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Evaluation of Outcomes and Complications of Large Volume Paracentesis without Albumin and Coagulopathy Therapy in Pediatrics with Severe Ascites

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Abstract

Background: Large-volume paracentesis has become the first treatment choice for patients with severe and refractory ascites. The studies have reported several complications after therapeutic paracentesis. But there are few published data on the complications with or without Albumin therapy. We aimed to analyze the safety and complications of large-volume paracentesis in children with or without albumin therapy.

Methods: This study was conducted on children with severe ascites with chronic liver disease who underwent large-volume paracentesis. They were divided into albumin-infused and albumin non-infused groups. In the case of coagulopathy, no adjustment was made. Albumin was not administered after the procedure. The outcomes were monitored to evaluate the complications. To compare two groups, a t-test was utilized, and the ANOVA test was used to compare several groups. If the requirements for using these tests were not met, Mann-Whitney and Kruskal-Wallis tests were applied.

Results: Decreased heart rate was observed in all time intervals and was meaningful six days after paracentesis. MAP also decreased statistically at 48 hours and six days after the procedure ($P < 0.05$). Other variables did not show any meaningful change.

Conclusion: Children having tense ascites with thrombocytopenia, prolonged PT, Child-Pugh class C, and encephalopathy can undergo large-volume paracentesis without any complication. Albumin administration before the procedure in patients with low levels of Albumin (<2.9) can effectively overcome the problems of tachycardia and increased mean arterial pressure. There will be no need for Albumin administration after paracentesis.

Keywords: Paracentesis, Cirrhosis, Albumin, Children, Pediatric, Complications, Ascites

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Introduction

Ascites is the most frequent complication in liver cirrhosis patients, both adults and children. Ascites is associated with the pathologic accumulation of fluid within the peritoneal cavity. Its occurrence is the hallmark of the transition

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↑What is "already known" in this topic:
LVP is one of the safest and most effective management techniques for treating severe and resistant ascites. Major complications of LVP include ascites fluid recurrence, intraperitoneal hemorrhage, circulatory dysfunction, and hepatorenal syndrome.

→What this article adds:
We evaluated the complications of paracentesis in children and identified appropriate strategies for managing these complications. Moreover, two crucial factors were evaluated: The level of Albumin and INR before the procedure and their effects on the outcome of LVP. The results of this study can be beneficial for policymaking and writing therapeutic guidelines in the future.

from the compensated to the decompensated stage of the disease. This transition often leads to the worsening of the patients' health and even death. Around five to ten percent of patients with compensated cirrhosis develop ascites yearly (1, 2). Several causes have been reported for developing ascites in fetuses, infants, and children. These include non-cirrhotic hepatic conditions (e.g., Budd-Chiari syndrome and congenital hepatic fibrosis) and non-cirrhotic non-hepatic conditions (e.g., peritoneal infections, intestinal diseases such as Crohn's disease, pancreatic diseases including acute pancreatitis, metabolic disorders, cancers, etc.) (3). The underlying etiology of ascites is the key to determining the medical and surgical management approaches. In children, depending on the cause, broad types of management strategies can be utilized, including sodium and fluid restriction, use of diuretics, implantation of shunt by surgery or intrahepatic portosystemic shunt, transjugular shunt, intravenous Albumin, prevention and treatment of infection, surgical and endovascular shunts, liver transplant, and paracentesis. Among these treatments, administering large-volume paracentesis (LVP) remains one of the safest and most effective management techniques for severe and resistant ascites (1, 2, 4). Paracentesis is a procedure to obtain a small ascitic fluid sample for diagnosis and a large volume for therapeutic purposes in children and adults with ascites (5). A needle or catheter is inserted into the peritoneal cavity, and ascitic fluid is removed, which may be used to determine the etiology of ascites (6). Performing paracentesis to diagnose peritonitis in children was first reported by Wenger et al. in 1920 (7). since then, it has been used to diagnose urinary, cardiac, traumatic, and chylous ascites (5, 8).

