International Journal of Advances in Medicine
*Dutta R et al. Int J Adv Med. 2023 Jul;10(7):502-510*
http://www.ijmedicine.com
pISSN 2349-3925 | eISSN 2349-3933
DOI: https://dx.doi.org/10.18203/2349-3933.ijam20231868

**Original Research Article**

# Accuracy of leukocyte esterase reagent strip test and platelet indices for early diagnosis of ascitic fluid infection in liver cirrhosis

**Rajib Dutta[1]*, Mohammad M. Rahman[1], Rezaul I. Patwary[1], Iftekhar Imam[2], Habib I. Ahmad[3], Shusmita D. Choudhury[4], Indrajit K. Datta[5], Tareq M. Bhuiyan[5]**

[1]Sheikh Russel National Gastroliver Institute and Hospital, Dhaka, Bangladesh
[2]United Hospital Limited, Dhaka, Bangladesh
[3]Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh
[4]Department of Medical Epidemiology, EcoHealth Alliance, IEDCR, Dhaka, Bangladesh
[5]Department of GHPD, BIRDEM, Dhaka, Bangladesh

**Received:** 05 April 2023
**Accepted:** 12 June 2023

***Correspondence:**
Dr. Rajib Dutta,
E-mail: docrajibdutta@gmail.com



## ABSTRACT

**Background:** Spontaneous bacterial peritonitis (SBP) is one of the serious complexities in patients with cirrhosis and ascites. 30-50% of death may occur if it not treated properly. The leucocyte esterase reagent (LER) strip test is a special apparatus for prior detection of neutrophils in the ascetic fluid. The aim of the study was to investigate the diagnostic accuracy of the LER strip test and platelet indices in the early detection of SBP in cirrhotic patients.
**Methods:** This cross-sectional study was carried out in the department of gastrointestinal hepatobiliary and pancreatic disorders (GHPD), BIRDEM, Dhaka, Bangladesh, from January 2018 to October 2019. A total of 110 indoor patients of liver cirrhosis with ascites were enrolled after fulfilment of the inclusion and exclusion criteria with adequate history taking and clinical examination.
**Results:** Out of 110 cases, 68 were male and 42 were female, and among them 23 (20.9%) patients had SBP. LER strip test at grade 4 set as a cut-off value which showed sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), accuracy was 91.3%, 90.8%, 70%, 97.5%, and 90% respectively. Mean platelet volume (MPV) and platelet distribution width (PDW) were done by complete blood count, where the MPV cut-off value set as 12.5 fl showed sensitivity, specificity, PPV, NPV, and accuracy were 82.6%, 90.8%, 66%, 96.25%, and 88.18% respectively. PDW cut-off value set on 18.10% revealed sensitivity, specificity, PPV, NPV, accuracy was 82.6%, 83.9%, 50%, 95.71% and 79% respectively. ROC curve was plotted to set the cut-off value by examining sensitivity and specificity. Results were considered statistically significant at $p<0.05$.
**Conclusions:** This study was undertaken to detect LER strip tests that showed significant results in bedside diagnosis of SBP. Apart from this, a significant increase in MPV and PDW was observed in SBP. So, LER strip tests and platelet indices measurement can be economical and reliable appliances for early diagnosis of SBP.

**Keywords:** SBP, Liver cirrhosis, Ascites

## INTRODUCTION

Cirrhosis is defined as a diffuse process characterized by fibrosis and the conversion of normal liver architecture into structurally abnormal nodules which lack normal lobular organization according to the World Health Organization (WHO).[1] Patient with liver cirrhosis is generally inclined to develop a bacterial infection, a primarily ascitic fluid infection which represents 10-30% of patients with cirrhosis and ascites.[2] Conn coined the term 'spontaneous bacterial peritonitis' to depict a syndrome of peritonitis and bacteremia in Laennec's

