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A Dedicated Paracentesis Clinic Decreases Healthcare Utilization for Serial Paracenteses in Decompensated Cirrhosis

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Abstract

PURPOSE—To describe the effect of a dedicated paracentesis clinic on healthcare utilization by patients with decompensated cirrhosis and refractory ascites.

METHODS—This Institutional Review Board-approved retrospective study identified cirrhotic patients receiving paracenteses over a six-month period before and after creating the paracentesis clinic. Patients were followed for 12 months to collect outcome data including characteristics of subsequent hospitalizations and paracenteses. Logistic regression was used to examine the association between the paracentesis clinic and outcomes.

RESULTS—There were 183 patients and 1364 paracenteses performed during the study time period. Age, gender, cirrhosis etiology, MELD, Child-Pugh, and Charlson comorbidity index was comparable between the two groups. Rates of mortality, transplant, and hospitalization were also similar during one year follow-up. After establishment of the paracentesis clinic, median paracenteses per patient increased from 2 (IQR 1–7) to 4 (IQR 2–11) ($P=0.01$), albumin replacement after paracenteses 5L improved from 76.3% to 91.7% ($P<0.001$), and the fraction of outpatient paracenteses performed in the emergency department decreased from 13.4% to 3.8% ($P<0.001$). Major complications remained negligible at 0.81% across both time periods. While fewer patients were admitted for ascites after the paracentesis clinic (39.6% versus 20.8%,

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Compliance with Ethical Standards

Ethical approval:

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent:

As a retrospective cohort study, formal consent is not required.

P=0.009), more patients had acute kidney injury (AKI) during follow up (47.2% vs 65.9%, P=0.02), with a trend towards more AKI admissions (22.6% vs 35.4%, P=0.09).

CONCLUSION—A dedicated paracentesis clinic can improve access and wait times, while also reducing admissions for ascites and paracenteses performed in the emergency department.

Keywords

cirrhosis; hospitalizations; paracentesis; healthcare utilization

Introduction

Ascites is a marker of severe liver disease and is the most common complication associated with cirrhosis [1]. It arises in half of patients within 10 years of cirrhosis diagnosis, and its onset is associated with 50% mortality within 5 years [2]. In uncomplicated and mild cases, ascites can be managed with a sodium-restricted diet and diuretics. However, up to 10% of patients develop medically-refractory ascites [3,4]. Short of liver transplantation, refractory ascites can be managed with serial large volume paracentesis (LVP) and transjugular intrahepatic portosystemic stent-shunt (TIPS). In large-scale randomized controlled studies, TIPS is superior to LVP in controlling ascites and transplant-free survival [5–9]. Unfortunately, TIPS is not an option for many patients with refractory ascites who have poor liver function, hepatic encephalopathy, cardiac disease, and other contraindications [10].

For those who are ineligible for TIPS, LVP is the preferred method of acute and chronic treatment for refractory ascites. LVP is fast, effective, and can be safely performed at the bedside via blind insertion of a drainage catheter using anatomical landmarks. Further, the wide availability of bedside ultrasonography has boosted success rates and decreased bleeding complications [11]. Concerns regarding paracentesis-induced circulatory dysfunction (PICD) are now addressed by the practice of intravenous albumin replacement [12–14].

Cirrhosis is the 12th leading cause of death in the United States, with hospitalizations alone costing an estimated \$1.8 billion per year [15]. Despite the rapid advance in therapies for acute and chronic liver diseases, the prevalence of cirrhosis continues to rise [16]. This necessitates development of an optimal structure to deliver serial LVPs, which can be required frequently for patients with refractory ascites. At many facilities, patients with tense ascites requiring LVP require hospital admission or an emergency department (ED) visit, which is time consuming and a poor allocation of medical resources. In other cases, patients are able to schedule an outpatient LVP, but without dedicated staff and procedural space, accessibility and wait times can be limiting. Few studies have examined formats for providing LVPs, and even fewer have quantified the impact on medical resource utilization [17–22].

In this study, we describe a dedicated paracentesis clinic established in 2011 for patients with decompensated cirrhosis as a solution to rising demand for outpatient paracentesis, which was placing undue strain on ED and hospital resources. The primary objective of this

study was to compare rates of hospital admissions before and after the clinic's introduction. Additionally, we sought to compare rates of ED utilization and acute kidney injury (AKI).