An early and accurate diagnosis of the etiology of ascites often depends on appropriate ascitic fluid analysis. Diagnostic paracentesis is used to diagnose etiology, including neutrophil count (to detect trauma, infection, or malignancy), amylase measurement (to diagnose pancreatitis and small bowel perforation), etc. When the etiology of ascites is unclear, measuring the Albumin content of ascites fluid is crucial to determine its cause, especially the serum-ascites Albumin gradient (SAAG). If the SAAG is greater than 1.1 g/dl, the ascites is most likely due to portal hypertension, while SAAG less than 1.1 g/dl does not indicate portal hypertension (9-11). Therapeutic paracentesis is often performed when a patient has diuretic refractory ascites or a large volume of ascites has caused significant pain or respiratory distress. Reducing the volume of ascites improves the child's appetite, which leads to better management of nutritional needs (3, 6, 12).

Therapeutic paracentesis might be associated with several complications, including ascites fluid recurrence, circulatory dysfunction, and hepatorenal syndrome, and may decrease life expectancy. Generally, coagulation evaluation (international normalized ratio (INR), prothrombin time (PT)), platelet count, and hematocrit are the required preoperative assessments; However, there is not any proven evidence favoring routine administration of fresh frozen plasma (FFP) or platelets before paracentesis in patients with coagulation disorders. INRs as high as 8.7 and platelet counts as low as 19000/mL do not need to be treated before LVP (13). Oncotic replacement using intravenous Albumin and plasma has also been reported; however, they require further investigation (4). Moreover, intraperitoneal hemorrhage due to bleeding and mesenteric varicose veins is another complication of paracentesis therapy, with a nearly 70% mortality rate in adults (14).

The complications after paracentesis therapy in the Iranian pediatric population have not been previously assessed to the best of our knowledge. The main aim of this interventional study was to evaluate the complications after LVP in children and identify appropriate strategies for controlling the complications. Additionally, we examined two crucial factors of paracentesis in the pediatric population: The level of Albumin and INR before the procedure and their effects on the outcome of LVP. Several critical contraindications of paracentesis, such as encephalopathy, coagulopathy, and spontaneous bacterial peritonitis (SBP), were also evaluated in our study. Hepatic encephalopathy is one of the most important clinical complications of liver cirrhosis. It occurs when the impaired function of the cirrhotic liver and portal-systemic shunting results in elevated blood concentrations of endogenous neurotoxic substances (including ammonia) reaching the brain through the blood-brain barrier. This phenomenon leads to impairment of cerebral function and disturbances of consciousness (15). All patients in our study were cirrhotic patients due to chronic liver diseases. The decrease in consciousness was due to impairment of the hepatic function, which was grade 1 or 2 of encephalopathy. According to the published reports, there is no correlation between grade 1 or 2 encephalopathy and hypothermia. Indeed, hypothermia delays the onset of encephalopathy prevents brain edema and impairs microglial activation (16). The results of this study can be beneficial for policymaking and writing therapeutic guidelines in the future.

Methods

Sampling, sample size, sample selection, sample definition

We performed a prospective study (ethics approval: IR.sums.med.rec.1400.373, Shiraz University of Medical Sciences) on 37 patients (2.5 months to 18 years old) with tense ascites and different etiologies of cirrhosis between March 2021 and February 2022. Before performing paracentesis, a questionnaire containing the patient's medical history, cause of cirrhosis, ascites fluid volume, and routine tests (primarily sodium, potassium, and basal creatinine) was filled out (a sample questionnaire can be found in Appendix).

Twenty-five patients with Alb<2.9 were considered as the group who needed to receive Albumin before paracentesis (indicated as Albumin (+) in the text), and 12 of them with Alb≥2.9 did not need Albumin before the procedure (Albumin (-)). None of the patients received Albumin after paracentesis. Paracentesis was performed until the ascites fluid was drained entirely (tap to dry). Thirty-seven patients were included for paracentesis according to the inclusion and exclusion criteria (section 2.2), and the number of paracentesis sessions was recorded for each patient. Albumin, complete blood count (CBC), INR, and PT were routinely

