Periprocedural Evaluation & Management of Nurse Practitioner-led Paracentesis & Thoracentesis

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Objectives

1. Elaborate on the top 3 risks and complications associated with paracentesis and thoracentesis

2. List the pre-procedure laboratory testing utilized in evaluate the patient

3. Evaluate the safety profile of drainages while on anticoagulants
What is a Paracentesis or Thoracentesis?

1. **Paracentesis**: therapeutic drainage of abdominal ascites (abnormal fluid from *abdomen*)

2. **Thoracentesis**: therapeutic drainage of pleural effusion (abnormal fluid from between *chest* wall & lung)

**Most typically performed in decompensated liver & metastatic cancer patients**
Who and where are paracentesis & thoracentesis’ being performed?

California: UCLA, UCSF

Interventional radiology (IR), hepatology, liver transplant surgery, pulmonology/critical care, internal medicine, family medicine, etc.

USA: Emory University\(^1\), Mayo Clinic

Globally: Wales\(^2\), United Kingdom
Benefits of an NP-led paracentesis & thoracentesis program

1. Close proximity to staff physicians & in protocol-defined environments
2. Removes pressure of patients needing to go the ER or being admitted for routine drainages
3. **Same day appointments** at different locations
4. Few post procedure complications with proceduralists
5. Same day discharge typically within an hour
6. **High patient satisfaction** with quality NP care
7. Established rapport with patients & clinicians with follow-up drainages; **communication support**
8. Foundation for other NP-led programs & educational opportunities for other services
Utility of NPs vs. MDs for paracentesis’ & thoracentesis’

Academic medical centers:

More consistent patient care with NPs vs. resident and fellow physicians

**Cost effective**: physicians can spend more time focusing on less time consuming tasks, such as image interpretation, and staffing complex interventional procedures that NPs are unable to perform

Consistent point of facilitation of radiology services

Non-academic medical centers:

**Cost effective**, especially with time constraints in outpatient medicine

**Continuity and consistency** of clinical care with time consuming procedure that is relatively repetitive and can be easily mastered
Similar rates of bleeding, leakage, peritonitis, and pneumothorax
Pre-procedure lab testing & preparation

1. H&P: usually within 30d
2. Check labs: CBC w/platelets, INR, PT/PTT, within 1-2 weeks, if on anticoagulants or chemotherapy, no longer than 30d
3. Imaging: review relevant imaging
4. Hold:
   a) Anticoagulants or NSAIDS, as directed by charge NP and by schedulers
   a) Hold diuretics, lactulose, and any other meds interfering with procedure until procedure completed. Anti-hypertensives need to be evaluated
5. NPO: not required for majority of cases, as sedation generally unnecessary
1. Investigate for any **anticoagulants** patient is on: hold times vary depending on anticoagulant

   *Up to 5 days with Plavix and only 1 hr with heparin gtt*

2. Severe thrombocytopenia (platelet count \(<20 \times 10^3/\mu L\) & coagulopathy with INR \(>2.0\)) are relative contraindications

3. INR \(>2.0\): receive fresh frozen plasma (FFP) prior to the procedure

   *One strategy is to infuse 1U FFP before the procedure & then perform the procedure while the 2nd unit is infusing*

4. Platelet count \(<20 \times 10^3/\mu L\):

   *Receive an infusion of platelets right before/during procedure*

5. Utilize imaging guidance to avoid vessels (color doppler)
General rule of safety with anticoagulants

Hold anticoagulants at least 2.5 half-lives. It takes 5 half-lives to clear the medication completely.

*Even more of a concern with the newer irreversible anticoagulants, as there are no reversal agents*
Safety profile of drainages with anticoagulants

**Heparin**: subQ qd-bid or IV; half-life 1-6h, IV half-life 0.5-1.5h. Reversal with protamine sulfate

*Hold at least 12h before procedure w/subQ, 1h with IV*

**Warfarin** (Coumadin): PO; half-life 20-60h. Reversal with vitamin K, prothrombin complex concentrates (PCC), Factor VIIa. **Do not hold** unless INR is too high

*Check INR*
Safety profile of drainages with anticoagulants

Anti-platelet agents:

Aspirin: PO; half-life 2-4.5 hrs with 150 mg qd, 15-30h with >4g. Reversal with platelets

Clopidogrel (Plavix): half-life 7-10 hrs. FFP, cryoprecipitate used, potential reversal with methylprednisolone and desmopressin

