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RESEARCH ARTICLE

Large-volume paracentesis with indwelling peritoneal catheter and albumin infusion: a community hospital study

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Background: The management of ascites can be problematic. This is especially true in patients with diuretic refractory ascites who develop a tense abdomen. This often results in hypotension and decreased venous return with resulting renal failure. In this paper, we further examine the risks and benefits of utilizing an indwelling peritoneal catheter to remove large-volume ascites over a 72-h period while maintaining intravascular volume and preventing renal failure.

Methods: We retrospectively reviewed charts and identified 36 consecutive patients undergoing continuous large-volume paracentesis with an indwelling peritoneal catheter. At the time of drain placement, no patients had signs or laboratory parameters suggestive of spontaneous bacterial peritonitis. The patients underwent ascitic fluid removal through an indwelling peritoneal catheter and were supported with scheduled albumin throughout the duration. The catheter was used to remove up to 3 L every 8 h for a maximum of 72 h. Regular laboratory and ascitic fluid testing was performed. All patients had a clinical follow-up within 3 months after the drain placement.

Results: An average of 16.5 L was removed over the 72-h time frame of indwelling peritoneal catheter maintenance. The albumin infusion utilized correlated to 12 mg/L removed. The average creatinine trend improved in a statistically significant manner from 1.37 on the day of admission to 1.21 on the day of drain removal. No patients developed renal failure during the hospital course. There were no documented episodes of neutrocytic ascites or bacterial peritonitis throughout the study review.

Conclusion: Large-volume peritoneal drainage with an indwelling peritoneal catheter is safe and effective for patients with tense ascites. Concomitant albumin infusion allows for maintenance of renal function, and no increase in infectious complications was noted.

Keywords: *ascites*; *peritoneal catheter*; *cirrhosis*; *renal function*

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Chronic liver disease and cirrhosis is a major cause of morbidity and mortality in the United States, causing over 36,000 deaths per year and over 100,000 hospitalizations (1). The most common cause for patients with cirrhosis to decompensate is secondary to the development of ascites (2). In addition, nearly half of all compensated cirrhosis patients will develop ascites over a 10-year interval (2). Paracentesis is performed at the time of diagnosis of ascites for both determination of etiology as well as detection of infection (3, 4). In addition, management strategies for ascites include sodium restriction, diuretics including loop diuretics, and aldosterone antagonists, as well as ascitic fluid removal with paracentesis (5). Refractory ascites, as defined by either fluid overload unresponsive to sodium restriction and high-dose diuretic therapy or by rapid recurrence after therapeutic paracentesis, is a particularly troubling feature of cirrhotic patients with ascites (6). Traditionally, serial therapeutic paracentesis with continued sodium restriction has been pursued for these patients. Consideration is given in these circumstances to colloid volume expansion (5, 6). In addition to serial paracentesis, transjugular intrahepatic portosystemic stent shunt has been used to manage ascites. This has been shown to improve general well-being of patient in addition to renal function and sodium excretion but has yet to demonstrate improved survival (7, 8).

The use of indwelling catheters is well established in malignant ascites (9). Its use in the management of large-volume or refractory ascites secondary to cirrhosis

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remains unclear. A study by Van Thiel documented its use and safety, when used for less than 72 h (10). Its safety has recently been questioned in a retrospective review by Kathpalia et al. (11). We hypothesize that indwelling peritoneal catheter is a safe and effective way for removal of ascetic fluid in patients with refractory ascites as long as the catheter stays in for less than 3 days as suggested by Van Thiel and colleagues (10, 12). Herein we present our experience in a retrospective review of 36 sequential patients who underwent indwelling peritoneal drainage catheter placement for large-volume or refractory ascites.

Materials and methods

At this institution, a retrospective review was performed and 36 consecutive patients were identified with decompensated cirrhosis with refractory or large-volume ascites where indwelling peritoneal catheter placement was utilized. Each patient had biopsy-proven cirrhosis, and an etiology was determined for each patient. All patients in the study had a MELD and Childs-Pugh score calculated.

