Original Article

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Predictors of 30-day hospital readmission in patients with spontaneous bacterial peritonitis, to improve health quality. Prospective cohort

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Abstract

Background: Spontaneous bacterial peritonitis (SBP) is a severe complication of ascitic patients. Hospital readmissions indicate poor care, but little is known regarding their frequency and determinants in SBP. This study aims to identify variables that can predict 30-day readmission in SBP patients.

Materials and methods: This study comprised 253 people hospitalized with SBP. A multivariable logistic regression analysis was performed using index hospitalization data to identify predictors of hospital readmission after 30 days.

Results: 200 patients completed the research, and 53 were readmitted (22.6% within the first week, 41.4% throughout the second weeks, 34% within the third week of departure, and none within the fourth week post departure. Readmitted patients were older, had MELD ≥15, lower serum albumin, and higher serum bilirubin than patients without readmission; however, there was a decrease in readmission with levofloxacin treatment for SBP. The results of a logistic regression study of the variables determining the readmission revealed a statistically significant relationship between increased readmission with age ≥ 60 (p= 0.003) with AOR 95% CI: 2.9 (1.4- 6.1), MELD ≥ 15 (p= 0.007) with AOR 95% CI: 2.8 (1.3-5.9), decreased serum albumin (p= 0.02) with AOR 95% CI: 2.5 (1.2-5.1), however, levofloxacin therapy was associated with reduced readmission; AOR 95% CI: 0.157 (0.02-1.22).

Conclusion: Increased age, MELD ≥ 15, and lower serum albumin were predictors of SBP 30-day readmission risk; however, levofloxacin therapy was related to a lower readmission rate. Early readmission can be discovered to avoid adverse outcomes potentially.

Introduction

Spontaneous bacterial peritonitis (SBP) is an infection of the ascitic fluid in the absence of an intra-abdominal infection [1]. In patients with ascites, 10% to 30% of people almost get it [2]. Initially, mortality rates ranged from more than 80% in historical reports to 10-30% [3]. The most accurate predictors of SBP-related early death were found to be renal impairment and the model for end-stage liver disease (MELD) [4]. The SBP's microbiological profile has altered. The frequency of quinolone-resistant, multi-resistant, and gram-positive bacteria appears to be rising [5]. The increased use of ambulatory quinolone-based regimens for SBP prophylaxis and patients' exposure to broad-spectrum antibiotics and invasive hospital procedures have all been connected to this tendency [6,7]. A microbiological profile with a predominance of Gram-negative bacteria continues to be the foundation for most current SBP therapy and prophylaxis guidelines. However, the effectiveness of these therapeutic interventions may be reassessed because of the continual shift in the SBP microbiological profile and possibly revised of these strategies [8]. The Centers for Medicare & Medicaid Services' top priority is reducing hospital readmission rates [9]. Although hospital readmissions are a sign of poor care, little is known about their frequency and the factors that influence it in patients with SBP living in the community.

This study evaluates the predictors linked to 30-day hospital readmission in patients with spontaneous bacterial peritonitis.

Materials and methods

Experimental animals:

This prospective cohort study aimed to find predictors linked to 30-day hospital readmission in patients with spontaneous bacterial peritonitis at the Tropical Medicine Department of Mansoura University Hospital in Egypt Between August 2018 and December 2019. The study included 200 patients under 18 with spontaneous bacterial peritonitis.

Inclusion Criteria: Patients with spontaneous bacterial peritonitis over 18 years.

Exclusion criteria: Secondary peritonitis, causes other than cirrhotic ascites (renal, cardiac, tuberculosis), patients with active infection in different sites, and patients who passed away during the follow-up period or whose readmission data was incomplete were also removed.

All patients who were discharged were given prophylactic antibiotics.

All Patients were subjected to the following:

Complete history taking physical examination.

Diagnostic paracentesis. Ascitic fluid samples were aspirated in an aseptic environment. 30 ml fluid samples were collected for culture and count polymorphonuclear cells. SBP was diagnosed once a polymorphonuclear cell count of more than 250/mm3 was obtained. Ascite fluid was promptly inoculated into blood culture bottles at the

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patient's bedside[10]. Based on culture and PMN count, SBP variants are identified (traditional SBP is culture-positive with PMN≥250/mm3). Ascites with a PMN count of ≥250 cells/mm3 but no positive bacterial culture is known as CNNAs[11].

