JHWCR JOURNAL OF HEALTH, WELLNESS AND COMMUNITY RESEARCH 3007-0570

Original Article Volume 3, Issue 8

Prevalence of Spontaneous Bacterial Peritonitis in Chronic Liver Disease at BMC SPH, Quetta

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ABSTRACT

Background: *Spontaneous bacterial peritonitis (SBP) is a frequent and life-threatening infection of ascitic fluid in chronic liver disease (CLD), contributing substantially to in-hospital morbidity and mortality. Local epidemiologic and microbiologic data are essential to guide early diagnostic vigilance and empiric antimicrobial therapy in hospitalized patients with cirrhosis and ascites.* ***Objective:*** *To determine the frequency of SBP among hospitalized CLD patients with ascites at Sendeman Provincial Hospital/BMC Quetta and to describe ascitic fluid culture yield and bacterial spectrum.* ***Methods:*** *A cross-sectional observational study was conducted in the Department of General Medicine, Unit IV, Sendeman Provincial Hospital/BMC Quetta from 06 January 2025 to 06 June 2025. Consecutive patients aged >15 years with CLD and ascites underwent diagnostic paracentesis within 24 hours of admission. Ascitic fluid (50 mL) was obtained under aseptic technique; 10 mL was inoculated directly into blood culture bottles and the remainder was analyzed for cell count/differential. SBP was diagnosed using standard criteria (ascitic polymorphonuclear leukocytes ≥250 cells/mm³) and infections were categorized by PMN count and culture status.* ***Results:*** *Among 139 patients (mean age 35.67±12.79 years; 61.0% male), SBP was present in 56 (40.3%). Ascitic fluid culture was positive in 80 (57.6%). Among culture-positive infections (n=80), classical SBP accounted for 52 (65.0%), bacterascites for 18 (22.5%), and culture-negative neutrocytic ascites for 10 (12.5%). Escherichia coli was the most common isolate (30/80, 37.5%), followed by Klebsiella species (15/80, 18.8%).* ***Conclusion:*** *SBP occurred in approximately two-fifths of hospitalized CLD patients with ascites, with predominance of classical SBP and enteric gram-negative pathogens, supporting routine early paracentesis and locally informed empiric management.*

Keywords: *spontaneous bacterial peritonitis; ascitic fluid; chronic liver disease; cirrhosis; bacterascites; culture-negative neutrocytic ascites; Escherichia coli; Klebsiella.*

INTRODUCTION

Spontaneous bacterial peritonitis (SBP) is a serious and potentially life-threatening bacterial infection of ascitic fluid that occurs in patients with chronic liver disease (CLD), particularly those with cirrhosis and portal hypertension. It is defined by infection of ascitic fluid in the absence of an evident intra-abdominal surgically treatable source such as gastrointestinal perforation, abscess, pancreatitis, or cholecystitis (1). SBP remains one of the most frequent complications of decompensated cirrhosis, with reported incidence ranging from 7% to 30% among hospitalized cirrhotic patients with ascites and is associated with significant in-hospital mortality despite advances in diagnostic and therapeutic strategies (1,2). The high fatality rate is largely attributable to complications such as acute variceal bleeding, hepatorenal syndrome, sepsis, and progressive hepatic failure (1).

The pathogenesis of SBP is multifactorial and closely linked to cirrhosis-related immune dysfunction. Impaired reticuloendothelial function, reduced complement activity, and altered neutrophil function facilitate bacterial translocation from the intestinal lumen to mesenteric lymph nodes, bloodstream, and ultimately the ascitic fluid (2).

Received: 10 June 2025
Revised: 24 June 2025
Accepted: 10 July 2025
Published: 15 July 2025

Citation: Click to Cite

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Gram-negative enteric organisms, particularly Escherichia coli and Klebsiella species, have historically been the most common causative pathogens, although recent studies have reported a rising proportion of gram-positive organisms, likely related to invasive procedures, hospitalization, and prophylactic antibiotic use (3–6). Identification of local microbiological patterns is therefore essential for guiding empirical antibiotic therapy and reducing mortality.

Clinically, SBP may present with a wide spectrum of manifestations, ranging from overt symptoms such as fever, abdominal pain, tenderness, jaundice, and hepatic encephalopathy to entirely asymptomatic cases detected only through routine diagnostic paracentesis (7). Diagnostic criteria are primarily based on an ascitic fluid polymorphonuclear (PMN) leukocyte count of ≥250 cells/mm³, with or without a positive bacterial culture, and SBP is further categorized into classical culture-positive SBP, culture-negative neutrocytic ascites (CNNA), and bacterascites depending on ascitic PMN count and culture results (7). Early diagnosis through routine paracentesis within the first 24 hours of hospital admission is strongly recommended, as delayed treatment is associated with worse outcomes.