checked before the procedure. Albumin levels were adjusted according to the initial amounts of Albumin. Albumin at a dose of 0.5 to 1 g/kg body weight was administered only for patients with Albumin deficiency (Albumin<2.9); Twenty-five patients received Albumin before paracentesis, and 12 patients did not receive Albumin before the procedure (with Albumin levels≥2.9). Patients with coagulation disorders underwent peritoneal paracentesis without any condition correction (13). Albumin and diuretics were prescribed based on their blood albumin levels before paracentesis or peripheral edema: 1. Spironolactone (Aldactone) for all patients 2. Spironolactone and furosemide for those with peripheral edema (12 patients) 2. Albumin, Aldactone, and Lasix for those with low Albumin levels (24 patients). So, only one patient received Aldactone alone. Furosemide with the initial dose of 1 mg/kg was prescribed for all patients, which later, in some cases, increased up to 4 mg/kg. Spironolactone was administered daily at a dose of 0.5 to 1 mg/kg in infants and 1 to 3 mg/kg in older children. In some patients, the spironolactone dose increased (maximum dose of 4-6 mg/kg every 5 to 7 days) based on previous reports (17-19). A low sodium diet (44-88 mEq/day in adolescents and 1-2 mEq/kg/day in younger children) was maintained for the patients. The position of the patients for the procedure was supine. Lidocaine 2.5% cream was used for local anesthesia. Needle placement was done using a fenestrated stainless-steel gauge 15 through the "Z technique." Vital signs, oxygen saturation, body weight, abdominal circumference, and urinary output were checked before, during, immediately after, and at 6 hours, 48 hours, and six days post-procedure. Abdominal circumference was checked for observing any evidence in favor of intra-abdominal bleeding. Echocardiography was performed immediately before and after paracentesis to evaluate left ventricular diastolic function. The mean arterial pressure (MAP) and heart rate (HR) were recorded before, immediately after, and at 6 hours, 48 hours, and six days after paracentesis.

Patients were divided into two groups based on their serum Albumin levels before the paracentesis procedure. Fluid characteristics, including appearance, Albumin, culture, antibiogram (to rule out SBP), cell count, and differentiation, were evaluated in the procedure outcome. Other factors observed and recorded for statistical analysis were as follows: duration of ascites (days), diuretics, pedal edema, stigmata of chronic liver disease, total serum bilirubin (mg/dL), serum Albumin (g/dL), INR, Child-Pugh score (A/B/C), pediatric end-stage liver disease (PELD score), the model for end-stage liver disease (MELD score), the volume of ascites extracted (ml/kg), Albumin infusion, the time duration of LVP (hours), the velocity of outflow (ml/h), ascitic fluid infection after procedure, urine output (ml/kg/h), serum creatinine (mg/dL), glomerular filtration rate (GFR) (ml/min), serum sodium (mEq/L), serum potassium (mEq/L). The essential side effects to evaluate and compare with other studies include post-operative pain, hemorrhage, hematoma, seroma, accidental puncture or laceration, infected post-operative seroma, post-operative infection, post-operative fistula, pneumothorax, hemothorax, and circulatory dysfunction. Other items were also given in the attached questionnaire form.

The criteria for grading the Child-Pugh score include encephalopathy, Albumin, ascites, prothrombin time, and bilirubin. Each variable has a particular score:

Encephalopathy: None = 1 point, Grade 1 and 2 = 2 points, Grade 3 and 4 = 3 points

Ascites: None = 1 point, slight = 2 points, moderate = 3 points

Bilirubin: under 2 mg/ml = 1 point, 2 to 3 mg/ml = 2 points, over 3 mg/ml = 3 points

Albumin: greater than 3.5mg/ml = 1 point, 2.8 to 3.5mg/ml = 2 points, less than 2.8mg/ml = 3 points

Prothrombin Time (sec prolonged): less than 4 sec = 1 point, 4 to 6 sec = 2 points, over 6 sec = 3 points

Based on the total score, the groups will be as below:

Child-Pugh A: 5 to 6 points

Child-Pugh B: 7 to 9 points

Child-Pugh C: 10 to 15 points (20, 21).

Inclusion and exclusion criteria

All children 0 to 18 years of age with tense ascites who required paracentesis were considered. Patients with unstable hemodynamics, hemorrhagic tap, extrahepatic portal venous obstruction, those on beta-blockers, clinically apparent disseminated intravascular coagulation, surgical scars at the proposed paracentesis site, overt systemic infection, primary fibrinolysis, pre-existing renal failure at the first evaluation (recorded by raised serum creatinine levels appropriate for age), massive ileus with bowel distention, and gastrointestinal bleeding in last two weeks were excluded based on previous studies (22-24). LVP was terminated in the following cases: hemorrhagic tap, developing hemodynamic instability needing resuscitation (systolic drop≥20 mmHg with or without delayed capillary filling time > 3 seconds), or worsening of an earlier grade of encephalopathy during the procedure (23).

