University of Calgary and University of Alberta

General Internal Medicine

Procedural Manual

Ultrasound Guided Paracentesis

This script is intended for Personal Study Only.
Please send all feedback to corresponding author: ima@ucalgary.ca
Version November 19, 2021

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Useful Online Paracentesis Videos

1) 13-minute video from Harrison's Principles of Internal Medicine, 20e. Clinical Procedure Tutorial, available via Access Medicine®:[1] Go to Multimedia>Procedural Videos > Gastroenterology/Hepatology > Abdominal Paracentesis

For learners at the University of Calgary:
https://accessmedicine-mhmedical-com.ezproxy.lib.ucalgary.ca/MultimediaPlayer.aspx?MultimediaID=17613884

2) 21-minute video "Ultrasound-Guided Paracentesis" Ma I, Sharma N, Nagassar S, Wishart I, Holroyd-Leduc J. MedEdPORTAL 2014:[2]
https://www.mededportal.org/doi/10.15766/mep_2374-8265.9774

3) 10-minute video from The New England Journal of Medicine Videos in Clinical Medicine series:[3]
https://www.nejm.org/doi/full/10.1056/NEJMvcm062234

Video on Confirming Presence of Intraperitoneal Free Fluid

1) 10-minute on confirming presence of intraperitoneal free fluid:
https://sites.google.com/site/calgaryimus/home/abdo

Pre-Procedure Checklist

The Canadian Internal Medicine Ultrasound (CIMUS) pre-procedural checklist can be found here:
https://docs.google.com/viewer?a=v&pid=sites&srcid=ZGVmYXVsdGRvbWFpbnxjYWxnYXJ5aW11c3xneDo2YTc5ZWI5NzM1MjYzZTk2

You can also get to all CIMUS procedural resources here: www.cimus.ca > Procedures tab on the left > Paracentesis

Notes below are intended for refresher and Personal Study Only. Not for Distribution.

Patient Preparation

Ensure procedure indicated	• **Diagnostic:** new onset ascites accessible for sampling,[4] rule out spontaneous bacterial peritonitis (SBP), or assess response to therapy of SBP 2 days post treatment,[4] any patient admitted to hospital with any complications of cirrhosis and presence of ascites[5] • **Therapeutic:** to relieve dyspnea, pain/discomfort from tense ascites
Ensure no contraindication	• Overlying infection, visibly enlarged subcutaneous vessels, abdominal wall hematomas, disseminated intravascular coagulation (DIC) or clinically evident fibrinolysis • Uncooperative patient (depending on degree of uncooperativeness, may be a relative contraindication) • Surgical scars should be avoided where possible due to potential underlying adhesions
	• Recommended Platelet > 20, INR < 2-3 [6] but routine fresh frozen plasma (FFP) or platelet transfusions not recommended[3] • This is particularly true of patients with cirrhosis where INR > 2-3 alone would not typically preclude the performance of a paracentesis • In patients with stable cirrhosis (known baseline abnormal coagulation parameters), American Gastroenterological Association (AGA) recommends **AGAINST** pre-procedural testing including repeat INR or platelet count and **against** routine use of blood products for bleeding prophylaxis, and **against** thrombopoietin receptor agonists for low platelets (conditional recommendation, very low certainty evidence)[7]
Relative contraindications	Pregnancy, organomegaly, bowel obstruction, bowel or bladder distension, abdominal adhesions
Obtain patient consent	• Ensure patient has capacity to consent If not, obtain consent from substitute decision maker (SDM) • Go over indications, complications (common and rare but serious ones), options for the patient if he/she does not wish to undergo procedure • Obtain written consent prior to procedure
Common complications	• Bleeding <3%[8] • Abdominal wall hematoma • Post-procedure leak (~5%)[9] • Localized skin infection
Serious complications	• Acute kidney injury (~5%)[10] • Bleeding requiring transfusions (<0.5%):[11] Puncture of the inferior epigastric artery • Post-procedure hypotension/shock • Bowel perforation (<1%);[12] usually self-sealing • Organ injury • Catheter tip fragmentation (0.2%)[12] • Infection (<0.05%)[9] • Death (<0.05%)[11]

Equipment Gathering

Note: Items in purple are already in the standardized kit (see Figure 1)