Globally, the reported frequency of SBP varies considerably across regions. Studies from Western countries have reported lower incidence rates compared to those from South Asia and the Middle East, where SBP frequencies as high as 30–60% among hospitalized cirrhotic patients with ascites have been documented (5,6).

In Pakistan, available data suggest substantial inter-center variability, with reported frequencies ranging from approximately one-third to more than half of admitted CLD patients with ascites (5,6).

These differences may reflect variations in patient characteristics, disease severity, hygienic conditions, healthcare access, diagnostic practices, and local microbial ecology. However, many regional studies are limited by small sample sizes, inconsistent diagnostic definitions, and incomplete reporting of microbiological profiles.

Despite the high burden of CLD in Balochistan and the routine admission of cirrhotic patients with ascites to tertiary care hospitals, contemporary data on the frequency and microbiological spectrum of SBP from this region remain scarce.

In particular, there is limited evidence from Sendeman Provincial Hospital / Bolan Medical College (BMC), Quetta, regarding the proportion of hospitalized CLD patients with ascites who develop SBP and the predominant causative organisms. This knowledge gap hampers the development of locally relevant diagnostic vigilance and empiric treatment protocols, which are critical for improving patient outcomes in resource-limited settings.

Therefore, the present study was designed to determine the frequency of spontaneous bacterial peritonitis among hospitalized patients with chronic liver disease and ascites at BMC/SPH Quetta and to describe the associated ascitic fluid culture findings and bacterial spectrum.

By generating local epidemiological and microbiological data, this study aims to support evidence-based clinical decision-making and contribute to the optimization of early diagnosis and empiric management of SBP in this high-risk population.

MATERIAL AND METHODS

This cross-sectional observational study was conducted to determine the frequency and microbiological profile of spontaneous bacterial peritonitis among hospitalized patients with chronic liver disease and ascites. The study was carried out in the Department of General

Medicine, Unit IV, Sendeman Provincial Hospital / Bolan Medical College (BMC), Quetta, over a six-month period from 06 January 2025 to 06 June 2025.

A cross-sectional design was selected because it is appropriate for estimating the frequency of a clinical condition and describing associated characteristics within a defined population at a specific point in time (8).

The study population comprised adult patients admitted with established chronic liver disease and clinically detectable ascites. Chronic liver disease was diagnosed on the basis of a compatible clinical history supported by biochemical abnormalities and radiological evidence of chronic liver pathology. Ascites was confirmed clinically and, where required, by ultrasonography.

Patients of either sex aged more than 15 years who underwent diagnostic paracentesis within the first 24 hours of hospital admission were eligible for inclusion. Patients were excluded if they had evidence of secondary peritonitis due to an identifiable intra-abdominal source, recent abdominal surgery, malignant ascites, peritoneal tuberculosis, or if they were receiving peritoneal dialysis, as these conditions could confound ascitic fluid findings and violate the diagnostic criteria of spontaneous bacterial peritonitis (9).

Participants were recruited using non-probability consecutive sampling, whereby all eligible patients presenting during the study period were approached for enrollment. After explaining the study objectives and procedures in the local language, informed written consent was obtained from each participant or their legally authorized attendant prior to inclusion. Recruitment and data collection were performed by the principal investigator to ensure uniformity in assessment and minimize inter-observer variability.

Data were collected using a pre-designed structured proforma. Baseline demographic variables included age and sex. Clinical variables included presenting symptoms such as fever, abdominal pain, nausea, vomiting, bowel disturbances, and history of gastrointestinal bleeding or portosystemic encephalopathy. Laboratory variables included prothrombin time, serum bilirubin, and serum creatinine, measured using standard hospital laboratory protocols.

Diagnostic paracentesis was performed under strict aseptic conditions within 24 hours of admission, and approximately 50 mL of ascitic fluid was obtained. Ten milliliters of ascitic fluid were inoculated directly at the bedside into aerobic blood culture bottles to enhance culture yield, as recommended by established guidelines (10). The remaining sample was sent immediately for ascitic fluid cell count and differential analysis.

Spontaneous bacterial peritonitis was defined operationally as an ascitic fluid polymorphonuclear leukocyte count of ≥ 250 cells/mm^3 in the absence of an alternative intra-abdominal source of infection (11).

