Evaluation of adults with ascites

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INTRODUCTION

Accumulation of fluid within the peritoneal cavity results in ascites. In the United States, ascites is most often due to portal hypertension resulting from cirrhosis. Other common causes include malignancy and heart failure. Successful treatment of ascites depends upon an accurate diagnosis of its cause (table 1 and table 2 and table 3 and algorithm 1) [1].

This topic will review the evaluation of adults with ascites. Performance of paracentesis, specific causes of ascites, the initial therapy of ascites in patients with cirrhosis, and the treatment of refractory ascites are discussed in detail separately. (See "Diagnostic and therapeutic abdominal paracentesis" and "Malignancy-related ascites" and "Chylous, bloody, and pancreatic ascites" and "Abdominal tuberculosis" and "Ascites in adults with cirrhosis: Initial therapy" and "Ascites in adults with cirrhosis: Diuretic-resistant ascites".)

The American Association for the Study of Liver Diseases (AASLD) has updated its practice guidance on the management of adult patients with ascites due to cirrhosis [2]. The discussion that follows is generally consistent with that guidance.

ETIOLOGY

There are numerous causes of ascites, but the most common cause of ascites in the United States is cirrhosis, which accounts for approximately 80 percent of cases (table 1) [3]. Up to 19 percent of patients with cirrhosis will have hemorrhagic ascites, which may develop

spontaneously (72 percent probably due to bloody lymph and 13 percent due to hepatocellular carcinoma) or following paracentesis [4]. Other common causes of ascites include malignancy-related ascites and ascites due to heart failure.

Ascites can be classified based on the underlying pathophysiology [5]:

- Portal hypertension
  - Cirrhosis (see "Pathogenesis of ascites in patients with cirrhosis")
  - Alcoholic hepatitis (see "Alcoholic hepatitis: Clinical manifestations and diagnosis")
  - Acute liver failure (see "Acute liver failure in adults: Etiology, clinical manifestations, and diagnosis", section on 'Clinical manifestations')
  - Hepatic veno-occlusive disease (eg, Budd-Chiari syndrome) (see "Budd-Chiari syndrome: Epidemiology, clinical manifestations, and diagnosis", section on 'Clinical manifestations' and "Hepatic sinusoidal obstruction syndrome (veno-occlusive disease) in adults", section on 'Clinical presentation')
  - Heart failure (see "Pathophysiology of heart failure with reduced ejection fraction: Hemodynamic alterations and remodeling", section on 'Pressure-volume relationships in HF')
  - Constrictive pericarditis (see "Constrictive pericarditis: Clinical features and causes", section on 'Pathophysiology' and "Constrictive pericarditis: Clinical features and causes", section on 'Incidence and causes')
  - Hemodialysis-associated ascites (nephrogenic ascites) (see "Unique aspects of gastrointestinal disease in patients on dialysis", section on 'Hemodialysis-associated ascites')
- Hypoalbuminemia
  - Nephrotic syndrome (see "Overview of heavy proteinuria and the nephrotic syndrome", section on 'Pathophysiology')
  - Protein-losing enteropathy
  - Severe malnutrition
- Peritoneal disease

- Malignant ascites (eg, ovarian cancer, mesothelioma) (see "Malignancy-related ascites", section on 'Etiology and pathogenesis').
- Infectious peritonitis (eg, tuberculosis or fungal infection) (see "Abdominal tuberculosis" and "Fungal peritonitis in peritoneal dialysis").
- Eosinophilic gastroenteritis (see "Eosinophilic gastrointestinal diseases", section on 'Serosal disease').
- Starch granulomatous peritonitis.
- Peritoneal dialysis (see "Clinical manifestations and diagnosis of peritonitis in peritoneal dialysis").
- Multicystic mesothelioma (peritoneal inclusion cysts) [6] (see "Malignant peritoneal mesothelioma: Epidemiology, risk factors, clinical presentation, diagnosis, and staging", section on 'Multicystic mesothelioma').

- Other etiologies

  - Chylous ascites (see "Chylous, bloody, and pancreatic ascites", section on 'Chylous ascites')
  - Pancreatic ascites (eg, from a disrupted pancreatic duct) (see "Chylous, bloody, and pancreatic ascites", section on 'Pancreatic ascites')
  - Myxedema (see "Clinical manifestations of hypothyroidism", section on 'Gastrointestinal disorders')
  - Hemoperitoneum (see "Chylous, bloody, and pancreatic ascites", section on 'Bloody ascites')
  - Urologic injury (See "Urinary tract injury in gynecologic surgery: Identification and management".)

There is also long list of rare causes of ascites that includes disorders such as abdominal pregnancy, Whipple disease, and sarcoidosis (table 2) [7-39].

Approximately 5 percent of patients with ascites have more than one cause, such as cirrhosis plus one of the following: tuberculosis peritonitis, peritoneal carcinomatosis, heart failure, or diabetic nephropathy [40]. Obesity-related complications (including diabetic nephropathy, heart failure, and cirrhosis due to nonalcoholic steatohepatitis) commonly coexist as causes of ascites. Patients with more than one cause for ascites formation are often the most difficult to diagnose because each partial cause may not be severe enough in-and-of itself to lead to fluid retention; it is the combination of partial causes that leads to ascites formation.

CLINICAL MANIFESTATIONS

Patients with ascites typically have abdominal distension that may be associated with symptoms such as abdominal discomfort, shortness of breath, and weight gain. In addition, signs and symptoms related to the underlying cause of the ascites, such as cirrhosis or malignancy, may also be seen.

Symptoms — Patients with ascites typically report progressive abdominal distension that may be painless or associated with abdominal discomfort. The time course over which the distension develops depends on the etiology of the ascites. It may develop over the course of days (eg, bloody ascites due to trauma) or months (eg, malignant ascites). Ascites due to cirrhosis and/or alcoholic hepatitis usually develops rapidly over a few weeks. Patients may also complain of weight gain, shortness of breath, early satiety, and dyspnea resulting from fluid accumulation and increased abdominal pressure. Patients with spontaneous bacterial peritonitis may also have symptoms such as fever, abdominal tenderness, and altered mental status. (See "Spontaneous bacterial peritonitis in adults: Clinical manifestations", section on 'Clinical manifestations'.)

Patients with cirrhosis may have other symptoms associated with hepatic decompensation, such as confusion or evidence of gastrointestinal bleeding. Patients with malignant ascites may have symptoms related to the underlying malignancy, such as weight loss, whereas patients with ascites due to heart failure may report dyspnea, orthopnea, and peripheral edema. Patients with chylous ascites may report diarrhea and steatorrhea, malnutrition, edema, nausea, enlarged lymph nodes, early satiety, fevers, and night sweats [41-44]. (See "Cirrhosis in adults: Overview of complications, general management, and prognosis", section on 'Major complications' and "Malignancy-related ascites", section on 'Etiology and pathogenesis' and "Chylous, bloody, and pancreatic ascites", section on 'Clinical manifestations' and "Heart failure: Clinical manifestations and diagnosis in adults", section on 'Clinical presentation'.)

Physical examination — Patients with ascites, regardless of the etiology, will typically have flank dullness on examination [45]. Patients may also have shifting dullness (a change in the location of dullness to percussion when the patient is turned due to movement of the ascites). We do not check for an abdominal fluid wave because the maneuver requires two examiners and is often not accurate. If pleural effusions are present, the right effusion is usually greater than the left. Pleural effusions are manifested by decreased breath sounds or dullness to percussion.

Almost all patients with cirrhosis severe enough to lead to ascites formation have stigmata of cirrhosis on physical examination. Stigmata that suggest the presence of cirrhosis include spider angioma, palmar erythema, and abdominal wall collaterals. Spider angiomata are most apparent on the face, neck, shoulders, and upper chest, and are unusual below the umbilicus.

The palmar erythema of cirrhosis is "blotchy" and most prominent on the hypothenar eminence and next most prominent on the thenar eminence, with sparing of the center of the palm. However, spider angiomata and palmar erythema may be difficult to detect in patients with dark skin. Abdominal wall collaterals are most apparent starting at the umbilicus and extending cephalad. The appearance is thought by some to resemble the head of the mythical Gorgon Medusa; however, the recanalized umbilical vein enlarges the veins cephalad, not caudad, from the umbilicus. (See "Cirrhosis in adults: Etiologies, clinical manifestations, and diagnosis", section on 'Clinical manifestations'.)

