Diagnostic and therapeutic abdominal paracentesis

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INTRODUCTION

Abdominal paracentesis is a simple bedside or clinic procedure in which a needle is inserted into the peritoneal cavity and ascitic fluid is removed [1]. Diagnostic paracentesis refers to the removal of a small quantity of fluid for testing. Therapeutic paracentesis refers to the removal of five liters or more of fluid to reduce intra-abdominal pressure and relieve the associated dyspnea, abdominal pain, and early satiety [2].

This topic will review the performance of abdominal paracentesis. Ascitic fluid analysis and the differential diagnosis of ascites are discussed elsewhere. (See "Evaluation of adults with ascites" and "Spontaneous bacterial peritonitis in adults: Diagnosis".)

WHO SHOULD PERFORM PARACENTESIS

Paracentesis can be performed safely by any clinician who has received proper training. Some hospitals have a dedicated procedure team that performs simple procedures such as paracentesis and central line insertion. These teams, which typically include an experienced clinician or mid-level provider and an assistant, often use an ultrasound machine to guide the procedure. The availability of adequately trained staff is imperative to prevent delays. Since the physician accrediting organization no longer requires proficiency of internists in performing paracentesis, interventional radiology mid-level providers are performing many of them. (See 'When to perform paracentesis' below.)

INDICATIONS, CONTRAINDICATIONS, AND SPECIAL CONSIDERATIONS

Indications — There are several generally accepted indications for abdominal paracentesis (table 1):

- Evaluation of new onset ascites.
- Testing of ascitic fluid in a patient with preexisting ascites who is admitted to the hospital, regardless of the reason for admission.
- Evaluation of a patient with ascites who has signs of clinical deterioration, such as fever, abdominal pain/tenderness, hepatic encephalopathy, peripheral leukocytosis, deterioration in renal function, or metabolic acidosis.

Performing a paracentesis at the time of admission to the hospital in patients with cirrhosis and ascites may decrease mortality rates. This was examined in a database study that included 17,711 patients with cirrhosis and ascites who were admitted to the hospital with a principle diagnosis of ascites or encephalopathy [3]. Paracentesis was performed in 61 percent of the patients, and the patients who underwent paracentesis had lower in-hospital mortality rates than those who did not (6.5 versus 8.5 percent, adjusted odds ratio 0.55, 95% CI 0.41-0.74).

In addition to helping to clarify the cause of ascites and evaluating for infection, paracentesis can identify unexpected diagnoses, such as chylous, hemorrhagic, or eosinophilic ascites. (See "Evaluation of adults with ascites", section on 'Determining the cause of the ascites'.)

Relative contraindications — The benefits of abdominal paracentesis in patients with appropriate indications almost always outweigh the risks. An analysis of the fluid helps determine the cause(s) of the ascites and the likelihood of bacterial infection, and it can identify antibiotic susceptibility of any organism(s) that is (are) cultured.

However, there are some relative contraindications to paracentesis:

- Patients with clinically apparent disseminated intravascular coagulation and oozing from needle sticks. This occurs in <1/1000 patients with ascites in our experience. Paracentesis can be performed once the bleeding risk is reduced by administering platelets and, in some cases, fresh frozen plasma. (See "Evaluation and management of disseminated intravascular coagulation (DIC) in adults", section on 'Prevention/treatment of bleeding'.)
- Primary fibrinolysis (which should be suspected in patients with large, three-dimensional bruises). Paracentesis can be performed once the bleeding risk is reduced with treatment

[4]. (See "Thrombotic and hemorrhagic disorders due to abnormal fibrinolysis", section on 'Therapies for hyperfibrinolytic states'.)

- Paracentesis should not be performed in patients with a massive ileus with bowel distension unless the procedure is image-guided to ensure that the bowel is not entered. In a study including nearly 1300 abdominal paracentesis procedures, ultrasound-guided paracentesis was associated with lower costs and lower complication rates compared with no ultrasound guidance (1.4 versus 4.7 percent) [5].

- The location of the paracentesis should be modified in patients with surgical scars so that the needle is inserted several centimeters away from the scar. Surgical scars are associated with tethering of the bowel to the abdominal wall, increasing the risk of bowel perforation. Ultrasound can also be used in this setting to avoid bowel entry with the needle.

Abnormal coagulation studies and thrombocytopenia — An elevated international normalized ratio (INR) or thrombocytopenia is not a contraindication to paracentesis, and in most patients there is no need to transfuse fresh frozen plasma or platelets prior to the procedure. Seventy percent of patients with ascites have an abnormal prothrombin time, but the actual risk of bleeding following paracentesis is very low (less than 1 percent of patients require transfusion) [6,7]. Exceptions are patients with clinically apparent disseminated intravascular coagulation or clinically apparent hyperfibrinolysis, who do require treatment to decrease their risk of bleeding. (See "Evaluation and management of disseminated intravascular coagulation (DIC) in adults", section on 'Prevention/treatment of bleeding' and "Thrombotic and hemorrhagic disorders due to abnormal fibrinolysis", section on 'Therapies for hyperfibrinolytic states'.)

The safety of paracentesis in patients with cirrhosis has been documented in several studies:

- A prospective study of 1100 large-volume paracenteses documented no bleeding complications with no pre- or post-procedure transfusions required despite INRs as high as 8.7 and platelet counts as low 19,000/mL [8].

- In another report (in which occasional patients received prophylactic fresh frozen plasma, platelets, or desmopressin [DDAVP]), severe bleeding was observed in only 9 of 4729 paracenteses (0.19 percent) [9]. The mortality rate attributable to the procedure was 0.016 percent. Eight of the nine patients who bled had renal failure, suggesting that the qualitative platelet dysfunction associated with renal failure contributed to the bleeding risk. Thus, it may be reasonable to use DDAVP before performing paracentesis in patients

with cirrhosis and renal failure, although no studies have formally established a benefit. (See "Uremic platelet dysfunction".)