Ascitic fluid infection was further classified into classical SBP (PMN ≥ 250 cells/mm^3 with positive culture), culture-negative neutrocytic ascites (PMN ≥ 250 cells/mm^3 with negative culture), and bacterascites (PMN <250 cells/mm^3 with positive culture), in accordance with internationally accepted definitions (11,12). Microorganisms isolated from ascitic fluid cultures were identified using standard microbiological techniques available at the institutional laboratory.

Several measures were adopted to reduce bias and enhance internal validity. Early paracentesis was uniformly performed within 24 hours of admission to reduce

misclassification due to prior antibiotic exposure. Standard diagnostic thresholds were applied consistently to all patients.

Data collection was conducted prospectively using a standardized instrument to minimize information bias. Potential confounding related to disease severity was partially addressed by recording key laboratory markers known to correlate with advanced liver dysfunction.

The sample size of 139 patients was calculated using the World Health Organization sample size calculator, assuming an anticipated population proportion of spontaneous bacterial peritonitis of 10%, a confidence level of 95%, and an absolute precision of 5%, which was considered adequate to estimate the frequency of SBP with acceptable statistical precision (13).

All collected data were coded and entered into Statistical Package for Social Sciences (SPSS) version 10.0 for analysis. Continuous variables such as age were summarized using mean and standard deviation, while categorical variables were presented as frequencies and percentages.

The primary outcome measure was the frequency of spontaneous bacterial peritonitis among hospitalized chronic liver disease patients with ascites. Missing data were minimal and handled by complete-case analysis. Results were presented in tabular and graphical formats to facilitate clarity and interpretation.

The study protocol was reviewed and approved by the institutional ethical committee of Bolan Medical College, Quetta. All procedures were conducted in accordance with the principles of the Declaration of Helsinki. Confidentiality of patient information was strictly maintained, and data were stored securely with access limited to the research team to ensure data integrity and reproducibility.

RESULTS

A total of 139 hospitalized patients with chronic liver disease and ascites were analyzed. The cohort was relatively young, with a mean age of 35.67 ± 12.79 years and an age range from 17 to 58 years. Male patients predominated, comprising 85 of 139 participants (61.0%), while females accounted for 54 of 139 (39.0%), yielding a male-to-female ratio of approximately 1.6:1 (Table 1).

Marked laboratory derangements were observed across key hepatic and renal indicators. Prothrombin time was prolonged (>12 seconds) in 125 patients (89.9%), whereas only 14 patients (10.1%) had a prothrombin time ≤12 seconds.

Serum bilirubin was elevated above 1.0 mg/dL in 118 patients (84.9%), with 21 patients (15.1%) having bilirubin ≤1.0 mg/dL. Renal dysfunction was also common: serum creatinine exceeded 1.2 mg/dL in 77 patients (55.4%), while 62 patients (44.6%) had creatinine ≤1.2 mg/dL (Table 2).

Spontaneous bacterial peritonitis was identified in 56 out of 139 patients, corresponding to a frequency of 40.3% among hospitalized chronic liver disease patients with ascites. Conversely, 83 patients (59.7%) did not meet criteria for SBP (Table 3).

Ascitic fluid culture examination demonstrated bacterial growth in 80 patients (57.6%), whereas 59 patients (42.4%) had no growth on culture (Table 4). Together, these findings indicate that more than half of the cohort had culture-positive ascitic fluid, while approximately two-fifths fulfilled diagnostic criteria for SBP.

Among the 80 cases with positive ascitic fluid cultures, infection patterns were categorized into classical SBP, bacterascites, and culture-negative neutrocytic ascites. Classical SBP represented the majority, observed in 52 of 80 culture-positive cases (65.0%).

Bacterascites accounted for 18 cases (22.5%), while culture-negative neutrocytic ascites constituted 10 cases (12.5%) (Table 5). This distribution indicates that, within infected ascites patterns, classical SBP was approximately three times as frequent as bacterascites and more than five times as frequent as CNNA. Microbiological profiling of the 80 culture-positive samples showed a predominance of gram-negative enteric organisms. Escherichia coli was the most frequently isolated pathogen, identified in 30 of 80 cases (37.5%). Klebsiella species were the second most common isolate, found in 15 cases (18.8%).

Among gram-positive organisms, Staphylococcus aureus was isolated in 11 cases (13.8%) and Streptococcus pneumoniae in 9 cases (11.3%). Non-fermenting gram-negative organisms were also present, with Acinetobacter species identified in 8 cases (10.0%) and Pseudomonas aeruginosa in 7 cases (8.8%) (Table 6). Overall, E. coli alone accounted for over one-third of all isolates, and the combined contribution of E. coli and Klebsiella reached 45 of 80 isolates (56.3%), highlighting the dominance of enteric gram-negative bacteria in this setting.