Many patients with advanced liver disease also have jaundice, muscle wasting, gynecomastia, and leukonychia (white nails). The lunula of the nail may be enlarged with a terminal red line. The liver and spleen may be palpable. Parotid enlargement may be present but is probably due to alcohol and not cirrhosis per se.

An umbilical nodule that is not bowel or omentum (ie, a Sister Mary Joseph nodule) provides evidence for cancer as the cause of ascites. Gastric cancer, colon cancer, hepatocellular carcinoma, or lymphoma can cause ascites accompanied by an umbilical nodule.

If the ascites is the result of heart failure, physical examination findings may include jugular venous distension, pulmonary congestion, or peripheral edema. An elevated jugular venous pressure suggests that heart failure or constrictive pericarditis may be the cause (or at least one cause) of ascites. On the other hand, cirrhosis in the absence of tense ascites, pulmonary hypertension, or renal insufficiency is associated with no jugular venous distension. (See "Heart failure: Clinical manifestations and diagnosis in adults", section on 'Physical examination'.)

Findings that may be present on physical examination in patients with chylous ascites include lower extremity edema, lymphadenopathy, cachexia, abdominal masses, and temporal wasting [46].

Laboratory tests — Laboratory test abnormalities seen in patients with ascites are related to the underlying cause of the ascites. Patients with cirrhosis or heart failure may have abnormal liver tests and evidence of renal failure. Patients with cirrhosis may also have an elevated international normalized ratio, hypoalbuminemia, thrombocytopenia, anemia, and leukopenia. Patients who have developed spontaneous bacterial peritonitis may have a leukocytosis, metabolic acidosis, and azotemia. (See "Cirrhosis in adults: Etiologies, clinical manifestations, and diagnosis", section on 'Laboratory findings' and "Determining the etiology and severity of heart failure or cardiomyopathy", section on 'Initial blood tests' and "Spontaneous bacterial peritonitis in adults: Clinical manifestations", section on 'Laboratory abnormalities'.)

Patient with chylous ascites may have hypoalbuminemia, decreased gamma globulin levels, and lymphopenia. (See "Chylous, bloody, and pancreatic ascites", section on 'Clinical manifestations'.)

DIAGNOSIS

The diagnosis of ascites is established with a combination of physical examination and abdominal imaging (usually ultrasonography). Once the diagnosis of ascites is made, the next step is to look for the cause. This typically includes a paracentesis to evaluate the ascitic fluid. (See 'Determining the cause of the ascites' below.)

A grading system for ascites has been proposed by the International Ascites Club [47]:

- Grade 1 – Mild ascites detectable only by ultrasound examination
- Grade 2 – Moderate ascites manifested by moderate symmetrical distension of the abdomen
- Grade 3 – Large or gross ascites with marked abdominal distension

However, the validity of the grading system has not yet been established. In particular, data on the natural history of "grade 1" ascites are limited [48-50]. In an observational study including 547 patients with cirrhosis with median follow up of 29 months, there was no significant difference in rates of developing overt ascites for patients with grade 1 ascites compared with no ascites [50].

An older system that grades ascites from 1+ to 4+ is also used. In this system 1+ is minimal and barely detectable, 2+ is moderate, 3+ is massive but not tense, and 4+ is massive and tense [51].

History and physical examination — Ascites is frequently suspected based upon the history and physical examination. The most helpful physical finding in confirming the presence of ascites is flank dullness [45]. When flank dullness is detected, it is useful to see if it shifts with rotation of the patient (ie, shifting dullness).

However, the accuracy of physical findings is variable depending in part upon the amount of fluid present, the technique used to examine the patient, and the clinical setting (eg, detection may be more difficult in patients who are obese). In a study comparing various physical findings with ultrasound as the gold standard, the sensitivity and specificity of the physical examination for detecting ascites ranged from 50 to 94 percent and 29 to 82 percent, respectively [45].

Imaging tests — Patients suspected of having ascites based on history and physical examination should undergo imaging to confirm the presence of ascites and to look for

evidence of cirrhosis or malignancy. Ultrasound is probably the most cost-effective modality [52]. Pocket-sized inexpensive machines are available that sync with smart phones. These may dramatically increase use of this modality.

Another advantage of ultrasound is that it involves no radiation or intravenous access, and no risk of contrast allergy or nephropathy. If a computed tomographic (CT) scan is performed, ascites is easily seen (image 1).

The usual liver ultrasound focuses attention on the gallbladder and does not examine the spleen. Specifically ordering a "complete abdominal ultrasound" is more likely to provide the needed information. The details of the ordering should be coordinated with the local imaging team.

In patients with cirrhosis, ultrasound, CT, or magnetic resonance imaging (MRI) may reveal evidence of a nodular liver. Ultrasound findings in patients with portal hypertension may include dilation of the portal vein to ≥13 mm, dilation of the splenic and superior mesenteric veins to ≥11 mm, reduction in portal venous blood flow velocity, splenomegaly (greatest dimension >12 cm), and recanalization of the umbilical vein [53,54]. (See "Cirrhosis in adults: Etiologies, clinical manifestations, and diagnosis", section on 'Radiologic findings'.)

Ultrasound may also reveal evidence of hepatocellular carcinoma, which can be further evaluated with CT or MRI. (See "Approach to the adult patient with an incidental solid liver lesion".)

Paracentesis — Abdominal paracentesis is central to determining the cause of ascites and in ruling out or confirming spontaneous bacterial peritonitis (SBP). In patients with SBP, mortality increases by 3.3 percent/hour of delay in performing a paracentesis [55]. (See 'Determining the cause of the ascites' below.)

The performance of paracentesis is discussed in detail elsewhere. (See "Diagnostic and therapeutic abdominal paracentesis".)

DIFFERENTIAL DIAGNOSIS

The differential diagnosis of ascites includes abdominal obesity, giant ovarian or mesenteric cyst, and bowel obstruction (mechanical or functional). Obesity decreases the accuracy of the abdominal examination [56]. These entities can typically be differentiated from ascites based on physical examination findings and abdominal imaging. (See "Etiologies, clinical manifestations,

and diagnosis of mechanical small bowel obstruction in adults" and "Postoperative ileus" and "Acute colonic pseudo-obstruction (Ogilvie's syndrome)" and "Sigmoid volvulus".)

The description of the onset of symptoms may be helpful for distinguishing obesity from ascites. Patients frequently seek medical attention within a few weeks of ascites development. The fluid usually accumulates rapidly, and patients are intolerant of the distension and the associated early satiety and shortness of breath. By contrast, the thickening abdominal wall and enlarging omentum associated with obesity develop over months or years.

DETERMINING THE CAUSE OF THE ASCITES

Abdominal paracentesis is crucial for determining the cause of a patient's ascites, though physical examination findings and abdominal imaging may suggest a cause for a patient's ascites, such as cirrhosis, malignancy, or heart failure. Abdominal paracentesis is indicated for all patients with new onset ascites (table 4) [57]. (See 'Physical examination' above and 'Imaging tests' above and "Diagnostic and therapeutic abdominal paracentesis".)

General approach — The tests that are ordered on samples of ascitic fluid are determined by the clinical setting (table 3 and algorithm 1). Two of the main issues that arise regarding ascites are:

- Is the fluid infected?
- Is portal hypertension present?

The routine tests to answer these questions are ordered on the first ascitic fluid sample. Additional tests may be indicated based on the clinical setting and results of initial testing. (See 'Other ascitic fluid tests' below and 'Additional testing based on ascitic fluid analysis' below.)

Initial tests that should be performed on the ascitic fluid include (see 'Initial ascitic fluid tests' below):

- Appearance assessment (eg, clear, bloody, cloudy, milky).
- Serum-to-ascites albumin gradient determination (SAAG) (table 5).
- Cell count and differential.
- Total protein concentration.

