Paracentesis in the management of ascites

Introduction

Ascites is the abnormal accumulation of fluid in the peritoneal cavity. Men have little or no peritoneal fluid, but women may have up to 20 ml depending on the phase of the menstrual cycle. Ascites is a relatively common clinical finding with a range of malignant and non-malignant causes (*Table 1*). About 85% of ascites is caused by liver disease (Runyon, 2004), and cancer accounts for about 10% of cases (Smith and Jayson, 2003; Becker et al, 2006).

Pathophysiology

Pathophysiology of ascites is multi-factorial. Fluid accumulates in the peritoneal cavity as a result of an imbalance between the amount of fluid generated and the rate at which it leaves the abdominal cavity. Ascites may occur when any of the following three conditions arise:

1. Disease in the peritoneal cavity producing excess fluid (e.g. infection or cancer)
2. Back pressure from liver or blood vessel pathology causing portal hypertension
3. Low protein status.

Symptoms

The symptoms of ascites can be very distressing. Large volumes of ascites can lead to troublesome symptoms such as discomfort, dyspnoea, nausea and pain (McNamara, 2000). *Table 2* lists other common symptoms.

Table 1. Common causes of ascites

Cirrhosis
Hepatitis
Portal vein thrombosis
Constrictive pericarditis
Congestive heart failure
Liver cancer
Ovarian cancer
Protein-losing enteropathy
Nephrotic syndrome
Pancreatitis

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Investigation and diagnosis

Ascites can be diagnosed by taking a careful history and carrying out a physical examination. Investigations such as ultrasound (*Figure 1*) and computed tomography can be useful in difficult cases to confirm or exclude the presence of free peritoneal fluid. The smallest amount of peritoneal fluid that can be detected by ultrasound is 100 ml (Adam and Adam, 2004). Ascites resulting from a malignant process may be indistinguishable on physical examination from ascites caused by other pathology; it is therefore extremely useful to obtain a sample of ascitic fluid for diagnostic purposes. This should be one of the first steps in evaluating new patients with ascites. The fluid should be sent for a number of tests including microscopy, biochemical and cytological analysis as well as culture (*Table 3*). Ascites caused by cirrhosis has more white blood cells and a higher lactate dehydrogenase level (Tamsma et al, 2001).

Table 2. Symptoms of ascites

Weight gain
Abdominal distension
Loss of appetite
Fatigue
Ankle swelling
Decreased bladder capacity
Altered bowel habit
Shortness of breath
Reduced mobility
Problems with body image

Paracentesis

To remove the fluid abdominal paracentesis may be performed where a tube is placed into the fluid to drain it. Fluid may be removed for either diagnostic or therapeutic purposes (*Table 4*).

Paracentesis is a simple, quick and safe procedure. Despite being a widely used and effective technique, the procedure used

Figure 1. Bowel floating in free fluid.

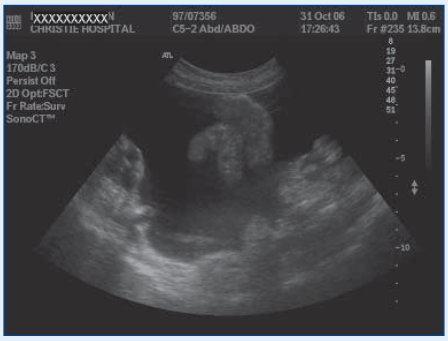


Table 3. Tests that can be carried out on ascitic fluid and their clinical significance

The serum-ascitic albumin gradient (SAAG) is calculated by subtracting the albumin concentration of the ascitic fluid from the albumin concentration of a serum specimen obtained on the same day	High SAAG ≥1.1 g/dl suggests portal hypertension as a cause
	Low SAAG < 1.1 g/dl is consistent with other causes such as peritoneal carcinomatosis or tuberculosis (Runyon et al, 1992)
Amylase concentration is increased in pancreatic ascites	
Triglyceride concentration is increased in chylous ascites	
White cell count > 350/μl is suggestive of infection. If most cells are polymorphonuclear, bacterial infection should be suspected. When mononuclear cells predominate, tuberculosis or fungal infection is more likely	
Red cell count > 50 000/μl denotes haemorrhagic ascites, which usually is caused by malignancy, tuberculosis or trauma	
Gram stain and culture can confirm the diagnosis of bacterial infection	
pH < 7 suggests bacterial infection	
Cytology can be diagnostic in malignancy	

varies considerably (Stephenson and Gilbert, 2002), particularly with regard to:

