Research Article

Frequency of Spontaneous Bacterial Peritonitis in Cirrhotic Patients Presenting with Ascites in Tertiary-Care Hospitals in Karachi

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Abstract: Background: Spontaneous Bacterial Peritonitis (SBP) is regarded as being related to the translocation of bacteria from the intestinal lumen into the peritoneum. Early recognition and empirical antimicrobial treatment are extremely effective in decreasing death rates.

Objective: To find out the prevalence of SBP in patients with cirrhosis and ascites admitted in the tertiary care hospitals in Karachi and to describe the demographic, clinical, biochemical and microbiological features of the patients.

Materials and Methods: The analytical cross sectional study was conducted at Jinnah Post Graduate Medical Centre (JPMC), Civil Hospital Karachi and Dow University Hospital (OJHA Campus) from 6th October 2025 till 6th January 2026. A total of 385 adult patients (20–70 years) with cirrhosis, Child-Pugh class B or C, and clinical ascites were selected. Patients with secondary peritonitis, tuberculous peritonitis, malignancy-related ascites and renal disease were excluded. All patients had a diagnostic paracentesis performed. SBP was defined as a PMN count of 250 cells/μL or higher in ascitic fluid indicates SBP. in the absence of any known intra-abdominal source of infection. Demographic, clinical and laboratory information was collected. The data obtained was analyzed statistically using IBM SPSS software, version 22.

Result: 107 out of 385 patients (27.8%) had been diagnosed with SBP.The average age of the study population was 49.7 ± 9.8 years, having a male-to-female ratio of 2.1:1. The most prevalent underlying cause of cirrhosis was hepatitis C virus infection (57.9%), followed by hepatitis B virus infection (23.9%). The predominant clinical symptoms of SBP were fever (63.6%), stomach discomfort (52.3%), and hepatic encephalopathy (40.1%). In 44 (41.1%) patients with SBP, ascitic fluid cultures yielded positive results, with *Escherichia coli* as the main strain (61.3%), next to *Klebsiella pneumoniae* (20.4%). SBP had a strong correlation with Child-Pugh class C illness ($p < 0.001$), decreased blood albumin levels, and elevated serum bilirubin concentrations.

Conclusion: SBP was common in cirrhotic patients admitted to hospitals in Karachi (27.8%), especially in those with severe liver disease resulting from chronic viral hepatitis. Regular diagnostic paracentesis and early empirical antibiotic treatment should be considered for hospitalized cirrhotic patients suffering from ascites to mitigate morbidity and death.

Keywords: Spontaneous bacterial peritonitis, Cirrhosis, Ascites, Hepatitis C, Diagnostic paracentesis.

INTRODUCTION

Cirrhosis is a major global health concern and represents the terminal phase of a chronic liver condition. The predominant clinical symptoms of decompensation of hepatic function are portal hypertension, variceal hemorrhage, hepatorenal syndrome, and ascites [1]. Ascites, the buildup of fluid in the peritoneal cavity, significantly impacts quality of life and is linked to a high likelihood of negative consequences, especially spontaneous bacterial peritonitis (SBP) [2].

SBP is a severe illness that manifests in cirrhotic individuals with ascites when no discernible intra-abdominal source of infection is present. The pathophysiology of SBP is mostly attributed to the proliferation of enteric bacteria in the intestines, subsequently leading to bacterial translocation over the gut barrier into the peritoneal cavity as a result of impaired local and systemic immune responses [3]. The infection induces the production of anti-inflammatory cytokines and exacerbates systemic

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inflammation [4]. Despite antimicrobial treatment, SBP is associated with increased mortality, especially in those with severe liver disease.

Epidemiology is different depending on geographical region but the incidence of SBP in hospitalized cirrhotic patients with ascites is usually between 20% and 30% [5]. Viral Hepatitis B and C are endemic in Pakistan, and contribute to major causes of cirrhosis and may make these patients more susceptible to SBP. But, the local epidemiology and microbiological picture of SBP is not fully characterized. A thorough understanding of local SBP presentation and factors is essential to create effective treatment plans and to get better results from treatment.