Laboratory tests: included complete Blood Count, liver function (serum Albumin, serum Bilirubin (total-direct), International Normalized Ratio), HCVAb, HBsAg, Alanine transaminase (ALT), Aspartate transaminase (AST), serum creatinine, Alpha-fetoprotein.

Child score [12]**.**

Upper Endoscopy.

Follow-up: Following an improvement in their clinical condition and ascitic fluid count, the study's discharged patients were monitored every week for 30 days via telemedicine or an outpatient visit to look for any changes or deteriorations in their clinical condition and the need for readmission when necessary.

Statistical analysis

The 2013 release of IBM SPSS Corp. was used to analyze the data. Version 22.0 of IBM SPSS Statistics for Windows. IBM Corp., Armonk, New York. Numbers and percentages were used to describe qualitative data. After determining the normality of the data using the Kolmogrov-Smirnov test, quantitative data were described using the median (minimum and maximum) for non-parametric data and the mean and standard deviation for parametric data. The results' significance was assessed at the (0.05) level. The Chi-Square test was used to compare two or more groups of data, and the MC Nemar test was used to compare changes in binominal variables before and after the changes. Parametric tests were used to compare quantitative data between groups, including the Student t-test for comparing two independent groups and the Paired t-test for comparing two study periods. Tests that are not parametric (Mann-Whitney U test)

Results

From August 2018 to December 2019, 253 individuals with SBP were admitted to the Tropical Medicine Department at Mansoura University Hospitals. The study excluded 53 individuals (23 died during the index hospitalization and follow-up, and 30 were omitted from further analysis due to a lack of follow-up at our institution after discharge). 200 patients completed the research, and 53 were readmitted 30 days post-departure (22.6% within the first week, 41.4% throughout the second weeks, 34% within the third week of departure, and none within the fourth week) **(Figure 1)**.

Table 1 shows the demographic and clinical data, and **Table 2** shows the laboratory data of the studied patient at index admission. Table 3 shows the demographic and clinical findings of readmitted patients. The majority of readmitted patients were males (69.8%), ≥60 years (73.6%) with (22.6%) only had positive ascitic fluid culture, Child B (69.8%), MELD≥15 (52.8%). 79.2% of readmitted patients had a previous history of oesophageal varices, and (15.1%) had hepatocellular carcinoma and cefotaxime as the most commonly used antibiotic (56.6%). **Table 4** displays a univariate analysis of factors present at index admission associated with readmission. In comparison to patients with no readmission, patients with readmission have significant ≥ 60 years, COR 95%CI: 2.8 (1.4-5.6), MELD≥15, (COR 95%CI: 2.44 (1.2-4.94) and a significantly decreased readmission with levofloxacin treatment for SBP, COR95%Cl: 0.157 (0.02-1.22).

Table 5 shows the laboratory data of readmitted patients compared to non-readmitted patients. There was a significant association between decreased serum albumin, increased serum bilirubin, and increased readmission rate (p value= 0.002, 0.003 respectively); however, no substantial change as regards ascetic fluid leukocytes, haemoglobin, WBCs, PLT, ALT, AST, INR and serum creatinine (p-value> 0.05). **Table 6** shows a multivariate logistic regression analysis of the variables influencing readmission. Age ≥ 60, MELD ≥ 15, and lower serum albumin had statistically significant correlations with increased readmission. The (95% CI) for these variables was 2.9 (1.4- 6.1), 2.8 (1.3-5.9) and 2.5 (1.2-5.1) respectively. However, levofloxacin therapy was linked to a lower readmission rate; 95% CI: 0.157 (0.02-1.22).