cirrhosis without an apparent cause of infection.[3] There is around a 10% prospect of expanding SBP in patients with end-stage liver disease and ascites over one year.[4] About 50% of SBP episodes are present at the time of hospital admission, and mortality rates 1 and 2 years after an episode of SBP is reported to be 50–70% and 70–75%, respectively.[5,6] However, 87% of patients with SBP are symptomatic when the infection is diagnosed. Symptoms of SBP are nonspecific. These include fever, abdominal pain, nausea, vomiting, and diarrhea.[7] Sometimes only hepatic encephalopathy or a precipitating event such as an upper gastrointestinal hemorrhage from ruptured esophageal varies cause SBP. Unfortunately, typical symptoms of SBP are not presented in all cirrhotic patients who develop SBP.[8] Sometimes clinical hints according to the presence of symptoms of SBP in an emergency room setting had a sensitivity of only 76% and specificity of 34% for the identification of SBP.[9] The International Ascites Club advises essential analysis of ascitic fluid in all cases of new-onset of ascites, worsening of ascites, and in all other cases whenever there is a suspicion of SBP.[7] Therefore, routine diagnostic paracentesis is advised for patients with ascites who evolve signs or risk factors for SBP. In most laboratories, the ascitic fluid cell count is assimilated by applying manual cell counting techniques. This is time-consuming and liable for a high error rate. Consequently, automated cell counts are standard.[10] For early detection of SBP, the leukocyte esterase reagent strip test and platelet indices could be the very supportive appliance.[11,12] The use of reagent strip testing for leukocyte esterase has been proposed for the rapid diagnosis of urinary tract infections, meningitis, and peritonitis in patients on peritoneal dialysis.[13] MPV and PDW are frequently concluded as parts of complete blood count. An increase in MPV and PDW has been found in chronic viral hepatitis as of an increase in the entry of newly produced platelets into circulation, which is greater than the old platelets.[14] Several studies in developed countries revealed that the LER strip test took a few minutes to identify SBP.[15] With sensitivity of 92% and specificity of 100%. In Bangladesh where ascitic fluid analysis is not possible in many rural hospitals set up, the LER strip test could be a feasible, inexpensive, and swift diagnostic kit for analysis of SBP. Besides this in many pragmatic conditions where ascitic fluid analysis is not practticable, MPV and PDW could be a good option of infection which can noninvasively diagnose SBP with the sensitivity 95.9% and specificity 91.7% and sensitivity 90% and specificity 55% respectively.[11,12,16] That is why; this study is designed to evaluate the diagnostic accuracy of LER strip test and platelet indices for early diagnosis of SBP both invasive and noninvasively respectively among the patient of liver cirrhosis. The aim of the study was to investigate the diagnostic accuracy of the LER strip test and platelet indices in the early detection of SBP in cirrhotic patients.

## METHODS

This cross-sectional study was carried out in the department of gastrointestinal, hepatobiliary and pancreatic disorders (GHPD), BIRDEM General Hospital, Shahbagh, Dhaka, Bangladesh from January 2018 to October 2019. Study aimed to evaluate the diagnostic accuracy of the LER strip test and Platelet indices in the early detection of SBP in cirrhotic patients. A total of 110 indoor diagnosed patients of liver cirrhosis with ascites having inclusion criteria admitted to the GHPD, BIRDEM General Hospital which was taken as the study population.

### *Inclusion criteria*

All patients with cirrhotic ascites, newly and previously diagnosed based on clinical, laboratory, radiological and endoscopic intervention methods in the GHPD department of BIRDEM, and patients with age more than 18 years were included.

### *Exclusion criteria*

Patients who had received antibiotics within the previous two weeks within or outside the hospital for any reason, who had a history of surgery for any reason in the past month; secondary bacterial peritonitis, peritonitis carcinomatosis, pancreatic ascites, and subjects with ascites due to malignancy or tuberculosis will also be excluded. Patients who were taking antiplatelet, anticoagulants, steroids, and other immunosuppressive drugs, and patients who were not willing to take part in the study were also excluded.

## RESULTS

Figure 1 depicts that the mean age of the patients was 60.39 (±11.52) years. The maximum age of patients was 90 years old and the minimum age was 30 years. The proportion of the participants was highest in 51-60 years (33.6%) and the lowest in 81-90 years (7%). A pie diagram showed, the distribution of patients according to gender. Among 110 patients, 61.8% were male and 38.2% were female. And the male, female ratio was 1.6:1 (Figure 2). Patients were divided into SBP group includinf 23 patients (17 men and 6 women) and a non-SBP group of 87 patients (51 men and 36 women) (Table 1). Table 2 showed that clinical features of SBP were abdominal pain (23,57.5%), fever (20,54%), altered mental status (8,80%), hematemesis (8,72.7%), melena (7,70%) in SBP group. HBV related cirrhosis was the common (65,59.1%) diagnosed of etiology of cirrhosis, 12 (10.9%) patients had cirrhosis related HCV infection whereas, 31 (28.2%) of the cirrhotic patients were non-B/non-C. The difference of leucocyte beween the SBP and non-SBP group was 12.5±5.5 and 7.96±3.69, respectivelyand they were significant, neutrophyll count compared between the both group was 84.9±3.5 and 72.3±9.3 which was highly significant. The difference between platelet count and ESR between SBP group and non-SBP group was 73.67±31.11, 72.5±21.1 and 113.25±46.65, 48.5±27.6, respectively. And CRP showed huge difference between two groups (92.8±29.5 versus 20.9±21.2) (Table 3). The mean±SD of the MPV level of cirrhotic patients with SBP was 13.5±1.5

and without SBP was 10.9±1.1 and PDW was highly significant in cirrhotic patients with SBP (18.8±1.1) and without SBP (15.1±2.2) (Table 4). Table 5 depicts that 'Uric 10 CF" reagent strip has colorimetric scales and most of the patients showed a color change to grade 1(37.3%) followed by grade 4 (26.36%) and between two groups grade 4 (26.36%) color change was more prominent in SBP group and grade 1 was observed more in non-SBP group. Figure 3 showed that the discrimination between SBP and non-SBP group. Table-6 showed that a cut-off MPV value 12.45 fl best for discrimination and yielded a sensitivity, specificity, positive predictive value and accuracy of 82.6%, 90.8%, 66.6%, 96.2% and 88.2%. And the comparative diagnostic validity of LER strip test sensitivity, specificity, accuracy 91.3%, 90.8%, 90% respectively.

