World Journal of Pharmaceutical and Life Sciences
WJPLS
www.wjpls.org
SJIF Impact Factor: 7.409

CLINICAL PROSPECTIVE REVIEW ON ASCITES AND ITS TREATMENT BY PARACENTESIS

Khushi Pathak*, Shruti Rana and Dr. Pankti Dalwadi

SNME Campus, Naroda-Dahegam Road, Near Sardar Patel Ring Road, Daskroi, Ahmedabad District, Enasan, Gujarat 382330.

***Corresponding Author: Khushi Pathak**
SNME Campus, Naroda-Dahegam Road, Near Sardar Patel Ring Road, Daskroi, Ahmedabad District, Enasan, Gujarat 382330.

Article Received on 21/12/2024 **Article Revised on 11/01/2025** **Article Accepted on 31/01/2025**

ABSTRACT
Ascites is the pathological accumulation of ascitic fluid in the peritoneal cavity of the abdomen which is a common complication of cirrhosis. This review article explores the pathophysiology, etiology, diagnosis and management of ascites by both standard and advanced treatment emphasizing on paracentesis. Paracentesis is often used for the treatment of tense ascites with albumin infusion. Paracentesis provides diagnostic insights, effectively reduces ascitic fluid, and alleviates symptoms. Combining LVP with albumin infusion is widely recommended to prevent circulatory dysfunction and renal impairment by reducing the complications such as hyponatremia and hepatorenal syndrome and enhancing patient stability compared to diuretics alone. Generally, LVP is very safe and effective procedure but low risk of complication like hemorrage, local infection, abdominal wall hematomas and bowel perforation are present. Future directions in ascites management are also reviewed to provide a comprehensive understanding of optimizing care in advanced liver disease.

KEYWORDS: Ascites, Severity of Ascites, Paracentesis, Albumin as expanders, Complications.

INTRODUCTION

The term “ascites” is derived from the Greek term “*askos*” in reference to its similar appearance to a winebag or sac.[1]

Ascites is the abnormal pathologic accumulation of fluid (i.e. Ascitic Fluid) in the peritoneal cavity of the abdomen. It is most commonly seen in cirrhosis and occurs in about 50% of patient with decompensated cirrhosis in 10 years. The development of ascites denotes the transition from compensated to decompensated cirrhosis.[2]

Mortality ranges from 15% in a year to 44% in 5 years.[2] The development of ascites in the setting of cirrhosis represents a landmark in the natural history of cirrhosis, predicting a poor prognosis with 50% mortality within 3 years[3,4] In cirrhosis, the pathogenesis of ascites is attributed to several complex pathways, making both the mechanisms of ascites formation more intricate and its treatment more challenging.[5]

In this review we will summarize the current knowledge of pathophysiology, diagnosis and its management by paracentesis.

Pathophysiology[1, 6, 7]

Liver diseases like cirrhosis and chronic liver disease leads to significant disruption of the liver function and blood flow. Fibrosis disturbs the functional capacity of the liver, causing abnormal hepatic function. This later decreases the albumin production causing decreased oncotic pressure leading to fluid leakage into the interstitial space and the formation of ascites and peripheral oedema. Moreover, the liver becomes incapable of removing toxins resulting in toxin accumulation which can cause encephalopathy.

On the systemic inflammation side, Cirrhosis increases the resistance to portal flow in the portal vein causing portal hypertension. This triggers splanchnic vasodilation, mediated by substances like nitric oxide, carbon monoxide, ECS leading to systemic arterial vasodilation and hypotension. This decrease in effective blood volume activates compensatory mechanisms, such as the renin-angiotensin-aldosterone system (RAAS), antidiuretic hormone (ADH), and sympathetic nervous system (SNS), which increase vasoconstriction, sodium and water retention, and renal dysfunction.

These mechanisms result in kidney construction, which exacerbates ascites. The ongoing renal dysfunction contributes to the risk of hepatorenal syndrome. The

disease worsens when water retention persists without sufficient sodium retention, triggering hyponatraemia. When combined, these processes produce a vicious cycle that prolongs fluid accumulation and the problems linked to cirrhotic ascites.