Ultrasound machine	• Curvilinear and linear transducer Phased array or microconvex transducer an acceptable alternative to curvilinear transducer • Ultrasound gel • Towel to wipe gel off • Disinfectant wipes
For preparing field	• Blue soaker pad • 3 chlorhexidine swabs (large swabs preferred where available) • Thoracentesis/paracentesis tray (Figure 1)
 **Figure 1: Thoracentesis/Paracentesis Tray**	
For anesthesia	• 1-2% lidocaine • 10 cc syringe* • 25G needle*; 22G* for deeper tissues
For procedure	• Sterile gloves, face mask, eye protection sterile gown (sterile gown optional) • Sterile drapes, sterile gauze • 60 cc syringe* • 18 G over the needle catheter* (Angiocath™) • Or a 5F One Step™ catheter or Caldwell needle, with optional 3- way stopcock if kit not available • Scalpel to get needle through skin • Optional: sterile ultrasound probe and sterile gel, if doing dynamic technique or if need to confirm the location of structures mid-procedure)
For diagnostic collection	NB: specimen tubes needed may be site-specific: **For Calgary:** • Lavender EDTA tube (cell count) • Gold-top tube SST (chemistry, albumin)

	• Aerobic/anerobic culture bottles (need to inoculate **10cc** of specimen at bedside) plus an additional sterile container (for gram stain, or additional tests such as PCR, AFB culture) • Blue transfer set for inoculating culture bottles if available (Figure 2); if not, use a blunt fill filterless transfer needle (red hub, see Figure 3) • Starplex sterile containers (G&S, culture, cytology); orange top or white top • Cytology: Send fresh fluid, no fixative, send with manual requisition for cytopathology https://www.albertahealthservices.ca/assets/wf/lab/if-lab-hp-cal-req9041cy-non.pdf • Optional: Arterial blood gas syringe for pH
	For Edmonton: • Acceptable to send all samples in Starplex containers or the clear specimen tubes that are in the procedural kit • Consider direct inoculation into aerobic/anerobic culture bottles to increase yield, but add another sample in Starplex container(s) for more efficient and sensitive bacterial culture yield • For cytology, may send up to 5 Starplex containers to increase yield

Figure 2. Transfer set. Transfer set and its packaging (left panel). Remove the white tip (bottom left in middle panel) to connect to the syringe that contains the fluid sample. Keep the inner adapter insert (top right, middle panel) in place for collection into sample tubes. For blood culture bottles, remove the inner adapter insert. When removing the inner adapter insert, be careful not to reach in too deep to where the sharp needle is (yellow arrow, right panel).

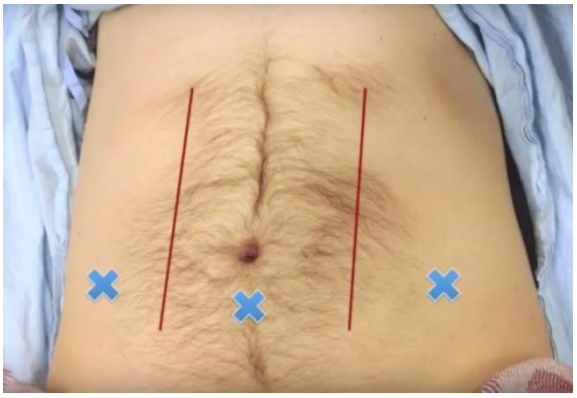
Figure 3. Blunt fill (filterless) needle.
Note: the hub should be red in colour, not purple. Needles with purple hubs have filters and will not allow easy transfer of samples

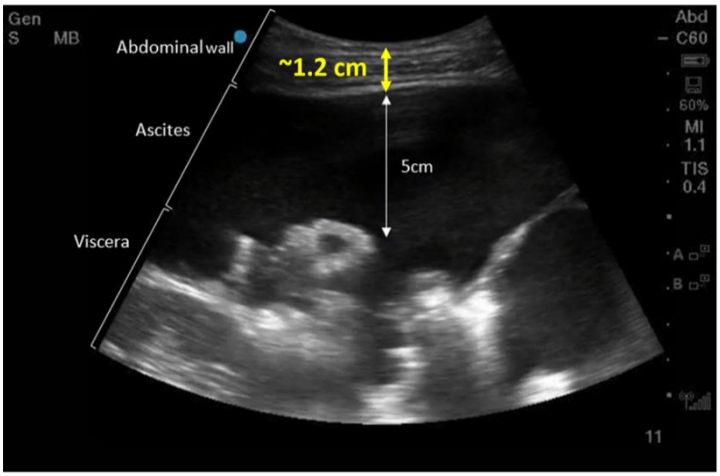
For therapeutic collection	• Large vacuum drainage containers

