Abstract
Ascites is one of the most prevalent complications of cirrhosis. Ascites can hamper the patients’ quality of life as well as predispose them to develop spontaneous bacterial peritonitis. Paracentesis is often used for diagnostic as well as therapeutic purposes in the management of cirrhotics with ascites. It is often performed as an outpatient procedure with or without the aid of ultrasound marking and the preferred site is the left lower quadrant. Diagnostic paracentesis is needed to ascertain the etiology of ascites as well as to exclude spontaneous bacterial peritonitis. Therapeutic paracentesis, total or large volume, is employed to relieve patient discomfort in cases refractory or resistant to diuretics. While coagulopathy is common in cirrhosis, it is not a contraindication to paracentesis, unless there is evidence of hyperfibrinolysis. Post-paracentesis circulatory dysfunction can occur in 20% of patients after therapeutic paracentesis and should be prevented by using albumin infusion during the procedure. Paracentesis, both diagnostic and therapeutic, is an essential and safe procedure for the management of end-stage liver disease and cirrhosis.

Chronic liver disease in the United States is mainly caused by hepatitis C and alcohol. Cirrhosis which represents the end stage of any chronic liver disease (CLD) is the twelfth leading cause of death in the US [1]. Ascites is not only the most common complication of decompensated liver disease but also the most common cause of hospital admissions [2]. Further on, development of ascites in a cirrhotic patient confers poor prognosis with around 44% dying within 5 years [3]. Appropriate management of ascites thus forms the cornerstone in the overall care of a cirrhotic patient.

Nomenclature Used in Assessment of Ascites
The International Ascites Club has broadly divided ascites into uncomplicated and refractory ascites. The former has been graded according to severity from mild to severe as 1, 2 and 3. The latter group has been subdivided into diuretic-resistant and
diuretic-intractable category according to response to diuretic treatment (table 1) [4, 5].

**Confirmation and Ascitic Fluid Analysis**

For confirmation of ascites, abdominal paracentesis followed by relevant analysis of fluid to figure out the etiology and complications is considered a safe as well as informative procedure [5]. Paracentesis is a vital skill for the internists, especially those taking care of patients with liver diseases.

**Indications of Abdominal Paracentesis**

Indications can be broadly divided into diagnostic when a limited amount of ascitic fluid is used to aid in diagnosis versus therapeutic aimed at relieving pressure symptoms in a patient with tense ascites (table 2).

**Contraindications**

Other than frank evidence of fibrinolysis or disseminated intravascular coagulation there are no absolute contraindications to abdominal paracentesis [6]. Though there are certain special situations like pregnancy, in patients with massive organomegaly or bowel obstruction use of USG may reduce the risk of injury to the patient during the procedure. To minimize the complications, use commonsense precautions like catheterization of distended urinary bladder, nasogastric decompression in case of

<table>
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<th>Classification</th>
<th>Uncomplicated ascites</th>
<th>Refractory ascites</th>
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<tr>
<td>No infection</td>
<td></td>
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<tr>
<td>No hepatorenal syndrome</td>
<td></td>
<td>diuretic-resistant</td>
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<tr>
<td>Grade 1 (mild)</td>
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<tr>
<td>Ascites diagnosed on USG only</td>
<td></td>
<td>diuretic-intractable</td>
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<td>Grade 2 (moderate)</td>
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<tr>
<td>Clinically appreciated with moderate distention</td>
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<tr>
<td>Grade 3 (large)</td>
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<td>Clinically marked or tense distention</td>
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Table 1. Classification of ascites according to severity and response to diuretics
bowel obstruction, avoiding sites such as areas of infection, abdominal wall hematomas, surgical scars, visibly engorged vessels and the anatomic location of the inferior epigastric arteries for paracentesis [7].

### Paracentesis Techniques

Various hospitals use different pre-packaged kits for paracentesis. The operator should be familiar with the type of kit being used in his hospital. Nevertheless, the principles of abdominal paracentesis remain the same regardless of the kit being used. After discussing the procedure with the patient, written consent should be obtained. The patient should be placed in a comfortable position which is usually supine.