Materials and Methods

The Paracentesis Clinic

A dedicated paracentesis clinic was established in the Department of Radiology of our tertiary care university hospital in June 2011 after increased patient volumes prompted the need to dedicate a separate area for these time-intensive procedures. Our clinic space contains three bays to accommodate multiple paracenteses simultaneously and requires only minimal staffing. Compared to our previous format and practices common at other medical centers, the paracentesis clinic improves long patient wait times because the procedures are no longer added onto a physician's schedule. A single advanced practice provider (APP) performs all procedures with the assistance of an ultrasound technologist. A registered nurse is also present as needed to administer albumin and monitor patient vital signs. The paracentesis clinic has improved efficiency, capacity, and ease-of-scheduling. Appointment time slots have decreased from 1.5 to 1 hour, and patients can now arrive just 15 minutes prior to their scheduled procedure instead of the previous 30 minutes. The clinic currently serves an average of 15 patients per day, the majority of which require albumin replacement. Previously, only a maximum of 3 patients requiring albumin infusion could be seen per day; additional LVPs would either be limited to 5 liters to avoid albumin replacement, or patients would be diverted to the ED. Increased capacity has also improved wait times. Patients are currently able to schedule an appointment within 24–48 hours instead of waiting almost a week, including same day scheduling for urgent cases.

Paracenteses are performed under ultrasound-guidance via a traditional lateral approach, though a midline linea alba technique can also be attempted if necessary. A Philips CX50 portable ultrasound unit with a 2–5MHz curvilinear probe is utilized to identify a safe pocket of ascites fluid at least 2cm in depth and devoid of vascular structures within the anticipated needle track. Our paracentesis-trained APPs are able to interpret the ultrasound imaging at bedside, and subsequently perform the procedure.

One particularly unique aspect of our dedicated paracentesis clinic is the ability for patients to obtain a standing order for paracentesis, thereby allowing them to quickly and autonomously schedule a procedure as needed or on a regular basis. Without having to write individual orders for each paracentesis, this system has significantly decreased the number of messages that providers receive from their panel of patients.

Due to the specialized nature of the clinic, a number of protocols have been instituted to ensure quality of care. Firstly, the standing order can specify volume limits for ascites drainage. Secondly, albumin replacement is automatically applied for the purpose of renal protection when patients have ≥ 5 liters of ascites drained based on American Association for the Study of Liver Diseases (AASLD) guidelines or when serum creatinine is greater than 1.5mg/dL. The paracentesis clinic can also triage patients to the appropriate level of care. It has the ability to send fluid studies on therapeutic paracenteses if the patient's clinical status is suggestive of spontaneous bacterial peritonitis (such as fever, encephalopathy, abdominal

tenderness, nausea, vomiting). Furthermore, by seeing patients multiple times between physician visits, the paracentesis clinic can identify early signs of clinical deterioration and subsequently direct patients to hepatology clinic, the emergency department, or have them directly admitted for further evaluation.

Data Collection, Variables, and Definitions

Institutional Review Board approval was obtained for this Health Insurance Portability and Accountability Act (HIPAA)-compliant retrospective cohort study. We identified patients who underwent a paracentesis at our University Hospital during the first six months of 2008 and 2012 to compare outcomes before and after the clinic was established. We chose these time periods to allow for adequate follow-up in both the pre- and post-clinic eras, and to avoid transitions in practice around the time that the clinic was established. We included only patients with an established diagnosis of cirrhosis based on liver biopsy, or typical clinical, endoscopic, and laboratory characteristics. From the time of their first paracentesis during the study period, patients' medical records were reviewed to follow their clinical course for up to one year or until death, transplant, or enrollment into hospice.

Data collected at enrollment included patient demographics, etiology of cirrhosis, standard laboratory data, complications of liver disease, measures of liver disease severity (Child-Pugh score [23], and Model for End-Stage Liver Disease [MELD] [24]), and Charlson comorbidity index. We recorded data on hospitalizations and emergency department (ED) visits during the follow-up period including the primary diagnosis and length of stay. For paracenteses performed during follow-up, we recorded the volume of ascites drained, major procedure-related complications, and the amount of intravenous albumin provided. Complications were defined as major if they resulted in patient observation, medical/surgical intervention, hospitalization, persistent disability, and/or death.