Data collection tools and process

The data collection form can be found under Appendix.

Statistical analysis

JAMOVI software was applied for statistical analysis. To compare two groups, a t-test was utilized, and the ANOVA test was used to compare several groups (p-value<0.05). If the requirements for using these tests were not met, Mann-Whitney and Kruskal-Wallis tests were applied.

Results

Of the 77 evaluated patients, 42 cases were admitted due to tense ascites. Five were excluded according to our exclusion criteria. The condition etiologies of the study subjects were divided into five groups (Figure 1). All patients had a history of chronic liver disease. The initiation period of ascites was 39.5±33.7 days. Sixteen patients were on diuretics before their hospitalization, and 21 patients started to take the medication during their admission to the hospital. For thirty-one patients, PELD (mean=36.4±11.9), and for 6 cases, MELD (mean=23.8±10.6) was measured. The Child-Pugh classification is a simple, convenient prognostic

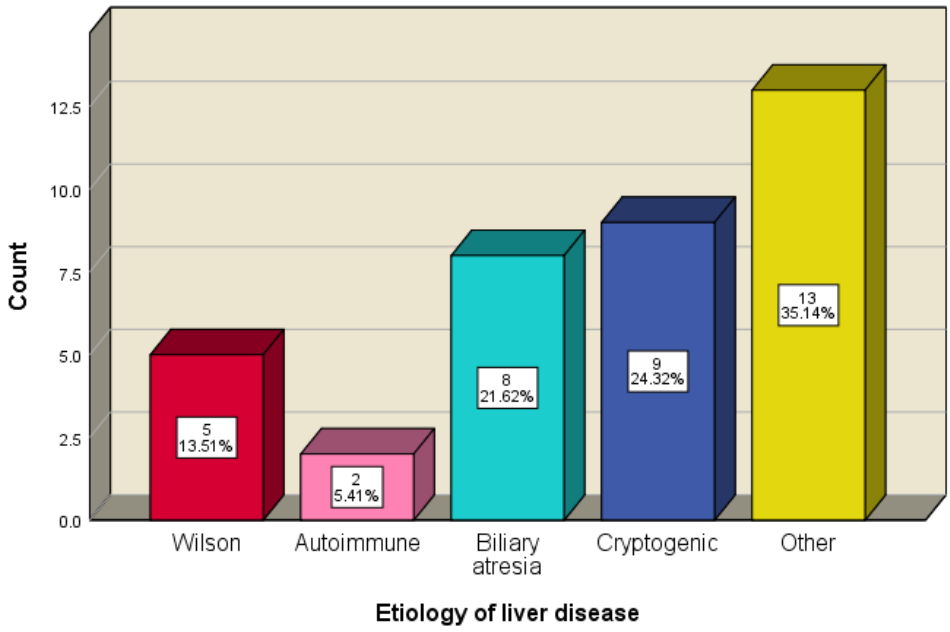

Figure 1. Etiologies of liver disease in this study

measure in patients with liver cirrhosis.

Therefore, all patients in our study were in group C of the child-pugh score, and none had any contra-indications for LVP. Twenty-six patients (70.3%) had SBP, 1 had positive blood culture, and all received antibiotics.