Additional tests that may be performed to aid in confirming a diagnosis include (see 'Other ascitic fluid tests' below):

- Culture with bedside inoculation of aerobic and anaerobic blood culture bottles (infection, bowel perforation)
- Glucose concentration (malignancy, infection, bowel perforation)
- Lactate dehydrogenase concentration (malignancy, infection, bowel perforation)
- Gram stain (suspected bowel perforation)
- Amylase concentration (pancreatic ascites or bowel perforation)
- Tuberculosis smear, culture, and adenosine deaminase activity (tuberculous peritonitis)
- Cytology and possibly carcinoembryonic antigen level (malignancy)
- Triglyceride concentration (chylous ascites)
- Bilirubin concentration (bowel or biliary perforation)
- Serum pro-brain natriuretic peptide (heart failure)

These additional tests may be performed with the initial paracentesis if there is clinical suspicion for a particular disorder, or they may be performed on a subsequent paracentesis based on the results of initial testing.

Initial ascitic fluid tests — The routine tests ordered on ascitic fluid samples include an analysis of the appearance, serum-to-ascites albumin gradient, cell count and differential, culture, and total protein (table 3 and algorithm 1).

Appearance — The gross appearance of the ascitic fluid can be helpful in the differential diagnosis. Clear fluid is typically seen in the setting of cirrhosis, turbid or cloudy fluid in the setting of infection, milky fluid in the setting of chylous ascites, and bloody fluid in the setting of malignancy or a traumatic paracentesis.

- **Clear** – Uncomplicated ascites in the setting of cirrhosis is usually translucent yellow; it can be completely clear if the bilirubin is normal and the protein concentration is very low.

- **Turbid or cloudy** – Spontaneously infected fluid is frequently turbid or cloudy. A study of 916 samples demonstrated that an "abnormal ascitic fluid appearance" as defined as hazy, cloudy, or bloody was 98 percent sensitive, but only 23 percent specific in detecting spontaneous bacterial peritonitis [58].

- **Opalescent** – Infrequently, ascitic fluid in the setting of cirrhosis is "opalescent" and has a slightly elevated triglyceride concentration [59]. This peculiarity does not seem to have clinical significance except to explain the opalescence, which can be misinterpreted as "pus."

- **Milky** – Milky fluid usually has a triglyceride concentration that exceeds the serum concentration, is greater than 200 mg/dL (2.26 mmol/L), and is often greater than 1000

mg/dL (11.3 mmol/L); such specimens are referred to as "chylous ascites" [41]. A study performed in a tertiary referral center reported that malignancy was the most common cause of chylous ascites; however, this probably represented selection bias [41]. By contrast, a prospective study performed in large general hospitals documented that cirrhosis caused 10 times as many cases of chylous ascites as malignancy [40]. Approximately 1 out of 200 patients (0.5 percent) with cirrhosis has chylous ascites in the absence of cancer [60]. (See "Chylous, bloody, and pancreatic ascites".)

- **Pink or bloody (and corrected neutrophil count)** – Pink fluid usually has a red cell concentration of >10,000 per mm^3. Frankly bloody fluid has a red cell count of tens of thousands per mm^3. Most bloody samples are due to a "traumatic tap" with trivial leakage of subcutaneous blood during the tap. In this setting, the fluid is heterogeneously bloody with clearance of the red color during the tap and clotting of the specimen if the sample is not promptly placed into the anticoagulant tube. If the fluid appears to be homogeneously bloody, the bleeding probably occurred long before the current tap with subsequent clot lysis and distribution of the red cells throughout the abdominal cavity. A rapid repeat paracentesis entering the other side of the abdomen can confirm that the fluid is homogeneously bloody.

  The differential diagnosis in this setting is bloody ascites due to cirrhosis, leakage of blood from a punctured collateral (eg, from a previous tap), or malignancy [61,62]. Of samples obtained from patients with cirrhosis, approximately 5 percent were bloody in one study [61]. Of the bloody samples, 41 percent were "spontaneous" and probably related to bloody lymph, 34 percent were due to bleeding hepatocellular carcinoma, 22 percent due to traumatic tap, and 3 percent due to tuberculous peritonitis [61]. Careful paracentesis technique minimizes the risk of puncturing a collateral vein or artery. (See "Diagnostic and therapeutic abdominal paracentesis".)

  Ascites is bloody in approximately 50 percent of patients with hepatocellular carcinoma [61-63] and in 22 percent of malignancy-related ascites overall [63]. Patients with hepatocellular carcinoma can develop massive intra-abdominal bleeding with hemodynamic instability and rapid death; embolization of the bleeding vessel by an interventional radiologist can be effective in stopping the bleeding [62,64]. Such patients rarely qualify for liver transplantation due to advanced tumor stage and intraperitoneal spread. (See "Malignancy-related ascites".)

  Contrary to popular belief, tuberculous peritonitis is rarely bloody [61]. (See "Abdominal tuberculosis".)

- **Brown** – Deeply jaundiced patients have brown ascitic fluid with a bilirubin concentration approximately 40 percent of the serum value [65]. If the ascitic fluid is as brown as molasses and the bilirubin concentration is greater than the serum value, the patient likely has a ruptured gallbladder or perforated duodenal ulcer [65].

Serum-to-ascites albumin gradient — The serum-to-ascites albumin gradient (SAAG) accurately identifies the presence of portal hypertension and is more useful than the protein-based exudate/transudate concept (table 3 and table 5 and algorithm 1) [40,66]. The SAAG is easily calculated by subtracting the ascitic fluid albumin value from the serum albumin value, which should be obtained the same day. The SAAG generally does not need to be repeated after the initial measurement.

- The presence of a gradient ≥1.1 g/dL (≥11 g/L) predicts that the patient has portal hypertension with 97 percent accuracy [40].
- A gradient <1.1 g/dL (<11 g/L) indicates that the patient does not have portal hypertension [40].

The SAAG will be elevated with any disorder leading to portal hypertension and is not specific to ascites due to cirrhosis (table 5). Other testing may be needed to differentiate cirrhotic from noncirrhotic portal hypertension. Additional testing will depend upon the clinical setting and may include an evaluation for heart failure, hepatic metastases, or Budd-Chiari syndrome.

Patients with ascites due to heart failure can narrow their gradient during diuresis, whereas the SAAG in the setting of cirrhosis remains stable unless blood pressure or portal pressure decreases significantly.

Cell count and differential — The cell count with differential is the single most useful test performed on ascitic fluid to evaluate for infection and should be ordered on every specimen, including therapeutic paracentesis specimens (ie, a paracentesis being performed as part of the treatment of ascites). Ascitic fluid infection is a reversible cause of deterioration and a preventable cause of death in patients with cirrhosis and ascites. The key to survival is early detection and treatment [57,67]. The cell count should be available within one hour, while the culture takes several hours to days [68,69]. Antibiotic treatment should be considered in any patient with a corrected neutrophil count ≥250/mm^3 [57,67,69].

The fluid should be submitted to the lab in a tube containing an anticoagulant to avoid clotting (usually EDTA—"purple top" tube). Rapid turn-around may require a "stat" order. Some laboratories prioritize routine peripheral blood tests over the processing of ascitic fluid cell counts, and a call should be placed to the laboratory if the result is not rapidly available. If the

results are delayed or if the clinician fails to follow-up on the cell count in a timely manner, infection may not be diagnosed until is at an advanced, and possibly fatal, stage.

The white blood cell and neutrophil counts need to be corrected in patients with bloody samples. One white blood cell should be subtracted from the white blood cell count for every 750 red blood cells to yield the "corrected white blood cell count," and one neutrophil should be subtracted from the absolute neutrophil count for every 250 red blood cells to yield the "corrected neutrophil count" [70]. In bloody ascites, the corrected neutrophil count is frequently <0 due to remote hemorrhage with lysis of neutrophils. (See 'Appearance' above and "Spontaneous bacterial peritonitis in adults: Diagnosis".)

Total protein concentration — Ascitic fluid can be classified as an exudate if the total protein concentration is ≥2.5 or 3 g/dL and a transudate if it is below this cutoff. However, the exudate/transudate system of ascitic fluid classification has been replaced by the SAAG, which is a more useful measure for determining whether portal hypertension is present [40]. (See 'Serum-to-ascites albumin gradient' above.)