Dipyridamole (Persantine, Aggrenox): half-life 7-10 hrs. Platelets prn

Prasugrel (Effient): half-life 7-10 hrs. Platelets prn

Ticagrelor (Brillinta): half-life 7-10 hrs. Platelets, FFP, cryo prn

Hold ideally 5-10d before procedure
Safety profile of drainages with anticoagulants

Low molecular weight heparin (LMWH)

1. **Enoxaparin** (Lovenox): subQ or IV; half-life 4.5-7h. Reversal with vitamin K, PCC or FFP. **Hold 24h prior to procedure**

2. **Fondaparinux** (Arixtra): subQ; half-life 17-21h. Reversal with vitamin K, PCC or FFP. **Hold at least 48h prior to procedure**

3. **Dalteparin** (Fragmin): subQ; half-life 5.7+/- 2h. Reversal with vitamin K, PCC or FFP. **Hold at least 2.5 half lives**

4. **Tinzaparin** (Innohep): subQ; half-life 3-4h. Reversal with vitamin K, PCC or FFP. **Hold at least 2.5 half lives**
Safety profile with newer anticoagulants

Direct thrombin inhibitors

1. Dabigatran (Pradaxa): PO qd-bid; half-life 12-17h. No reversal agent.

   Insufficient evidence of FFP, HD (60% removal of drug) may be used as majority of dabigatran is unbound to protein

   *Hold 24-48h or 3-5d with renal impairment*

2. Argatroban: IV; half-life 39-51 min. **Monitor by PTT** (INR inaccurate). No reversal agent. *Hold at least 2.5 half lives*

3. Bivalirudin (Angiomax): IV, half-life 22 min. No reversal agent

   Modified ultrafiltration (45-89% removal) and HD (25% removal) may facilitate the removal of bivalirudin; Factor VII 90 mcg/kg IV; FFP or cryoprecipitate may also help displace bivalirudin from thrombin. *Hold at least 2.5 half lives*
Safety profile with newer anticoagulants

Direct Factor Xa inhibitor
1. **Apixaban** (Eliquis): PO bid; half-life 12-17h. No reversal agent. Hold at least 24-48h
2. **Rivoroxaban** (Xarelto): PO qd-bid; half-life 5-9h, 9-13h in elderly. No reversal agent with acute bleed: use factor VII and prothrombin complex concentrate. Hold 24h for healthy pts to 48h for renal/elderly

Glycoprotein IIb/IIIa inhibitors:
1. **Abciximab** (Reopro): IV; half life 30 min. No reversal agent. Hold 24h
2. **Eptifibatide** (Integrilin): IV; half-life 2.5h. No reversal agent. Hold at least 2.5 half lives
3. **Tirofiban** (Aggrastat): IV; half-life 2h. No reversal agent. HD, platelets for supportive management. Hold at least 2.5 half lives
Paracentesis

Be nice to me... I may be your nurse someday!!!! Remember...catheters and needles come in sizes that I choose!!!!!

your ecards
someecards.com
**Why does ascites develop?**

**Most common causes:**
- Cirrhosis
- Hepatitis – infectious and autoimmune
- End stage liver disease (ESLD)
- Malignancies and metastasis
- Portal vein thrombosis
Symptoms of ascites

- Abdominal distention
- Abdominal discomfort/pain
- Abdominal compartment syndrome
- Early satiety
- Nausea
- Vomiting
- Back pain
- Respiratory compromise
- Lower extremity edema
- Testicular or vulvar edema
General management of ascites

Ascites:
Dietary sodium restriction
Diuretics

**Dietary sodium restriction & diuretics don’t often provide symptomatic relief of refractory ascites in patients with advanced cancer**

Paracentesis indications:

**Diagnostic:** rule out spontaneous bacterial peritonitis (SBP), abdominal TB, malignancy with new onset ascites

**Therapeutic:** Ascites causing abdominal pain or abdominal compartment syndrome, early satiety, nausea, vomiting, or respiratory compromise

**First drainage:** often dual indication (diagnostic & therapeutic)
Contraindications to Paracentesis

Mild hematologic abnormalities do not increase the risk of bleeding.