Demographic data is provided in Table 1 for our patient populations. Records reviewed included complete blood count, comprehensive metabolic panel, coagulation panel, viral serologies, and biopsy reports. Metabolic syndrome and alcohol use were assessed. All patients were up to date with alpha-fetoprotein and abdominal ultrasound testing for hepatocellular carcinoma with three patients undergoing active therapy. A pigtail catheter was utilized and placed into the peritoneal cavity via the Seldinger technique under sterile procedure (10, 12). Prior to placement, the patient was evaluated with both shifting dullness and abdominal ultrasound to document large-volume ascites. A site was determined with shifting dullness or abdominal ultrasound, whichever was more appropriate. All catheters were placed within the right lower quadrant. After site determination, a surgical scrub was utilized to prep the surface and a sterile drape was placed overlying the area. Under sterile technique, the skin was anesthetized with 5–10 mL of 1% xylocaine solution. Free fluid was aspirated with the small 22-gauge needle to assure adequate placement and positioning. Subsequently, a small superficial skin incision was made. A needle was then introduced into the peritoneal space through the anesthetized tract. The pigtail catheter was then inserted over the guide wire into the peritoneal space. A locking device was then placed on the catheter. The drain was then sutured in using a 2-0 prolene. Triple antibiotic solution was placed at the skin surface adjacent to the peritoneal drain. A dressing was applied to the site of entry. The pigtail catheter was then connected to a 3-L collection bag.

Ascites was removed at a rate of 3 L every 8 h. If 3 L was achieved, the nursing staff would utilize the locking device to halt additional fluid output until an 8-h shift had passed before again allowing gravity drainage to take place. Albumin (25%, 50 g) was infused if 3 L was removed in the 8-h shift. Daily ascitic fluid cell counts were performed in addition to daily laboratory profiles with complete blood count (CBC) and comprehensive metabolic panel (CMP).

All patients signed an informed written consent for paracentesis with indwelling peritoneal drainage for up to 72 h. In addition, this retrospective study was approved by the Institutional Review Board at University of Illinois College of Medicine at Peoria.

Analysis was conducted with SAS 9.4 (by SAS Institute Inc, Cary, NC, USA). Descriptive results were reported as mean ± standard deviation for continuous variable, and percentage for categorical variable. Generalized estimating equations were used to estimate and compare clinical characteristics at different time points. A two-tailed

Table 1. Profile of patients

Demographics	Frequency ($n = 36$)	Percent
Age in year (mean ± SD)	57.1 ± 10.0	
30–50	6	16.7
51–60	17	47.2
61–70	10	27.8
71–80	3	8.3
Gender (male)	26	72.2
Weight in lb (mean ± SD)	201.3 ± 53.3	
Cirrhosis (yes)	3	8.3
Alcoholic (yes)	29	80.6
NASH (yes)	6	16.7
Hepatitis B (yes)	2	5.6
Hepatitis C (yes)	12	33.3
Liver enzymes (median, quartile)		
ALT (units per liter)	39 (31–46)	
AST(units per liter)	64 (45–88)	
Blood urea nitrogen (mg/dL)	28.9 ± 19.6	
MELD (mean ± SD)	23.5 ± 9.8	
Child-Turcotte-Pugh		
B:7–9 points	6	15.8
C:10–15 points	30	84.2
DM (yes)	9	25.0
HTN (yes)	15	41.7
Systolic CHF (yes)	3	8.3
CKD (yes)	7	19.4
H/O cancer (yes)	1	2.8
HCC (yes)	3	8.3
Smoker		
No	5	13.9
Yes, now	21	58.3
Yes, former	10	27.8
Furosemide (yes)	18	50.0
Spironolactone (yes)	17	47.2

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P value was calculated for all tests, and $P \leq 0.05$ is considered as being statistically significant.

Results

The epidemiologic characteristics of our 36 patients are given in Table 1. The mean age of patients in our study was 57.1 ± 10 years. Alcohol use was the dominant etiology for cirrhosis, present in 80% of patients. The values of serum creatinine improvement, albumin infused, plasma white blood cell count, ascitic fluid white blood cell count, and blood urea nitrogen (BUN) are given in Table 2. The mean ascitic fluid removed on day 1, 2, and 3 was 6.60, 5.72, and 4.21 L respectively. The amount of albumin given directly correlated with the amount of fluid removed with 80.76, 68.26, and 60.0 g being infused on day 1, 2, and 3, respectively, correlating to 12 g/L. The mean weight on day 1 was 86.5 kg (range: 75.9–97.0 kg), and on day 3, it was 77.8 kg (range: 66.8–88.8 kg). Serum creatinine declined statistically from 1.37 on day 1 to 1.21 on day 3 ($P < 0.05$).

At a follow-up at a mean time of 17 days, the creatinine was not statistically elevated as compared with baseline values. Serum BUN values were not affected significantly throughout with mean values of 31.1, 31, 29, and 25.5 mg/dL on day 1, 2, 3, and follow-up, respectively. No patient required a repeat paracentesis or indwelling peritoneal drain for at least 2 weeks after the initial drain placement. No patient was noted to develop any clinical signs or laboratory evidence of infection or secondary bacterial peritonitis. The ascitic fluid white blood cell count trended upwards from 126 on day 1 to 234 on day 3. None of the patients met the criteria for secondary bacterial peritonitis of neutrophil count > 250 cells/μL. The most common complaints encountered were pain at insertion site in seven patients and minor bleeding in two patients as represented in Table 3. There was no case in which drain was removed inadvertently. No episodes of intra-abdominal bleed or hypotension were observed.