Despite its problems, the ascitic fluid total protein concentration remains of some value. This parameter does not change with development of spontaneous bacterial peritonitis (SBP), and patients with a value less than 1 g/dL have a high risk of SBP [71,72]. Selective intestinal decontamination may help prevent SBP in patients with low protein ascites [73]. (See "Spontaneous bacterial peritonitis in adults: Treatment and prophylaxis", section on 'Prophylaxis'.)

Measurement of total protein, glucose, and lactate dehydrogenase (LDH) in ascites may also be of value in distinguishing SBP from bowel perforation into ascites [74,75]. Patients with ascitic fluid that has a corrected neutrophil count ≥250 cells/mm^3 and meets two out of the following three criteria are unlikely to have SBP and warrant immediate evaluation to determine if bowel perforation into ascites has occurred [74,75]:

- Total protein >1 g/dL
- Glucose <50 mg/dL (2.8 mmol/L)
- LDH greater than the upper limit of normal for serum

The total protein concentration may also help differentiate uncomplicated ascites from cirrhosis from cardiac ascites, both of which have a SAAG ≥1.1 g/dL (≥11 g/L). In the case of ascites from cirrhosis, the total protein is <2.5 g/dL (<25 g/L), whereas in cardiac ascites it is ≥2.5 g/dL (≥25 g/L).

In patients with nephrotic ascites, the SAAG is <1.1 g/dL (<11 g/L), and the total protein in the ascites of <2.5 g/dL (<25 g/L).

Other ascitic fluid tests — Other tests should be ordered in appropriate settings (table 3 and algorithm 1) [57]. These additional tests may be performed with the initial paracentesis if there is clinical suspicion for a particular disorder, or they may be performed on a subsequent paracentesis based on the results of initial testing. As a general rule, these tests are most useful when there is suspicion of something other than sterile ascites due to cirrhosis.

- **Culture** – Cultures of ascitic fluid should be obtained on specimens from patients who are being admitted to the hospital with ascites and those who deteriorate with fever, abdominal pain, azotemia, acidosis, or confusion [57]. By comparison, therapeutic paracentesis samples in patients without symptoms of infection do not need to be cultured [76,77].

  An adequate volume of ascitic fluid (generally 10 mL per bottle, but the amount varies according to the manufacturer of the bottle) should be inoculated into aerobic and anaerobic blood culture bottles at the bedside; this method is more sensitive for detecting bacterial growth in ascitic fluid than conventional culture methods [68]. Bedside inoculation of the blood culture bottles is preferable to delayed inoculation of the bottles in the microbiology laboratory [78]. (See "Spontaneous bacterial peritonitis in adults: Diagnosis".)

- **Glucose concentration** – The ascitic fluid glucose concentration is similar to that in serum unless glucose is being consumed in the peritoneal cavity by white blood cells or bacteria [71]. Malignant cells also consume glucose; thus, the concentration of glucose may be low in peritoneal carcinomatosis [63]. In the setting of bowel perforation (eg, perforated ulcer or diverticulum) into ascitic fluid, glucose may be undetectable [74,75].

- **Lactate dehydrogenase concentration** – Because lactate dehydrogenase (LDH) is a much larger molecule than glucose, it enters ascitic fluid less readily [79]. The ascitic fluid/serum (AF/S) ratio of LDH is approximately 0.4 in uncomplicated ascites due to cirrhosis. In SBP, the ascitic fluid LDH level rises such that the mean ratio approaches 1.0 [71]. If the LDH ratio is more than 1.0, LDH is being produced in or released into the peritoneal cavity, usually because of infection, bowel perforation, or tumor.

- **Gram stain** – Although a Gram stain of ascitic fluid is frequently ordered when SBP is suspected, careful inspection of the centrifuged sediment of 50 mL of ascites is only 10 percent sensitive in visualizing bacteria in early detected SBP [68,80], and a Gram stain of uncentrifuged fluid is positive in only 7 percent [68]. In one report, a Gram stain was

positive in only 31 of 796 fluid samples; sensitivity and specificity for SBP were estimated to be 10 and 98 percent, respectively [80]. Choice of antibiotics was changed in only one patient, while 16 of 31 positive samples occurred in patients without SBP and were thought to have represented contaminants.

Approximately 10,000 bacteria/mL are required for detection by Gram stain, while the median concentration of bacteria in SBP is only one organism/mL [68]. Thus, a Gram stain of ascitic fluid is analogous to a Gram stain of blood in bacteremia; it is only positive when there is an enormous colony count. The Gram stain is most helpful in ruling in free perforation of the bowel into ascites, in which case sheets of multiple bacterial forms can be seen (picture 1). A syringe or tube of fluid must be submitted to the laboratory in addition to the culture bottles when requesting a Gram stain.

- **Amylase concentration** – The mean ascitic fluid amylase concentration is about 100 int. units/L in uncomplicated ascites due to cirrhosis, and the AF/S ratio of amylase is approximately 0.4 [81]. The ascitic fluid amylase concentration rises above this level in the setting of pancreatitis or bowel perforation into ascites [75,81]. In pancreatic ascites, the ascitic fluid amylase concentration is approximately 2000 int. unit/L, and the AF/S ratio is approximately 6.0 [81]. (See "Chylous, bloody, and pancreatic ascites".)

- **Tests for tuberculous peritonitis** – A variety of tests have been used for the detection of tuberculous peritonitis. When there is high suspicion of tuberculous peritonitis, peritoneoscopy with mycobacterial culture and histology of a biopsied tubercle is the most rapid route to the diagnosis. (See "Abdominal tuberculosis".)

  - Direct smear – The direct smear of ascitic fluid has only 0 to 2 percent sensitivity for detecting mycobacteria [82]. We have not encountered a single true positive ascitic fluid Mycobacterial smear.

  - Culture – When one liter of fluid is cultured, sensitivity for Mycobacteria reportedly reaches 62 to 83 percent [82,83]. However, most laboratories can only process 50 mL of ascitic fluid for Mycobacterial culture.

  - Peritoneoscopy – Peritoneoscopy with culture of a biopsy specimen has a sensitivity for detecting tuberculous peritonitis that approaches 100 percent [84]. Fluid and tissue can be sent for PCR for tuberculosis [85].

  - Cell count – Tuberculous peritonitis can mimic the culture-negative variant of SBP, but mononuclear cells usually predominate in tuberculosis. (See "Spontaneous bacterial peritonitis variants".)

- Adenosine deaminase – Adenosine deaminase is a purine-degrading enzyme that is necessary for the maturation and differentiation of lymphoid cells. Adenosine deaminase activity of ascitic fluid has been proposed as a useful non-culture method of detecting tuberculous peritonitis; however, patients with tuberculous peritonitis who also have cirrhosis usually have falsely low values [84]. This test is useful in countries such as India, but it is of very limited utility in the United States because most patients in the United States with tuberculous peritonitis also have cirrhosis [84].

- **Cytology** – Almost 100 percent of patients with peritoneal carcinomatosis will have positive ascitic fluid cytology due to the presence of viable malignant cells exfoliating into the ascitic fluid [63]. However, only about two-thirds of patients with malignancy-related ascites have peritoneal carcinomatosis. The remaining patients have massive liver metastases, chylous ascites due to lymphoma, or hepatocellular carcinoma; these patients usually have negative cytology [63]. As a result, the overall sensitivity of cytology smears for the detection of malignant ascites is 58 to 75 percent [86,87]. Hepatomas rarely metastasize to the peritoneum [88,89]. (See "Malignancy-related ascites".)

  Some cytology laboratories prefer that specimens be submitted in alcohol fixative, while others prefer fresh unfixed specimens. It is best to coordinate this with the local laboratory to maximize the sensitivity of the cytology.

- **Carcinoembryonic antigen concentration** – Measurement of carcinoembryonic antigen (CEA) in ascitic fluid has been proposed as a helpful test in detecting malignancy-related ascites [90]. However, the study that validated CEA was small and did not subgroup patients based on the type of cancer. CEA may be of some utility in ascitic fluid analysis, but its precise value remains unclear.