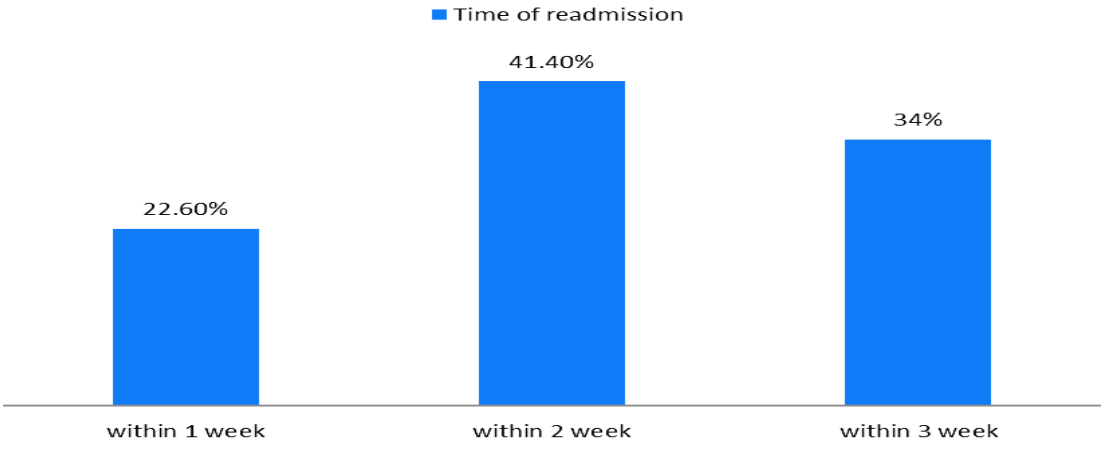

Figure 1: Time of readmission.

Table 1. Demographic and clinical findings of study patient on index admission

Variable	N (%) (N=200)/ Mean ± SD
Age (years)	58.4± 7.7
< 60	88(44%)
≥ 60	112(56%)
Sex	
Male	131(65.5%)
Female	69(34.5%)
AF culture(+ve)	16(8%)
Comorbidities	67(33.5%)
Oesophageal varices	144 (72%)
Hepatocellular carcinoma	44 (22%)
Child score	
Child A	-
Child B	132 (66%)
Child C	68 (34%)
MELD score	
Median (Min-Max)	14 (6-34)
≤ 15	78 (39%)
>15	122 (61%)
Antibiotic taken	
Cefotaxime	102 (51%)
Ceftriaxone	72 (36.0%)
Levofloxacin	17 (8.5%)
Imipenem	4 (2.0%)
Cefoprazone	4 (2.0%)
Ceftazidime	1 (0.5%)

Table 2. Comparison of oxidative stress markers in liver tissues studied groups.

Parameter	Mean ± SD / Median (Min-Max)
Ascitic fluid leucocytes (cells/mm3)	400 (250-2700)
HB(g/dl)	9.32 ± 1.72
WBCs/µL	5.19 (1.4-23)
PLT/µL	74(15-500)
Albumin (g/dl)	2.34± 0.56
Bilirubin (mg/dl)	1.5 (0.15-23)
ALT (U/L)	40 (14-255)
AST (U/L)	44 (18-869)
INR	1.47± 0.37
Creatinine (mg/dl)	1.18 (0.6-11.3)
AFP(ng/ml)	10.3 (1.1-3101)

***HB**=hemoglobin, **WBCs**=white blood cells, **PLT**=platelets, **ALT**=alanine transaminase, **AST**=aspartate transaminase, **INR**=international normalized ratio, **AFP**=alpha fetoprotein.*

Table3: Demographic and clinical findings of readmitted patients.

Variable	N (%) (N=53) / Mean ± SD
Age (years)	61.1 ± 7.4
< 60	14 (26.4%)
≥ 60	39 (73.6%)
Sex	
Male	37 (69.8%)
Female	16 (30.2%)
Comorbidities	19 (35.8%)
AF culture (+ve)	12 (22.6%)
Oesophageal varices	42 (79.2%)
Hepatocellular carcinoma	8 (15.1%)
Child score	
Child A	-
Child B	37 (69.8%)
Child C	16 (30.2%)
MELD score Median (Min -Max)	15 (8-29)
≤ 15	25 (47.2%)
>15	28 (52.8%)
Antibiotic taken	
Cefotaxime	30 (56.6%)
Ceftriaxone	11 (20.8%)
Levofloxacin	9 (17%)
Imipenem	1 (1.9%)
Ampicillin	1 (1.9%)
Unasyn	1 (1.9%)

Table 4: univariate analysis of factors existing at index admission linked with readmission.