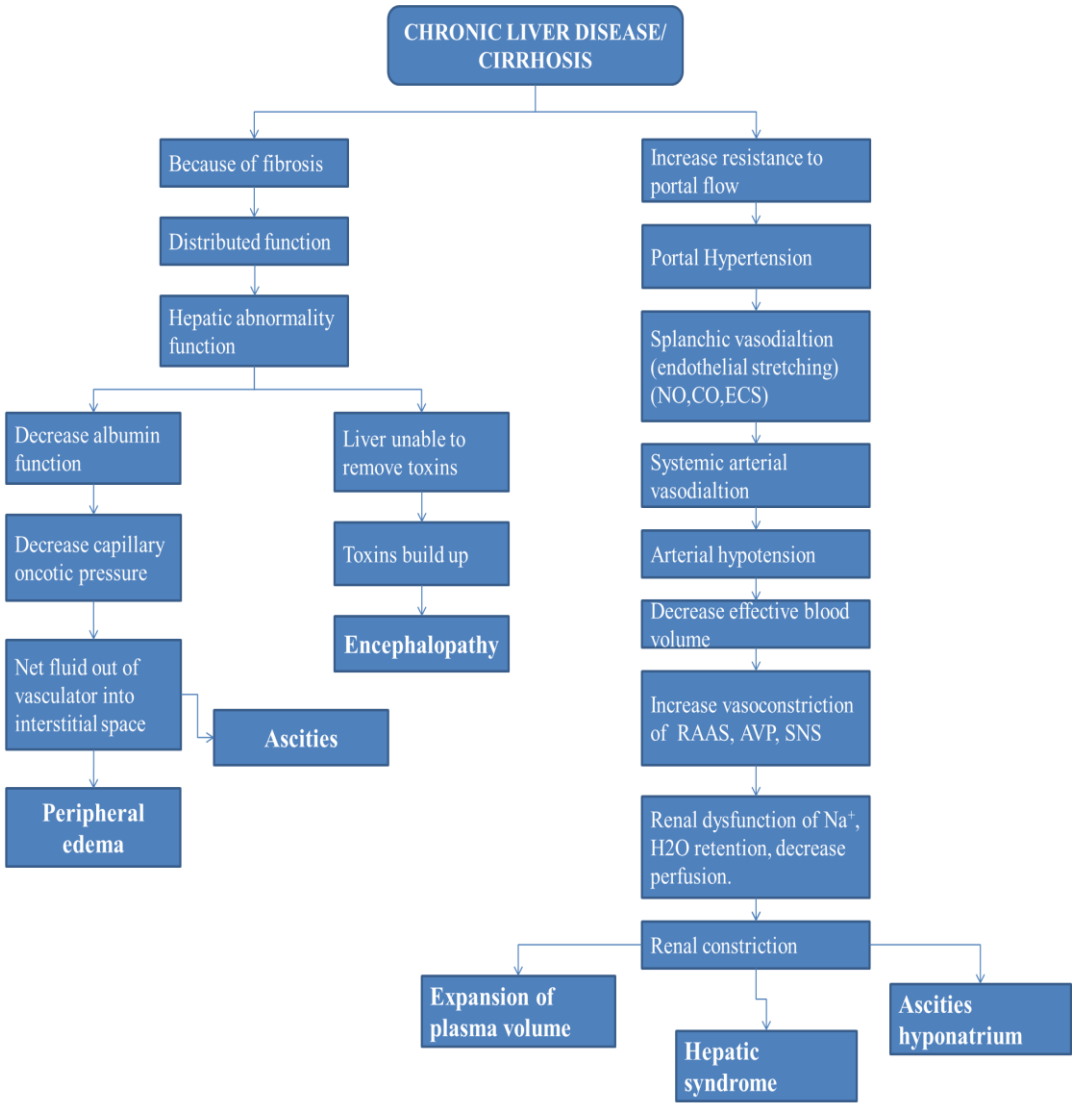

Fig 1: Pathophysiology of Ascites.