- **Triglyceride concentration** – A triglyceride concentration should be obtained on ascitic fluid that is milky. Chylous ascites has a triglyceride content greater than 200 mg/dL (2.26 mmol/L) and usually greater than 1000 mg/dL (11.3 mmol/L) [41,60].

- **Bilirubin concentration** – The bilirubin concentration should be measured in patients with brown ascites. As mentioned above, an ascitic fluid bilirubin value greater than the serum suggests bowel or biliary perforation into ascites [65]. (See 'Appearance' above.)

- **Serum pro-brain natriuretic peptide concentration** – Measurement of pro-brain natriuretic peptide in serum can help distinguish ascitic fluid due to cirrhosis from ascitic fluid due to heart failure. In one report, median values were significantly higher in heart failure compared with cirrhosis, with very little overlap (6100 versus 166 pg/mL). Patients with both heart failure and cirrhosis have values in the heart failure range [91].

- **Useless tests** – Some tests of ascitic fluid appear to be useless. These include pH, lactate, and "humoral tests of malignancy" such as fibronectin, cholesterol, and many others [69,92].

Additional testing based on ascitic fluid analysis — Based on the results of the diagnostic evaluation of the ascitic fluid, additional testing may be indicated (algorithm 1). The diagnostic approaches to the disorders associated with ascites are discussed elsewhere:

- (See "Cirrhosis in adults: Etiologies, clinical manifestations, and diagnosis".)
- (See "Determining the etiology and severity of heart failure or cardiomyopathy".)
- (See "Noncirrhotic portal hypertension".)
- (See "Spontaneous bacterial peritonitis in adults: Diagnosis".)
- (See "Malignancy-related ascites".)
- (See "Chylous, bloody, and pancreatic ascites".)
- (See "Abdominal tuberculosis".)
- (See "Unique aspects of gastrointestinal disease in patients on dialysis", section on 'Hemodialysis-associated ascites'.)
- (See "Overview of heavy proteinuria and the nephrotic syndrome", section on 'Diagnosis'.)

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

- **Etiology** – There are numerous causes of ascites (table 1 and table 2), but the most common cause of ascites in the United States is cirrhosis. Other common causes of ascites include malignancy-related ascites and ascites due to heart failure. Approximately 5 percent of patients will have two or even three causes for ascites formation. (See 'Etiology' above.)

- **Clinical manifestations** – Patients with ascites typically report progressive abdominal distension that may be painless or associated with abdominal discomfort. The time course over which the distension develops depends upon the etiology of the ascites. It may develop over the course of days (eg, bloody ascites due to trauma) or months (eg, malignant ascites). Patients may also complain of weight gain, shortness of breath, early satiety, and dyspnea resulting from fluid accumulation and increased abdominal pressure. (See 'Symptoms' above.)

  Patients with ascites, regardless of the etiology, will typically have flank dullness on examination. Other findings include shifting dullness (a change in location of dullness to percussion when the patient is turned due to movement of the ascites) and/or evidence of pleural effusions (eg, decreased breath sounds or dullness to percussion). Patients may also have physical examination findings related to the underlying cause of the ascites, such as stigmata of cirrhosis. (See 'Physical examination' above.)

- **Diagnosis** – The diagnosis of ascites is established with a combination of physical examination and abdominal imaging (usually ultrasonography). Once the diagnosis of ascites is made, the next step is to look for the cause. This typically includes a paracentesis to evaluate the ascitic fluid. (See 'Diagnosis' above.)

- **Analyzing ascitic fluid** – Abdominal paracentesis is crucial for determining the cause of a patient's ascites and is indicated for all patients with new onset ascites (table 4). Analysis of the ascitic fluid can help determine if the fluid is infected and if it is due to portal hypertension or other causes (algorithm 1 and table 5). (See 'Determining the cause of the ascites' above.)

Initial tests that should be performed on the ascitic fluid include (table 3) (see 'Initial ascitic fluid tests' above):

- Appearance assessment (eg, clear, bloody, cloudy, milky)
- Serum-to-ascites albumin gradient determination
- Cell count and differential
- Total protein concentration

Additional tests that may be performed to aid in confirming a diagnosis include (table 3) (see 'Other ascitic fluid tests' above):

- Culture with bedside inoculation of aerobic and anaerobic blood culture bottles
- Glucose concentration (malignancy, infection, bowel perforation)
- Lactate dehydrogenase concentration (malignancy, infection, or bowel perforation)
- Gram stain (suspected bowel perforation)
- Amylase concentration (pancreatic ascites or bowel perforation)
- Tuberculosis smear, culture, and adenosine deaminase activity (tuberculous peritonitis)
- Cytology and possibly carcinoembryonic antigen level (malignancy)
- Triglyceride concentration (chylous ascites)
- Bilirubin concentration (bowel or biliary perforation)
- Serum pro-brain natriuretic peptide (heart failure)

REFERENCES

1. Runyon BA. Management of adult patients with ascites caused by cirrhosis. Hepatology 1998; 27:264.
2. Biggins SW, Angeli P, Garcia-Tsao G, et al. Diagnosis, Evaluation, and Management of Ascites, Spontaneous Bacterial Peritonitis and Hepatorenal Syndrome: 2021 Practice Guidance by the American Association for the Study of Liver Diseases. Hepatology 2021; 74:1014.
3. Runyon BA. Care of patients with ascites. N Engl J Med 1994; 330:337.
4. Urrunaga NH, Singal AG, Cuthbert JA, Rockey DC. Hemorrhagic ascites. Clinical presentation and outcomes in patients with cirrhosis. J Hepatol 2013; 58:1113.
5. Norton J. Greenberger. Ascites & spontaneous bacterial peritonitis. In: Current diagnosis & treatment: Gastroenterology, hepatology, & endoscopy, Second Edition, Norton J. Greenber ger (Ed), McGraw-Hill, New York 2012. p.515.

6. Vallerie AM, Lerner JP, Wright JD, Baxi LV. Peritoneal inclusion cysts: a review. Obstet Gynecol Surv 2009; 64:321.
7. Miedema EB, Bissada NK, Finkbeiner AE, Casali RE. Chylous ascites complicating retroperitoneal lymphadenectomy for testis tumors: management with peritoneovenous shunting. J Urol 1978; 120:377.
8. Müller-Schoop JW, Wang SP, Munzinger J, et al. Chlamydia trachomatis as possible cause of peritonitis and perihepatitis in young women. Br Med J 1978; 1:1022.
9. Ackerman Z. Ascites in Nephrotic syndrome. Incidence, patients' characteristics, and complications. J Clin Gastroenterol 1996; 22:31.
10. Wilkins KW Jr, Hoffman GS. Massive ascites in systemic lupus erythematosus. J Rheumatol 1985; 12:571.
11. Mauer K, Manzione NC. Usefulness of serum-ascites albumin difference in separating transudative from exudative ascites. Another look. Dig Dis Sci 1988; 33:1208.
12. Ryu JH, Doerr CH, Fisher SD, et al. Chylothorax in lymphangioleiomyomatosis. Chest 2003; 123:623.
13. Dees A, Kluchert SA, van Vliet AC. Pseudo-renal failure associated with internal leakage of urine. Neth J Med 1990; 37:197.
14. Cappell MS, Shetty V. A multicenter, case-controlled study of the clinical presentation and etiology of ascites and of the safety and clinical efficacy of diagnostic abdominal paracentesis in HIV seropositive patients. Am J Gastroenterol 1994; 89:2172.
15. Saab S, Rickman LS, Lyche KD. Ascites and the acquired immunodeficiency syndrome. Report of 54 cases. Medicine (Baltimore) 1996; 75:131.
16. Jamidar PA, Campbell DR, Fishback JL, Klotz SA. Peritoneal coccidioidomycosis associated with human immunodeficiency virus infection. Gastroenterology 1992; 102:1054.
17. Fábregues F, Balasch J, Ginès P, et al. Ascites and liver test abnormalities during severe ovarian hyperstimulation syndrome. Am J Gastroenterol 1999; 94:994.
18. Gregora MG, McNamara T. Ascites--an unusual association with pelvic inflammatory disease. Aust N Z J Obstet Gynaecol 1997; 37:477.
19. Ross JA, Hacket E, Lawton F, Jurkovic D. Massive ascites due to abdominal pregnancy. Hum Reprod 1997; 12:390.
20. el-Newihi HM, Antaki JP, Rajan S, Reynolds TB. Large bloody ascites in association with pelvic endometriosis: case report and literature review. Am J Gastroenterol 1995; 90:632.
21. Paspatis GA, Kissamitaki V, Kyriakakis E, et al. Ascites associated with the initial

presentation of Crohn's disease. Am J Gastroenterol 1999; 94:1974.