The objective of this study was to find out the prevalence of SBP in patients with ascites in tertiary care hospitals in Karachi, Pakistan. Further, the demographic, clinical, biochemical and microbiological characteristics of these patients were described and factors associated with SBP were determined.

MATERIALS AND METHODS

The study was conducted at three large tertiary-care hospitals in Karachi, Pakistan, namely Jinnah Postgraduate Medical Centre (JPMC), Civil Hospital Karachi and Dow University Hospital (OJHA Campus) through analytical cross sectional method for a period of 3 months from 6th October 2025 to 6th January 2026. The Institutional Review Board (IRB) of JPMC granted ethical approval (No.F.2.81/2025-GENL/271/JPMC), dated: 21-04-25. Confidentiality of patient information was preserved throughout.

These are the hospitals where patients from advanced liver disease from Sindh and nearby areas are referred. All participants or legal guardians gave written informed consent.

The sample size was determined using the singular population proportion formula, $n = Z^2p(1-p)/d^2$, where n is the necessary sample size, Z is the standard normal variate at a 95% confidence level (1.96), p is the predicted prevalence of SBP, and d is the margin of error (5%). In the lack of an accurate local frequency estimate, a prevalence of 50% was estimated to optimize the sample size. According to these factors, the necessary minimum sample size was determined to be 384 individuals, then rounded to 385. A total of 385 cirrhotic individuals with ascites was included. Cirrhosis was diagnosed clinically and supported by ultrasound and blood examinations indicating portal hypertension, increased prothrombin time (INR >1.5), low serum albumin, and coarse liver echotexture. Patients with secondary peritonitis, tuberculous peritonitis, malignancy-related ascites, renal disease, and those unwilling to participate were excluded. Non-probability consecutive sampling was used for recruitment.

Patients diagnosed with SBP were treated according to standard institutional protocols. Empirical antibiotic therapy was initiated immediately after diagnostic paracentesis, primarily using third-generation cephalosporins such as cefotaxime or ceftriaxone. Antibiotic regimens were subsequently modified based on culture and sensitivity results when indicated. The duration of therapy ranged from 5 to 7 days, depending on clinical response and the treating physician's assessment.

All patients underwent detailed clinical examination, and diagnostic paracentesis was conducted within 24 hours of admission. Ascitic fluid was analyzed immediately for total and differential leukocyte count using a Neubauer chamber, culture and sensitivity through the BacT/Alert automated system, ascitic albumin, and ascitic protein. Routine laboratory parameters, including serum bilirubin, alanine transaminase (ALT), aspartate transaminase (AST), INR, and creatinine, were also measured.

The diagnosis of SBP was established based on an ascitic fluid polymorphonuclear (PMN) cell count of ≥250 cells/μL with no detected source of intra-abdominal infection on clinical and radiological assessment.

Study variables included age, sex, place of residence, etiology of cirrhosis, and clinical symptoms including fever, abdominal pain, encephalopathy, jaundice, hypotension, and worsening ascites. Biochemical information and ascitic fluid-related data were recorded for analysis.

STATISTICAL ANALYSIS

Data were evaluated with IBM SPSS software, version 22. Continuous data were presented as means with standard deviations (SD), whereas categorical variables were represented as frequencies and percentages. The Student's t-test and Chi-square test were used to assess differences within the SBP and non-SBP groups for continuous and categorical data, correspondingly. Independent determinants of SBP were determined using a multivariable binary logistic regression model. A p-value of less than 0.05 was deemed statistically significant.

RESULTS

Baseline Characteristics

385 patients with ascites were studied. Most of the patients were male and more than half of the population were living in urban Karachi, while the rest were living in rural areas of Sindh and Balochistan (Table **1**).

Table 1. The patients (n = 385) were of the Demographic and Etiological Profile.