- A somewhat higher complication rate (1.6 percent) was reported in a prospective study of 515 paracentesis in patients with cirrhosis [10]. Five patients bled, three developed infections, and two died. However, one of the complications was "catheter residue broken into abdominal wall," which taken together with the relatively high complication rate, raises concern as to whether there were specific technique-related factors that may have contributed to the adverse outcomes.

Many clinicians inappropriately transfuse fresh frozen plasma or platelets, or avoid performing minor procedures altogether, in patients with cirrhosis because of concern that patients are "auto-anticoagulated." However, there is now convincing evidence disproving the common misconception [11]. The liver makes coagulation factors as well as anticoagulant proteins [12]. As a result, liver disease can lead to a hypocoagulable state or a hypercoagulable state. The relative balance or imbalance of these factors is not reflected in conventional indices of coagulation, such as the prothrombin time (PT), activated partial thromboplastin time (aPTT), or INR [12]. (See "Hemostatic abnormalities in patients with liver disease", section on 'Paracentesis'.)

Transfusion of blood product to reverse the coagulopathy before paracentesis is discouraged since it is **not** supported by the available data, can delay the procedure, exposes the patient to risk of transfusion, and is costly [6-8,13,14]. The routine administration of fresh frozen plasma prior to paracentesis would lead to transfusion of approximately 140 units of plasma to prevent transfusion of two units of red cells [6,7,15].

There are no data to support coagulation testing prior to paracentesis. Ordering these tests prior to a therapeutic paracentesis delays performing the procedure. Patients returning for repeat therapeutic paracenteses prefer to minimize the time that they spend getting the procedure performed.

For the vast majority of patients, we will perform a paracentesis without giving fresh frozen plasma or platelets. The exceptions are in patients with clinically apparent disseminated intravascular coagulation or clinically apparent hyperfibrinolysis [8]. These conditions occur in less than 1 in every 1000 patients with ascites. In patients with disseminated intravascular coagulation, we will administer platelets and, in some cases, fresh frozen plasma prior to performing a paracentesis. For patients with hyperfibrinolysis we treat with aminocaproic acid or intravenous tranexamic acid. The management of patients with these disorders is discussed elsewhere. (See "Evaluation and management of disseminated intravascular coagulation (DIC)

in adults", section on 'Prevention/treatment of bleeding' and "Hemostatic abnormalities in patients with liver disease", section on 'Physiologic effects of hepatic dysfunction'.)

Thromboelastography can be used to assess global coagulation and fibrinolysis and to confirm the low risk of bleeding from paracentesis and other invasive procedures without transfusion of blood products [16].

WHEN TO PERFORM PARACENTESIS

Diagnostic paracentesis should be performed promptly, especially if there is concern for spontaneous bacterial peritonitis (SBP; eg, the patient is febrile or has abdominal pain). In our experience, delays are often due to a lack of available clinicians experienced with paracentesis and/or undue concern about its safety. Paracentesis should be carried out promptly in patients with suspected SBP. Delays in performing paracentesis or failure to perform paracentesis have been associated with increased mortality in patients with SBP (in one study, every hour delay in performing a paracentesis was associated with a 3.3 percent increase in mortality) [3,17]. (See "Spontaneous bacterial peritonitis in adults: Diagnosis", section on 'Paracentesis'.)

In many cases, the procedure is performed by interventional radiologists or their nurse practitioners, and communication with the proceduralist is important to ensure that the sample is sent for the desired diagnostic testing. (See "Spontaneous bacterial peritonitis in adults: Diagnosis".)

PATIENT PREPARATION

Patient preparation consists of explaining the procedure to the patient and obtaining informed consent. Patients do not need to be fasting before the procedure. It is inappropriate to delay the procedure while observing an arbitrary interval of fasting.

EQUIPMENT AND STAFF

In addition to a clinician experienced with performing paracentesis, an assistant should also be present during the procedure to help the operator once the operator puts on sterile gloves. The assistant can be a trainee, nurse, or other suitably-trained clinical staff.

All of the equipment needed for the paracentesis should be assembled prior to the procedure (table 2). We try to make the procedure as efficient as possible by writing/entering orders for

the ascitic fluid tests that we are planning to obtain. We prefer to have specimen labels and order forms available before beginning the procedure. Even if a simple therapeutic paracentesis is anticipated (in which we typically obtain only a cell count and differential), the appearance of the fluid or the patient's clinical features may prompt additional testing. As an example, bacterial cultures should be obtained in patients with clinical features suggestive of infection (eg, fever, abdominal pain, cloudy fluid). (See "Spontaneous bacterial peritonitis in adults: Diagnosis", section on 'Handling the ascitic fluid'.)

Overview of required equipment — Equipment required for a paracentesis includes:

- Signed consent form
- Ultrasound machine if needed to localize the entry site
- Completed lab slips and labels
- Red-top tube, purple-top (EDTA) tube, blood culture bottles (2)
- 1- to 2-liter vacuum bottles (for therapeutic paracentesis, enough bottles to remove 8 L of fluid should be available)
- Iodine or chlorhexidine
- Alcohol wipes (3)
- Sterile 4x4 gauze sponges (2)
- Sterile and nonsterile gloves
- Sterile syringes (3, 5, and 20 mL)
- Skin anesthesia needles (25- or 27-gauge 1.5 inch needle, or a tuberculin syringe plus, an 18-gauge 1 to 1.5 inch needle and a 22-gauge 1.5 or 3.5 inch needle) (see 'Anesthetizing using a Z-track technique' below)
- Paracentesis needles (see 'Choice of paracentesis needle' below)
- 18-gauge needles for inoculating blood culture bottles and specimen tubes (2 or 3)
- #11 blade scalpel (for therapeutic paracentesis)
- Lidocaine, 1 percent
- Adhesive bandage
- Sharp receptacle box

Some clinicians use gowns, caps, and sterile (surgical) drapes for paracentesis. We have used no gown, no cap, and no sterile drape for decades and have had virtually no contaminated culture bottles or procedure-related infections [15].