Etiology[2,4,8,9]

The most common cause of ascites all over world is cirrhosis accounting for almost 80% from all the liver disease. However almost 15% of ascites cause are other than liver disease which can be cancer, cardiac failure, nephrotic syndrome, dialysis or tuberculosis and others, 2%. Other causes of ascites include Peritoneal carcinomatosis, Peritoneal tuberculosis, Chronic hepatitis C or B infection, Alcohol overuse, Fatty liver disease (non-alcoholic steatohepatitis or NASH), Cirrhosis caused by genetic diseases, IV drug use, Obesity, Hypercholesterolemia, Type 2 diabetes, Nephrotic syndrome, Severe malnutrition, Pancreatic ascites, Ovarian lesions. These aetiologies can be also be divided into portal hypertensive ascites, non-portal hypertensive ascites and mixed ascites according to different aetiologies.

Understanding the aetiology is directly related to diagnosis in clinical practice since it enables a more accurate evaluation of the disease process and directs customised treatment.

Diagnosis

The main purpose of diagnostic assessment of a patient with ascites is to establish the presence of ascites, determine its severity, its cause and detect the presence of complication of ascites.

Diagnostic assessment includes the initial assessment of ascites by medical history, physical examination, abdominal doppler ultrasound, blood tests and a diagnostic paracentesis for the analysis of ascites.[10, 11]

- A complete physical examination should be performed on the patient and later complete assess should be made using[4, 8] complete blood count,

liver function test, renal function tests , serum and urine electrolytes, Serum albumin test, Bacterial culture test by bedside inoculation, Coagulation tests. For further assessment Imaging techniques such as Chest x-ray, Ultrasound, CT scan, MRI scan, Diagnostic paracentesis for appearance, cell count, total protein, and serum-ascites albumin gradient. Additional tests for specific diagnosis include: Lactate dehydrogenase (LDH), Amylase, Mycobacterial culture test.[9]

- Paracentesis is often performed to analyze ascitic fluid and determine etiology, particularly to differentiate between transudative and exudative causes by calculating the serum ascites albumin gradient (SAAG) level.[10]
- The severity of ascites can be determined by the combination of various clinical assessment, imaging and laboratory evaluation. Clinically the severity of ascites can be defined using MELD score, Child Pugh score or MELD-Na score.[12, 13, 14]

Table 1: Severity of ascites.[15]

According to amount of Fluid accumulation		Indications	Diagnosis	Terminology
Grade 1	Mild ascites	Limited fluid buildup, And little to no abdominal distension at all.	Only using ultrasound to detect	Responsive ascites
Grade 2	Moderate ascites	Fluid causes mild abdominal distension. Patient - supine, ascites isvisible in flanks.	Moderate symmetric abdominal distension	Recurrent ascites(Repeated episodes of ascites after Treatment)
Grade 3[16]	Large, tense or gross ascites	Abdomen is visibly distended. Patient: upright, the ascites is clearly evident. Significant discomfort And respiratory problemsexist.	Marked abdominal distension	Refractory ascites

- Recent studies have shown the CIRrhotic Ascites Severity (CIRAS) model only for the ascites related variables and specifically for Hepatic hydrothorax (HH) which is a rare but severe manifestation of cirrhotic ascites. CIRAS model is used to predict the first occurrence of HH requiring thoracentesis. The CIRAS model is the combination of multiple clinical parameters to assess the risk of patient developing significant, refractory ascites or diuretic- responsive ascites.[17] The CIRAS model is interpreted by adding up the scores from each component. The higher the total score, the greater the risk of developing ascites and its complications.[14]