Variable	Frequency n (%)
Age < 40 years	71 (18.4%)
Age 40–60 years	249 (64.7%)
Age > 60 years	65 (16.9%)
Male	248 (64.4%)
Female	137 (35.6%)
Hepatitis C	223 (57.9%)
Hepatitis B	92 (23.9%)
Alcoholic liver disease	28 (7.3%)
Cryptogenic	42 (10.9%)
Child-Pugh Class B	157 (40.8%)
Child-Pugh Class C	228 (59.2%)

Frequency of SBP

There were 385 patients who were evaluated, and 107 (27.8%) patients had a diagnosis of spontaneous bacterial peritonitis (Table **2**).

Table 2. Frequency of Spontaneous Bacterial Peritonitis (SBP) in Cirrhotic patients with Ascites (n = 385).

Variable	Frequency (n)	Percentage (%)
Total patients	385	100.0%
SBP present	107	27.8%
SBP absent	278	72.2%
Male patients with SBP	73	68.2%
Female patients with SBP	34	31.8%
Mean age of SBP patients (years)	51.0 ± 9.4	—
Child-Pugh Class C with SBP	78/228	34.2%
Child-Pugh Class B with SBP	29/157	18.5%
p-value (Class C vs Class B)	—	<0.001

Clinical Presentation

The most frequent symptoms in SBP patients were fever (63.6%), abdominal pain/tenderness (52.3%), and hepatic encephalopathy (40.1%), and were the clinical manifestations of the disease (Table **3**).

Table 3. The Clinical Manifestations were Compared between the Two Groups: SBP vs Non-SBP Groups.

Feature	SBP (n = 107)	Non-SBP (n = 278)	p-value
Fever	68 (63.6%)	71 (25.5%)	<0.001
Abdominal pain	56 (52.3%)	92 (33.1%)	0.002
Encephalopathy	43 (40.1%)	49 (17.6%)	<0.001
Worsening ascites	39 (36.4%)	60 (21.6%)	0.006
Hypotension	25 (23.4%)	23 (8.3%)	0.001

Laboratory and Biochemical Profile

The biochemical parameters were significantly different between the two groups (Table **4**).

Table 4. Laboratory Parameters are Compared.

Parameter	SBP Mean ± SD	Non-SBP Mean ± SD	p-value
Serum bilirubin (mg/dL)	5.4 ± 2.7	3.1 ± 1.9	<0.001
ALT (U/L)	74.6 ± 38.2	55.2 ± 27.1	0.012
Albumin (g/dL)	2.5 ± 0.4	3.1 ± 0.6	0.001
INR	1.9 ± 0.3	1.6 ± 0.2	0.024
Creatinine (mg/dL)	1.5 ± 0.7	1.2 ± 0.5	0.035

Ascitic Fluid Analysis

The increase in PMN in the ascites fluid of patients with SBP (1286 ± 324 cells/μL) compared with non-SBP (114 ± 42 cells/μL, $p < 0.001$) was used to confirm the presence of active infection. Average ascitic protein levels in patients with SBP were 1.1 ± 0.3 g/dL, and 1.8 ± 0.4 g/dL ($p = 0.006$) in non SBP patients.

Culture and Sensitivity Results

In the 107 patients that were diagnosed with SBP, 44 (41.1%) had positive ascitic fluid cultures.Antimicrobial susceptibility testing revealed that most isolates had decreased susceptibility to fluoroquinolones but remained susceptible to third generation cephalosporins and piperacillin-tazobactam (Table **5**).

Table 5. A Total of 44 Patients who were Culture Positive were included in this Study.

Organism	Frequency, n (%)	Cefotaxime Susceptibility n (%)	Piperacillin-Tazobactam Susceptibility n (%)	Fluoroquinolone Susceptibility n (%)
Escherichia coli	27 (61.3%)	23 (85.2%)	25 (92.6%)	20 (74.1%)
Klebsiella pneumoniae	9 (20.4%)	7 (77.8%)	8 (88.9%)	6 (66.7%)
Streptococcus spp.	5 (11.3%)	5 (100.0%)	5 (100.0%)	5 (100.0%)
Enterococcus spp.	3 (6.8%)	2 (66.7%)	2 (66.7%)	3 (100.0%)

Complications and Outcomes

SBP was associated with severity of outcome (Table **6**).