22. Bourantas KL, Christou LG, Dalekos GN, et al. A 54-year-old stockbreeder with ascites. Lancet 1997; 349:994.
23. Kapoor OP, Nathwani BN, Joshi VR. Amoebic peritonitis. A study of 73 cases. J Trop Med Hyg 1972; 75:11.
24. Peterkin IR, Lewandowski BJ. Salmonella enteritis: a cause for ascites. Am J Gastroenterol 1993; 88:1274.
25. Parikh VA, Edlund JW. Ascites associated with antibiotic-associated pseudomembranous colitis. South Med J 1997; 90:460.
26. Hui JY, Woo PC, Kan PS, Tang AP. A woman with ascites and abdominal masses. Lancet 2000; 355:546.
27. Alegre A, Martínez-Chamorro C, Fernández-Rañada JM. Massive myelomatous ascites responsive to VAD chemotherapy and autologous stem cell transplantation. Bone Marrow Transplant 1999; 24:343.
28. Shimoni A, Shvidel L, Shtalrid M, et al. Prolymphocytic transformation of B-chronic lymphocytic leukemia presenting as malignant ascites and pleural effusion. Am J Hematol 1998; 59:316.
29. Runyon BA, Hoefs JC. Peritoneal lymphomatosis with ascites. A characterization. Arch Intern Med 1986; 146:887.
30. Bonnet P, Smadja C, Szekely AM, et al. Intractable ascites in systemic mastocytosis treated by portal diversion. Dig Dis Sci 1987; 32:209.
31. Myers TJ, Kyle RA, Jacobson DR. Familial amyloid with a transthyretin leucine 33 mutation presenting with ascites. Am J Hematol 1998; 59:249.
32. Oren I, Goldman A, Haddad N, et al. Ascites and pleural effusion secondary to extramedullary hematopoiesis. Am J Med Sci 1999; 318:286.
33. Abarca M, Andrade RJ, García-Arjona A, et al. Portal hypertension and refractory ascites associated with multicentric Castleman's disease. Dig Dis Sci 2000; 45:697.
34. de Kerguenec C, Hillaire S, Molinié V, et al. Hepatic manifestations of hemophagocytic syndrome: a study of 30 cases. Am J Gastroenterol 2001; 96:852.
35. Loeb JM, Hauger PH, Carney JD, Cooper AD. Refractory ascites due to POEMS syndrome. Gastroenterology 1989; 96:247.
36. Iwai M, Kashiwadani M, Okuno T, et al. Cholestatic liver disease in a 20-yr-old woman with histiocytosis X. Am J Gastroenterol 1988; 83:164.

37. Imparato AM. Gaucher's Disease With Ascites: Response to Portacaval Shunt. Ann Surg 1960; 151:431.
38. West GA, Berger MS, Geyer JR. Childhood optic pathway tumors associated with ascites following ventriculoperitoneal shunt placement. Pediatr Neurosurg 1994; 21:254.
39. Isenberg JI, Gilbert SB, Pitcher JL. Ascites with peritoneal involvement in Whipple's disease. Report of a case. Gastroenterology 1971; 60:305.
40. Runyon BA, Montano AA, Akriviadis EA, et al. The serum-ascites albumin gradient is superior to the exudate-transudate concept in the differential diagnosis of ascites. Ann Intern Med 1992; 117:215.
41. Press OW, Press NO, Kaufman SD. Evaluation and management of chylous ascites. Ann Intern Med 1982; 96:358.
42. Steinemann DC, Dindo D, Clavien PA, Nocito A. Atraumatic chylous ascites: systematic review on symptoms and causes. J Am Coll Surg 2011; 212:899.
43. Browse NL, Wilson NM, Russo F, et al. Aetiology and treatment of chylous ascites. Br J Surg 1992; 79:1145.
44. Aalami OO, Allen DB, Organ CH Jr. Chylous ascites: a collective review. Surgery 2000; 128:761.
45. Cattau EL Jr, Benjamin SB, Knuff TE, Castell DO. The accuracy of the physical examination in the diagnosis of suspected ascites. JAMA 1982; 247:1164.
46. Cárdenas A, Chopra S. Chylous ascites. Am J Gastroenterol 2002; 97:1896.
47. Moore KP, Wong F, Gines P, et al. The management of ascites in cirrhosis: report on the consensus conference of the International Ascites Club. Hepatology 2003; 38:258.
48. European Association for the Study of the Liver. Electronic address: easloffice@easloffice.eu, European Association for the Study of the Liver. EASL Clinical Practice Guidelines for the management of patients with decompensated cirrhosis. J Hepatol 2018; 69:406.
49. European Association for the Study of the Liver. EASL clinical practice guidelines on the management of ascites, spontaneous bacterial peritonitis, and hepatorenal syndrome in cirrhosis. J Hepatol 2010; 53:397.
50. Tonon M, Piano S, Gambino CG, et al. Outcomes and Mortality of Grade 1 Ascites and Recurrent Ascites in Patients With Cirrhosis. Clin Gastroenterol Hepatol 2021; 19:358.
51. Stanley MM, Ochi S, Lee KK, et al. Peritoneovenous shunting as compared with medical treatment in patients with alcoholic cirrhosis and massive ascites. Veterans Administration

Cooperative Study on Treatment of Alcoholic Cirrhosis with Ascites. N Engl J Med 1989; 321:1632.

52. Rudralingam V, Footitt C, Layton B. Ascites matters. Ultrasound 2017; 25:69.
53. Berzigotti A, Ashkenazi E, Reverter E, et al. Non-invasive diagnostic and prognostic evaluation of liver cirrhosis and portal hypertension. Dis Markers 2011; 31:129.
54. Aagaard J, Jensen LI, Sørensen TI, et al. Recanalized umbilical vein in portal hypertension. AJR Am J Roentgenol 1982; 139:1107.
55. Kim JJ, Tsukamoto MM, Mathur AK, et al. Delayed paracentesis is associated with increased in-hospital mortality in patients with spontaneous bacterial peritonitis. Am J Gastroenterol 2014; 109:1436.
56. Silk AW, McTigue KM. Reexamining the physical examination for obese patients. JAMA 2011; 305:193.
57. Runyon BA, AASLD Practice Guidelines Committee. Management of adult patients with ascites due to cirrhosis: an update. Hepatology 2009; 49:2087.
58. Chinnock B, Hendey GW. Can clear ascitic fluid appearance rule out spontaneous bacterial peritonitis? Am J Emerg Med 2007; 25:934.
59. Runyon BA, Akriviadis EA, Keyser AJ. The opacity of portal hypertension-related ascites correlates with the fluid's triglyceride concentration. Am J Clin Pathol 1991; 96:142.
60. Rector WG Jr. Spontaneous chylous ascites of cirrhosis. J Clin Gastroenterol 1984; 6:369.
61. DeSitter L, Rector WG Jr. The significance of bloody ascites in patients with cirrhosis. Am J Gastroenterol 1984; 79:136.
62. Akriviadis EA. Hemoperitoneum in patients with ascites. Am J Gastroenterol 1997; 92:567.
63. Runyon BA, Hoefs JC, Morgan TR. Ascitic fluid analysis in malignancy-related ascites. Hepatology 1988; 8:1104.
64. Kung CT, Liu BM, Ng SH, et al. Transcatheter arterial embolization in the emergency department for hemodynamic instability due to ruptured hepatocellular carcinoma: analysis of 167 cases. AJR Am J Roentgenol 2008; 191:W231.
65. Runyon BA. Ascitic fluid bilirubin concentration as a key to choleperitoneum. J Clin Gastroenterol 1987; 9:543.
66. Hoefs JC. Serum protein concentration and portal pressure determine the ascitic fluid protein concentration in patients with chronic liver disease. J Lab Clin Med 1983; 102:260.
67. Such J, Runyon BA. Spontaneous bacterial peritonitis. Clin Infect Dis 1998; 27:669.