1. Pre-procedure ultrasound scanning and the best site for inserting the drain
2. Equipment used
3. Pre-procedure fresh frozen plasma (FFP) and platelet infusions
4. Use of intravenous fluids and albumin
5. Length of time over which drainage occurs.

Optimal site for drainage and pre-procedure scans

The literature has suggested various sites to carry out a paracentesis (Sakai et al, 2005). In the past the midline was the preferred site, but studies have shown that the left or right iliac fossa may be better as the abdominal wall is generally thinner, decreasing the chance of a dry tap. Ultrasound studies have also shown a greater pool of fluid in these quadrants (Sakai et al, 2005).

In patients who have malignancies or who have had previous abdominal surgery there may be adhesions or organomegaly. In these cases perforation of bowel or organs may be more likely. It is therefore prudent to arrange pre-procedure or peri-procedure ultrasound so that a site for drainage can be identified and marked. This may also be of benefit in obese patients to assess the depth to the peritoneum, and also if loculations are present in the ascites, the largest locule can be located for drainage. In many cases of gross ascites clinical examination alone should be adequate to identify a safe drainage site. Check the protocols at your centre for advice. Patients should be asked to empty their bladders pre-procedure or be catheterized if in retention to reduce the risk of bladder perforation. Those with bowel obstruction should be considered for a nasogastric tube insertion.

Table 4. Reasons for carrying out a paracentesis

Diagnostic tap	Help determine the cause of ascites
	Diagnose peritonitis
	Detect and characterize malignant cells
	Evaluate abdominal injury (i.e. the nature of free fluid in the abdomen)
Therapeutic tap	Remove large amounts of fluid causing breathing difficulty as a result of diaphragmatic splinting
	Relieve abdominal pain
	Reduce pressure affecting function of kidneys and bowel

Equipment

Equipment used for paracentesis has come a long way from the days of using trocars. However, there is little consistency in the equipment used. Technique varies from hospital to hospital and between countries. Some operators use a large bore intravenous cannula attached to a giving set and draining into a catheter bag or even bucket. These are usually too short to allow easy drainage and the narrow bore can inhibit flow; repeated puncture may thus be required with the additional risk that entails.

More commonly a peritoneal dialysis catheter such as the Bonanno catheter is used. This has the advantage of coming in a kit complete with introducer and tubing. In addition the blunt-ended, fenestrated tube can allow rapid drainage of fluid. The sealed system should also minimize infection risk. Pre-packed paracentesis kits are available but are seldom used in the UK. In the USA it is also common to use large evacuated jars to collect large volume ascites (Thomsen et al, 2006); this expedites the process and has even be performed in patients' homes (Moorsom, 2001). *Table 5* shows the common equipment needed for a paracentesis.

Table 5. Materials needed for paracentesis

Appropriate catheter (e.g. Bonanno peritoneal dialysis catheter)
Catheter bag
Blood collection tubing, or a secondary intravenous tubing set
8 gauge needle
5 cc syringe with 25 gauge needle for anaesthesia infiltration
Skin preparation solution
Dressings pack with sterile draping
1% or 2% lidocaine for local anaesthesia
If available, a bedside ultrasound machine

Platelet and plasma infusions

It is practice in some hospitals to give blood products, i.e. FFP and/or platelets, routinely before paracentesis, but this is not supported by the literature. The risks and costs of prophylactic transfusions exceed the benefit and can also carry a small risk of post-transfusion hepatitis (Runyon, 2004). A significantly raised creatinine (>530 μmol/litre) increases the bleeding risk (McVay and Toy, 1991), and disseminated intravascular coagulation is a contraindication to the procedure. The platelet count and coagulation screen should be reviewed before paracentesis and any significant abnormalities corrected: usually considered platelets $<50x10^9$/litre and international normalized ratio (INR) > 2 (McVay and Toy, 1991).