Table 6. The Outcome and Complications of SBP when Compared with those of Non-SBP Patients.

Outcome	SBP (n = 107)	Non-SBP (n = 278)	p-value
Hepatorenal syndrome, n (%)	26 (24.3%)	0 (0.0%)	<0.001
Gastrointestinal bleeding, n (%)	18 (16.8%)	12 (4.3%)	0.003
In-hospital mortality, n (%)	22 (20.5%)	27 (9.7%)	0.007
Length of hospital stay (days), mean ± SD	8.9 ± 3.2	6.1 ± 2.4	<0.001

Multivariable Logistic Regression Analysis

Variables were then entered into a multivariable logistic regression model to identify independent predictors of SBP, if they were statistically significant in univariate analysis. Child-Pugh Class C classification, lower serum albumin, lower ascitic protein and fever turned out to be statistically significant independent predictors associated with SBP after adjustment for the confounding factors (Table **7**).

Table 7. Multivariable Logistic Regression Analysis was done for Factors associated with SBP.

Variable	Adjusted Odds Ratio (AOR)	95% CI	p-value
Child-Pugh Class C	2.41	1.45–4.01	<0.001
Serum albumin (g/dL)	0.52	0.33–0.81	0.004
Ascitic protein (g/dL)	0.61	0.40–0.94	0.026
Fever	2.08	1.22–3.56	0.007
Age	1.01	0.98–1.04	0.451
Male sex	1.17	0.68–2.01	0.572

DISCUSSION

This study indicates that within the population of patients with ascitic cirrhosis, there is significant clinical burden due to SBP. The frequency of SBP in this group was 27.8%, which is within the range of 20–30% reported worldwide in hospitalized cirrhotic patients. This is similar to the prevalence rates found in earlier studies conducted in South Asian countries of 26%-30% [6- 8]. This rate highlights the importance of early identification and intervention because SBP continues to be a major morbidity and mortality problem in this patient population [9].

A total of 107 SBP patients were studied in the present work with only 44 (41.1%) returning positive ascitic fluids, leaving 58.9% of the patients with culture-negative neutrocytic ascites. The results are consistent with those reported in the literature. This may be because of previous antibiotic treatment, because there are few bacteria in ascitic fluid or because of the inadequacies of routine culture methods [10-13]. The main finding of the demographic analysis was that the study group was predominantly male and this is consistent with the overall epidemiology of cirrhosis, especially chronic liver disease due to viral hepatitis. SBP patients mean age was similar to what was reported by Koulaouzidis *et al.* and Ageely *et al.* [10, 14-16].

One of the best factors associated with SBP was the Child-Pugh classification. SBP was much more prevalent in Child Pugh Class C than in Class B. Similarly, Wang and Zhang (2018) and Yan *et al.* (2024) found advanced liver disease to be a key risk factor. This relationship is probably due to physiological susceptibilities in severe cirrhosis, such as the dysregulated immune function and enhanced translocation of bacteria [17, 18].

The clinical symptoms seen in the present study, mainly fever, abdominal pain, hepatic encephalopathy are similar to that reported by Khan and Linganna 2023 [19].

Importantly, asymptomatic patients with SBP accounted for 9% of the patients. Importantly, 9% of patients with SBP were diagnosed serendipitously during routine diagnostic paracentesis at admission. This highlights the importance of routine screening of hospitalized patients with cirrhosis and ascites.

In biochemistry, hypoalbuminemia and high level of bilirubin were significantly correlated with SBP. Low serum albumin level is a sign of marked liver disease and depressed immune function, which have been associated with greater gut bacterial translocation [20]. Raised INR and creatinine are further evidence of systemic failure and heightened risk of infection.