Outcomes

The primary outcome was hospital admissions during follow-up. The secondary outcomes were (1) ED utilization for paracentesis and (2) acute kidney injury. Adherence to clinical practice guidelines for albumin replacement after paracentesis was also examined [14]. Notably, AASLD guidelines for the management of ascites was different between the pre and post paracentesis clinic time periods, having underwent revisions in 2004 and 2012 [25,14]. Guidelines from both time periods recommended albumin replacement for LVPs greater than 5 liters, but the replacement amount decreased from 8–10 g/L in the 2004 version to 6–8 g/L in the 2012 update, and the 2012 guidelines were supported by a higher level of evidence [26].

Statistical analysis was performed with Stata version 13.0 (StataCorp LP, College Station, TX). Student's t-test and the Wilcoxon rank-sum test were employed to compare continuous variables, while Pearson's X^2 test was utilized to compare categorical variables. Logistic regression was used to examine the association between the paracentesis clinic and outcomes, while controlling for pertinent variables (age, sex, and MELD score).

Results

Patient Characteristics

183 patients were included in our analysis, 53 before and 130 after the paracentesis clinic was established (Table 1). Patient characteristics were similar in the two eras. The average age was 58.5 ± 9.9 years, 63.9% were male, and 91.8% were Caucasian. The majority of patients were Medicare (46.5%) or Medicaid (19.1%) beneficiaries. The etiology of cirrhosis was 12.6% alcoholic, 29.0% hepatitis C, 18.0% combined hepatitis C and alcoholic, and 21.9% NASH. The prevalence of NASH was 25.4% post-clinic, compared to 13.2% pre-clinic. Surrogate measures for disease severity were not significantly different between the two time periods. The average Charlson Comorbidity Index was 6.4 ± 2.4 , MELD score was 17.9 ± 6.3 , and Child-Pugh score was 10.4 ± 2.0 , with 63.9% of the cohort meeting Child-Pugh class C cirrhosis. Twelve percent of patients had hepatocellular carcinoma. The proportion of patients on a diuretic at time of enrollment was 84.7%, with no significant differences in the dosage of furosemide or spironolactone between time periods. Median follow-up time was similar in the two eras, 158 days pre-clinic versus 119 days post-clinic ($p=0.96$).

Paracentesis Characteristics and Outcomes

A total of 1,364 paracenteses were performed, 275 pre-clinic and 1,089 post-clinic (Table 2). After the clinic was established, the median number of paracenteses per patient increased from 2 to 4 ($P=0.01$), and the fraction of outpatient paracenteses performed in the ED decreased from 13.4% to 3.8% ($P<0.001$).

The mean volume of ascites drainage remained consistent at 5.0 ± 2.7 liters through both time periods. While the percentage of paracenteses removing ≥ 5 liters of ascites did not vary significantly between time periods, albumin replacement was provided more often post-clinic (75.7% pre versus 91.7% post; $P<0.001$). The percentage of patients receiving albumin replacement when <5 liters of ascites was removed increased from 9.6% pre-clinic to 26.6% post-clinic ($P<0.001$). The average amount of albumin replaced decreased from $8.1\text{g/L} \pm 2.2$ pre-clinic to $7.2\text{g/L} \pm 1.9$ post-clinic ($P<0.001$), corresponding to a decrease in the proportion who received albumin replacement greater than 8g/L (49.2% pre versus 18.9% post; $P<0.001$). 46.2% of patients received the AASLD-recommended 8–10g/L of albumin replacement pre-clinic, while 68.1% of patients received the recommended 6–8g/L in the post-clinic era.

Major complications were rare, occurring after 11 paracenteses ($<1\%$) during both time periods. In the pre-clinic time period, there were two complications, both requiring hospital admission (abdominal wall hematoma and syncope). The most frequent complication overall was hypotension, which accounted for 5 cases resulting in 3 admissions for resuscitation and monitoring, all of which occurred in the paracentesis clinic time period. The remaining complications after paracentesis clinic implementation consisted of ascites leakage, abdominal wall hematoma, acute anemia, and allergic reaction to albumin infusion. A total of 6 hospital admissions for complications occurred over the two time periods, none of

which resulted in death, hospital stay >48 hours, surgical intervention, or persistent disability.

Patient Outcomes

The proportion of patients requiring hospital admission during follow-up was similar during the two periods (66.0% pre vs. 74.6% post, $p=0.24$) (Table 3). However, following availability of the paracentesis clinic, there was a significant decrease in the proportion admitted for ascites (39.6% pre vs. 20.8 post, $p=0.009$) and a trend towards increased admissions for AKI (22.6% pre vs. 35.4% post, $p=0.09$). Similarly, a greater proportion of patients developed AKI during follow-up in the paracentesis clinic era (47.2% pre vs. 65.9% post, $p=0.02$) despite a similar percentage of patients with recurrent AKI (2 episodes during follow up) in this population (36% vs 44.7%, $p=0.44$). The number of AKI episodes during follow up was not significantly different between diuretic users and non-users at time of enrollment (0.98 vs 1.17 episodes of AKI, $p=0.47$).