Use of intravenous fluids and albumin

The use of plasma volume expansion after paracentesis is a subject of debate. Following large volume paracentesis hypotension and hyponatraemia may occur. However, a prospective trial has demonstrated that a single 5 litre paracentesis can be performed safely without significant side effects (Kao et al, 1985). If repeated paracentesis is to be performed, albumin may reduce the incidence of renal impairment or severe hyponatraemia (Gines et al, 1988). Other cheaper plasma expanders such as dextrose and saline may be used although albumin may be superior in preventing circulatory dysfunction (Becker et al, 2006). Post-paracentesis plasma expansion is not considered necessary for a single paracentesis of less than 4–5 litres (Runyon, 2004).

Rate of drainage

There are still no guidelines for the optimal rate of ascites drainage; times between 30 minutes to 24 hours have been mentioned. In North America 5–6 litres of ascitic fluid is often drained over 20–30 minutes. In the UK many cases involve overnight admission and fluid is drained over several hours (Moorsom, 2001). Studies have suggested that symptom relief occurs only with the initial removal of a few litres, there is no evidence to suggest that further drainage results in greater benefit for the patient (McNamara, 2000). Shorter procedure paracentesis does not need to be done in an inpatient setting, the procedure has been performed in patients' homes and in hospices with excellent results (Moorsom, 2001; Stephenson and Gilbert, 2002).

Guide to insertion of a drain

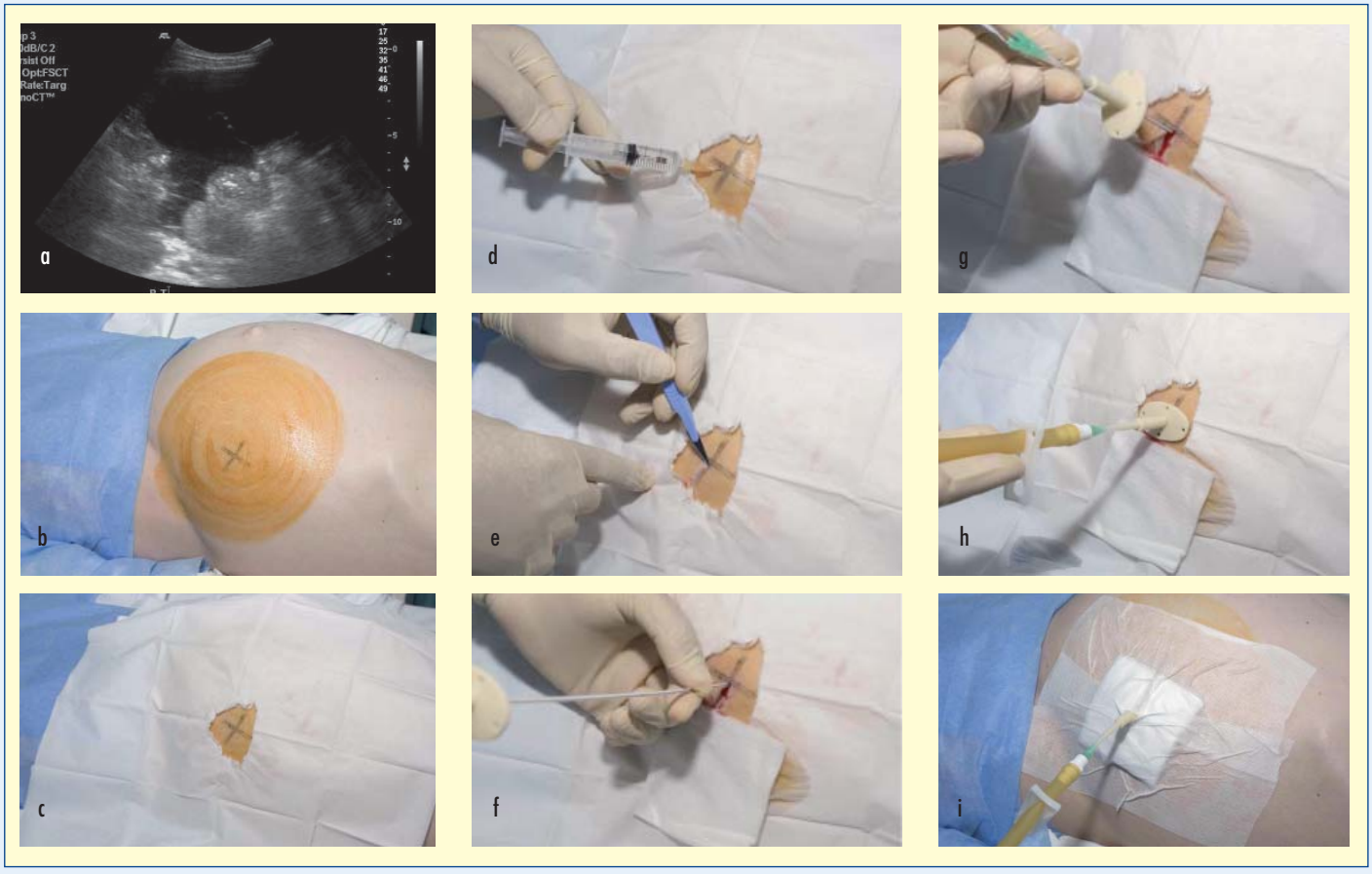
The instructions described are a general guide. Additional information can be obtained from the referenced papers. *Table 6* lists contraindications to the procedure.