Escherichia coli was the predominant pathogen followed by *Klebsiella pneumoniae*. The findings are in line with international data which show that Gram-negative enteric bacteria continue to be the most prevalent causes of SBP globally [21]. Empiric treatment for fluoroquinolones is becoming a concern as there is increasing resistance, especially within the *E. coli* and *K. pneumoniae* populations, and antimicrobial surveillance programs should continue to monitor for resistance to these antibiotics and others in order to prevent treatment failures [22, 23].

SBP had a systemic effect as indicated by clinical outcomes. The frequency of gastrointestinal bleeding was 16.8% and Hepatorenal syndrome was 24.3% in the SBP patients. The in-hospital mortality was significantly higher in patients with SBP than in those without SBP. This is in line with earlier reports which indicated that despite therapy SBP may be associated with high mortality rates in cirrhosis [24].

Also, Child-Pugh Class C, low serum albumin, low ascitic protein and fever were found to be independent factors for the development of SBP by multivariable logistic regression analysis. The correlation between low protein level and SBP in the serum and ascitic fluid suggests their potential as clinical risk markers and should be further studied longitudinally. Acknowledging these factors could help guide clinicians to consider earlier paracentesis, if it is a diagnostic procedure, in high-risk patients and could encourage empiric antibiotic therapy [18, 23, 25].

LIMITATIONS

There are several limitations of the present study. First, as this is cross-sectional, causal inferences between clinical factors identified and the development of SBP cannot be deduced. Second, the study length of three months restricts the examination of seasonal changes in the occurrence of SBP and/or microbiological parameters. Third, the study was conducted in three tertiary-care hospitals of Karachi with non-probability consecutive sampling which may not be representative of cirrhotic patients in Pakistan and smaller secondary care hospitals. Thirdly, culture and sensitivity testing was carried out, but in 58.9% of the SBP cases, complete microbiological characterization was not possible due to negative culture results. Last, specific antibiotic switching regimens, accurate treatment duration outcomes and long-term survival after discharge was not gathered. Long-term and multi-center prospective studies should be carried out in the future for better understanding and provide more evidence for the epidemiology of SBP.

CONCLUSION

This study demonstrates that the incidence of SBP in the patients with cirrhosis with ascites in Karachi is 27.8% which is a common and serious complication in these patients. This complication occurred more frequently in those with hypoalbuminemia, low ascitic protein levels and Child-Pugh Class C liver disease. Microbiologically, *Escherichia coli* was again the most common cause of infection. Current clinical guidelines are for routine diagnostic paracentesis and early empiric antibiotic therapy. The results highlight the importance of proactive screening, infection control and antimicrobial stewardship to help optimize management and outcomes in patients with SBP.

ABBREVIATIONS

ALT: Alanine Aminotransferase.

AST: Aspartate Aminotransferase.

HRS: Hepatorenal Syndrome.

INR: International Normalized Ratio.

IRB: Institutional Review Board.

JPMC: Jinnah Postgraduate Medical Centre.

PMN: Polymorphonuclear (Leukocyte).

SAAG: Serum-Ascites Albumin Gradient.

SBP: Spontaneous Bacterial Peritonitis.

SD: Standard Deviation.

AUTHORS' CONTRIBUTION

Usman Rehman: Conceptualized, Study design, Methodology, Data analysis and interpretation, Writing Draft and Final approval, final proof to be published.

Syed Masroor Ahmed and **Shabnam Naveed**: Critical review and revision of the manuscript

Maryam Fatima Waqar: Methodology, Data analysis and interpretation.

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ETHICAL DECLARATIONS

Data Availability Statement

The dataset analyzed during the current study is available from the corresponding author on reasonable request.

Ethical Approval

Ethical approval was obtained from JPMC (No.F.2.81/2025-GENL/271/JPMC), dated: 21-04-25.

Consent to Participate

Written informed consent was secured from all participants or their legal guardians.

Consent for Publication

Consent for publication was obtained from all individual participants included in the study.

Conflict of Interest

The authors declare no conflict of interest.

Competing Interest/Funding

Declared none.

Use of AI-Assisted Technologies

The authors declare that ChatGPT was used solely for language refinement. The final content was reviewed and verified by the authors, who take full responsibility for the content of the article.

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