There were no significant differences in mortality (27.9%), referral to hospice (13.1%), or transplant (16.9%) between the two groups. In logistic regression analyses, adjustment for age, sex, and MELD score did not significantly change the strength, direction, or significance of the associations between the paracentesis clinic and patient outcomes. The adjusted odds of ascites admissions was decreased (OR 0.38, 95% CI: 0.19–0.78) and AKI was increased (OR 2.34, 95% CI: 1.19–4.58) with the paracentesis clinic.

Discussion

This study describes a dedicated paracentesis clinic, which caters to patients with decompensated cirrhosis requiring large volume paracentesis in the outpatient setting. We found that the paracentesis clinic was associated with a significant decrease in the rate of admissions for ascites as well as a reduced proportion of outpatient paracenteses performed via the ED. Despite these improvements, there was an increase in the incidence of AKI, which coincided with a change in recommended albumin replacement dosing for large volume paracenteses. These findings build on prior studies examining healthcare utilization for ascites management.[17–22,27,28]

Numerous studies have detailed the burden placed on healthcare systems when outpatient paracentesis is unavailable. Fagan and colleagues followed patients with decompensated cirrhosis and ascites requiring paracentesis over a one year period [17]. These 41 patients accounted for 127 hospital admissions resulting in 1164 occupied bed days. Notably, 80% of these admissions were for management of ascites. In another study, an estimated 22% of 30-day hospital readmissions were possibly preventable, with “failure to plan ahead for paracentesis” being one of the primary reasons for such readmissions [18]; the average cost of readmission was \$29,000.

There is clearly a need to improve care delivery for cirrhotic patients requiring serial paracenteses. Unfortunately, novel methods to achieve this are described sparingly in literature. In one study, trained advanced practice providers were able to provide safe, effective paracenteses in a dedicated paracentesis clinic [29], much like our current

paracentesis clinic format. Importantly, a successful outpatient paracentesis clinic can lead to significant benefits in cost and patient satisfaction. Nurse-led paracentesis clinics in the United Kingdom resulted in cost savings ranging from £30,000–250,000 per year compared to prior models where patients were admitted for paracentesis [20,21]. On a per-procedure basis, Planella and colleagues reported a 39% savings by an outpatient paracentesis service compared with admission to a conventional care unit [27]. Studies of these outpatient services have demonstrated decreases in readmission for ascites by 55–75% [22,20], with substantial reductions in bed occupancy [20]. Beyond avoiding the hassle of hospital admission, Vaughan and colleagues reported that their dedicated paracentesis clinic decreased patient wait time from 100 to 44 minutes, and also increased the percentage of patients who received their procedure in under an hour from 35% to 87% [28]. These outpatient services scored highly on measures of patient satisfaction [20,28].

These studies, while encouraging, may not be applicable to the US healthcare system, which offers different models of care delivery and provider reimbursement. In the United States, Sehgal and colleagues avoided roughly 100 admissions over a two year period with an outpatient paracentesis clinic staffed by a hospitalist and a nurse [19]. However, this study has only been published in abstract form. Our study demonstrates several findings that are novel additions to the literature. We also documented reduced admissions for ascites management, but further demonstrated reduction in ED utilization for paracenteses as well as improved compliance with guidelines for albumin replacement after LVPs. After large volume paracentesis (≥ 5 liters), albumin was administered in 91.7% of paracentesis clinic patients, a significant improvement from 76.3% pre-clinic. Interestingly, there was also an increase in the proportion who received albumin amongst those with <5 liters removed. Although paracentesis of these low volumes are not associated with systemic or renal hemodynamic changes [30], in practice albumin is often given for renal protection in those with pre-existing chronic kidney disease. It is notable that the 2012 AASLD guidelines reduced the recommended amount of albumin from 8–10g/L ascites to 6–8g/L [26]. For patients requiring albumin infusion, based on AASLD guidelines available at the time of procedure there was improved adherence to the specific amount of albumin replacement.