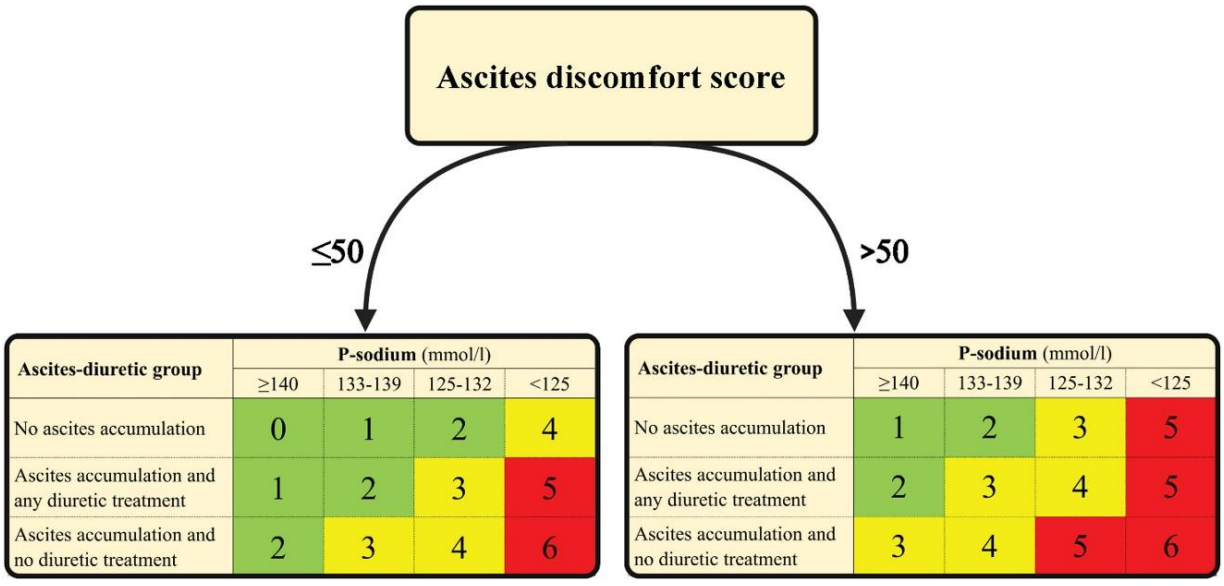

Fig. 2: CIRAS Model.

Management of ascites[16, 18, 19]

The basic treatment of ascites is to avoid alcohol, NSAIDs and sodium restriction to 2g per day. Severe sodium restriction can easily mobilize ascites but it is not suggested in the patient with weight changes (malnutrition) or fluid loss because it is directly linked with the sodium balance in the body. Medicines like oral diuretics to counterbalance aldosterone responsible for the dietary salt retention are used. Moreover, the treatment of ascitic patients depends on the cause of fluid accumulation in the body which can be easily identified by SAAG levels.[9] With self-restraint and time ascites may become more responsive to medical therapy but patient who is resistant to show response or shows poor response to diuretic therapy can be treated using albumin-infused large volume paracentesis (LVP).

For the patient with recurrent ascites or advanced cirrhosis shunts maybe used. Commonly used shunts are the transjugular intrahepatic portosystemic shunt (TIPS), peritoneovenous shunt, and portacaval shunt. In severe cases of liver failure, the last treatment option is liver transplantation.