Discussion

Paracentesis is known to reduce short-term mortality and improve outcomes in patients with cirrhosis. A nationwide analysis showed in-hospital mortality reported to be lower in decompensated cirrhosis patients who underwent paracentesis within 24 h of admission (5.7% vs 8.1%; $P = 0.49$) (13). Traditionally, large-volume paracentesis with colloid infusion has been shown to be more effective than diuretics alone in managing ascites in hospitalized patients (5). This often results in large-volume shifts with development of intravascular volume depletion and renal insufficiency. Hepatorenal syndrome is a manifestation of this physiologic derangement.

In our study, we attempted to demonstrate the efficacy and safety of indwelling peritoneal catheter placement for refractory and large-volume ascites, especially its effect on renal function. Patients with refractory ascites often have contraindications to the use of diuretics due to their concomitant renal dysfunction, fostering electrolyte imbalance and precipitating hepatic encephalopathy (14). While previous studies have documented its safety, its role in maintaining renal function has not been reported. It has been shown that increased intra-abdominal pressure can cause acute renal failure in humans and animals (15, 16). Removal of this pressure resulted in immediate improvement in renal function and resolution of anuria (16–19). In our study, a mean of 16.53 L of fluid was removed over a period of 72 h. This corresponded with a mean drop of 8.7 kg body weight between day 1 and day 3. The removal of this volume of fluid from the patient alone could be responsible for causing a significant

Table 2. Predicted values (mean, 95%CI) of clinical characteristics based on generalized estimation equations

Item	Day 1 ($n = 36$)	Day 2 ($n = 36$)	Day 3 ($n = 27$)	Follow-up[a] ($n = 20$)
Ascites removal (L)	6.6	5.7	4.2*	NA
	(5.7–7.5)	(4.3–7.1)	(3.0–5.4)	
Albumin infusion (g)	81.6	69.1	61.2	NA
	(66.5–96.8)	(51.3–87.0)	(40.7–81.7)	
White blood cell (10^3/μL)	9.4	8.0*	8.6	8.8
	(7.4–11.3)	(6.0–10.0)	(6.0–11.1)	(6.3–11.4)
Serum creatinine (mg/dL)	1.37	1.31	1.21*	1.32
	(1.04–1.81)	(0.98–1.75)	(0.90–1.63)	(0.97–1.78)
Weight (kg)	86.5	–	77.8*	
	(75.9–97.0)		(66.8–88.8)	–
Blood urea nitrogen (mg/dL)	31.1	31.0	29.0	25.5
	(24.7–39.2)	(24.4–39.3)	(22.1–38.0)	(19.2–33.9)

*$p < 0.05$ compared to the baseline (day 1).
[a]Follow-up within 2–6 weeks.

Table 3. Complications

Complications	Frequency ($n=36$)	Percent
Pain at insertion site	7	19.4
Minor bleeding	2	5.6
Spontaneous bacterial peritonitis	0	0.0
Major bleeding	0	0.0
Inadvertent drain removal	0	0.0

improvement in renal perfusion and subsequent renal function seen in our patient population, secondary to reduced intraperitoneal pressures.

Large-volume paracentesis supported with albumin infusion has been shown to decrease the risk of post-paracentesis related circulatory dysfunction (PPCD). It has been reported that the use of albumin was associated with a significantly reduced risk of PPCD (reducing odds by 66%) and reduction in morbidity and mortality by 36%. While this reduction in PPCD is mainly believed to be due to albumin, the slow gravity-dependent removal of large volume of fluid could play a further role in preventing this complication (20). Moreover, slow gravidity-dependent removal of ascites along with albumin infusion not only helps in effective removal of ascitic fluid but also facilitates fluid movement from the interstitium into the vascular space due to the increased oncotic effect of albumin in the plasma. This also plays a role in preventing the rapid re-accumulation of fluid as well as improved renal perfusion (10). In this study, the improved creatinine levels were maintained 2 weeks post drain removal at 1.14. The mean albumin infused in our study was 80.76, 68.26, and 60.00 g on days 1, 2, and 3, respectively, with albumin infusion directly correlating with the amount of fluid evacuated. This equated to 12 g per liter of albumin infused. It has already been demonstrated that albumin infusion helps in the resolution of hepatorenal syndrome (21). We believe that this slow gravity-dependent removal of ascites along with albumin infusion could have a further beneficial role in preventing renal dysfunction and subsequent development of hepatorenal syndrome, but more prospective studies are needed to validate such findings.