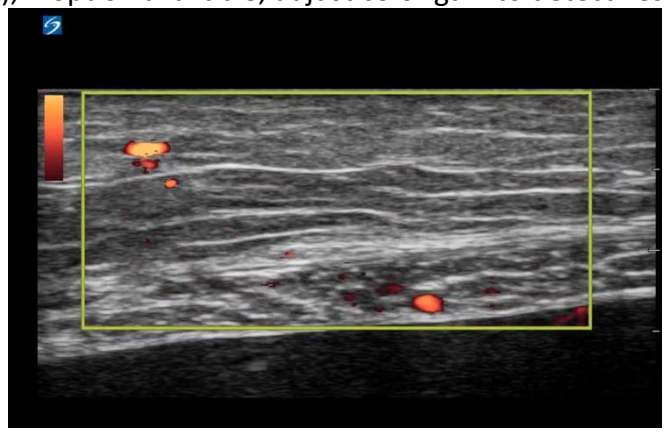
	• If vacuum containers not available, may use any large containers (e.g. 2L gravity bag in the procedural kit; urine Foley bags)
For post-procedure	Bandage

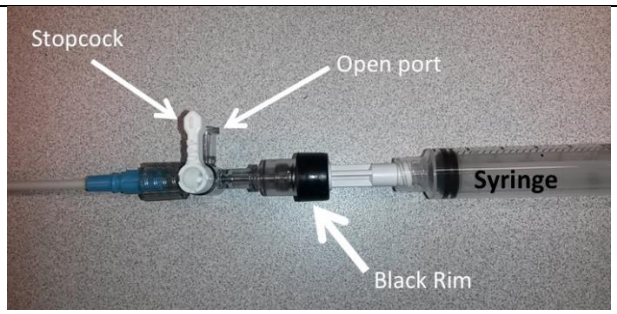
Items in purple are already in tray (see Figure 1).*

Procedure Steps (after consent obtained)

	Confirm presence of intraperitoneal free fluid by performing a Focused Assessment with Sonography in Trauma (FAST) examination (see video: https://sites.google.com/site/calgaryimus/home/abdo)
	Gather equipment (see above)
	Print up lab requisition forms (if performing diagnostic taps) and patient labels, where relevant
	Wash hands
	Patient position
	Have patient void prior to procedure to minimize risk of bladder injury
	Place blue soaker pad under supine patient, elevate head of bed at 30-45° May tuck pillow under flank on one side to encourage more fluid to collect in the opposite quadrant
	Obtain baseline vitals
	Historically Reported Acceptable sites (see Figure 4 below)
	1) Either lower quadrants (lateral to rectus sheath to avoid inferior epigastric artery) in area of dullness; or in the left lower quadrant (3cm cephalad and 3 cm medial to the anterior superior iliac spine)[13] 2) Midline 2 cm below umbilicus (ensure bladder empty)[3] - we seldom perform paracentesis at this site due to risk of bladder puncture if a distended bladder is present 3) Consider avoiding quadrants with prior surgery or instrumentation due to possible presence of adhesions  **Figure 4. Accepted sites for landmark based paracentesis.[3]** 2 cm below umbilicus or in either lower quadrant (marked X), lateral to the rectus sheath (red lines) to avoid inferior epigastric arteries. Left lower quadrant is preferred.[2]
	2012 AASLD guidelines prefer left lower quadrant (LLQ) for the following reasons:[8,13]
	1. Abdominal wall thinner in LLQ vs midline 2. Depth of ascites deeper than at midline 3. Preferred over RLQ: concern re: dilated cecum or appendectomy scar[1]

	We recommend: Regardless of site chosen, **MUST** check with ultrasound prior to needle insertion.
	With ultrasound guidance,[14] site selection should instead be guided by the size of the fluid pocket and other factors such as absence of overlying vessels, proximity to other structures/organs, etc.
	Perform initial ultrasound scan to identify suitable pocket of fluid
	Place machine in direct line of vision (in front of you)
	Select curvilinear transducer
	Using ultrasound, note locations of structures/organs to avoid (liver, spleen, kidneys, bladder) on deep inspiration
	Scan site in 2 planes (and slide 5-10 cm in each direction), covering an area of at least **5 cm x 5 cm** (Figure 5)
	 **Figure 5. Must scan in a minimum of two planes** From a transverse view (left), slide probe superiorly and inferiorly for a ~5-10 cm distance to ensure pocket is free from bowel or other structures throughout. From a sagittal view (right), slide probe medially and laterally to ensure pocket is free from structures.
	Ideal anechoic pocket should be a **minimum of 2cm depth** (5cm or more if you're not experienced), free from bowel, far away from organs (Figure 6)  **Figure 6. Identification of adequate fluid pocket.**