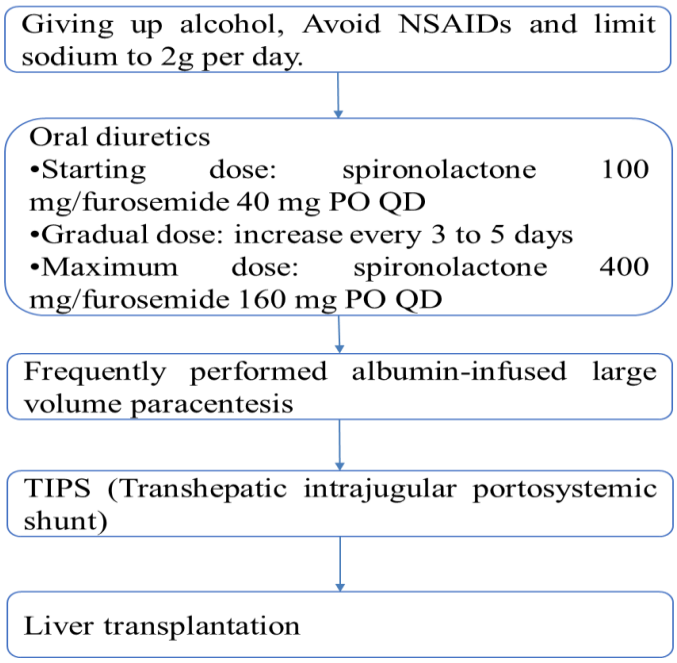

Fig. 3: Management of Ascites.

Paracentesis

Paracentesis is generally safe and very effective procedure for the treatment or diagnosis of ascites. It involves draining of ascitic fluid using a needle or catheter for either diagnostic or therapeutic purpose.[20] LVP is completed in single session by inserting a needle or catheter in the left iliac fossa under strict sterile conditions.[16] In the availability of ultrasound it is normally used to localize the best puncture site to minimize the risk of bowel perforation.[21] LVP is normally performed in hemodynamically stable patients with tense ascites to alleviate discomfort or respiratory compromise.[22]

Fluid Analysis in Diagnostic Paracentesis

Diagnostic paracentesis is used to analyse small sample of ascitic fluid about 20-50 ml to determine the cause of ascites or to evaluate infection in the patient.[1,5] Most important parameters for determining the cause of ascites are ascitic fluid protein and SAAG. Normally, low ascitic fluid protein (<2.5 g/dL) with elevated SAAG (>1.1 g/dL) indicates cirrhotic ascites, and low ascitic fluid protein (<1.5 g/dL) predicts a higher risk for the development of spontaneous bacterial peritonitis (SBP). Moreover, the most important parameter for SBP is defined as the neutrophil count > 250 cells/mm^3 and a positive mono-microbial ascitic culture. When the cell count is less than 250 cells/mm^3 with a positive ascitic culture, this condition is referred to as non-neutrocytic bacterascites (NNBA). Conversely, if the cell count is greater than 250 cells/mm^3 but the ascitic culture is negative, it is classified as culture-negative neutrocytic ascites (CNNA).[1, 23, 24]

Patients with low SAAG level <1.1g/dL do not have portal hypertension and the patients with high SAAG level >1.1g/dL have portal hypertension. Patient with early Budd- Chiari syndrome or heart failure may also have high SAAG levels with high ascitic fluid protein >2.5g/dL. For cardiac failure serum Brain natriuretic protein (BNP) < 40 pg/mL, and a NT-proBNP <125 pg/mL helps to rule out the underlying heart condition.[5, 23, 25] Other tests like ascitic fluid pH, amylase, glucose, bilirubin and lactate dehydrogenase are usually recommended to rule out case-to-case basis.[23]

Therapeutic Paracentesis and Fluid Removal Considerations

Large volume paracentesis (LVP) or therapeutic paracentesis is usually first line treatment tense/refractory ascites. It is less likely to cause complication than the use of diuretics in the refractory ascites.[26]

LVP is often accompanied by the administration of albumin to prevent complications resulting from the shift of fluids within the body causing post-paracentesis circulatory dysfunction (PPCD). The fluid shift leads to further stimulation of vasoconstrictor systems which is characterized by deterioration of renal function. This PPCD can lead to renal impairment, hypotension, and an increased risk of morbidity and mortality. which can be reduced by using albumin like plasma expanders.[21]

Albumin and other expanders

As observed in the meta- analysis of randomized trials the patients treated with LVP and albumin plasma expanders reduce morbidity and mortality among patients with tense ascites undergoing large-volume paracentesis, as compared with alternative treatments without plasma expanders[27,28] Albumin infusion after LVP helps prevent PPCD by expanding intravascular plasma volume. Albumin affects the colloid osmotic pressure quickly which raises effective blood volume and reverses hypovolemia.[29]