Overall there is a paucity of literature regarding the efficacy and side effects of an indwelling catheter in the management of non-malignant refractory ascites 10–12. In addition, concerns have been raised regarding the risk of bacterial peritonitis with the use of indwelling peritoneal catheters (11, 12, 15). Recently, a retrospective observational study reported the risk of secondary bacterial peritonitis as high as 10% in patients with indwelling peritoneal catheters. This was based solely of neutrophilic criterion of fluid analysis and did not correlate with cultures or known clinical decompensation after drain removal (11, 22).

In our study, none of our 36 patients developed bacterial peritonitis in the 72-h time frame of indwelling peritoneal catheter. Our ascitic fluid white blood cell count trended from a mean value of 126/mm^3 on day 1 to 234/mm^3 on day 3. No patients had >250/mm^3 neutrophils throughout the study. This trend likely represents several pathophysiologic processes occurring in patients with an indwelling peritoneal catheter. The first is a concentration of the ascitic fluid volume within the peritoneal cavity, thereby increasing all cellular material per unit of measurement. The second is mild abdominal wall irritation from the drain catheter with a resulting mild inflammatory response. In addition, over a 4-week follow-up period, no patients presented to the hospital with clinical findings or laboratory evaluation consistent with bacterial peritonitis.

The most common side effects encountered in our study were pain at insertion site in seven patients (19.4%) and minor bleeding from the drain site in two patients (5.6%). Both cases of minor bleeding responded to local pressure for 10 min to the insertion site with no recurrence. The mortality also did not seem to be affected by drain placement with average survival being around 22 months after drain placement varying in different patients according to the severity of their respective MELD scores (11).

Our results are consistent with a previous study done by Van Thiel and colleagues. In their study, 40 patients underwent peritoneal drain placement with no evidence of infection. The duration of indwelling drain placement was up to a maximum of 72 h similar to our study. The most common complaint accompanied in their study was abdominal wall discomfort in 63% of the patients and abdominal wall hematoma in 5% of the patients (10, 22). Another study by Nadir and colleagues showed the risk of spontaneous bacterial peritonitis (SBP) to be more only in those patients in whom the drain was left in for more than 3 days (12).

In addition, previous studies have shown increased risk of concurrent proton pump inhibitor (PPI) therapy and development of SBP (23, 24). This risk is greater with a PPI therapy ($n=3{,}815$; OR 3.15, 95% CI 2.09–4.74) as compared with those on H2 therapy ($n=562$; OR 1.71, 95% CI 0.97–3.01) (25). In our study 30 ($\sim$75%) patients were on some form of PPIs while the indwelling catheter was placed in and none had clinical SBP, thus suggesting that PPIs did not enhance the risk of developing SBP.

In conclusion, continuous paracentesis with an indwelling peritoneal catheter represents an important modality in the evacuation of ascites in selected patients. This technique when used for less than 72 h and with albumin infusion can be a safe and effective means to manage patients in the hospital with large-volume tense ascites.

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Authors' contribution

SW, ZA, and KR collected the data; RJ analyzed the data; and DM and SD reviewed the literature and made critical revisions related to the content of the article. All authors approved the final version of the article to be published.

Conflict of interest and funding

The authors have not received any funding or benefits from industry or elsewhere to conduct this study.