**Bleeding may be increased if:**
- Prothrombin time (PTT) > 21 seconds
- International normalized ratio (INR) > 1.6
- Platelet count < 50,000 per cubic millimeter

**Absolute contraindication:** acute abdomen requiring surgery, i.e.) bowel perforation

**Relative contraindications are:**
- Pregnancy
- Distended urinary bladder
- Abdominal wall cellulitis
- Distended bowel
- Intra-abdominal adhesions
- Abdominal masses at insertion site
Paracentesis Complication Risks

1. Bleeding 0-2.7%
2. Local leakage of ascitic fluid 0.36%-2.35%
3. Abdominal wall hematoma 0.9%

Wound infection 0.83%

Post-paracentesis Hypotension: can be >12 hrs post procedure*

Hepatorenal syndrome, acute kidney injury
Failed attempt to collect peritoneal fluid

Bowel Perforation
Spontaneous hemoperitonium: rare; dt mesenteric variceal bleeding after large ascites >4L
Dilutional hyponatremia
Death

*With large volume paracentesis
Pre-procedure

1. Review **indication** and perform **time-out**
2. **Consent** status: screen prior to scheduling to determine if patient is consentable or if it needs to be obtained from the DPOA
3. Patient consent: patient must be A & O X 4 (must be able to state their name, DOB, time, place, and be able to understand and elaborate risks of procedure they are undergoing)
4. Make sure patient has voided bladder
5. **Obtain consent: risks, benefits, and alternatives**
6. **Baseline BP status evaluation**: monitoring for hypotensive patients or those on midodrine
7. Patient **must be cooperative** or sedation may be arranged if required
Procedure technique

1. Position patient: generally supine or sitting for paras & sitting with support on bedside table for thoras
2. Pre-procedural imaging performed to confirm fluid
3. Insertion area marked with permanent marker; patient must maintain position throughout procedure to prevent fluid shifting
4. Procedure kit opened and sterile gloves donned
5. Procedural area prepped steriley, typically with chlorhexidine, allowing to fully dry and drapes applied
6. Procedure kit prepped, including drawing up lidocaine and prepping catheter
7. Ultrasound probe covered with sterile probe cover*
8. Insertion site confirmed again with imaging*
9. Local anesthetic given, typically 1% lidocaine or buffered with sodium bicarbonate, with or without imaging guidance
10. Catheter inserted with or w/o imaging guidance. Stylet removed once fluid noted
11. Drain fluid & obtain diagnostic samples, if indicated
12. Remove catheter & apply bandage for hemostasis and to prevent infection and leaking

*Optional based on provider preference
Paracentesis sites: avoid inferior epigastric arteries
Ascites on Ultrasound

Ascites

Loops of small bowel
Cleaning skin
Sterile draping
Prepping kit
Local anesthesia administration
Nicking for catheter insertion
Catheter insertion
Confirm catheter is in the fluid
Remove stylet once catheter is inserted
Connect to drainage tubing
Drain into negative pressure evacuation containers
Remove catheter when drainage completed
Label & send specimens to lab for analysis
Evidence Findings: Albumin Infusions

A meta-analysis from Kwok et al (2013) suggests that the use of albumin in cirrhotic patients undergoing paracentesis reduces paracentesis-induced circulatory dysfunction & reduces death and renal impairment.

Large volume fluid removal: more than 5 liters

Intravenous serum albumin (25% albumin, 6-8 gms/L) to prevent hypotension may be indicated for some patients, i.e.) hypotensive, low albumin

Small volume initial paracentesis, followed by large volume with albumin and hemodynamic support, inpatient or outpatient, may be considered

Laboratory tests: Ascitic fluid

1. Cell count with differential: infection
2. Albumin: calculate SAAG
3. Protein: calculate SAAG
4. Bacterial culture: infection
5. Glucose level
6. Gram stain: rarely provides clinically useful information for the detection of SBP
7. Triglyceride levels (elevated in chylous ascites)
8. Bilirubin level (may be elevated in bowel perforation)
9. Amylase level (elevation suggests pancreatic source)
10. Lactate dehydrogenase (LDH) level
11. Cytology: rule out malignancies
Ascitic fluid analysis: Cell Count

**Cell count with differential:** elevated counts suggest infection, such as spontaneous bacterial peritonitis (SBP). Anaerobic bacteria not associated with SBP

**Primary SBP:** infection of ascitic fluid without intra-abdominal infection with chronic liver disease due to translocation of enteric bacteria, such as e. coli, klebsiella pneumoniae, enterococcal species, and steptococcus pneumoniae

**Higher risk for SBP:** renal failure patients using peritoneal dialysis, SLE patients, and children with nephrosis

Ascitic fluid polymorphonuclear leukocyte (PMN) count \( >250/uL \) with \( >50\% \) PMNs in fluid is presumptive for SBP => treat empirically, regardless of sxs