1. Look at any previous scans the patient has had to identify any adhesions, organomegaly or loculations. Consider pre-procedure ultrasound.
2. Check the platelet count and coagulation. Patients with an INR > 2.0 should receive vitamin K or FFP before the procedure. One method is to give one unit of FFP before the procedure and then perform the procedure while the second unit is infusing. Patients with platelet <50x10^9/litre should receive an infusion of platelets before the procedure.
3. Explain the procedure, benefits, risks, complications, and alternative options to the patient or the patient's representative and obtain signed, informed consent before starting.
4. Set up equipment on a clean trolley.
5. Lay the patient flat on the bed or with the head end slightly elevated.
6. Intravenous access should be obtained so that intravenous fluid can be easily administered.
7. If an ultrasound machine is available, scan the patient to help localize fluid collection (*Figure 2a*).
8. Clean the skin in the area where the drain is to be inserted with an antiseptic solution (*Figure 2b*).
9. Apply a sterile drape with a small hole over the insertion site to create a sterile field (*Figure 2c*).
10. Inject local anaesthetic subcutaneously (*Figure 2d*).
11. Once the local anaesthetic has had time to work infiltrate deeper, drawing back on the syringe as it is advanced to check that a vessel has not been entered. Once a flash-back of ascitic fluid has been obtained inject a little local anaesthetic to anaesthetize the peritoneum. It is important to note the depth at which the peritoneum is entered, particularly in obese patients.
12. Use a scalpel blade or the tip of a large-bore cannula to make a small nick in the skin to allow an easier catheter passage (*Figure 2e*).
13. Insert the needle into the selected entry point. Some practitioners recommend an angled approach or going in perpendicularly after the skin has been drawn caudally to make sure that the external skin puncture and internal peritoneal puncture are out of line when the procedure is finished to reduce post-procedure ascites leak. However, there is little evidence for this and many practitioners insert the needle perpendicularly.

Table 6. Contraindications to paracentesis

Absolute	Acute abdomen that requires surgery
	Disseminated intravascular coagulation
Relative	Platelet count < 50x10^9/litre or international normalized ratio > 2.0
	Pregnancy
	Distended urinary bladder
	Abdominal wall cellulitus at the proposed site of puncture
	Distended bowel as a result of obstruction
	Intra-abdominal adhesions

Figure 2. Procedure for ascitic drainage.