68. Runyon BA, Canawati HN, Akriviadis EA. Optimization of ascitic fluid culture technique. Gastroenterology 1988; 95:1351.
69. Runyon BA, Antillon MR. Ascitic fluid pH and lactate: insensitive and nonspecific tests in detecting ascitic fluid infection. Hepatology 1991; 13:929.
70. Hoefs JC. Increase in ascites white blood cell and protein concentrations during diuresis in patients with chronic liver disease. Hepatology 1981; 1:249.
71. Runyon BA, Hoefs JC. Ascitic fluid chemical analysis before, during and after spontaneous bacterial peritonitis. Hepatology 1985; 5:257.
72. Runyon BA. Low-protein-concentration ascitic fluid is predisposed to spontaneous bacterial peritonitis. Gastroenterology 1986; 91:1343.
73. Soriano G, Guarner C, Teixidó M, et al. Selective intestinal decontamination prevents spontaneous bacterial peritonitis. Gastroenterology 1991; 100:477.
74. Runyon BA, Hoefs JC. Ascitic fluid analysis in the differentiation of spontaneous bacterial peritonitis from gastrointestinal tract perforation into ascitic fluid. Hepatology 1984; 4:447.
75. Akriviadis EA, Runyon BA. Utility of an algorithm in differentiating spontaneous from secondary bacterial peritonitis. Gastroenterology 1990; 98:127.
76. Kolle L, Ortiz J, Ricart E, et al. Ascitic fluid culture is not necessary in asymptomatic cirrhotic outpatients undergoing repeated therapeutic paracentesis (abstract). Hepatology 1996; 24:445A.
77. Jeffries MA, Stern MA, Gunaratnam NT, Fontana RJ. Unsuspected infection is infrequent in asymptomatic outpatients with refractory ascites undergoing therapeutic paracentesis. Am J Gastroenterol 1999; 94:2972.
78. Runyon BA, Antillon MR, Akriviadis EA, McHutchison JG. Bedside inoculation of blood culture bottles with ascitic fluid is superior to delayed inoculation in the detection of spontaneous bacterial peritonitis. J Clin Microbiol 1990; 28:2811.
79. Wilson JA, Suguitan EA, Cassidy WA, et al. Characteristics of ascitic fluid in the alcoholic cirrhotic. Dig Dis Sci 1979; 24:645.
80. Chinnock B, Fox C, Hendey GW. Gram's stain of peritoneal fluid is rarely helpful in the evaluation of the ascites patient. Ann Emerg Med 2009; 54:78.
81. Runyon BA. Amylase levels in ascitic fluid. J Clin Gastroenterol 1987; 9:172.
82. al Karawi MA, Mohamed AE, Yasawy MI, et al. Protean manifestation of gastrointestinal tuberculosis: report on 130 patients. J Clin Gastroenterol 1995; 20:225.
83. Singh MM, Bhargava AN, Jain KP. Tuberculous peritonitis. An evaluation of pathogenetic mechanisms, diagnostic procedures and therapeutic measures. N Engl J Med 1969;

281:1091.

84. Hillebrand DJ, Runyon BA, Yasmineh WG, Rynders GP. Ascitic fluid adenosine deaminase insensitivity in detecting tuberculous peritonitis in the United States. Hepatology 1996; 24:1408.
85. Anand BS, Schneider FE, El-Zaatari FA, et al. Diagnosis of intestinal tuberculosis by polymerase chain reaction on endoscopic biopsy specimens. Am J Gastroenterol 1994; 89:2248.
86. Cardozo PL. A critical evaluation of 3000 cytologic analyses of pleural fluid, ascitic fluid, and pericardial fluid. Acta Cyto 1966; 10:455.
87. DiBonito L, Falconieri G, Colautti I, et al. The positive peritoneal effusion. A retrospective study of cytopathologic diagnoses with autopsy confirmation. Acta Cytol 1993; 37:483.
88. Chetty R, Learmonth GM, Taylor DA. Giant cell hepatocellular carcinoma. Cytopathology 1990; 1:233.
89. Matsukuma S, Sato K. Peritoneal seeding of hepatocellular carcinoma: clinicopathological characteristics of 17 autopsy cases. Pathol Int 2011; 61:356.
90. Loewenstein MS, Rittgers RA, Feinerman AE, et al. Carcinoembryonic antigen assay of ascites and detection of malignancy. Ann Intern Med 1978; 88:635.
91. Sheer TA, Joo E, Runyon BA. Usefulness of serum N-terminal-ProBNP in distinguishing ascites due to cirrhosis from ascites due to heart failure. J Clin Gastroenterol 2010; 44:e23.
92. Runyon BA. Malignancy-related ascites and ascitic fluid "humoral tests of malignancy". J Clin Gastroenterol 1994; 18:94.

Topic 1261 Version 38.0

GRAPHICS

Causes of ascites

Cirrhosis	81 percent
Cancer	10 percent
Heart failure	3 percent
Tuberculosis	2 percent
Dialysis	1 percent
Pancreatic disease	1 percent

Other	2 percent

Data from: Runyon BA, Montano AA, Akriviadis EA, et al. Ann Intern Med 1992; 117:215.

Graphic 56069 Version 3.0

Rare causes of ascites

Infectious
Amebiasis
Ascariasis
Brucellosis
Chlamydia peritonitis
Complications related to HIV infection
Pelvic inflammatory disease
Pseudomembranous colitis
Salmonellosis
Whipple's disease
Hematologic
Amyloidosis
Castleman's syndrome
Extramedullary hematopoiesis
Hemophagocytic syndrome
Histiocytosis X
Leukemia
Lymphoma
Mastocytosis
Multiple myeloma
Miscellaneous
Abdominal pregnancy
Crohn's disease
Endometriosis
Gaucher's disease
Lymphangioleiomyomatosis
Myxedema
Nephrotic syndrome (in children, adults with nephrotic syndrome and ascites usually have another cause such as cirrhosis)
Operative lymphatic tear or ureteral injury

Ovarian hyperstimulation syndrome
POEMS syndrome
Systemic lupus erythematosus
Ventriculoperitoneal shunt