According to the guidelines for Intravenous Albumin Administration at Stanford Health Care albumin dose for patients undergoing LVP with removal of more than 4 liters of ascitic fluid or any amount if serum creatinine is greater than 1.5 mg/dL the dosing recommendation is 6-8 grams of 25% albumin per liter of ascitic fluid removed.[30]

Comparison of Albumin with Other Plasma Expanders

While albumin is the most widely used plasma expander for LVP other plasma expanders like dextran-40, synthetic colloids like hydroxyethyl starch and other colloids like polygeline, fresh frozen plasma are also studied.[31] In the randomized studies it is found that Hydroxyethyl starch 6% is as safe and effective as human albumin in protecting patients treated with LVP from developing PPCD. However, transient hypotension following paracentesis was more common in the hydroxyethyl starch group.[32] Francesco Salerno et al. conducted a randomised trial on the use of albumin and dextran-70 in cirrhotic patients with tense ascites treated with total paracentesis. The study found no significant differences between the groups in terms of complications, serum electrolytes, or renal and hepatic function. On day 6, however, patients treated with dextran-70 showed a significant rise in plasma renin activity and aldosterone levels, suggesting a higher risk of renal and electrolyte problems than those treated with albumin.[33] According to all the studies conducted albumin is considered the superior option for preventing complications in cirrhotic patients with ascites after paracentesis.

Albumin infusion with LVP compared to diuretics treatment

Many randomized studies have reported following results. (1) Compared to diuretics, LVP with albumin infusion is more efficacious and considerably shortens hospital stays. (2) The majority of research indicates that LVP + albumin is less likely to cause hyponatraemia, renal impairment, and hepatic encephalopathy than diuretics. (3) The two strategies do not significantly differ in terms of survival or hospital readmission rates. (4) There is very little chance (1%) of local problems like bleeding or intestinal perforation after LVP, making it a safe surgery.[15, 34]

Complication of Paracentesis

Paracentesis is usually a very safe and effective producer but some complications may take place. The most frequent complications are found to be persistent leakage of ascites fluid. Hypoalbuminemia, coagulopathy, and platelet alteration may correlate with a higher risk of complications.[35] A case report of extraordinary complication after LVP have been reported. This complication is characterized by significant swelling extending from the right abdominal wall to the right hemithorax. A few case reports have also showed genital swelling post-paracentesis.[36] Abdominal paracentesis in emergency or inpatient settings carries a higher risk of hemorrhagic complications. The use of a 6-french catheter may also increase this risk compared to smaller catheters.[37] Prior studies have also shown overall 1% risk of complication in the patients undergoing LVP like, local infection, abdominal wall hematomas, intraperitoneal hemorrhage, and intestinal perforation.[34, 38 39]

Future Directions

- Improving long term quality of life associated with different paracentesis technique
- More research on the use of plasma expanders other than albumin infusion.
- Improve procedural efficiency to reduce further complications, and refining personal treatment strategies to enhance patient outcomes in ascites management.

CONCLUSION

In conclusion, LVP is the most common, safe and effective procedure for the treatment of refractory ascites. This procedure often provides significant benefits in terms of symptoms relief, reduction of hospital stays and decreased complications than other treatment alternatives. Studies have shown LVP with albumin infusion is more effective than diuretics, providing faster symptom resolution with fewer complications. Furthermore, it also reduces the hospital readmission and increases the rate of survival. Researches have also showed comparison between albumin infusion and other plasma expanders with LVP for treatment of ascites concluding albumin to be the standard plasma expander available.

Generally, LVP is safe technique but risk of complication like hemorrhage, local infection, abdominal wall hematomas and bowel perforation are extremely low, particularly when advanced techniques such as ultrasound guidance are used.

In summary, LVP with albumin is a preferred treatment strategy for tense ascites, providing both clinical and safety measures, and research into its optimization is expected to continue improving patient outcomes.

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