Variable	Re-admission (N=53)	No re-admission (N=200)	COR (95%CI)	P value
Age (years)	61.1 ± 7.4	57.5 ± 7.6		
< 60	14 (15.9%)	74 (84.1%)	1r	0.003
≥ 60	39 (34.8%)	73 (65.2%)	2.8 (1.4-5.6)	
Sex				
Male	37 (28.2%)	94 (71.8%)	1.30 (0.66-2.56)	0.4
Female	16 (23.2%)	53 (76.8%)	1r	
Comorbidities				
Yes*	19 (28.4%)	48 (71.6%)	1.2 (0.6-2.2)	0.67
No	34 (25.6%)	99 (74.4%)	1r	

AF culture				
Positive	5 (31.3%)	11(68.8%)	1.29 (0.426-3.89)	0.66
Negative	48 (26.1%)	136(73.9%)	1r	
Hepatic encephalopathy				
Yes	6 (15.4%)	33 (70.8%)	2.27 (0.89-5.77)	0.08
No	47 (29.2%)	114 (84.6%)	1r	
Hepatorenal syndrome				
Yes	7 (25.0%)	21 (75.0%)	1r	0.846
No	46 (26.7%)	126 (73.3%)	1.09 (0.437-2.75)	
Oesophageal varices				
Yes	42(29.2%)	102 (70.8%)	1.68 (0.79-3.56)	0.2
No	11(19.6%)	45(80.4%)	1r	
Hepatocellular carcinoma				
Yes				
No	8(18.2%)	36(81.8%)	1r	0.157
	45(28.8%)	111(71.2%)	1.8(0.787-4.22)	
Child score				
Child A	-	-		0.4
Child B	38 (28.8%)	94 (71.2%)	1.4 (0.7-2.8)	
Child C	15 (22.1%)	53 (77.9%)	1r	
MELD score				
≤ 15	13 (17.3%)	65 (83.3%)	1r	0.012*
>15	40 (32%)	82 (67.2%)	2.44 (1.2-4.94)	
Antibiotic taken				
Cefotaxime	24 (23.5%)	78 (76.5%)	0.731 (0. 39-1.38)	0.331
Ceftriaxone	24 (33.3%)	48(66.7%)	1.71 (0.89-3.24)	0.100
Levofloxacin	1 (5.9%)	16 (94.1%)	0.157 (0.02-1.22)	0.030
Imipenem	1 (25.0%)	3 (75.0%)	0.923 (0.09-9.07)	0.95
Cefoprazone	2 (50.0%)	2 (50.0%)	reference	
Ceftazidime	1 (100.0%)	0 (0.0)	undefined	

P-value assessed by $\chi 2$ Chi-square test. statistical significance is defined as p-value ≤0.05. **COR**: Crude Odds Ratio, **CI**: Confidence Interval, r: reference group.

Table 5: Comparison between laboratory data in readmission and no readmission.

Parameter	Readmission (N=53)	No readmission (N=200)	P value
Hemoglobin (g/dl)	10.32±0.35	10.42±0.45	0.13
WBCs, Median(Min-Max)	5.3 (1.8-13)	5 (1.4-23)	0.986
PLT/µL, Median(Min-Max)	75(35-183)	76 (35-193)	0.150
Albumin (g/dl)	2.34±0.21	2.61±0.26	0.001
Bilirubin (mg/dl)/Median (Min-Max)	1.7 (0.7-10)	1 (0.6-5.7)	0.003*
ALT (U/L)Median(Min-Max)	51(21-93)	48(20-146)	0.510
AST (U/L)Median(Min-Max)	62 (19-123)	59 (20-143)	0.669
INR	1.52±0.38	1.51±0.37	0.86
Creatinine (mg/dl)Median(Min-Max)	1.12 (0.6-2.6)	1.20 (0.6-11.3)	0.729

Table 6. Multivariate logistic regression analysis of risk factors associated with readmission.