INR values were as follows: <1.5 (6 patients), 1.5-2 (3 patients), 2-4 (16 patients), 4-6 (5 patients), and >6 (7 patients). All patients with platelet>19000 or INR<8.7 underwent LVP (the minimum platelet count in our study subjects was 34000, and the maximum INR level was 7, pretreatment). Na^+ was 115-146 mEq/ml (mean 134.2±6.8), and K^+ was 3.4-5.4 mEq/ml (mean 4.18±0.54). Bilirubin total before the tap was 0.5-43 mg/dl (mean 18.2±10.5). The volume of drained fluid was reported as cc/kg, which was between 11.2-212 cc/kg (77.03±50.8). It was considered therapeutical paracentesis when the volume of drained fluid was more than 10% of the weight. Considering these criteria, all the patients in our study underwent therapeutical paracentesis. The total volume of drained fluid was 100-4200 cc (mean 1136±1.35), the time duration of LVP was 0.25-5 hours (mean 1.039±0.8), and the velocity of outflow was 56-4200 cc/h (mean1060±978.8). Urine Output was 1-5 cc/kg/h (mean 2.23±0.63), and a higher output was observed in those who received diuretics. The hepatorenal syndrome was ruled out in all patients. The serum creatinine in most patients was low; however, the measurement was inaccurate because of the high amounts of bilirubin, which interacted with serum creatinine. Therefore, creatinine and GFR were not included in the statistical analysis. Decreased heart rate was observed at all time intervals and was meaningful six days after paracentesis (p=0.025). MAP also decreased statistically at 48 hours and six days after the procedure (p<0.05). However, its change was not significant immediately and 6 hours after paracentesis. RBC, WBC, platelet, and Hb were routinely monitored before the tap. For encephalopathic patients (7 cases), there were no significant differences in the evaluated outcomes with other cases. Although the patients with platelet>19000/mL and INR<8.7 did not receive platelet and FFP, any bleeding or other side effects related to thrombocytopenia or coagulopathy were not observed even with high-volume fluid drained. MAP and HR 6 hours and 48 hours after paracentesis in Alb (+) group were lower than in the Alb (-) group and were statistically meaningful (p<0.05). Both groups had normal vital signs and O_2 saturation before and after paracentesis. There was no increase in abdominal circumference as a sign of intra-abdominal hemorrhage after paracentesis. One of the markers in patients undergoing LVP was post-paracentesis circulatory dysfunction (PPCD) which was assessed by echocardiography and hemodynamic evaluation performed before and after the procedure. Hemodynamic status was evaluated immediately after, 6 hours, 48 hours, and six days post-procedure. There was no evidence of PPCD in any of the groups. The ascitic fluid leak was more observed in those with lower drained fluid. In contrast, the patients with higher drained volumes did not leak after paracentesis, and the results were not statistically meaningful (p=0.177). Twenty patients were required to repeat paracentesis because of low drained volume, which was not necessary to perform in cases with complete drainage. Some children could not tolerate the procedure because of agitation. The fluid leak was more common in such cases than in the patients who had a "tap to dry" procedure. The data of these children was not meaningful (p-value=0.671). Twelve patients who did not have complete fluid drainage had a fluid leak. Using the Z technique for paracentesis resulted in a lower fluid leak. The fluid leak was not correlated to Albumin administration before paracentesis. Tables 1 and 2 summarize the results.

Table 1. Baseline clinical and laboratory data in the two groups: Note (values expressed as mean ± SD; Alb (+): Albumin infused, Alb (-): Albumin non-infused). The flow rate of extraction (mL/h) = Total volume (mL) ÷ Duration of LVP (h).

Variable	Group Alb (-) (n=12)	Group Alb (+) (n=25)	*P*
Age	3.6 ± 4.9 (years)	5.3 ± 5.53	0.505
Wilson disease	1	4	
Autoimmune Liver disease	1	1	
Biliary Atresia	3	5	
Cryptogenic	1	8	
Others	6	7	
Duration of ascites (days)	32 ± 18	27 ± 38	0.818
Weight Z scores	-1.5 ± 1.5	-1.6 ± 1.3	0.89
Height Z scores	-1.9 ± 1.3	-1.5 ± 1.3	0.378
Bili total (mg/dl)	20.8 ± 12.4	17.02 ± 9.4	0.322
Duration of LVP (hour)	0.92 ± 0.4	1.09 ± 0.938	0.906
Flow rate of extraction (ml/h)	780 ± 666	1195 ± 1084	0.299
Ascitic fluid infection (n)	3	9	0.711
Alb (g/dL)	3.2 ± 0.43	2.3 ± 0.37	0.49
INR	3.6 ± 2.3	3.5 ± 1.8	0.922

Table 2. Comparison of HR and MAP after single time LVP: Note (values expressed as mean ± SD; Alb (+): Albumin infused, Alb (-): Albumin non-infused)