References

1. CDC. Available from: http://www.cdc.gov/nchs/fastats/liver-disease.htm
2. Gines P, Quintero E, Arroyo V, Teres J, Bruguera M, Rimola A, et al. Compensated cirrhosis: Natural history and prognostic factors. Hepatology 1987; 7(1): 12–18.
3. Runyon BA. Care of patients with ascites. N Engl J Med 1994; 330(5): 337–42.
4. Borzio M, Salerno F, Piantoni L, Cazzaniga M, Angeli P, Bissoli F, et al. Bacterial infection in patients with advanced cirrhosis: A multicentre prospective study. Dig Liver Dis 2001; 33(1): 41–8.
5. Moore KP, Wong F, Gines P, Bernardi M, Ochs A, Salerno F, et al. The management of ascites in cirrhosis: Report on the consensus conference of the International Ascites Club. Hepatology 2003; 38(1): 258–66.
6. Sola E, Gines P. Renal and circulatory dysfunction in cirrhosis: Current management and future perspectives. J Hepatol 2010; 53(6): 1135–45.
7. Wong F, Sniderman K, Liu P, Allidina Y, Sherman M, Blendis LM. The effects of transjugular intrahepatic portosystemic shunt on systemic and renal hemodynamics and sodium homeostasis in cirrhotic patients with refractory ascites. Ann Intern Med 1995; 122: 816–22.
8. Gines P, Uriz J, Calahorra B, Garcia-Tsao G, Kamath P, Ruiz del Arbol L, et al. Transjugular intrahepatic portosystemic shunt versus paracentesis plus albumin for refractory ascites in cirrhosis. A multicenter randomized comparative study. Gastroenterology 2002; 123(6): 1839–47.
9. Barnet TD, Rubins J. Placement of a tunneled peritoneal drainage catheter for palliation of malignant ascites: A simplified percutaneous approach. J Vasc Interv Radiol 2002; 13(4): 379–83.
10. Van Thiel DH, Moore CM, Garcia M, George M, Nadir A. Continuous peritoneal drainage of large-volume ascites. Dig Dis Sci 2011; 56(9): 2723–7.
11. Kathpalia P, Bhatia , Robertazzi S, Ahn J, Cohen SM, Sontag S, et al. Indwelling peritoneal catheters in patients with cirrhosis and refractory ascites. Intern Med J 2015; 45(10): 1026–31.
12. Nadir A, Van Thiel H. Frequency of peritoneal infections among patients undergoing continuous paracentesis with an indwelling catheter. J Ayub Med Coll Abbottabad 2010; 22(1): 37–41.
13. Orman ES, Hayashi PH, Bataller R, Barritt AS. Paracentesis is associated with reduced mortality in patients hospitalized with cirrhosis and ascites. Clin Gastroenterol Hepatol 2014; 12(3): 496–503.
14. Cardenas A, Gines P. Management of refractory ascites. Clin Gastroenterol Hepatol 2005; 3(12): 1187–91.
15. De Gottardi A, Thevenot T, Spahr L, Morard I, Bresson-Hadni S, Torres F, et al. Risk of complications after abdominal paracentesis in cirrhotic patients: A prospective study. Clin Gastroenterol Hepatol 2009; 7(8): 906–9.
16. Richards WO, Scovill W, Shin B, Reed W. Acute renal failure associated with increased intraabdominal pressure. Ann Surg 1983; 197(2): 183–7.
17. Gotlieb WH, Feldman B, Feldman-Moran O, Zmira N, Kreizer D, Segal Y, et al. Intraperitoneal pressures and clinical parameters of total paracentesis for palliation of symptomatic ascites in ovarian cancer. Gynecol Oncol 1998; 71(3): 381–5.
18. Umgelter A, Reindl W, Franzen M, Lenhardt C, Huber W, Schmid RM. Renal resistive index and renal function before and after paracentesis in patients with hepatorenal syndrome and tense ascites. Intensive Care Med 2009; 35(1): 152–6.
19. Cade R, Wagemaker H, Vogel S, Mars D, Hood-Lewis D, Privette M, et al. Hepatorenal syndrome. Studies of the effect of vascular volume and intraperitoneal pressure on renal and hepatic function. Am J Med 1987; 82(3): 427–38.
20. Bernardi M, Caraceni P, Navickis RJ, Wilkes M. Albumin infusion in patients undergoing large-volume paracentesis: A meta-analysis of randomized trials. Hepatology 2012; 55(4): 1172–81.
21. Sort P, Navasa M, Arroyo V, Aldeguer X, Planas R, Ruiz-del-Arbol L, et al. Effect of intravenous albumin on renal impairment and mortality in patients with cirrhosis and spontaneous bacterial peritonitis. N Engl J Med 1999; 341(6): 403–9.
22. Bhogal H, Sanyal AJ. Treatment of refractory ascites. Clin Liver Dis 2013; 2(3): 140–2.
23. Goel GA, Deshpande A, Lopez R, Hall GS, van Duin D, Carey WD. Increased rate of spontaneous bacterial peritonitis among cirrhotic patients receiving pharmacologic acid suppression. Clin Gastroenterol Hepatol 2012; 10(4): 422–7.
24. Bajaj JS, Zadvornova Y, Heuman DM, Hafeezullah M, Hoffmann RG, Sanyal AJ, et al. Association of proton pump inhibitor therapy with spontaneous bacterial peritonitis in cirrhotic patients with ascites. Am J Gastroenterol 2009; 104(5): 1130–4.
25. Deshpande A, Pasupuleti V, Thota P, Pant C, Mapara S, Hassan S et al. Acid-suppressive therapy is associated with spontaneous bacterial peritonitis in cirrhotic patients: A meta-analysis. J Gastroenterol Hepatol 2013; 28(2): 235–42.