We prefer to have a sharp receptacle box on the floor near the procedure area so that needles can be discarded immediately, without having to walk across the room to a wall-mounted sharp disposal container. This minimizes the chance of a needle stick. A wastebasket is also a useful

item to have readily available to discard other items to minimize clutter on the bedside tray, which can also help minimize the chance of a needle stick.

Choice of paracentesis needle — The choice of the needle depends upon whether a diagnostic or therapeutic paracentesis is planned. As a general rule, the narrowest needle should be used to minimize complications in the event that a blood vessel or the bowel is entered by the needle. A diagnostic paracentesis can be performed in a lean patient with a 1 or 1.5 inch 22-gauge needle, while a 3.5 inch 22-gauge "spinal" needle can be used for diagnostic paracentesis in a patient with obesity. For a therapeutic paracentesis, a larger, 15- or 16-gauge needled is used to speed the removal of ascitic fluid.

We specifically avoid plastic-sheathed needles. When these needles are used with a Z-track technique (see below), there is a danger of shaving off part of the sheath into the abdominal wall or abdomen if the sharp inner component is reintroduced after it is initially withdrawn [10]. Retrieval of the plastic sheath could require laparotomy or laparoscopy, neither of which is well tolerated in patients with advanced liver disease. In addition, plastic needle sheaths are rather large in diameter and thus have the potential to create larger holes in vessels or bowel that they enter. (See 'Paracentesis needle insertion' below.)

Single-hole metal needles are safest for diagnostic paracentesis. Single-hole or multiple-hole, two-piece metal needles are safest and fastest for therapeutic paracentesis. The metal can be made very thin, thereby minimizing the diameter of the needle. The Caldwell needle (Kimberly-Clark Quick-Tap Paracentesis Tray) has a sharp inner trocar and a blunt outer metal cannula with side holes to permit withdrawal of fluid if the end hole is occluded by bowel or omentum. This needle comes in 15- and 18-gauge diameters and is made in 2.25, 3.25, and 4.75 inch lengths. The 3.25-inch length is the most commonly used. The 15-gauge needle is better for therapeutic paracentesis.

PARACENTESIS TECHNIQUES

Paracentesis is carried out to obtain ascitic fluid for analysis and to remove large amounts of fluid in patients with tense ascites. Proper technique is important to decrease the risk of sample contamination and complications. The description that follows represents our approach to performing paracentesis. We have found that carefully following this approach prevents contamination of the blood culture bottles and minimizes complications.

Preparation of blood culture bottles — Wearing nonsterile gloves, we wipe the top of each of the blood culture bottle with an alcohol wipe and leave the wipe on the bottle top to attempt to

maintain sterility during the performance of the procedure.

Patient position — Paracentesis is usually performed with the patient supine. The bed or gurney is either flat, or the head of the bed is slightly elevated. Rarely, the patient can be positioned prone on "all fours" or spanning two gurneys. This position is used only when there is a small amount of fluid and making a diagnosis is crucial to the patient's management (eg, tuberculous peritonitis). The face-down position with the fluid pooled in the dependent abdomen permits drainage of the last few milliliters of fluid.

Selecting the needle entry site — Paracentesis is typically performed through the abdominal wall in the left lower quadrant (figure 1). In the midline cephalad or caudad to the umbilicus, abdominal wall collateral vessels may be present, so those areas that should be avoided [18]. Surgical scars and visible veins should also be avoided. Surgical scars may be associated with bowel that is tethered to the abdominal wall by adhesions, thus putting the patient at risk for bowel injury if the paracentesis is performed near a scar.

A prospective study showed that the abdominal wall was thinner in the left lower quadrant than in the midline and that the pool of fluid was deeper in the left lower quadrant [19]. This has led to the left lower quadrant being the preferred site of entry. By contrast, the right lower quadrant is less desirable since it may have an appendectomy scar or a cecum filled with gas in patients taking lactulose. If the left lower quadrant is chosen, it is helpful to have the patient roll slightly to his or her left to permit pooling of fluid in that area.

The anterior superior iliac spine should be located and a site chosen that is two fingerbreadths (3 cm) medial and two fingerbreadths (3 cm) cephalad to this landmark (figure 1). In patients with Class 2 or 3 obesity, it may be more difficult to find this landmark. The inferior epigastric artery traces from a point just lateral to the pubic tubercle (which is 2 to 3 cm lateral to the symphysis pubis), cephalad within the rectus sheath. This artery can be 3 mm in diameter and can bleed massively if punctured with a large-caliber needle. Thus, this site should be specifically avoided.

When choosing a site, it is useful to confirm that there is dullness to percussion, that the spleen is not palpable, and that there are no surgical scars within several centimeters of the intended entry site. If there is uncertainty, ultrasound can be used to further confirm the presence of fluid and the absence of bowel or the spleen within range of the needle.

Once we have chosen a site, we place an "X" at the site using an ink pen and then make marks at positions 12, 3, 6, and 9 o'clock, a few centimeters from the central "X." We sterilize the skin at and around the "X" with iodine or chlorhexidine, which removes the original "X." However, the original position of the "X" will be at the center of the four marks. If a drape with a hole in it is

used, the marks should be placed such that they are visible through the hole. The sterilization should not be so extensive that it erases all of the marks.