	Longitudinal view of left lower quadrant. Ascites is represented by the anechoic region(s). An ideal location for paracentesis is one where there is at least 5 cm of ascitic fluid between the peritoneum and underlying viscera/bowel (white arrow). Depth to peritoneum is estimated from the skin surface to the edge of the anechoic region, indicated by the yellow arrow (1.2 cm).
	Apply downward pressure on the ultrasound probe to see how closely the bowel loops approximates the abdominal wall. Ideally the depth of fluid pocket remains > 2cm even with downward pressure
	Ensure that this depth is at least 5 cm and bowel/organ-free **THROUGHOUT** your ~5cm x 5cm area
	Mentally note depth to peritoneum (yellow arrow in Figure 6). Note this depth may be underestimated if excessive downward transducer pressure is applied
	Two Probe Technique to rule out overlying vasculature[15]
	Switch to linear probe (better at picking up superficial vessels than curvilinear probe)
	Use Power or Colour Doppler: Adjust flow to detect low flow (if option available); turn down pulse repetition frequency (PRF), if option available; adjust color gain to detect vessels (see Figure 7).  **Figure 7. Identification of inferior epigastric artery using power Doppler.** Transverse view of the abdominal wall showing blood flow indicated by Power Doppler (inferior epigastric artery). An additional vessel is also seen on screen left in the near field. Ensure Doppler box (yellow box) captures the entire abdominal wall
	Slowly scan selected site in 2 planes (and slide 5-10 cm in each direction), covering an area of at least **5 cm x 5 cm** using the linear probe to ensure no superficial vessels in path of needle entry
	Mark Target Site for Needle Entry
	After ensuring site is free from bowel, organs/structures, overlying vessels and has a safe size pocket, mark with surgical pen or sustained pressure with end of needle cap
	Wipe off nonsterile gel
	Wash hands and don nonsterile gloves
	If no allergy to chlorhexidine, clean with chlorhexidine swabs x 3, let dry in between, with application and dry time per manufacturer's recommendations. For example, for the 3M™ SoluPrep™ (2% chlorhexidine gluconate, 70% isopropyl alcohol swabs), a minimum 30 sec application time is recommended[16]
	If using a procedure kit that has sterile chlorhexidine sponges within the kit itself, then do this step after donning personal protective equipment step below
	If allergy, use 70% alcohol, or iodine[17]
	Don Personal Protective Equipment
	Wash hands again, put on mask, face shield/eye protection, sterile gown (optional), and sterile gloves
	Prepare field
	Drape with fenestrated drape (be careful not to contaminate your gloves during draping)

	Anesthesia
	Using 25 G needle, raise lidocaine bleb under skin, aspirate as you go in (to ensure you are not in a blood stream), inject as you come out
	Use a 22G for deeper tissues (same technique, aspirate as you go in, inject as you come out) until you are into peritoneum
	Once in the peritoneum, inject 3-5 cc more to anesthetize the parietal peritoneum (do not exceed 30 cc)
	Mentally note the depth and needle angle required to reach the peritoneum (should correspond to the depth noted on ultrasound)
	Be cautious: over use of anesthetic in superficial layers may distort landmarks
	Note
	Maximum recommended dose of lidocaine without epinephrine is 4.5 mg/kg or 300mg[18]
	Maximum recommended dose of lidocaine with epinephrine is 7 mg/kg or 500mg[18]
	In practical terms, 1% lidocaine contains 10 mg lidocaine per mL; thus 300 mg = 30 mL
	Needle Insertion
	Make a small nick (1-2mm) in skin with scalpel This step is optional. It is useful if you have difficulty inserting the needle and can prevent you from needing to exert excessive downward pressure with the needle. This pressure can decrease the size of the fluid pocket immediately beneath the needle, thereby increasing the risk of perforating deeper structures (e.g. bowel).
	Using the needle catheter device, aspirate as you advance the needle; watch for ascites in the syringe. 
	Once ascites is aspirated, advance just a few mm (~ 5-10 mm) more to ensure catheter is also fully in the peritoneum
	Holding the needle steady (**do not further advance or retract the needle**), slide the catheter off the needle and advance the catheter all the way in. For the hand that is holding the syringe, you can anchor that arm/elbow to your side to stabilize yourself. Once you have stabilized this, use other hand to push the catheter in (black rim is the part attached to the catheter, so that's the part you will advance, Figure 8).
	 **Figure 8. 8 Fr. Angiocath in Safet-T™ Thora-Para Tray**