Despite higher rates of compliance to albumin replacement after LVP, a notable finding in our analysis was the increased percentage of patients suffering acute kidney injury, and a higher rate of admissions related to AKI (though the latter did not reach significance). The reasons for this increase are not clear. Our study did not determine the temporal relationship between paracentesis and subsequent onset of AKI, thus a causal relationship between the two findings cannot be evaluated. While the median number of paracenteses essentially doubled from two to four after the paracentesis clinic was established, concurrent with an increase in the percentage of patients suffering AKI during follow up, there was no significant difference in the percentage of patients who had recurrent AKI (≥ 2 episodes) between time periods. There were also no significant differences in the percentage of patients on diuretic therapy and their dosages at time of enrollment into our study.

Conceivably, the convenience of the paracentesis clinic may have encouraged patients to obtain more care at our medical center, leading to higher detection rates of AKI events and admissions. Alternatively, it may be worth exploring the change in albumin replacement

guidelines. The 2004 guidelines recommended 8–10g/L of albumin replacement after LVP based on studies utilizing this dose [5,12,13], while the 2012 guidelines decreased albumin replacement to 6–8g/L based on a meta-analysis where 14 of 17 studies replaced albumin at this lower concentration [26]. Therefore, the 2012 AASLD guidelines recommended this dosage because it was the most common dose in studies that demonstrated efficacy. While one trial demonstrated that replacement of albumin at 4g/L was non-inferior to currently recommended levels of albumin replacement [31], to our knowledge there are no studies comparing complication and mortality rates between current (6–8g/L) and previous (8–10g/L) albumin doses. Further prospective studies examining paracentesis frequency and volume, as well as albumin replacement regimens are needed to better understand and optimize care for this population.

Complications were rare, with no significant difference between time periods. Complications were previously described in 1.6% of procedures in one study of 515 paracenteses, the majority of which were performed without ultrasound [32]. In our study, a major complication occurred in only 11 out of 1,364 paracenteses. Abdominal hematoma and/or hemorrhage was documented in 0.15% of procedures in this study, similar to a previous study on complications after ultrasound-guided paracentesis, which cited a 0.27% complication rate [33]. Without ultrasound-guidance, rates of abdominal hematoma are as high as 1.25% [33,32]. In our study, there were no instances of death or infection due to paracentesis, which is consistent with low rates of infection (0.58–0.63%) and death (0–0.39%) described in other studies [34–36].

This study has several limitations. The retrospective study design did not allow for comparison of important patient-centered outcomes, including patient satisfaction scores, wait times, and costs. Additionally, the before-and-after design could result in unmeasured confounding and selection bias. Paracenteses performed at bedside outside of radiology were also not represented in this study, though these numbers are likely to be diminutive, based on the clinical practice patterns at our medical center. Additionally, we were unable to obtain data on paracenteses and hospitalizations outside of our hospital network. The temporal associations between individual paracentesis clinic visits and events such as hospitalizations, AKI, and mortality were not explored in this study. Therefore, the direct impact of a single paracentesis on clinical events (aside from direct complications) could not be identified. Finally, this single-center experience may have limited generalizability; successful implementation of a paracentesis clinic in a cost-effective manner may be difficult at medical centers with lower volumes of cirrhosis patients.

In conclusion, a dedicated paracentesis clinic for cirrhotic patients with ascites can improve some aspects of healthcare utilization by decreasing ascites admissions and ED visits. Patients with complex chronic illnesses such as cirrhosis may benefit from similar changes to the healthcare delivery system. Further studies of innovative models of care for this population are needed to improve outcomes.

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Table 1

Patient Demographics and Disease Severity.