Skin sterilization — Wearing nonsterile gloves, the operator cleans the selected needle entry site with iodine or chlorhexidine solution using widening circular motions starting at the "X." We use three iodine-soaked 4x4 inch gauze sponges, three iodine swabs, or three of the chlorhexidine applying devices. Sterility is optimized if the solution has dried by the time the skin is touched. A drape is not necessary for this clean, but not truly sterile procedure. (See 'Selecting the needle entry site' above.)

Anesthetizing using a Z-track technique — We then put on sterile gloves and draw up a 1 percent lidocaine solution into a sterile 3 to 5 mL syringe with the help of the assistant, who has wiped the lidocaine plastic/rubber bottle top with an alcohol wipe. Sterility of the bottle top cannot be assumed without wiping it (figure 2).

The ideal needle for administering lidocaine to anesthetize the skin is a 1.5 inch 25- to 27-gauge needle, since it is usually sufficiently long to deliver anesthetic throughout the intended paracentesis track, except in patients with obesity. An 18-gauge needle can be used to draw up the lidocaine into a 3 to 5 mL syringe. That needle can then be removed, and the 25- to 27-gauge needle placed on the syringe.

However, 25- to 27-gauge needles can be difficult to find and may be available only on a tuberculin syringe with a 1 mL capacity. If this is the only available "skin" needle, it can be used to draw up 1 mL of lidocaine. The remainder of the lidocaine is drawn up into a 3 to 5 mL syringe fitted with a 1.5 inch or 3.5 inch (for patients with obesity) 22-gauge needle.

The skin can then be anesthetized by approaching the chosen entry site tangentially with the needle and raising a wheal with a small amount of lidocaine. Once the wheal has been raised, the needle is withdrawn and placed at the entry site perpendicular to the curve of the abdominal wall. Using a Z-track technique, 3 to 5 mL of lidocaine is used to anesthetize the entire soft tissue tract. The Z-track creates a non-linear pathway between the skin and the ascitic fluid, thereby helping to minimize the chance of an ascitic fluid leak. (See 'Ascitic fluid leak' below.)

The proper approach to creating a Z-track can be a source of confusion. The Z-track should be created by pulling the skin downward with one hand, while inserting the needle with the other hand (figure 3). It is helpful to use a gauze pad (2x2 or 4x4) to pull on the skin, since it permits more traction on the abdominal wall, especially if the skin is wet from the cleansing solution. The operator must be able to maneuver the syringe with one (the dominant) hand,

stabilizing the outer component with the thumb and a few fingers, while pulling on the plunger of the syringe with a few fingers of the same hand.

Novice operators often find this technique difficult initially and regularly pull the nondominant hand from the abdominal wall in order to use both hands to maneuver the syringe and plunger. This defeats the purpose of the Z-track. The hand on the abdominal wall should not be moved until the needle enters the fluid.

The needle and attached syringe are inserted in 5 mm increments. Then the plunger should be pulled back a few millimeters with each advancement to see if any blood is aspirated. If no blood is evident, a small amount of anesthetic is injected, and the needle advanced another 5 mm. This process is continued until the needle enters the ascitic fluid. As the needle is advanced, aspiration should be intermittent, not continuous. Continuous aspiration may pull bowel or omentum onto the needle tip as soon as it enters the peritoneal cavity, occluding the tip. This may give the false impression that there is no fluid present since no fluid enters the needle and syringe. If bowel or omentum is pulled to the needle tip, releasing the suction on the syringe plunger may allow the bowel or omentum to float away and permit flow of fluid into the needle and syringe. The aspiration of yellow (or other colored) fluid into the syringe tells the operator that the peritoneal cavity has been entered.

An effort should be made to reach the fluid with the anesthetic syringe and needle to confirm the presence of fluid and the depth of penetration needed to reach the ascites. The anesthetic should be injected into the same route planned for passage of the paracentesis needle in order to minimize pain, especially if a larger-bore needle is used to obtain the fluid. (See 'Choice of paracentesis needle' above.)

Paracentesis needle insertion — The paracentesis needle should be inserted along the pathway that was anesthetized. The paracentesis needle is also inserted using a Z-track technique. If a 15- or 16-gauge needle is being used for a therapeutic paracentesis, a #11 blade scalpel nick in the skin will be required to permit insertion of the needle. This tiny nick should be just long enough to permit the entry of the needle. The larger the nick, the higher the likelihood of a post-paracentesis leak. (See 'Anesthetizing using a Z-track technique' above.)

Once the paracentesis needle has entered the peritoneal cavity and fluid is aspirated, the hand that is on the abdominal wall can be removed to assist with further maneuvers. The depth of entry of the needle must be stabilized so that it does not pull out of the peritoneal cavity. If the skin has been properly held on the abdominal wall during needle insertion, fluid should drip from the hub of the needle once the syringe is removed. This proves that the needle is still in good position.

During laparoscopy, we have seen the peritoneum "tent" over the needle as the needle is pushed into the abdomen. The parietal peritoneum is highly elastic and may tent a few centimeters before it is pierced. From the outside, the operator cannot see this tenting and may misinterpret the absence of fluid entering the syringe, despite a deep needle penetration, as a "dry tap." Rotating the needle 90 degrees or more may allow it to pierce the peritoneum, at which point fluid should flow into the syringe. When fluid is clearly present by examination and imaging, sampling the fluid should be possible, provided the needle is long enough to reach it, the needle entry site is well chosen, and the patient is positioned to allow the fluid to pool at the entry site.

Initiating the flow of fluid — Frequently, when there is not much fluid present, it can be rather difficult to obtain a free flow of fluid. This is because the bowel or omentum may block the end of the needle. Multiple-hole needles (used almost exclusively for therapeutic paracentesis) help prevent this problem; when the end hole is blocked, fluid can still enter the needle through the side holes.