**Secondary SBP:** infected ascitic fluid associated with an intra-abdominal infection
Ascitic fluid analysis: SAAG

Serum ascites albumin gradient (SAAG): can be calculated to determine the cause of ascites. **Draw serum albumin same day as fluid albumin & protein**

\[
\text{SAAG} = (\text{serum albumin}) - (\text{albumin level of ascitic fluid})
\]

**Normal** = <1.7

**High gradient ascites** (>1.1 g/dL): dt portal HTN from liver or non-liver dz w/97% accuracy

*Causes:* Budd-Chiari syndrome, CHF, or cirrhosis

**Low gradient ascites** (<1.1 g/dL): not dt portal pressure

*Causes:* peritoneal carcinomatosis, TB, pancreatitis, nephrotic syndrome, serositis

**SAAG is preferred method for characterizing ascites**

*More discriminant than older methods of classifying fluid as transudative vs. exudative*
Thoracentesis

How to Read a Chest X-ray

Step 1:
Make sure X-ray is right side up.

Step 2:
Check name on X-ray.

Wait, why is there an outline of breasts in Mr. Smith's X-ray?

Step 3:
The X-ray shows cardiomegaly with a left-sided pleural effusion.

You mean right-sided? Um, sure.

Read radiologist's report.
Why does pleural fluid develop?

Normally, only small amounts of pleural fluid exist for lubrication (~10mL)

Liquid (pleural effusion) or air (pneumothorax) can accumulate due to different conditions

1. Transudative (CHF, 5-10% of cirrhosis pts develop hepatic hydrothorax)
2. Exudative (PNA, CA, PE, viral infx, recent chest or cardiac surgery)

Malignancy: most common cause of pleural fluid accumulation as a complication of cancer
Symptoms of pleural effusion

Dry, nonproductive cough
Breathing difficulty
Chest pain
Fever
Edema
Weight loss
General management of pleural effusions

Pleural effusion:
Observation & monitoring
Diuretics, if indicated
Antibiotics, if clinically indicated

Thoracentesis indications:

Diagnostic: rule out infection, malignancy with new onset or unilateral pleural effusion

Therapeutic: pleural effusions causing respiratory compromise or significantly increasing in volume

First drainage: often dual indication (diagnostic & therapeutic)
Thoracentesis Complication Risks

1. Bleeding/Hematoma
2. Infection (2%)
3. Limited coughing, dyspnea, or chest discomfort with post-procedural lung expansion

Pneumothorax
Re-expansion pulmonary edema after 1L: limit to <2 liters
Dry tap (no free fluid); may need chest tube if empyema present
Vasovagal syncope/hypotension
Death
Contraindications to Thoracentesis

Mild hematologic abnormalities do not increase the risk of bleeding.

Bleeding may be increased if:
1. Prothrombin time (PTT) > 21 seconds
2. International normalized ratio (INR) > 1.6
3. Platelet count < 50,000 per cubic millimeter

Absolute contraindication: acute chest requiring surgery, i.e.) trauma

Relative contraindications are:
Local cutaneous condition
Severe coagulopathy
Bronchial obstruction: mediastinal shift toward effusion -> bronchoscopy recommended
Pleural effusion on CXR
Pleural fluid on CT
Pleural effusion on ultrasound
Technique for thoracentesis

- Patient sitting upright and leaning on table
- Pleural space filled with excess fluid
- Fluid pushes on left lung
- Fluid collects in bag or syringe
Prep the skin
Drape the back
Administer local lidocaine
Nick the skin
Close look at pleural space
Align catheter device

Advance device over the superior aspect of the rib
Insert catheter device
Advance catheter over stylet & remove stylet
Collect diagnostic samples
Drain into negative pressure evacuation containers
Post-Thoracentesis CXR Indications

1. **Not required** unless otherwise indicated by symptoms or signs of complication

1. Signs of pneumothorax post-procedure
   - Progressive post-procedure chest pain and dyspnea
   - Voice transmission absent superior to thoracentesis site
   - Tactile fremitus absent superior to thoracentesis site
Pneumothorax (air between lung and chest wall):  

*Rates up to 20-39% - without imaging guidance*  
*Rates up to 11%; 2% needing chest tubes - with imaging guidance*

1. Can be spontaneous  
2. Through hole between the ribs/lungs: trauma  
3. Iatrogenic: ‘ex vacuo’ related to lack of post-procedural lung re-expansion related to disease