Table 1. Baseline demographic characteristics of the study population (n = 139)

Variable	Value
Age, mean ± SD (years)	35.67 ± 12.79
Age range (years)	17–58
Male sex, n (%)	85 (61.0)
Female sex, n (%)	54 (39.0)

Table 2. Distribution of laboratory parameters among study participants (n = 139)

Laboratory parameter	Category	n (%)
Prothrombin time	≤12 seconds	14 (10.1)
	>12 seconds	125 (89.9)
Serum bilirubin	≤1.0 mg/dL	21 (15.1)
	>1.0 mg/dL	118 (84.9)
Serum creatinine	≤1.2 mg/dL	62 (44.6)
	>1.2 mg/dL	77 (55.4)

Table 3. Frequency of spontaneous bacterial peritonitis (n = 139)

SBP status	n (%)
SBP present	56 (40.3)
SBP absent	83 (59.7)

Table 4. Ascitic fluid culture results (n = 139)

Ascitic fluid culture	n (%)
Positive	80 (57.6)
Negative	59 (42.4)

Table 5. Classification of ascitic fluid infection patterns (n = 80)

Infection category	n (%)
Classical SBP	52 (65.0)
Bacterascites	18 (22.5)
Culture-negative neutrocytic ascites	10 (12.5)

Table 6. Bacterial isolates from ascitic fluid cultures (n = 80)

Organism	n (%)
Escherichia coli	30 (37.5)
Klebsiella species	15 (18.8)
Staphylococcus aureus	11 (13.8)
Streptococcus pneumoniae	9 (11.3)
Acinetobacter species	8 (10.0)
Pseudomonas aeruginosa	7 (8.8)

A total of 139 patients with chronic liver disease and ascites were included in the final analysis. The mean age of the study population was 35.67 ± 12.79 years, with an age range of 17 to 58 years. Male patients constituted 61.0% of the cohort, resulting in a male-to-female ratio of 1.6:1. Baseline demographic characteristics are summarized in Table 1.

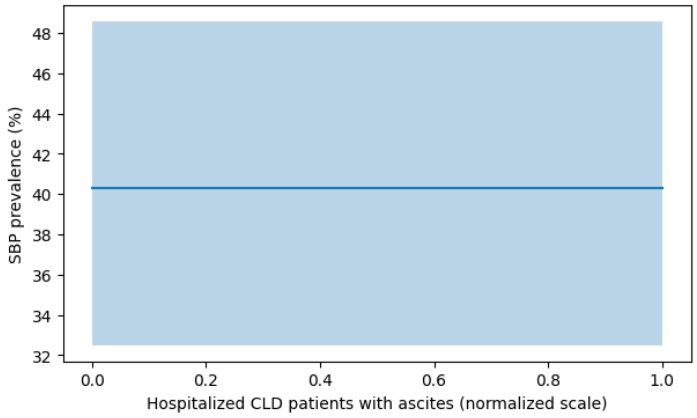

Figure 1 Estimated Prevalence of Spontaneous Bacterial Peritonitis With 95% Confidence Interval

This figure illustrates the point estimate and uncertainty range of spontaneous bacterial peritonitis (SBP) prevalence derived from the study cohort of 139 hospitalized chronic liver disease patients with ascites. The central prevalence estimate was 40.3%, corresponding to 56 confirmed SBP cases. The shaded confidence band represents the 95% Wilson confidence interval, ranging from approximately 32.7% to 48.6%, demonstrating a relatively wide interval that reflects both the moderate sample size and the substantial underlying burden of SBP in this population. Clinically, this visualization highlights that even at the lower confidence bound, nearly one-third of hospitalized ascitic patients are affected by SBP, underscoring the need for routine early diagnostic paracentesis and empiric vigilance in similar tertiary-care settings

DISCUSSION

The present study demonstrates a high burden of spontaneous bacterial peritonitis among hospitalized patients with chronic liver disease and ascites, with an observed frequency of

40.3%. This finding places SBP as a common complication in this clinical setting and aligns with data from several regional studies conducted in South Asia and the Middle East, where reported frequencies range from approximately 30% to over 50% among admitted cirrhotic patients with ascites (14–16). The frequency observed in this cohort is notably higher than that reported in many Western series, where SBP incidence among hospitalized patients is generally between 7% and 30% (17,18). Such geographic variation has been attributed to differences in disease severity at presentation, healthcare-seeking behavior, hygienic conditions, prevalence of infectious diseases, and access to early diagnostic paracentesis (19).