There is a common misconception that poor or sporadic flow of fluid means that the fluid is loculated. We have encountered true loculation infrequently in more than 41 years of performing paracenteses. Loculated fluid is typically encountered in the setting of peritoneal carcinomatosis with accumulating malignant adhesions or bowel rupture with surgical peritonitis and adhesions. Loculation essentially never happens in the setting of cirrhosis or heart failure with ascites. Spontaneous bacterial infection of the fluid usually does not lead to adhesions or loculations, unless the infection was detected and treated late in its course or not treated at all (typically resulting in the death of the patient with loculations detected at autopsy).

Sometimes there is a flow of a few drops of fluid, and then the flow ceases. This may be due to a narrow plane of fluid, with bowel or omentum occluding of the needle tip. The patient can be slowly and gently repositioned to pool more fluid in the vicinity of the needle. This will usually reestablish the flow of fluid. In some cases, the operator has inadvertently allowed the needle tip to pull out of the peritoneal cavity, back into the abdominal wall. If this occurs, the needle can be inserted further in an attempt to reestablish the flow of fluid. A stable angle and depth of penetration of the needle are crucial to a successful paracentesis. Nervous operators frequently bounce the needle in and out of the peritoneal cavity. Patience and persistence are the keys to successful paracentesis.

If stable, deeper needle insertion does not lead to a free flow of fluid, the needle depth and angle can be stabilized with one hand, while the other hand removes the syringe from the needle to see if fluid will drip from the needle hub, as is done during a lumbar puncture. Enough fluid can be obtained by this method to send for a cell count and differential at the

minimum. While laboratories may request a minimum of 1 mL for cell count and differential, it takes approximately 10 microliters to fill a manual hemocytometer well and a few microliters to be spread on a slide for the differential. If only a few drops of fluid are obtained, they should be placed into a purple top tube and sent for cell count and differential, informing the laboratory that there is some fluid in the tube, even though there is not enough to be easily visible. Fluid can be dripped into the purple top tube after the assistant has removed its top and holds it to catch the dripping fluid. More fluid can be obtained for other tests as needed if the operator is patient.

Obtaining fluid for testing — Once ascitic fluid is flowing, the fluid can be collected for diagnostic testing. Usually approximately 25 mL of fluid are needed for a cell count, differential, chemical testing, and bacterial cultures. We remove approximately 5 mL with a 5 mL syringe initially. It is easier to get a "feel" for the ease of fluid removal and to see the fluid enter the syringe using a smaller syringe rather than a larger syringe. The 5 mL syringe is then removed from the needle carefully, to avoid pulling the needle tip out of the peritoneal cavity. That syringe is handed to the assistant, who is wearing nonsterile gloves. An 18- or 22-gauge needle is attached to that syringe by the assistant, and 1 to 2 mL of fluid are injected into the glass tube containing the anticoagulant; this tube usually has a purple top. If the fluid is allowed to clot prior to exposure to the anticoagulant, an accurate cell count cannot be performed. This is why the purple top tube is injected first. The remainder of the fluid in the 5 mL syringe is injected into the tube that contains no anticoagulant (usually a red-top tube) for chemical analyses.

If cultures or other tests are desired, a 20 mL syringe is connected to the needle that is in the abdominal wall, and the syringe is filled with ascitic fluid. This fluid is used to inoculate the blood culture bottles. The amount of fluid placed into the bottle is similar to the amount of blood that would be injected, usually 10 mL per bottle. The assistant removes the alcohol wipe from the bottle top and a new (18- or 22-gauge) needle is attached to the syringe to inoculate the bottles. A needle that has passed through the skin should **not** be used to inoculate the bottles. The operator should also be careful not to inject any air bubbles into the bottles.

A single needle can be used to inoculate multiple bottles. The author has inoculated up to 20 culture bottles (for research purposes) with the same needle without contamination. However, if multiple syringes of fluid are being used to inoculate the blood culture bottles, each syringe should have a new needle. This is to decrease the risk of a needle-stick injury that could occur if the needle were transferred among the syringes. (See "Spontaneous bacterial peritonitis in adults: Diagnosis", section on 'Handling the ascitic fluid'.)

Multiple syringes of fluid or a 60 mL syringe can be used instead of a single 20 mL syringe if multiple miscellaneous tests are desired. As an example, we send 50 mL for cytology and 50 mL

for smear and culture for tuberculosis, as needed [20]. The exact sample requirements for these or other unusual tests should be coordinated with the local laboratory. Some laboratories want the cytology fluid delivered immediately in a syringe or sterile cup. Others want it mixed with fixative. (See "Evaluation of adults with ascites", section on 'Other ascitic fluid tests'.)

Removing large volumes of fluid (therapeutic paracentesis) — A large-volume paracentesis has been defined as the removal of >5 liters of ascitic fluid [1,2]. The diagnostic portion of the fluid can either be obtained with the smaller bore needle or the larger bore needle. The minimal amount of testing of the fluid removed for therapeutic purposes includes a cell count and differential; this test can lead to the detection of ascitic fluid infection at an early stage [1,2]. (See "Spontaneous bacterial peritonitis in adults: Diagnosis", section on 'Interpretation of ascitic fluid test results'.)

Patients with tense ascites should have enough fluid removed to relieve the intra-abdominal pressure in order to make the patient comfortable and to minimize the chance of a leak of ascitic fluid. If a patient is known to have refractory ascites, the removal of as much fluid as possible will extend the interval to the next paracentesis. If a patient's diuretic-responsiveness is not known, the removal of approximately 5 liters of fluid is enough to reduce the intra-abdominal pressure. A sodium-restricted diet and diuretics are used to further reduce the amount of fluid. (See "Ascites in adults with cirrhosis: Initial therapy".)