	Once fluid is obtained, hold the syringe steady and advance the black rim/hub, which is connected to the catheter, into the peritoneal space.
	Remove the needle once catheter fully advanced
	Turn stopcock towards patient (or plug with your thumb if you are using the One Step catheter)
	Apply 60 cc syringe to the open port to collect specimens, or tubing for therapeutic collections
	You will need to turn the stopcock to the black rim to allow flow during fluid collection
	Examine the fluid and send for appropriate labs
	Techniques that may help minimize risk of post-procedure fluid leak
	1) Angular entry technique: Insert needle at 45°angle. Note: needle trajectory must NOT extend beyond the area previously determined by ultrasound scanning to be safe
	2) Z-tract: Pull skin inferiorly during initial needle entry through the superficial layers, then release tension prior to needle entry into peritoneum. Note: skin should not be pulled beyond area previously determined by ultrasound scanning to be safe
	Important safety point: Should not attempt procedure > 2 times. Ask for help if unsuccessful
	Post-procedure
	Remove catheter and apply bandage
	Dispose of sharps
	Measure vitals post-procedure. Consider monitoring vitals during procedure especially if large volume paracentesis is performed
	Replace with albumin if more than 5 L removed: 6-8 g of albumin for each liter removed[4,5]
	Albumin not necessary if less than 4-5 L removed (Class I, Level C recommendation)[13]
	Document the procedure (including any complications) in the patient chart

Troubleshooting Techniques

Sluggish flow or flow stops during drainage	
Ensure vacuum intact and no tubing leakage	
	If able to manually aspirate using a syringe, but no flow to the vacuum bottles, check for leakage or loss of vacuum
Possibly due to bowel loops blocking ports	
	Try: 1) rotating catheter; 2) redirect the angle of catheter; 3) withdraw catheter in 1-2 mm increments. Note that withdrawn portions of the catheter cannot be re-advanced
Possibly due to decrease in volume of ascites available	
	Without contaminating sterile field, try adjusting patient positioning: 1) elevate head of bed so patient sitting more upright; 2) Have patient rotate towards drainage side. Can ask assistant to tuck pillow beneath opposite hip for support.

Sending Specimens

Tube	Minimum volume	Send for
Lavender EDTA (or dark green NaHep)	3-4 cc	Cell count & diff
Gold top SST (or light green PST)	0.5cc	Alb, Total protein
Culture bottles (higher yield if direct inoculation from bedside)[8]	8-10cc[8]	Gram stain, C&S**

Orange Starplex container		Gram stain, C&S**
Cytolyt container (white top); Orange Starplex container	Higher volume to increase	Cytology

** In Edmonton, consider sending samples directly inoculated culture bottles and another sample in Orange Starplex container for more efficient and sensitive bacterial culture yield.

Additional useful related diagnostic and therapeutic information

Please note, this section does not constitute clinical advice and may not be up to date. Please consult clinical resources for the latest information.

Serum ascites albumin gradient (SAAG):

Portal hypertension (SAAG ≥ 11)	Non-portal hypertension (SAAG < 11)
Cirrhosis	Infection
Right heart failure	Malignancy
Portal vein thrombus	Pancreatic ascites
Budd-Chiari	Nephrotic syndrome

Total protein:

For patients with SAAG ≥ 11, ascites total protein may help further differentiate causes:[19]

Ascites protein ≥ 25	Ascites protein < 25
Cardiac ascites	Cirrhosis
Early Budd-Chiari	Late Budd-Chiari
Sinusoidal obstruction syndrome	Pancreatic ascites
	Nephrotic syndrome

Diagnosis of SBP:[8]

	+LR	-LR	Implications
Ascites PMN > 250	6.4	0.20	Threshold to start treatment*
Ascites PMN > 500	10.6	0.16	
Ascites WBC > 500	5.9	0.21	
Ascites WBC > 1000	9.1	0.25	Most accurate
Ascites pH < 7.35	9.0	0.31	
Blood-ascites pH	7.1	0.30	

Treatment consists of starting antibiotics (3rd generation cephalosporin, unless nosocomial or health-care associated or recent exposure to broad-spectrum antibiotics, or septic shock)[4] and IV albumin[4,5] (1.5 g/kg at diagnosis and 1 g/kg on day 3).

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