Parameter	B	AOR (95%CI)	P value
Age (years)	1.1	2.9 (1.4-6.1)	0.005
MELD score	1.06	2.8 (1.3-5.9)	0.008
Albumin	0.9	2.5 (1.2- 5.1)	0.030
Levofloxacin therapy	1.02	0.157 (0.02-1.22)	0.030

β: regression coefficient, **AOR**: Adjusted Odds Ratio, **CI**: Confidence Interval.

Discussion

Spontaneous bacterial peritonitis, was found in 20% of hospitalized patients, with a death rate of 30% to 50% [13-15]. There have been few studies on the predictors of 30-day hospital readmissions in such patients. In this study, patients who were departure from the hospital with a principal diagnosis of spontaneous bacterial infection had a 26.6% chance of being readmitted within 30 days. This matches a research by Dahiya et al, who found that 30% of patients with SBP were readmitted within 30 days in the United States[16].andMousa et al discovered 26.5% 30-day hospital readmissions in cirrhotic spontaneous bacterial peritonitis [17]. Hospital readmission is an expensive and frequent issue [18]. In addition to the detrimental effects readmissions have on patients' lives, they are increasingly used to gauge quality [19]. The Hospital Readmission Reduction Programme (HRRP) imposes consequences for excessive readmissions for high-risk conditions [20].

In this study the factors linked with increased re-hospitalization at index admission were older age, had MELD ≥ 15 , low albumin and high bilirubin however, levofloxacin therapy for SBP was linked to to lower re-hospitalization.

Age 60 years was associated with a higher readmission rate in the current study. This is in line with the conclusions reached by Abdel-Razik et al., who established that older people have a higher incidence of SBP, probably due to deterioration of liver condition and because they have more comorbid conditions, which make them more susceptible to infectious diseases [21]. Furthermore, Chirapongsathorn et al stated that older age was a major risk factor for index hospitalization in cirrhotic patients [22]. In contrast to our findings, a study found that, SBP 30-day readmissions had a lower mean age at index admission than non-readmitted patients [16].

The MELD score is an indicator of kidney and liver condition. Most studies looked at this score, which was usually linked to shorter times and higher rate between first readmission and 30-day readmission rates in cirrhotic patients. Considering this reliably occurring link, variations in MELD scores among studies restrict the ability to reach conclusions about particular cutoff values that might identify participants at the greatest risk.. Our study found that patients with MELD ≥ 15 at index admission significantly had early readmissions at 1-month. An up-to-date research investigation found that patients who had

higher MELD scores were much more likely to have 30-day readmissions as well as initial hospital admissions among patients who had not yet been admitted[23-25]. According to other research, however, there is no significant link between the severity of liver disease as determined by the MELD score and re-admission in patients with cirrhosis [26]. But Mousa et al. discovered that MELD score MELD > 15 was a significant score connected to hospital readmission risk in cirrhotic SBP patients [17].To reduce complications and improve survival, empirical antibiotic therapy should be started as soon as the diagnosis of SBP is made [27]. Third-generation cephalosporins or piperacillin-tazobactam were recommended as the first line of treatment for SBP in international recommendations [28]. In this study, we discovered that the use of levofloxacin in the treatment of SBP lowers the readmission rate compared to other antibiotics. In light of the recent appearance of Gram-positive bacteria with cephalosporin resistance in SBP, Yakar et al. concluded that levofloxacin is a good alternative and may be a better option as an initial treatment of SBP [29]. Furthermore, a significant correlation was found between decreased serum albumin increased serum bilirubin and an increased readmission rate. Lower serum albumin on admission was substantially related to readmission in Bajaj et al.'s model for readmission prediction in cirrhotic patients utilizing index admission data [30]. Furthermore, Xu X et al. discovered that increased total bilirubin, reduced serum albumin, INR, and serum creatinine were risk factors for re-hospitalization in cirrhotic patients [31], in addition to these variables, thrombocytopenia was discovered by Mousa et al. [17] to be a predictor of 30-day readmission. However, there was no proven link between INR, platelet count, or serum creatinine and readmission in this investigation.

Conclusion

This study demonstrates that serum albumin and MELD score, in addition to age, can be utilised as simple, low-cost predictors of 30-day hospital readmission rate in patients with SBP, assisting in early management and lowering readmission costs.

Competing interests. The authors declare that they have no conflict of interest.

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