Vacuum bottles should be used to speed removal of fluid. Using a 60 mL syringe with no vacuum bottles is too slow and is used only as a last resort. The semirigid tubing available in paracentesis kits that connects the abdominal needle to the vacuum bottles should have a 16-gauge needle at one end and a Luer lock at the other. Once a large-bore (15- or 16- gauge) needle is in the peritoneal cavity, the diagnostic testing has been obtained, and the metal cover over the input diaphragm of the vacuum bottle has been removed by the assistant, the semirigid tubing is connected by Luer lock to the hub of the needle that is in the abdomen. The needle that is at the other end of the tubing is then inserted into the soft diaphragm of the vacuum bottle, and fluid is allowed to flow.

With abdomens full enough to permit the removal of 8 to 10 liters of fluid, flow is usually brisk for several liters. As the fluid is depleted, the bowel and omentum are more likely to occlude the needle hole(s) and slow or stop the flow of fluid. If the flow slows, the patient can be slowly and gently repositioned to pool fluid at the needle site. In addition, either an assistant or the patient can press the abdomen to maximize the amount of fluid removed. Some patients who have had many taps spontaneously press on the contralateral side of the abdomen with one or both hands to push the fluid toward the needle to maximize fluid removal. The more fluid removed with each paracentesis, the longer the interval between procedures.

Needle removal — Once it has been determined that no further fluid is needed, the needle should be removed in one rapid, smooth withdrawal motion. We have found that it is helpful to distract patients by asking them to cough as the needle is removed. The cough seems to prevent the patients from sensing pain during removal of the needle.

COLLOID REPLACEMENT

The need for colloid replacement after a therapeutic paracentesis remains controversial. Typically it is not required for paracenteses that remove 5 liters or less. This issue is discussed elsewhere. (See "Ascites in adults with cirrhosis: Diuretic-resistant ascites", section on 'Colloid replacement'.)

COMPLICATIONS

Serious complications from abdominal paracentesis are uncommon, but a number have been described (table 3).

Ascitic fluid leak — The most common complication following paracentesis is an ascitic fluid leak, which occurred in 5 percent of patients in one study [10]. Leaks typically arise when a Z-track has not been performed properly, a large-bore needle has been used, and/or a large skin incision has been created. We have rarely encountered a leak using the technique described above. (See 'Paracentesis techniques' above.)

When a leak occurs, placing an ostomy bag over the leak site allows quantitation of the amount of fluid that is leaking. Placing gauze dressings over the site usually leads to rapid soaking of the dressings, rapid dressing changes, and maceration of the skin. Usually the amount of fluid decreases over a period of a few days if the patient is diuretic-sensitive. If the fluid is refractory to diuretic therapy, another therapeutic paracentesis may need to be performed (using proper technique) to stop the leak. Cellulitis may develop in the skin near the leak if it is prolonged. Retrograde infection of the ascitic fluid is exceedingly rare. If there is a large scalpel incision at the site, it can be sutured. However, the fluid may then dissect into the underlying soft tissue.

Bleeding — Bleeding from an artery or vein that is impaled by the needle can be severe and potentially fatal [10]. An external figure-of-eight suture can be placed surrounding the needle entry site if the inferior epigastric artery is bleeding. Rarely, a laparotomy is required to control the hemorrhage. The risk of serious bleeding appears to be higher if renal failure is present [9]. Patients with primary fibrinolysis may develop three-dimensional hematomas and require

antifibrinolytic treatment [4]. (See 'Abnormal coagulation studies and thrombocytopenia' above.)

Bowel perforation and infection — Infection is rare unless the bowel is entered by the paracentesis needle [10,15]. Bowel perforation by the paracentesis needle occurs in approximately 6/1000 taps. Fortunately, it usually does not lead to clinical peritonitis and is generally well tolerated [21]. Treatment is not required unless patients develop signs of infection (eg, fever, abdominal tenderness).

Mortality — Death due to paracentesis is exceedingly rare (zero in most series) [6-8]. In the two largest series, there were a total of nine deaths out of 5244 procedures (mortality rate 0.16 to 0.39 percent) [9,10]. Eight of the deaths were due to bleeding, and one was due to infection.

SOCIETY GUIDELINE LINKS

Links to society and government-sponsored guidelines from selected countries and regions around the world are provided separately. (See "Society guideline links: Portal hypertension and ascites".)

INFORMATION FOR PATIENTS

UpToDate offers two types of patient education materials, "The Basics" and "Beyond the Basics." The Basics patient education pieces are written in plain language, at the 5th to 6th grade reading level, and they answer the four or five key questions a patient might have about a given condition. These articles are best for patients who want a general overview and who prefer short, easy-to-read materials. Beyond the Basics patient education pieces are longer, more sophisticated, and more detailed. These articles are written at the 10th to 12th grade reading level and are best for patients who want in-depth information and are comfortable with some medical jargon.

Here are the patient education articles that are relevant to this topic. We encourage you to print or e-mail these topics to your patients. (You can also locate patient education articles on a variety of subjects by searching on "patient info" and the keyword(s) of interest.)

- Basics topic (see "Patient education: Fluid in the belly (ascites) (The Basics)")

SUMMARY AND RECOMMENDATIONS

- **Background** – Abdominal paracentesis is a simple bedside or clinic procedure in which a needle is inserted into the peritoneal cavity and ascitic fluid is removed. Diagnostic paracentesis refers to the removal of a small quantity of fluid for testing. Therapeutic paracentesis refers to the removal of 5 liters or more of fluid to reduce intra-abdominal pressure and relieve the associated dyspnea, abdominal pain, and early satiety. (See "Evaluation of adults with ascites" and "Ascites in adults with cirrhosis: Diuretic-resistant ascites", section on 'Therapeutic paracentesis'.)