In the past, the infraumblical midline site 2 cm below the umbilicus was used – a preferred site in the belief that this region had no blood vessels [5]. This approach has been abandoned now as one laparoscopic study found that in patients with portal hypertension there are collaterals in the midline which can rupture during paracentesis [8]. Amongst the lateral approach, either right or left lower quadrant (2–4 cm medial and cephalad to the anterior superior iliac spine), the left lower quadrant is the preferred position. This is because a study using USG found that the abdominal wall in the left lower quadrant is significantly thinner with a larger pool of ascitic fluid in this location as compared to the midline infraumblical location [9]. As the prevalence of obesity rises, this becomes particularly relevant. There is also a minor risk of perforating a dilated cecum (especially if the patient is on lactulose) if the right lower quadrant is used [6].

Paracentesis should be performed using standard sterile precautions. The entry site and the deeper tissues in the anticipated tract of the needle along with the pain-

<table>
<thead>
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<th>Diagnostic</th>
<th>Therapeutic</th>
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<td>With new onset ascites to detect etiology</td>
<td>To relieve respiratory distress/abdominal pain in tense ascites</td>
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<tr>
<td>With pre-existing ascites when SBP is suspected clinically or on laboratory parameters</td>
<td>Serial large-volume paracentesis in refractory cases</td>
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<td>Hospitalized patients with ascites</td>
<td>Prior to TIPS and USG for better procedural success and visualization</td>
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<tr>
<td></td>
<td>To prevent impending rupture of umbilical hernia</td>
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sensitive parietal peritoneum should be numbed with a local anesthetic (5–10 ml of 1 or 2% lidocaine). A small puncture with either a scalpel or a large-bore needle (gauge 18) is made at the entry site to facilitate entry of the paracentesis needle [7].

Usually, various needle sizes are chosen depending upon whether the patient is thin or obese (1.5–3.5 inch, 22-gauge needle). Many experts prefer to use steel needles as compared to plastic-sheathed cannulas because of problems in draining the fluid due to kinking and obstruction of flow after the cannula is removed [10]. One of the most common complications of paracentesis is the leakage of fluid from the puncture site described as 5% in one study [11]. To prevent this special needle insertion, special techniques (namely angular insertion and Z-tract technique) are employed [12]. In the former, 45° angulation of the needle is used all along its tract from the epidermis into the peritoneal cavity while in the latter the skin is pulled 2 cm downwards before insertion of the needle and is then let go only after ascitic fluid is seen to be flowing. With these techniques, the needle tract gets sealed as the skin resumes its normal shape. The key to a successful outcome is to advance the needle in slow increments (approximately 5 mm) with the dominant hand while using the other hand to guide the needle path and intermittently aspirating on the needle. When the ascitic fluid is seen, the advancement of the needle should be stopped and the catheter guided over the needle while the needle is withdrawn. Further on, depending on the indication of paracentesis (if for diagnostics around 30–60 ml fluid is withdrawn using a syringe and if the intent is therapeutic), attaching vacuumized containers via high pressure connection tubing is performed. A sterile dressing is placed over the paracentesis site as the procedure is completed.

**Large-Volume Paracentesis**

Approximately 10% of patients with cirrhosis develop ascites refractory to medical treatment alone [13] and hence need serial therapeutic paracentesis. In large-volume paracentesis (LVP) more than 5 liters of ascitic fluid is drained. Other indications for LVP may include tense ascites, respiratory distress, and impending rupture of the umbilical hernia prior to adequate USG examination of liver and transjugular intra-hepatic portosystemic shunt (TIPS) placement [14].

The role of plasma expanders in LVP has been dealt with in another chapter of this book. It is sufficient to mention here that if albumin is the plasma expander being infused, using 6–8 g/l is appropriate if greater than 5 liters of ascitic fluid is removed [3]. This is useful since in about 20% of patients LVP gets complicated by postparacentesis circulatory dysfunction (PPCD) [14]. As opposed to LVP, in total volume paracentesis (TVP) all the ascitic fluid is drained and this can be performed safely when albumin has been used [14]. Both LVP and TVP are associated with immediate symptomatic relief but this is short lived as there is recurrence of ascites. Hence, repeated procedures are involved without a significant increase in survival [15].
Transjugular intrahepatic portosystemic shunt (TIPS) is yet another modality of treatment available for the treatment of refractory ascites. TIPS is a side-to-side portocaval shunt aimed at correcting the portal hypertension [16]. It is hence effective not only in controlling ascites but also in preventing its re-accumulation. In a recently published meta-analysis of 4 large-scale published trails comparing the effect of TIPS versus LVP in cirrhotics with refractory ascites, it was concluded that TIPS was significantly better than LVP in transplant-free survival but encephalopathy occurred more in the former group as compared to the latter [17]. TIPS improved the quality of life in all patients apart from those who developed encephalopathy. Of the above trials, The North American Study of Treatment of Refractory Ascites (NASTRA) had the largest number of patients in each group and this trial clearly demonstrated that, similar to LVP, TIPS did not improve patients’ survival [18]. The authors concluded that TIPS should be considered as a second-line therapy or a bridge to liver transplantation (LT). Referral to a LT center should be hastened in these patients as LT is considered to be the only treatment which improves the morbidity and mortality in these patients.