14. In general, avoid advancing the needle deeper than 1 cm beyond the depth at which ascitic fluid was obtained by the lidocaine syringe. As the needle is advanced use one hand to firmly hold the needle close to the insertion point to prevent it going deeper into the peritoneal cavity. The other hand can be used to draw back on the syringe to identify when the peritoneal cavity is reached.
15. When a flashback of ascitic fluid is obtained push the needle in another few millimetres to ensure secure location in the peritoneal cavity.
16. The catheter can now be slid over the needle into the peritoneal cavity. Great care should be taken to ensure that the needle is not inadvertently pushed further into the abdomen. If resistance is noticed, the catheter is probably misplaced. If this is the case, withdraw the device completely and reattempt insertion. When withdrawing, remove the needle and catheter together to prevent the bevel from cutting the catheter.
17. While holding the catheter in place, pull the needle out. Use your thumb to stop any leak (*Figure 2f*).
18. To obtain a fluid sample attach the 60 ml syringe to the catheter and aspirate to obtain ascitic fluid and distribute it to the specimen vials (*Figure 2g*).
19. Connect one end of the collection tubing to the catheter and the other to the drainage container or bag (*Figure 2h*).
20. The catheter can be secured in place using a sterile gauze square and tape as illustrated (*Figure 2i*).
21. The catheter can be left to drain until up to 5 litres have been obtained. The patient should be observed and blood pressure and pulse checked regularly.
22. Once the desired volume of ascitic fluid has been drained the catheter is removed.
23. Apply firm pressure to stop any bleeding. Place an occlusive dressing over the skin puncture site to prevent leakage.
24. The patient should be observed following the procedure. In the authors' experience it is possible to discharge patients following drainage of malignant ascites after 45–60 minutes observation. If a large volume of fluid has been drained patients should be warned to watch for symptoms of postural hypotension, reduced urine output or infection.

Complications

Although there are a number of potential complications serious events such as haemoperitoneun or bowel perforation are thought to occur in less than 1 in 1000 procedures (Runyon, 2004) and there were no deaths or infections in a series of 229 procedures (Runyon, 1986). Complications include:

- Haemorrhage: A retrospective study identified a 2% incidence of haemorrhagic complications requiring hospitalization and transfusion (Webster et al, 1996). The patients were at relatively high risk as all had cirrhosis and portal hypertension. The rate is likely to be much lower in other patient groups.
- Secondary peritonitis
- Bowel perforation
- Hypotension
- Patient discomfort
- Protein loss
- Dehydration
- Re-accumulation of fluid.

Infection: spontaneous bacterial peritonitis

Infection of the ascitic fluid without intra-abdominal infection usually occurs in patients with chronic liver disease as a result of translocation of enteric bacteria. Common pathogens include *Escherichia coli*, *Klebsiella pneumoniae*, enterococcal species, and *Streptococcus pneumoniae*. An ascitic fluid polymorphonuclear cell count of greater than 250 cells/μl, with the percentage of polymorphonuclear cells greater than 50%, is presumptive evidence of spontaneous bacterial peritonitis. Patients whose levels meet these criteria should be treated empirically, regardless of symptoms.

Other methods of dealing with ascites

In general malignant ascites remains refractory to medical management (Adam and Adam, 2004). The situation differs in non-malignant ascites where oral diuretics and sodium restriction have a role to play (Smith and Jayson, 2003).

To overcome the problems of frequently repeated paracentesis indwelling peritoneal catheters were developed draining ascitic fluid directly into a large vein. There are two main types of peritoneo-venous shunt, LeVeen and the Denver shunt. Insertion is complicated and usually needs to be done under general anaesthetic with intensive monitoring for the first 24–48 hours in a high dependency unit.

Conclusions

Most of the research concerning the management of ascites has been carried out in cases of chronic liver disease as these provide the majority of cases. Extrapolation to the setting of malignancy should therefore be made with care. **BJHM**

Conflict of interest: none.

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KEY POINTS

- Paracentesis is a simple, quick, and safe procedure for diagnosis or removal of ascites.
- It appears that rapid drainage of up to 5 litres of fluid can be performed safely.
- It can be performed as an outpatient procedure.