- **Indications** – There are several generally accepted indications for paracentesis (table 1) (see 'Indications' above):

  - Evaluation of new onset ascites.
  - Testing of ascitic fluid in a patient with preexisting ascites who is admitted to the hospital, regardless of the reason for admission.
  - Management of tense ascites, or ascites that is diuretic-resistant.
  - Evaluation of a patient with ascites who has signs of clinical deterioration, such as fever, abdominal pain/tenderness, hepatic encephalopathy, peripheral leukocytosis, deterioration in renal function, or metabolic acidosis.

- **Relative contraindications** – The benefits of abdominal paracentesis in patients with appropriate indications almost always outweigh the risks. There are some relative contraindications to paracentesis, though in most cases steps can be taken to allow for paracentesis, even in the setting of a relative contraindication. (See 'Relative contraindications' above.)

  Relative contraindications include:

  - Clinically apparent disseminated intravascular coagulation
  - Primary fibrinolysis
  - Massive ileus with bowel distension
  - Surgical scars at the proposed paracentesis site

- **Patients with abnormal coagulation studies or thrombocytopenia** – An elevated international normalized ratio or thrombocytopenia is not a contraindication to paracentesis, and for most patients, transfusion of blood product before paracentesis is discouraged since it is **not** supported by the available data, can delay the procedure, exposes the patient to risk of transfusion, and is costly. Exceptions are patients with clinically apparent disseminated intravascular coagulation or clinically apparent

hyperfibrinolysis, who do require treatment to decrease their risk of bleeding. (See 'Abnormal coagulation studies and thrombocytopenia' above.)

- **Technique** – Proper technique is important to decrease the risk of sample contamination and complications. In particular, proper Z-track technique minimizes the chance of an ascitic fluid leak, the most common complication of paracentesis. Other complications are much less common. (See 'Paracentesis techniques' above and 'Complications' above.)

  Testing for cell count and differential should be performed on all specimens, even scheduled therapeutic paracenteses. (See 'Obtaining fluid for testing' above.)

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Topic 16203 Version 24.0

GRAPHICS

Indications for abdominal paracentesis

New onset ascites
Hospitalization of a patient with ascites
Management of tense ascites or ascites that is diuretic-resistant
Clinical deterioration of an inpatient or outpatient with ascites
- Fever
- Abdominal pain
- Abdominal tenderness
- Hepatic encephalopathy
- Peripheral leukocytosis
- Deterioration in renal function
- Acidosis

Graphic 65249 Version 3.0

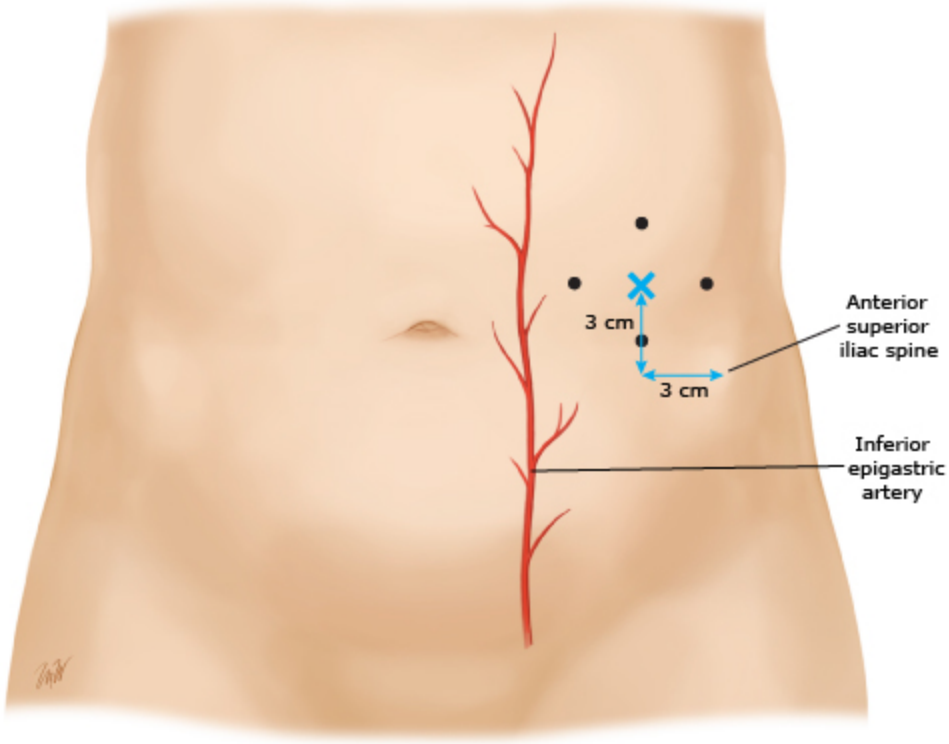
Diagnostic and therapeutic paracenteses checklist

Supplies needed for diagnostic and therapeutic paracenteses
Signed consent form
Ultrasound machine if needed to localize the entry site
Completed lab slips and labels
Red-top tube
Purple-top (EDTA) tube (or other tube depending on the lab)
Blood culture bottles (2, for aerobic and anaerobic culture)
1- to 2-liter vacuum bottles (for therapeutic paracentesis, enough bottles to remove 8 L of fluid should be available)
Iodine or chlorhexidine skin sterilizer
Alcohol wipes (3)
4x4 sterile gauze sponges (3)
Sterile and nonsterile gloves
25- to 27-gauge 1.5 inch needle, if available (if not, a tuberculin syringe can be used) (1)

18-gauge 1 to 1.5 inch needles (2 or 3)
22-gauge 1.5 inch needle, if available
22-gauge 3.5 inch spinal needle
Sterile syringes (3, 5, 20 mL)
Lidocaine 1 percent
#11 blade scalpel (for therapeutic paracentesis)
Adhesive bandage
Sharp receptacle box