**Ascitic Fluid Analysis**

If clinically uncomplicated ascites is suspected, the baseline laboratory parameters to be ordered include: total cell count with differentials, albumin, total protein concentration, and calculation of serum-ascites albumin gradient (SAAG), which is calculated by subtracting the ascitic fluid albumin level from concurrently tested serum albumin level. The clinical utility of SAAG is that it can predict that ascites is due to portal hypertension with 97% accuracy if the value of SAAG is equal to or greater than 1.1 g/dl [19].

Appropriate specimen tubes (EDTA-treated tube for cell counts and differentials and a plain tube for albumin) for collection of aspirated fluid should be used for prompt delivery to the laboratory. In those patients who get serial LVP in an outpatient setting, ordering total and differential cell counts is sufficient if they appear to be clinically stable [6].

A genuine concern in the evaluation of a patient with ascites is to determine whether the fluid is infected either spontaneously or secondarily. A polymorphonuclear cell (PMN) count of ≥250 cells/mm³ along with a positive fluid culture without an obvious intra-abdominal source points towards spontaneous bacterial peritonitis (SBP) [20]. SBP, unlike secondary bacterial peritonitis, is usually a mono-microbial infection, therefore >1 organism on culture should raise the suspicion of secondary peritonitis. Further tests to help differentiate between SBP and secondary peritonitis include lactate dehydrogenase, glucose and total proteins [21]. Gram stain of ascitic fluid has a low yield (7–10%) in early SBP but it may be helpful in secondary bacterial peritonitis. The causes of hemorrhagic ascites (due to ascitic red blood cells >50,000/
mm³) include traumatic tap, cirrhosis (2%), malignancy, peritoneal carcinomatosis and congestive heart failure [22]. Appropriate correction to PMN cell counts should be applied in this scenario.

Specific tests should be ordered in response to a particular clinical scenario like ordering ascitic fluid triglyceride level if chylous ascites is drained, carcinoembryonic antigen or alkaline phosphatase level if gut perforation is suspected, checking ascitic fluid amylase if pancreatic etiology is suspected, and tubercular cultures if tubercular peritonitis is suspected. Ascitic fluid cytology is an expensive test and should only be ordered if peritoneal carcinomatosis is a diagnostic consideration.

Coagulopathy in Liver Disease

In patients with liver disease, the hemostatic balance is maintained by multiple and often opposing variables which are in a dynamic state [23]. There is a delicate balance between the pro-thrombotic and anti-thrombotic forces which sometimes gets further challenged by additional factors like infections, thrombocytopenia and severity of underlying liver disease. While bacterial infections in cirrhotic patients have been shown to predispose to bleeding (due to heparin-like effect) nonalcoholic fatty liver disease and the metabolic syndrome is associated with a prothrombotic state [24]. From a simplistic view, this state can be likened to a ‘see-saw’ with the net clinical status of the patient being determined by which forces dominate. To further complicate this picture, the global tests of coagulation prothrombin time and international normalized ratio (PT-INR) do not reflect the changes in the anticoagulants and, hence, may not accurately predict bleeding risks [25]. There is no data-supported evidence to use coagulation parameters to assess bleeding risk in a patient with liver disease undergoing potentially hemorrhagic procedure like liver biopsy or paracentesis. Hence, no cut-off values for PT exist beyond which paracentesis should be avoided [5].

Patients with hyperfibrinolysis clinically present with mucocutaneous bleeding or hematoma formation which is diagnosed using euglobin clot lysis time (ELT) <120 min [26]. Some experts recommend using EACA in patients with hyperfibrinolysis after documenting the same using ELT and performing paracentesis only after ELT improves [6].