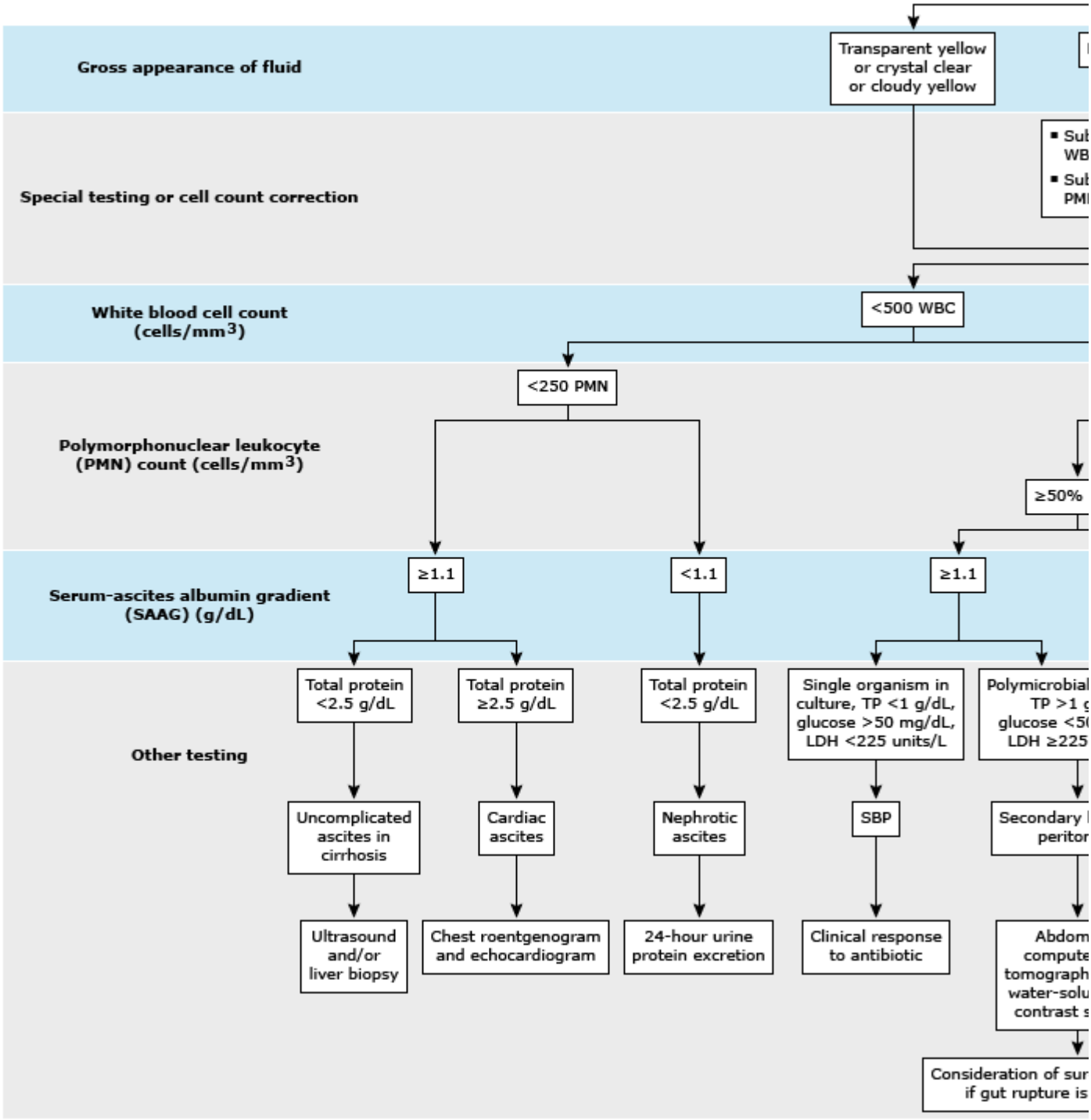
Graphic 51299 Version 1.0

Tests performed on ascitic fluid

Routine tests
Cell count and differential
Albumin concentration
Total protein concentration
Optional tests
Culture in blood culture bottles
Glucose concentration
Lactate dehydrogenase concentration
Gram stain
Amylase concentration
Unusual tests
Tuberculosis smear and culture
Adenosine deaminase activity
Cytology
Triglyceride concentration
Bilirubin concentration
Serum pro-brain natriuretic peptide
Carcinoembryonic antigen (CEA) concentration
Alkaline phosphatase concentration

Graphic 62032 Version 5.0

Differential diagnosis of ascites

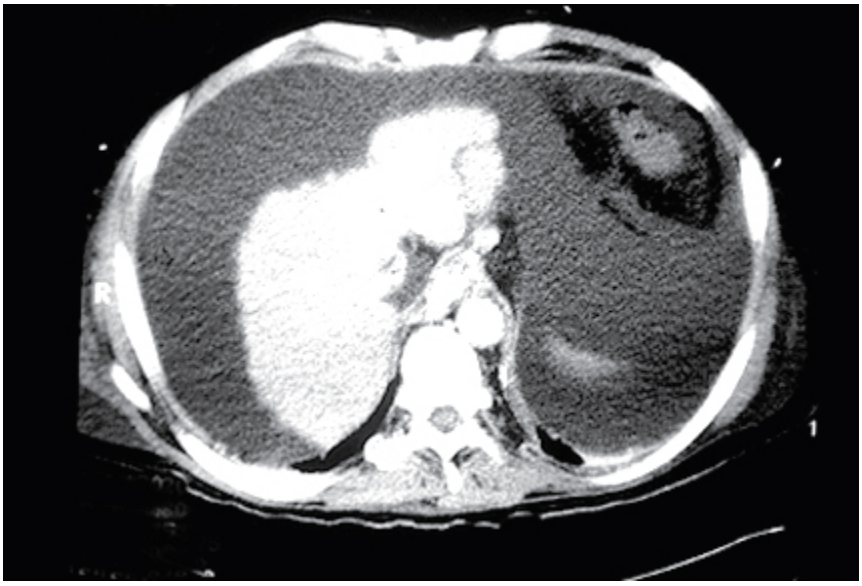


WBC: white blood cell; RBC: red blood cell; PMN: polymorphonuclear leukocyte; TP: total protein; LDH: lactat

Modified with permission from: Sleisenger & Fordtran's Gastrointestinal and Liver Disease: Pathophysiology/Diagnosis/Management, 2002 WB Saunders Company.

Graphic 77605 Version 3.0

Ascites



CT scan shows a large volume of ascitic fluid surrounding a small shrunken cirrhotic liver. The fluid is of low attenuation and is free floating without septations or solid material.

CT: computed tomography.

Courtesy of Jonathan Kruskal, MD.

Graphic 77598 Version 3.0

Indications for abdominal paracentesis in a patient with ascites

New onset ascites
At the time of each admission to the hospital
Clinical deterioration, either inpatient or outpatient
Fever
Abdominal pain
Abdominal tenderness
Mental status change
Ileus
Hypotension
Laboratory abnormalities that may indicate infection
Peripheral leukocytosis
Acidosis
Worsening of renal function
Gastrointestinal bleeding (a high risk time for infection)

Reference: Runyon BA, AASLD. Introduction to the revised American Association for the Study of Liver Diseases Practice Guideline management of adult patients with ascites due to cirrhosis 2012. Hepatology 2013; 57:1651.

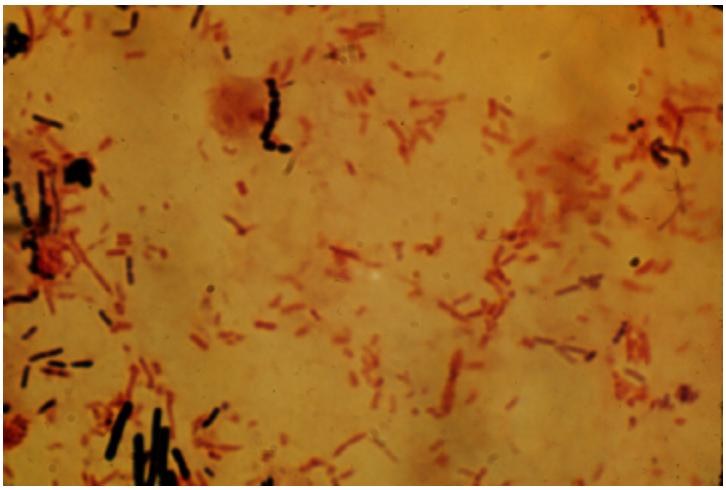
Graphic 64189 Version 3.0

Classification of ascites by the serum-to-ascites albumin gradient

High albumin gradient (SAAG ≥1.1 g/dL)
Cirrhosis
Alcoholic hepatitis
Heart failure
Massive hepatic metastases
Heart failure/constrictive pericarditis
Budd-Chiari syndrome
Portal vein thrombosis
Idiopathic portal fibrosis
Low albumin gradient (SAAG <1.1 g/dL)
Peritoneal carcinomatosis
Peritoneal tuberculosis
Pancreatitis
Serositis
Nephrotic syndrome

Graphic 81696 Version 5.0

Mixed flora in peritoneal fluid from a ruptured viscus



Gram stain of peritoneal fluid (x1000) shows several different organisms, including gram-positive cocci in chains, gram-positive rods, plump enteric gram-negative bacilli, and thinner gram-negative rods. Mixed fecal flora grew from this specimen.

Courtesy of Harriet Provine.

Graphic 77736 Version 3.0

Contributor Disclosures

Bruce A Runyon, MD, FAASLD No relevant financial relationship(s) with ineligible companies to disclose. **Keith D Lindor, MD** Consultant/Advisory Boards: Pliant [DSMB member]. All of the relevant financial relationships listed have been mitigated. **Kristen M Robson, MD, MBA, FACG** No relevant financial relationship(s) with ineligible companies to disclose.

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