Graphic 73987 Version 5.0

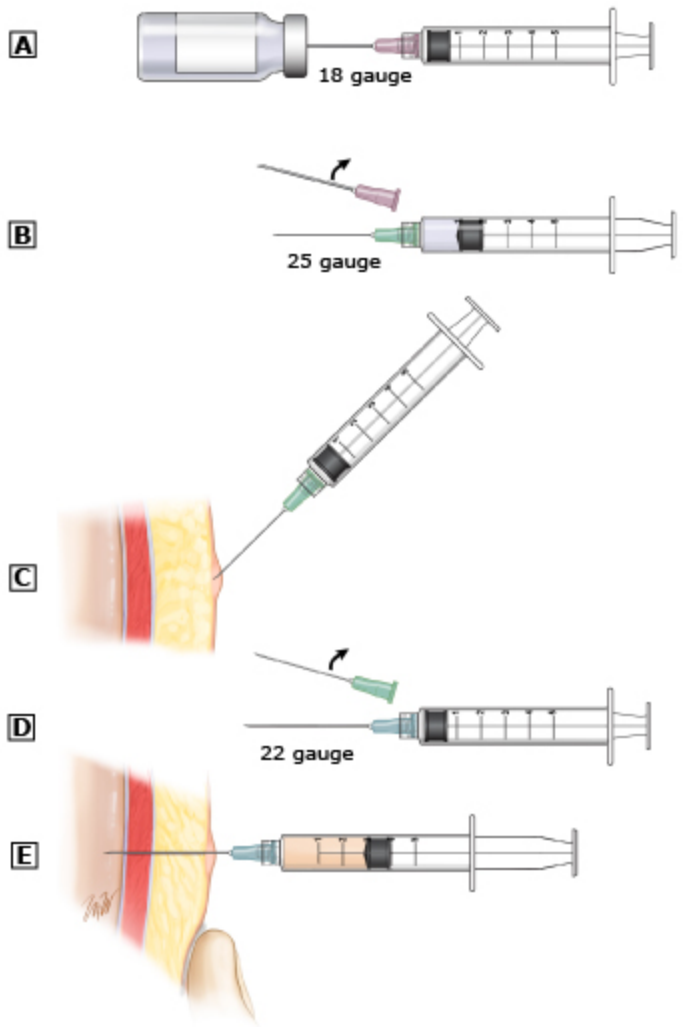
Abdominal paracentesis sites



Abdominal wall anatomy showing the author's preferred site for abdominal paracentesis and the inferior epigastric artery, which should be avoided.

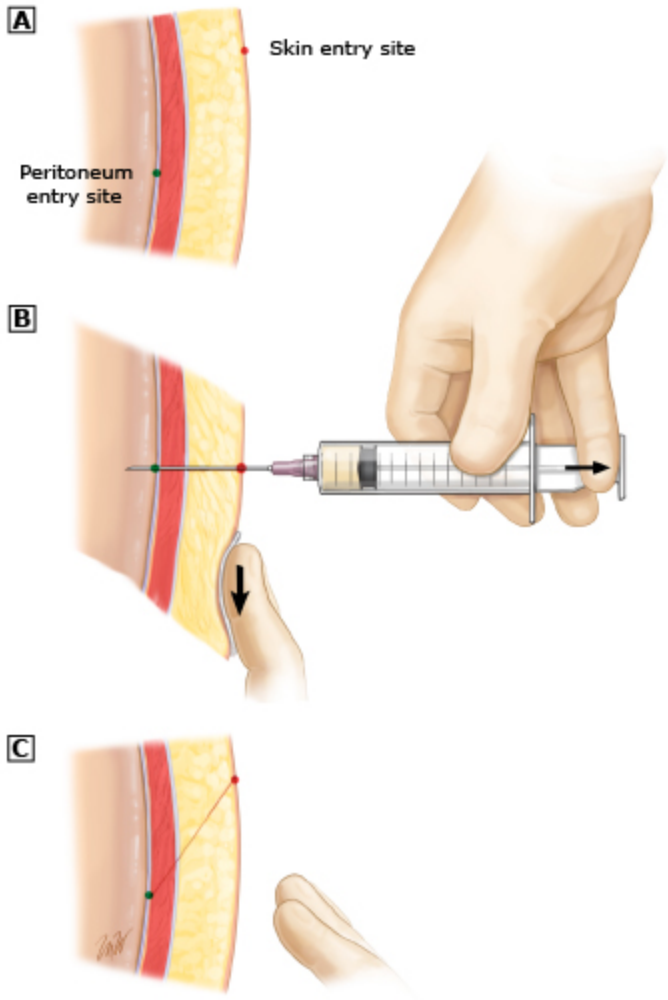
Graphic 59687 Version 2.0

Diagnostic paracentesis needles



Graphic 60064 Version 2.0

Z-track technique for needle insertion during paracentesis



A: Relative locations where the needle will enter the skin and the peritoneal cavity.

B: The skin is pulled down, and the needle is then advanced in 5 mm increments, pulling the plunger back a few millimeters with each advancement to see if any blood or ascitic fluid is aspirated.

C: The skin is released, returning the skin and peritoneal cavity entry sites to their original positions.

Graphic 76099 Version 3.0

Complications of abdominal paracentesis

Leak of ascitic fluid	5 percent
Severe hemorrhage	0 to 0.97 percent
Infection due to paracentesis	0.58 to 0.63 percent
Death associated with paracentesis	0 to 0.39 percent

Data from:

1. *de Gottardi A, Thevenot T, Spahr L, et al. Risk of complications after abdominal paracentesis in cirrhotic patients: a prospective study. Clin Hep Gastro 2009; 7:906.*
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Graphic 54050 Version 2.0

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