**CT:**  
Black airspace compared to contralateral chest

**CXR:**  
No lung markings compared to contralateral chest
Pneumothorax management

I. **Stable Patients with Small Pneumothoraces**
1. Observation for up to 3 to 6 hours
2. Discharge home if a repeat chest radiograph excludes progression
3. Follow up within 12-48 hours with repeat chest radiograph to document resolution, if clinically indicated

II. **Patients with Large Pneumothoraces**
1. Hospitalization
2. Re-expansion of lung using a small-bore catheter or placing a 16-22 F chest tube
3. Suction if lung fails to re-expand
Transudative vs. Exudative Fluid

Transudates: **thin, watery** fluid oozing into cavity due to loss of osmotic pressure or back pressure from the circulation. **Systemic disease**

**Causes:** CHF, hypoalbuminemic states such as cirrhosis and liver failure, portal vein thrombosis, nephrosis, PE, myxedema, etc.

Exudates: **thicker, more viscous** fluid usu. due to tissue damage, allowing albumin & water to seep out. **Local disease**

**Causes:** malignancies, pneumonia, PE, peritoneal carcinomatosis, nephrotic syndrome, TB, autoimmune dz (RA, SLE), esophageal perforation, pancreatic or biliary disease, pericarditis, radiation (accidental or therapeutic), peritonitis, ischemic or obstructed bowel, medication SE’s, rare conditions
Other types of fluid

**Blood (sanguinous):**
Related to trauma severing blood vessels, malignancies

Evaluate hematocrit (Hct): Hemothorax if >50% of the serum Hct

**Chyle (chylous):**
Related to trauma from surgery, MVA, malignancies, idiopathic, intestinal lymphgiectasia, subclavian venous thrombosis, tumors, filarasis, lymphangiomyomatosis

White or milky in color due triglycerides from digestion (erosion of thoracic duct carrying lymph fluid from intestines to the heart)
Laboratory tests: Pleural fluid

1. Cell count with differential: WBCs indicate infection and subtypes gives clues as to type of infection. RBCs indicate bleeding
2. Cultures & gram stains: may yield infectious organism prior to other cx, including blood & sputum, including TB
3. Amylase: 2X’s serum level or absolute value >160 indicative of pancreatitis, dissected or ruptured pancreatic pseudocyst, cancer, or esophageal rupture
4. Glucose: low if pleural fluid value <50% of normal serum value; differential includes RA, SLE, bacterial empyema, malignancy, TB, and esophageal rupture
5. pH: normal is 7.60. <7.3 with normal arterial blood pH has same differential as low pleural glucose
6. Triglyceride & cholesterol: >110 mg/dL and presence of chylomicrons indicates chylous effusion from rupture of thoracic duct most frequently resulting from trauma or malignancy, such as lymphoma
7. Adenosine deaminase: high for empyema, RA. >70 U/L for TB
8. Cytology: rule out malignancy, such as lung cancer, pleural meothelioma, and metastasis
## Pleural effusion management

<table>
<thead>
<tr>
<th>Pleural Anatomy</th>
<th>Pleural Fluid Bacteriology</th>
<th>Pleural Fluid Chemistry</th>
<th>Need for Drainage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Minimal effusion</strong></td>
<td></td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>(&lt;10 mm on lateral decubitus view); free-flowing</td>
<td>Cx and GS unknown</td>
<td>pH unknown</td>
<td></td>
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<tr>
<td><strong>Small to moderate effusion</strong></td>
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<td>No</td>
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<tr>
<td>(&gt;10 mm to &lt; one half of hemithorax on lateral decubitus view); free-flowing</td>
<td>Negative Cx and GS</td>
<td>pH &gt; 7.20</td>
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<tr>
<td><strong>Large effusion</strong></td>
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<td></td>
<td>Yes</td>
</tr>
<tr>
<td>(&gt; one half of hemithorax on lateral decubitus view) or loculated fluid or thickened pleura</td>
<td>Positive Cx or GS</td>
<td>pH &lt; 7.20</td>
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</tr>
<tr>
<td><strong>Any</strong></td>
<td>Pus</td>
<td>pH &lt; 7.0</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Dweik (2010). Pleural disease. Cleveland Clinic
Conclusion: Key to Positive Outcomes

1. Check labs
2. Review H&P
3. Manage anticoagulants, if applicable
4. Use imaging guidance
5. Monitor appropriately for complications
6. Patients: Live long & prosper!
The first five days after the weekend are always the hardest.