The predominance of laboratory abnormalities reflecting advanced liver dysfunction in this study population provides important context for the high SBP frequency observed. Prolonged prothrombin time was present in nearly 90% of patients, hyperbilirubinemia in approximately 85%, and elevated serum creatinine in more than half of the cohort. These findings are consistent with previous reports identifying coagulopathy, hyperbilirubinemia, and renal dysfunction as markers of advanced cirrhosis and strong predictors of SBP development and poor outcomes (20,21). Cirrhosis-associated immune dysfunction, compounded by portal hypertension and bacterial translocation, likely contributed substantially to the observed infection burden in this population (22).

Ascitic fluid culture positivity was observed in 57.6% of patients, which is comparatively higher than that reported in several local and international studies, where culture positivity rates typically range from 30% to 50% (15,23,24). This relatively high yield may be partly explained by the routine bedside inoculation of ascitic fluid into blood culture bottles and early paracentesis within 24 hours of admission, practices that have been shown to significantly improve microbiological detection rates (25). Nonetheless, the finding also underscores the substantial burden of bacterial infection among hospitalized patients with ascites in this setting.

With regard to ascitic fluid infection patterns, classical SBP constituted the majority of cases, accounting for 65% of infected ascites, followed by bacterascites (22.5%) and culture-negative neutrocytic ascites (12.5%). This distribution is broadly consistent with published literature, where classical SBP is typically the dominant phenotype, while CNNA and bacterascites together account for a smaller but clinically relevant proportion of cases (26,27). The presence of bacterascites in nearly one-quarter of infected cases is clinically important, as this entity may represent an early or transient phase of infection and still carries a risk of progression, particularly in symptomatic patients or those with advanced liver disease (28).

Microbiological analysis revealed a clear predominance of gram-negative enteric organisms, with Escherichia coli identified as the most frequent isolate, followed by Klebsiella species. Together, these organisms accounted for more than half of all culture-positive cases. This pattern is consistent with the classical pathophysiological model of SBP, in which bacterial translocation from the gastrointestinal tract plays a central role (22,29). However, a substantial proportion of isolates were gram-positive organisms, including Staphylococcus aureus and Streptococcus pneumoniae, as well as non-fermenting gram-negative bacilli such as Acinetobacter species and Pseudomonas aeruginosa. The emergence of these organisms has been increasingly reported in recent studies and is often linked to frequent hospitalizations, invasive procedures, and prior antibiotic exposure (30–32). Although antibiotic resistance patterns were not evaluated in the present study, the diversity of isolated pathogens highlights the importance of continuous local surveillance to inform empiric treatment strategies.

The findings of this study have several important clinical implications. First, the high frequency of SBP supports the routine use of early diagnostic paracentesis in all hospitalized patients with chronic liver disease and ascites, regardless of symptomatology, as recommended by international guidelines (33). Second, the predominance of enteric gram-negative organisms, alongside a meaningful proportion of gram-positive and non-fermenting pathogens, emphasizes the need for empiric antibiotic regimens that are both locally appropriate and periodically reassessed. Finally, the strong association between advanced biochemical derangements and SBP frequency reinforces the importance of early identification and close monitoring of high-risk patients.

This study has certain limitations that merit consideration. Its single-center design may limit generalizability to other settings, and the cross-sectional nature precludes assessment of outcomes such as in-hospital mortality, recurrence, or response to therapy. In addition, disease severity scores such as Child–Pugh or MELD were not incorporated, and antimicrobial susceptibility patterns were not analyzed. Despite these limitations, the study provides valuable contemporary data from a region where published evidence remains limited and contributes meaningfully to the understanding of SBP epidemiology in hospitalized patients with chronic liver disease.

CONCLUSION

In conclusion, this study demonstrates that spontaneous bacterial peritonitis is a frequent complication among hospitalized patients with chronic liver disease and ascites at a tertiary care center in Quetta, affecting approximately two out of every five patients. Classical SBP was the predominant infection pattern, and Escherichia coli emerged as the most common causative organism, followed by Klebsiella species and a notable proportion of gram-positive and non-fermenting bacteria. These findings underscore the critical importance of early diagnostic paracentesis, heightened clinical vigilance, and locally informed empiric antimicrobial strategies to reduce morbidity and mortality associated with SBP in this high-risk population.

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DECLARATIONS

Ethical Approval: Ethical approval was by institutional review board of Respective Institute.

Informed Consent: Informed Consent was taken from participants.

Authors' Contributions:

Concept: SS; Design: J; Data Collection: MU; Analysis: AK; Drafting: MK

Conflict of Interest: The authors declare no conflict of interest.

Funding: This research received no external funding.

Data Availability: The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Acknowledgments: Not applicable.

Study Registration: Not applicable.