Variable	Group Alb (-) (n=12)			Group Alb (+) (n=25)		
	Baseline	48h	6d	Baseline	48h	6d
MAP (mm Hg)	76.2 ± 7.34	80.2 ± 9.4	77	73 ± 7.07	69.6 ± 6.4	74.9 ± 5.4
HR (beats/minute)	126 ± 15.7	122 ± 13.2	124 ± 16	114 ± 17.7	108 ± 21.6	108.6 ± 17.2

Discussion

The study's primary aim was to evaluate the outcomes of therapeutical paracentesis in children with different etiologies of ascites. In the case of coagulopathy, no FFP or platelet was prescribed. Albumin was infused only for patients with low levels of Albumin (<2.9) before the procedure. After paracentesis, no patients received Albumin. Encephalopathic and Child-Pugh class C patients also underwent the procedure. All groups were examined for post-operative pain, hemorrhage, hematoma, seroma, accidental puncture or laceration, infected post-operative seroma, post-operative infection, post-operative fistula, pneumothorax, hemothorax, circulatory dysfunction, and fluid leak. No significant complications were observed in patients who did not receive Albumin, or their coagulopathy was not treated. The same outcome was observed for the patients with encephalopathy (reduced consciousness state) and child-Pugh class C patients.

According to Sherlock's Diseases of the Liver and Biliary System textbook, clotting abnormalities are not considered a contraindication for LVP. The reference indicates that fluid leakage is rare and happens when therapeutical paracentesis is incomplete (25). Our results match this statement about performing LVP for patients with coagulopathy and repeating it in cases with insufficient drainage.

Our data analysis represented that hyponatremia (Na^+<130 mEq/L) was more associated with hepatic encephalopathy (p-value=0.027), which was also reported in another research (25).

Paracentesis is sometimes performed in combination with ultrasound to access the exact point for needle placement; however, in most cases, it can be done safely without ultrasound (5). LVP is only effective in adults if the volume of the drained fluid is over 2 liters per day (2). A retrospective study by Kramer et al. showed that the amount of removed fluid during LVP in pediatric patients aged six months to 2 years was approximately 118±56 ml/kg over around 3 hours. In this study, no patient had a potential adverse clinical sequel of hypotension or hemorrhage (5). In another study reported by Gottardi et al., LVP complications were divided into minor and major complications. Minor complications included self-limiting complications such as ascites fluid leakage. Major complications such as bleeding or hematoma require medical intervention. According to the authors, major complications were more due to therapeutic paracentesis other than diagnostic paracentesis. Infection, bleeding, and ascites fluid leakage were commonly reported complications (26). In another study, the side effects of paracentesis therapy were evaluated in adults. The complications were classified into two categories: early and late. The study reported that 12% of the complications were early, and 5% were delinquent. Utilizing ultrasound, coagulopathy status, and drainage fluid did not affect the complications (27). It has been reported that low-dose Albumin administration effectively prevented renal complications in therapeutic paracentesis in patients with cirrhosis. This study also reported that 4 g/lit Albumin administration could effectively prevent PICD (paracentesis-induced circulatory dysfunction) associated with renal impairment in therapeutic paracentesis (23).

For adults, Albumin is recommended in paracentesis with more than 5 to 6 liters of fluid drainage (28). As mentioned before, our study investigated decreased heart rate and MAP after paracentesis. This is the only complication observed when the Alb (-) and Alb (+) groups were compared. This finding can be justified as follows: A patient with severe ascites has a lower venous return, leading to higher systemic vascular resistance and increased arterial pressure for compensating the cardiac output. After LVP, venous return improves, alleviating the compensation mechanism. Therefore, the systemic vascular resistance and MAP decrease, resulting in a normal cardiac output. Forty-eight

hours after a tap in Alb (+) patients, there was a significant decrease in heart rate and MAP. Therefore, it can be concluded that Albumin administration before paracentesis in patients with low levels of Albumin prevents the body from utilizing the compensation mechanisms, eventually improving heart function.

Sarma et al. showed that more than 197.5 ml/kg of fluid draining was associated with PPCD (post-paracentesis circulatory dysfunction). The study demonstrated that the best method of paracentesis in adults and children is to perform it with Albumin administration. If Albumin is not prescribed, fluid extraction should be limited to less than 200 ml/kg per dry body weight and a maximum rate of 680 ml/h. Otherwise, the risk of PPCD and hyponatremia in the patient increases. PPCD was observed in 80% of cases of ascites in adults and increased the mortality rate (29). Other reported side effects include intestinal perforation, bleeding, EPIT (early paracentesis-induced thrombocytopenia) (30-32), Lower epigastric artery pseudoaneurysm (33), and pulmonary edema (34), acute cardiovascular events (acute coronary syndrome) (35), and midline varices (36).