	Total	2008 (pre-clinic)	2012 (post-clinic)	P-value
Patient Totals, n	183	53	130	
Age, mean (SD)	58.5 (9.9)	57.0 (9.9)	59.1 (9.9)	0.19
Male, %	63.9	69.8	61.5	0.29
Race, %				
White	91.8	92.5	91.5	0.50
Black	6.6	5.7	6.9	
Health Insurance, %				
Private	32.8	32.1	33.1	0.31
Medicare	46.5	39.6	49.2	
Medicaid	19.1	24.5	16.9	
Cirrhosis Etiology, %				
Alcohol	12.6	17	10.8	0.22
HCV	29	24.5	30.8	
HCV/alcohol	18	22.6	16.2	
NASH	21.9	13.2	25.4	
Other	18.6	22.6	16.9	
HCC, %	12	11.3	12.3	0.85
Serum Creatinine, mg/dL, median (IQR)	1.2 (0.8–1.5)	1.2 (0.8–1.9)	1.1 (0.9–1.4)	0.24
Serum albumin, g/dL, mean (SD)	2.6 (0.6)	2.5 (0.6)	2.7 (0.6)	0.03
Bilirubin, mg/dL, median (IQR)	2.5 (1.5–4.1)	2.3 (1.6–3.9)	2.5 (1.4–4.1)	0.81
INR, mean (SD)	1.6 (0.5)	1.6 (0.4)	1.6 (0.5)	0.76
MELD, mean (SD)	17.9 (6.3)	18.7 (6.6)	17.5 (6.2)	0.25
Child-Pugh Score, mean (SD)	10.4 (2.0)	10.5 (2.2)	10.4 (1.9)	0.64
Child-Pugh Class, %				
A	1.1	1.9	0.8	0.80
B	35	34	35.4	
C	63.9	64.2	63.8	
Charlson Comorbidity Index, mean (SD)	6.4 (2.4)	6.2 (2.3)	6.4 (2.5)	0.55
Median follow up time, days, median (IQR)	134 (52–365)	158 (47–365)	119 (53–365)	0.96
Diuretic Use, %	84.7	83	89.2	0.25
Furosemide dosage, mg, mean (SD)	59 (37)	58 (38)	59 (37)	0.53
Spironolactone dosage, mg, mean (SD)	129 (106)	122 (68)	132 (118)	0.57

HCV Hepatitis C, *NASH* non-alcoholic steatohepatitis, *HCC* hepatocellular carcinoma

Table 2

Characteristics of Paracenteses Performed During Follow Up.

	Total	2008 (pre-clinic)	2012 (post-clinic)	P-value
Paracentesis totals, n	1364	275	1089	
Outpatient paracentesis totals, n	1021	231	790	
Paracentesis per patient, median (IQR)	3 (1–9)	2 (1–7)	4 (2–11)	0.01
Outpatient paracentesis per patient, median (IQR)	2 (1–6)	2 (1–4)	2 (1–8)	0.22
ED paracentesis totals, n	61	31	30	
Outpatient paracenteses performed in ED, %	4.5	13.4	3.8	<0.001
Ascites volume removed (liters), mean (SD)	5.0 (2.7)	5.2 (2.9)	5.0 (2.6)	0.11
Paracenteses with volume $\geq$ 5 liters, %	48.1	50.5	47.5	0.36
Paracenteses receiving albumin, %				
All paracenteses	54.6	43.3	57.5	<0.001
Paracenteses <5 liters	23.3	9.6	26.6	<0.001
Paracenteses $\geq$ 5 liters	88.4	76.3	91.7	<0.001
Albumin given, grams, mean (SD)	46.5 (17.7)	59.3 (20.8)	44.0 (15.9)	<0.001
Albumin given, g/L, mean (SD)	7.3 (2.0)	8.1 (2.2)	7.2 (1.9)	<0.001
Amount of albumin replaced, %				
<6 g/L	16.6	7.5	18.6	<0.001
6–8g/L	64.1	46.2	68.1	
>8 g/L	19.3	46.2	13.3	
Major complication totals, n (%)	11 (0.81%)	2 (0.73%)	9 (0.83%)	0.87
Complication resulting in admission, n	6	2	4	0.42

ED emergency department

Table 3

Patient Outcomes and Healthcare Utilization.

	Total	2008 (pre-clinic)	2012 (post-clinic)	P-value
Hospital Utilization				
Patients admitted to hospital, %	72.1	66.0	74.6	0.24
Admissions per patient, median (IQR)	1 (0–2)	1 (0–2)	1 (0–3)	0.18
LOS, median (IQR)	6 (4–10)	5 (3–9)	6 (4–10)	0.17
Patients admitted for liver-related complication, %	71	67.9	72.3	0.55
Patients admitted for ascites, %	26.2	39.6	20.8	0.009
Patients admitted for AKI, %	31.7	22.6	35.4	0.09
Patient Outcomes				
Mortality, %	27.9	26.4	28.5	0.78
Palliative care, %	13.1	13.2	13.1	0.98
Transplant, %	16.9	11.3	19.2	0.20
AKI, %	60.4	47.2	65.9	0.02
TIPS placement, %	6.0	3.8	6.9	0.42

LOS length of stay, *AKI* acute kidney injury, *TIPS* transjugular intrahepatic portosystemic shunt