In a prospective study (163 patients and 410 paracentesis) conducted in an emergency room setting under ultrasound guidance, the pre-procedure INR for PT was more than 1.5 in 142 paracentesis with platelet count <50,000 cells/mm³. A minor complication rate of only 0.5% was reported. They concluded that bleeding complications are uncommon and mild even if they occur and that routine correction and checking of elevated INR or platelets is not desired [27].

Till the time that better tests for measuring coagulopathy in liver disease become available, it is advisable to use clinical judgment not only to assess risk of bleeding in
an individual but also as a guide to using agents such as platelets, blood factors and or antifibrinolytics.

Complications

The fear about serious complications of abdominal paracentesis including death stems from the older literature when trocars were used. Currently, paracentesis is considered a safe procedure [6]. The complications of diagnostic paracentesis may be divided into bleeding complications, perforation of intra-abdominal organs, introduction of local or peritoneal infection and post-paracentesis persistent leakage of ascitic fluid. The bleeding complications present themselves either as abdominal wall hematoma, hemorrhage into the peritoneal cavity or bleeding related to direct puncture of the inferior epigastric artery.

In a large retrospective study (4,729 procedures), 9 patients (0.19%) were identified to have developed severe hemorrhage: all of these patients were in hospital and had significantly impaired renal function [28]. The mortality following bleeding complications in 0.02% of all paracentesis occurred in those patients who were hospitalized with severe thrombocytopenia and/or elevated INR. A prospective study (628 patients/1100 LVP) carried out in an outpatient setting reported no major complications: the proprocedure platelet counts ranged from 19,000 to 341,000 cells/mm³ and INRs for PT ranged from 0.9 to 8.7. They also reported a very low incidence of persistent leakage from the paracentesis site (0.36%) which responded to local measures [29]. Another retrospective study did not find any increased bleeding in patients who had PT/PTT even up to twice the normal or platelet count of 50,000–99,000 cells/mm³. The overall transfusion-requiring events were very low at 0.2%, which led the authors to conclude that prophylactic treatment with blood products is not necessary [30]. A more recent prospective study (171 patients/515 paracentesis) observed complications in 10.5% which were mostly minor (8.9%). Local bleeding was observed in 2.3% of the cases and overflow of ascitic fluid from the puncture site in 5% of the cases. The major complications accounting for 1.6% included 2 patients with major hematoma, 3 cases with intraperitoneal bleeding and 3 cases with infectious complications. Technical problems were observed in 5.6% of the cases which included repeating the puncture due to flow interruption, repositioning of the catheter, and no ascites at the first attempt. Major complications were significantly associated with therapeutic procedures. In this study, a plastic sheath was used which could have accounted for the increased rate of complications [11].

Iatrogenic infection of the ascitic fluid is a concern. An earlier prospective study [5] did not report this complication while a more recent study observed infectious complications in 0.6% of the patients [11].

On review of the literature there seems to be no convincing evidence about coagulopathy or thrombocytopenia precluding abdominal paracentesis, either diagnostic or
therapeutic, and if hemorrhagic complications occur at all they are minor and easily controlled. Major hemorrhagic complications occur mainly in severely sick patients with comorbid illnesses like renal failure. It seems that LVP as compared to diagnostic paracentesis does not seem to be have increased complication rates [5].

In about 20% of the patients, LVP gets complicated by postparacentesis circulatory dysfunction which is a complication unique to LVP [7]. This is characterized pathophysiologically as worsening of vasodilatation manifesting as hypotension, hyponatremia and increased catecholamine and renin levels. This state peaks at around 24–48 h and can lead to renal failure and even death [14].

**Key Messages**

- Abdominal paracentesis for acquisition of ascitic fluid for diagnostic or therapeutic considerations is a quick, common and safe procedure.
- There are no absolute contraindications for paracentesis except hyperfibrinolysis.
- Using sterile precautions, proper tools and techniques along with the safest site, i.e. left lower abdominal quadrant, for paracentesis will help minimize the complications.
- The bleeding complications even in patients with deranged currently used parameters for coagulopathy in liver diseases and low platelet counts are rarely seen.
- Large-volume paracentesis effectively relieves pressure symptoms in patients with tense refractory ascites but can get complicated by postparacentesis circulatory dysfunction.

**References**

26 Gunawan B, Runyon B: The efficacy and safety of epsilon-aminocaproic acid treatment in patients with cirrhosis and hyperfibrinolysis. Aliment Pharmacol Ther 2006;23:115–120.

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