It has been reported that performing paracentesis under an ultrasound guide reduces the risk of bleeding after paracentesis, thus reducing hospital stay length, hospitalization complications, and related costs (22, 37, 38). Ultrasound scanning using a pocket ultrasound device as a physical examination for pre-paracentesis evaluation has been demonstrated to effectively prevent post-operative complications. Only a few minor side effects have been reported, all resolved on a self-limiting basis (39). In a systematic review conducted in 2014, the type of bleeding after therapeutic paracentesis and its prevalence was assessed. In this study, three types of bleeding were identified: abdominal wall hematoma (52%), hematoperitoneum (41%), and pseudoaneurysm (7%). Therefore, abdominal wall hematoma and peritoneal hematoma are the most common types of bleeding complications after therapeutic paracentesis. It is recommended to perform transcatheter coiling, embolization, and coiling to prevent this complication (40). PICD is a common but hidden complication after paracentesis. Left ventricular diastolic function is a significant factor in patients with cirrhosis and ascites, which may lead to premature hepatic cardiomyopathy (41). Kramer et al. performed pediatric paracentesis therapy with an 18-gauge intravascular catheter and a 15-gauge fenestrated stainless-steel needle. They examined the outcomes for each type of needle. They stated that paracentesis therapy in children could be performed without complications, and paracentesis needles significantly increased drainage speed, making it more effective in children (5).

Albumin is an expensive product. Based on our findings, it is unnecessary to be administered to patients with Albumin levels Alb≥2.9. Moore et al. have also reported that using Albumin after paracentesis has potential disadvantages such as the increased risk of infection, downregulation of Albumin, and cost (42).

Conclusion

The results of our study show that LVP can be done in all age groups without significant local or systemic complications. It can also be conducted in patients with thrombocytopenia, prolonged PT, Child-Pugh class C, and encephalopathy. The best strategy to overcome the problems of tachycardia and increased MAP in patients with low levels of Albumin (<2.9) is to perform LVP combined with Albumin administration before the procedure. There will be no need for Albumin administration after paracentesis. Performing LVP with complete fluid drainage will prevent fluid leakage.

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Ethics approval

This work was done with ethical approval and consent to participate (IR.sums.med.rec.1400.373, Shiraz University of Medical Sciences).

Conflict of Interests

The authors declare that they have no competing interests.

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Appendix

Paracentesis questionnaire
Age (y)
Sex
Weight Z-scores
Height Z-scores

Etiology of liver disease
• Budd-Chiari syndrome
• Wilson disease
• Autoimmune liver disease
• Chronic hepatitis B
• Biliary atresia
• Alagille syndrome
• Cryptogenic
- Other

Paracentesis:
Diagnostic ☐
Therapeutic ☐ indication:

Fluid characteristics:
- Appearance
- Cell count diff
- Alb
- Culture
- Antibiogram

	Onset	During	At 6 Hours	48 Hours	Day 6.
Heart rate					
Blood pressure					
Oxygen saturation.					
Wt					
Abd girdle					

Duration of ascites (months)

Diuretics

Pedal edema (n)

Stigmata of chronic liver disease

PHX of SBP

Platelet count (109/L)

Total serum bilirubin (mg/dL)

Serum albumin (g/dL)

International normalized ratio

Child-Pugh score (A/B/C)

PELD score

Volume of ascites extracted (mL/kg)

Alb infusion

Duration of LVP (hours)

Flow rate of extraction (mL/h)

Ascitic fluid infection

Urine output (mL/kg/h)

Serum creatinine:(mg/dL)

GFR (mL/min)

Serum sodium (mEq/L)

Serum potassium (mEq/L)

Adverse events:

- Post-operative pain
- Hemorrhage
- Hematoma,
- Seroma
- Accidental puncture or laceration
- Infected post-operative seroma
- Post-operative infection,
- Post-operative fistula
- Pneumothorax
- Hemothorax.
- Circulatory Dysfunction: