see a small amount of blood return in the hub of the catheter. If you do not get blood, withdraw slowly, and change angle slightly. If you do see blood and it continues, slide the wire forward and then advance the catheter over the wire (drop the angle of the catheter so that it is slightly more parallel to the floor). If you meet resistance, the needle may be in the artery but not the catheter: bring the catheter back and try to advance the entire system forward 1-2mm before trying to thread the catheter again.
- If successful, hook up to pressure bag. Suture A-line in place on both sides.

Tips:
- Do not push against resistance - you will tear the artery and make it harder later.
- If no blood comes out of the catheter once it is advanced and the needle is out, you are not in the artery. Withdraw slowly. If you get blood return at any point, consider re-threading the wire and re-advancing. NEVER use the needle to do this. If there is still no return, remove and hold pressure.
- Do not make the patient into a pin cushion. The artery will go into spasm. The best thing to do is to stop and try again later or consider another site.

CENTRAL VENOUS CATHETER

Indications:
Poor peripheral access, CVP monitoring, need for large volume resuscitation, inotropic meds, TPN

Contraindications:
Coagulopathy (INR >1.5, plt <50), venous thrombosis, untreated sepsis

Types of Lines:
Triple Lumen (16g and 2x18g), Double lumen (14g and 16g), Cordis (7.5F, good for rapid volume delivery, need for SWAN), Groshong (plasmapheresis or dialysis), Mehurkur (dialysis), Hohn catheter (tunneled line), Hickman (tunneled line, can be single or double lumen), Port-a-Cath (tunneled with subcutaneous access port)

Sites:
Internal jugular = subclavian >> femoral (last choice unless ongoing CPR)
Materials:
Sterile gown/gloves/mask/hat and drape, Chloraprep, ultrasound, appropriate line kit, lidocaine (usually in kit), flush, probe cover for ultrasound, nurse for assistance, monitors (EKG and pulse ox), end pieces for catheter, dressing

Positioning:
IJ: Supine, Trendelenberg, head turned away
Subclavian: Supine, Trendelenberg, towel between scapula, traction on ipsilateral arm, head turned away
Femoral: Supine, flat

Steps:
IJ:
- Prep neck, set up equipment, place flush in tray, don sterile gear, drape patient with full body drape.
- Set up site, locate IJ vessel under ultrasound guidance.
- Anesthetize area with lidocaine.
- Prepare line by flushing all ports. Place equipment on field in easy reach.
- Attach insertion needle to 5cc syringe loosely. Puncture skin and advance catheter while aspirating. Should be done under ultrasound guidance until see needle entering vessel (vein is the compressible vessel).
- If you get arterial blood (bright, pulsatile) – withdraw and hold pressure. If no blood is obtained – withdraw and re-aim (pass to someone else after three attempts). If there is a question, you can transduce the line to see the waveform. If venous return (dark, non-pulsatile), proceed.
- Introduce wire – should pass with no resistance. Watch for PVCs. Once in place, remove needle, leaving wire.
- Use scalpel to make a small nick in skin at wire entry site. Advance dilator over wire and then remove.
- Insert catheter over wire. (ALWAYS have a hold of the wire). Once catheter is in place, remove wire. Flush all ports by first aspirating then flushing saline.
- Suture in place, apply sterile dressing, and get a CXR.

Subclavian:
- Prep area, set up equipment, place flush in tray, don sterile gear, drape patient with full body drape.
- Place index finger at sternal notch and thumb at intersection of clavicle and 1st rib (about 1/3 distance out on the clavicle).
- Anesthetize area with lidocaine, especially around rib.
- Prepare line by flushing all ports. Place equipment on field in easy reach.
- Attach insertion needle to 5cc syringe loosely. Puncture skin and advance catheter while aspirating. Keep horizontal to floor at all times. Advance towards sternal notch until at clavicle. Then pull back slightly and lower entire needle (horizontal) under the clavicle before advancing to vein.
If venous access obtained, proceed with wire and Seldinger technique as outlined above. If arterial access – stop, hold pressure. If no blood is obtained, withdraw needle, re-aim and try again. After three attempts, someone else should takeover.

Suture in place, apply sterile dressing, and get a CXR.

**Femoral:**
- Prep area, set up equipment, place flush in tray, don sterile gear, drape patient with full body drape (if there is time – these are usually done in more emergent setting. They should therefore be replaced later if possible. Clip hairs if needed.)
- Palpate pulse in groin below inguinal ligament and aim just medially
- Anesthetize with lidocaine.
- Insert needle at a 45-degree angle until you see blood return. Follow steps above.

**Complications:**
- **IJ:** carotid cannulation, infection, pneumothorax, air embolus, malposition, dysrhythmia
- **Subclavian:** artery cannulation, pneumothorax, infection, air embolus, malposition
- Femoral: artery cannulation, infection, must stay flat while line in.

*If you realize the line is in the artery after it has been dilated, don’t panic. Leave line in place and call for help.

**SWAN GANZ CATHETER**

*Placement should be cleared by Chief/Fellow/Attending. You must have monitoring and a nurse who knows how to set up and use a SWAN.

**Indications:**
No clear indication – used for monitoring hemodynamics and volume status in patients with confusing clinical picture

**Steps:**
*Brief – read about this extensively before doing and have someone present who is experienced
  - Prep and drape area. Nurse should prepare SWAN.
  - Test catheter – check all three ports, inflate balloon, check whip, check monitor.
  - Place swandom over the catheter. Pass into Cordis with balloon down.
  - Once at 20cm, have the nurse inflate balloon (say “balloon up”). Continue to advance steadily watching wave forms as you pass through SVC, RA, RV, to PA.
  - By around 50cm (depends on size of patient), you should see PA waveform. When wedged, the wave form will flatten. If the wave form flattens but starts shooting up, you are over-wedged – pull back slightly with the balloon down and re-wedge by inflating the balloon. Once you are wedged and the wave form is stably flat, deflate the balloon (say “balloon down”), and the waveform should reappear. Leave the balloon down.
If you reach 60-70cm and you still have not seen the PA waveform, deflate the balloon, pull back and start over. The balloon should be up whenever you advance and down whenever you pull back.

**Equations to know:**

- \( CO = HR \times SV \)  
  - *SV is determined by preload, afterload and contractility.*
- \( CI = \frac{CO}{BSA} \)
- \( SVI = \frac{SV}{BSA} \)
- \( SVR = \left[\frac{(MAP-CVP)}{CO}\right] \times 80 \)
- \( PVR = \left[\frac{(PAP-PAWP)}{CO}\right] \times 80 \)
- \( RVSWI = 0.0136 \times (PAP-CVP) \times SVI \)
- \( LVSWI = 0.0136 \times (MAP-PAWP) \times SVI \)

**Complications:**
Pulmonary infarction, arrhythmias, balloon rupture, pneumothorax, pulmonary artery rupture, knotting of catheter, infection, damage to cardiac valves

**CHEST TUBE**

**Indications:**
Drain air (pneumothorax, tension pneumothorax), blood (hemothorax), water (effusion), or pus (empyema)

**Size Selection (range from 24Fr to 36Fr):**
- Pneumothorax, simple effusion – 24Fr, 28Fr
- Large air leak, large effusion – 32Fr, 36Fr
- Blood, pus, complex effusion – 36Fr

**Materials:**
Chest tube tray, tube, lidocaine, sterile gown/gloves, suture kit and dressing

**Positioning:**
Supine, ipsilateral arm behind head, wide sterile field, keep nipple visible

**Steps:**
- Good local anesthetic is key, consider some sedation if possible for awake patients.
- Make ~2cm (enough for the tube and your finger) horizontal incision along the anterior axillary line, roughly parallel to nipple or at most one rib space below (4th or 5th intercostal space).
- Use curved Kelly to bluntly dissect or small scissor bites to tunnel up one rib space.
- Penetrate pleura bluntly, controlling Kelly tip, hugging the top of the rib to avoid neurovascular bundle.
o Verify entry by inserting finger into chest, sweeping away adhesions.
o Insert tube with Kelly, manually verifying placement in chest. Default position is posterior, apical.
o Secure with large suture (type of stitch varies by service/attending). Most common dressing is dry gauze covered with foam tape.
o Post-procedure CXR is mandatory!

Pleurovac Basics:
o Standard 3-chamber unit: right side (largest) chamber collects fluid directly from patient. Central chamber is filled with water to create a water seal (typically 2cm), which allows air to escape from patient but does not let air back in when negative pressure is created (i.e. during normal inspiration). Water in this chamber should rise and fall with respiration. The left chamber is for suction control. Normally, this is created by filling the chamber with water to the -20cm mark, and then applying suction, which causes air to bubble through the chamber. Note that the level of water in the chamber, not the amount of wall suction or the rapidity of the bubbling, is what controls the suction level.
o Testing for air leak: Bubbles in central chamber indicate an air leak, either from the patient or the system. To test for system leak, temporarily clamp tube at skin level; if bubbles persist, look for leak in system.
o Water seal/gravity drainage: If suction is not needed, disconnect suction chamber tubing from wall suction device and leave open. Clamping this tube prevents air from escaping and can lead to a tension pneumothorax.

Tube Removal:
o Timing depends on original purpose for tube. In general, there should be no air leak, chest x-ray showing complete expansion of lung, drainage <~150ml/day (variable by attending). Chest tubes for empyema stay in longer.
o Optimal method of actual removal is unsettled, but most favor pulling tube (rapidly) at end-inspiration or with patient bearing down, in order to minimize chance of residual pneumothorax. If tube secured with U-stitch, will require one person to pull tube and another to tie the suture. Cover with occlusive dressing. Obtain a post-pull CXR.

THORACENTESIS:

Indications:
Diagnostic, therapeutic drainage of pleural effusion

Contraindications:
Coagulopathy, if only small volume - consider US guidance

Positioning:
Sitting erect at edge of bed, rest arms and head on table or lateral recumbent
Materials:
Thoracentesis kit, sterile gear, vacuum bottles, ultrasound

Steps:
- Prep and drape patient in sterile fashion.
- Percuss to locate effusion (or have US mark). Choose rib space below top of effusion and anesthetize with lidocaine. Be sure to cover skin, subq, and periosteum. Carefully walk needle OVER the rib until pleural fluid is aspirated – pull back and anesthetize pleura.
- Following same path and using 2 handed stabilization technique, insert thoracentesis needle. Once in pleural cavity (as identified by withdrawal of pleural fluid), insert wire and then catheter using Seldinger technique.
- Connect extension tubing to the catheter and connect the side to vacuum bottles.
- Patient may cough as fluid comes off and lung re-expands. Be careful to remove large volumes slowly (consider chest tube) to avoid expansion pulmonary edema.
- When finished, withdraw catheter, place dressing, obtain CXR.
- Send fluid for: cultures, gram stain, cytology, glucose, protein, LDH, etc. as indicated.

Complications:
Intercostal bleed, pneumothorax, inadequate drainage (try different patient positions)

**DIAGNOSTIC PERITONEAL LAVAGE**

Indications:
Blunt abdominal trauma, unstable trauma patient

Contraindications:
Need for laparotomy. Pregnant. Careful in cirrhotics, obese (consider open technique), prior surgeries (use open technique), retroperitoneal injury (may get false positive).

Positioning:
Supine, must have NG tube and foley in place. If pelvic fracture, go above umbilicus.

Materials:
Sterile gown/gloves, Chloraprep, DPL kit, access to open tray, 1L NS, tubing

Steps:
* Percutaneous:
  - After prepping and draping, anesthetize area with lidocaine.
  - Make a small nick in skin below umbilicus with scalpel.
  - Use towel clamp to elevate umbilicus.
  - Insert needle with attached syringe (with NS) through fascia and peritoneum into abdomen (3 pops).
Pull back on syringe to see bubbles, inject small amount to see saline drop in. Then pull back with syringe. If you get 10cc blood or grossly positive -> OR.

Otherwise thread wire and using Seldinger technique, insert catheter into abdomen. If resistance is met, you may not be in. If there is continued trouble at any point, convert to open.

Once catheter is in, attach tubing and instill 1L NS – watch for air-leaks. Once at 800cc, drop bag to floor while holding catheter and allow to drain back out. Once all the saline is back, send specimen to lab.

If positive and unstable -> OR. If stable, consider CT if DPL negative or pending.

Open:

After prepping and draping, anesthetize area with lidocaine. Make a small incision through linea alba.

Incise fascia and peritoneum and grab with Allis clamps.

Introduce dialysis catheter towards pelvis. Again, gross blood or enteric contents -> OR.

Otherwise attach tubing and instill 1L warm NS. Once at 200cc, let bag drop and allow to drain out.

Send specimen to lab. Close fascia with 0 Vicryl.

Positive DPL if: RBC >100,000, WBC >500, amylase >175, food particles or bacteria present.

Complications:
Bladder, bowel, arterial injury, peritonitis, wound infection

PARACENTESIS

Indications:
Diagnostic, drainage of ascites, SBP

Contraindications:
Coagulopathy, pregnancy, infected skin, bowel obstruction

Positioning:
Supine, have patient empty bladder beforehand

Materials:
Paracentesis kit (needle and tubing), lidocaine, vacuum bottles, Chloraprep
*Consider US guidance. If large volume, choose site lateral lower quadrant or infra-umbilical (watch out for epigastrics).
**Steps:**
- Prep and drape. Anesthetize site of entry with lidocaine.
- Introduce catheter and needle until able to withdraw fluid, then advance catheter over needle and withdraw needle.
- If diagnostic, aspirate 20-30cc then remove. If therapeutic, attach catheter to tubing and hook to vacuum bottle.
- If flow decreases at any point during drainage, manipulate catheter or have patient change positions. Once finished, remove catheter and cover with dressing.
- Send fluid for: cultures, gram stain, cytology, glucose, protein, LDH, etc. as indicated.

**Complications:**
Hypotension, bleeding, bowel perforation, ascites leak, bladder perforation
*If draining large amount, consider intravascular replacement with 5% or 25% albumin.

**BEDSIDE PORT-A-CATH/HICKMAN REMOVAL**

*Be sure patient has adequate plts >50 and coagulation factors have been checked.

**Steps:**
- Ask OR for the Hickman Line tray – ensures you have all the instruments you might need.
- Infiltrate area and track with local anesthetic. Use sterile technique.
- Patient must be in Trendelenberg to prevent air embolus. Key to Hickman is freeing up cuff (done with a mosquito) – do not pull hard. You do not want to break the catheter. For ports, you need to cut the sutures holding it in place.
- If line breaks outside skin, put clamp on it to avoid bleeding/air embolus. If under skin, call IR.
- Send the line for culture. Hold pressure over the site where the line enters the vessel, not where it leaves the chest.

**ABSCESS INCISION & DRAINAGE:**

**Materials:**
I&D kit (scalpel, hemostat, gauze, drape), Q-tips, 2L NS w/ irrigation tip, sterile gear including mask w/ face shield, lidocaine, 10cc syringe, 18g needle to draw up, Chloraprep, packing tape or gauze

**Steps:**
- Anesthetize circumferentially w/ lidocaine, be sure to go deep as well. Lido must be in viable tissue to work. Consider supplementing with IV pain medications.
- Incise w/ scalpel over area of maximal fluctuance. Make incision large enough for easy dressing changes by patient (err on the larger side).
- Probe cavity with hemostat and or Q-tips to break up loculations and check for tracking/tunneling.
- Irrigate with 2L NS. Face shield is absolutely necessary.
- Pack with gauze or packing tape depending on wound cavity size. The goal is to keep the entire pocket open to heal from the bottom. Need someone at home to help with this or appropriate follow-up.
- Should have CBC and blood cultures sent. All should receive dose of antibiotics. If WBC >12, need IV antibiotics and consider admission. If surrounding cellulitis, consider antibiotics regardless of WBC count.
## REFERENCES

### Normal Hemodynamic Parameters - Adult

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Equation</th>
<th>Normal Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arterial Blood Pressure (BP)</td>
<td>Systolic (SBP)</td>
<td>90 - 140 mmHg</td>
</tr>
<tr>
<td></td>
<td>Diastolic (DBP)</td>
<td>60 - 90 mmHg</td>
</tr>
<tr>
<td>Mean Arterial Pressure (MAP)</td>
<td>SBP + (2 x DBP)(^3)</td>
<td>70 - 105 mmHg</td>
</tr>
</tbody>
</table>
| Systolic Pressure Variation (SPV)| \((SP\text{max} - SP\text{min})^*\)          | <5 mmHg unlikely to be preload responsive  
|                                  |                                               | >5 mmHg likely to be preload responsive    |
| Pulse Pressure Variation (PPV)   | \(\frac{(PP\text{max} - PP\text{min}) \times (PP\text{max} + PP\text{min})}{2} \times 100^*\) | <10% unlikely to be preload responsive  
|                                  |                                               | >13-15% likely to be preload responsive    |
| Stroke Volume Variation (SVV)    | \(\frac{(SV\text{max} - SV\text{min}) \times (SV\text{max} + SV\text{min})}{2} \times 100^*\) | <10% unlikely to be preload responsive  
|                                  |                                               | >13-15% likely to be preload responsive    |

* = averaged over 10 sec. of BP data updated every 4 beats

- **Right Atrial Pressure (RAP)**: 2 - 6 mmHg
- **Right Ventricular Pressure (RVP)**: Systolic (RVSP) 15 - 25 mmHg  
  Diastolic (RVDSP) 0 - 8 mmHg
- **Pulmonary Artery Pressure (PAP)**: Systolic (PASP) 15 - 25 mmHg
  Diastolic (PADP) 0 - 15 mmHg
- **Mean Pulmonary Artery Pressure (MPAP)**: \(\frac{P\text{ASP} + (2 \times P\text{ADP})}{3}\) 10 - 20 mmHg
- **Pulmonary Artery Wedge Pressure (PAWP)**: 6 - 12 mmHg
- **Left Atrial Pressure (LAP)**: 6 - 12 mmHg
- **Cardiac Output (CO)**: \(HR \times SV\times 1000\) 4.0 - 8.0 l/min
- **Cardiac index (CI)**: \(\frac{CO}{BSA}\) 2.5 - 4.0 l/min/m²
- **Stroke Volume (SV)**: \(CO/HR \times 1000\) 60 - 100 ml/beat
- **Stroke Volume Index (SVI)**: \(CO/HR \times 1000\) 33 - 47 ml/m²/beat
- **Systemic Vascular Resistance (SVR)**: \(\frac{80 \times (MAP - RAP)}{CO}\) 800 - 1200 dynes · sec·cm⁻⁵
- **Systemic Vascular Resistance Index (SVRI)**: \(\frac{80 \times (MAP - RAP)}{CI}\) 1070 - 2390 dynes · sec·cm⁻⁵/m²
- **Pulmonary Vascular Resistance (PVR)**: \(\frac{80 \times (MPAP - PAWP)}{CO}\) <250 dynes · sec·cm⁻⁵
- **Pulmonary Vascular Resistance Index (PVRI)**: \(\frac{80 \times (MPAP - PAWP)}{CI}\) 255 - 265 dynes · sec·cm⁻⁵/m²
### Oxygenation Parameters - Adult

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Equation</th>
<th>Normal Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Partial Pressure of Arterial Oxygen (PaO₂)</td>
<td></td>
<td>80 - 100 mmHg</td>
</tr>
<tr>
<td>Partial Pressure of Arterial CO₂ (PaCO₂)</td>
<td></td>
<td>35 - 45 mmHg</td>
</tr>
<tr>
<td>Bicarbonate (HCO₃⁻)</td>
<td></td>
<td>22 - 28 mEq/l</td>
</tr>
<tr>
<td>pH</td>
<td></td>
<td>7.38 - 7.42</td>
</tr>
<tr>
<td>Arterial Oxygen Saturation (SaO₂)</td>
<td></td>
<td>95 - 100%</td>
</tr>
<tr>
<td>Mixed Venous Saturation (SvO₂)</td>
<td></td>
<td>60 - 80%</td>
</tr>
<tr>
<td>Arterial Oxygen Content (CaO₂)</td>
<td>(0.0138 x Hgb x SaO₂) + (0.0031 x PaO₂)</td>
<td>17 - 20 ml/dl</td>
</tr>
<tr>
<td>Venous Oxygen Content (CvO₂)</td>
<td>(0.0138 x Hgb x SvO₂) + (0.0031 x PvO₂)</td>
<td>12 - 15 ml/dl</td>
</tr>
<tr>
<td>A-Y Oxygen Content Difference (CaO₂-CvO₂)</td>
<td></td>
<td>4 - 6 ml/dl</td>
</tr>
<tr>
<td>Oxygen Delivery (DO₂)</td>
<td>CaO₂ x CO x 10</td>
<td>950-1150 ml/min</td>
</tr>
<tr>
<td>Oxygen Delivery Index (DO₂/l)</td>
<td>CaO₂ x CI x 10</td>
<td>500 - 600 ml/min²</td>
</tr>
<tr>
<td>Oxygen Consumption (VO₂)</td>
<td>(CI x VO₂) x CO x 10</td>
<td>200 - 250 ml/min</td>
</tr>
<tr>
<td>Oxygen Consumption Index (V/O₂)</td>
<td>(CI x VO₂) x CI x 10</td>
<td>120 - 150 ml/min²</td>
</tr>
<tr>
<td>Oxygen Extraction Ratio (O₂ER)</td>
<td>[(CaO₂-CvO₂)/CaO₂] x 100</td>
<td>22 - 33%</td>
</tr>
<tr>
<td>Oxygen Extraction Index (O₂EI)</td>
<td>[SaO₂ - SvO₂]/SaO₂ x 100</td>
<td>20 - 25%</td>
</tr>
</tbody>
</table>
BASIC LIFE SUPPORT ALGORITHM:

1. No movement or response

2. PHONE 911 or emergency number
   Get AED
   or send second rescuer (if available) to do this

3. Open AIRWAY, check BREATHING

4. If not breathing, give 2 BREATHS that make chest rise

5. If no response, check pulse:
   Do you DEFINITELY feel pulse within 10 seconds?
   - Definite Pulse
   - Give 1 breath every 5 to 6 seconds
   - Recheck pulse every 2 minutes
   - No Pulse

6. Give cycles of 30 COMPRESSIONS and 2 BREATHS
   until AED/defibrillator arrives, ALS providers take over, or
   victim starts to move
   Push hard and fast (100/min) and release completely
   Minimize interruptions in compressions

7. AED/defibrillator ARRIVES

8. Check Rhythm
   - Shockable rhythm?

9. Shockable
   - Give 1 shock
   - Resume CPR immediately for 5 cycles

10. Not Shockable
    - Resume CPR immediately for 5 cycles
      Check rhythm every 5 cycles; continue until ALS providers take over or
      victim starts to move
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