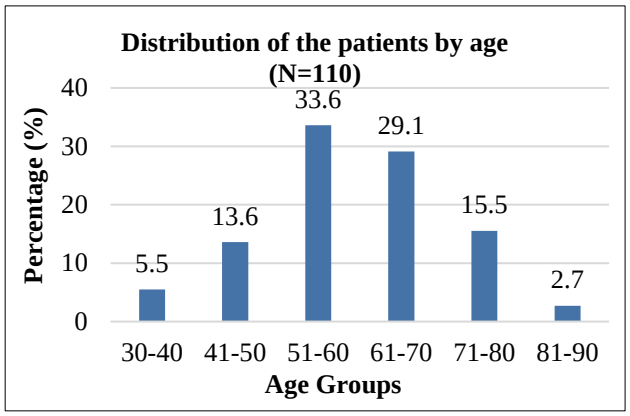


**Figure 1: Age distribution of patients (n=110).**

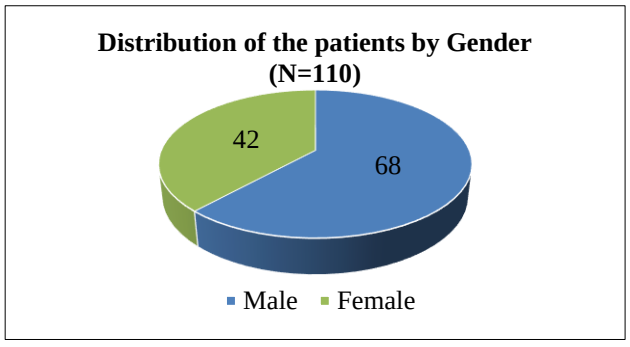


**Figure 2: Gender distribution of patients (n=110).**

Table 7 found that, all 23 patients with SBP diagnosed by MPV and 87 patients without SBP diagnosed by MPV and 20 patients with SBP true positive. Figure 4 showed the performance of MPV. Table-8 showed that the cutoff value of PDW was 18.10% and all 23 patients of true SBP diagnosed by PDW. Figure 5 depicted the performance of PDW. Table 9 showed the cutoff value of LER strip was grade 4 and 21 patients with SBP were true posiive and about non-SBP group 78 patients were true negative. Figure 6 found the performance of LER strip. Figure 7 depicted the comparison of diagnostic validity of LER strip test, MPV, and PDW in SBP group.

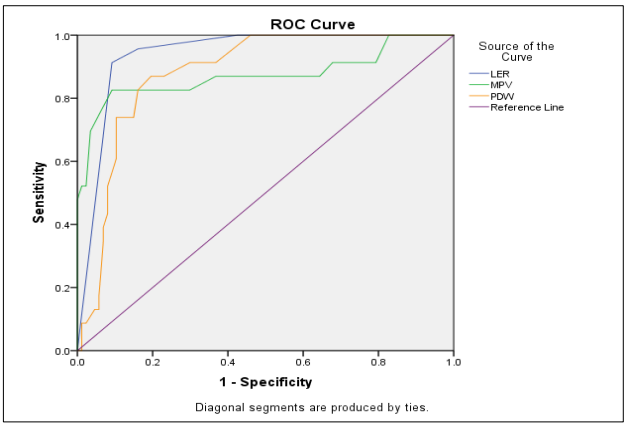


**Figure 3: Receiver operating characteristic (ROC) curves of LER strip test, MPV and PDW in detecting SBP in cirrhotic patients.**

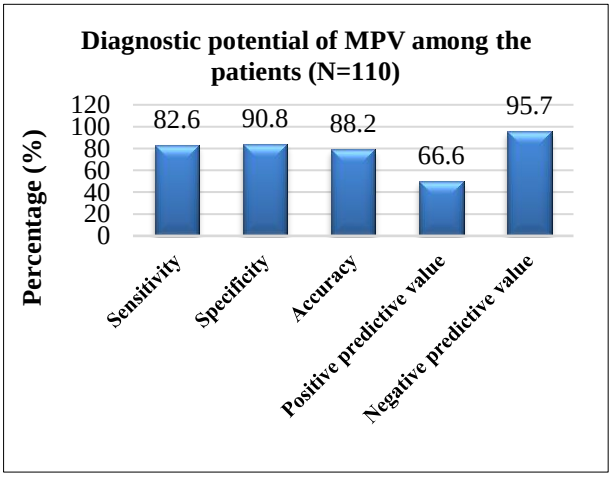


**Figure 4: Bar diagram showing performance characteristics of MPV in the diagnosis of spontaneous bacterial peritonitis (N=110.**

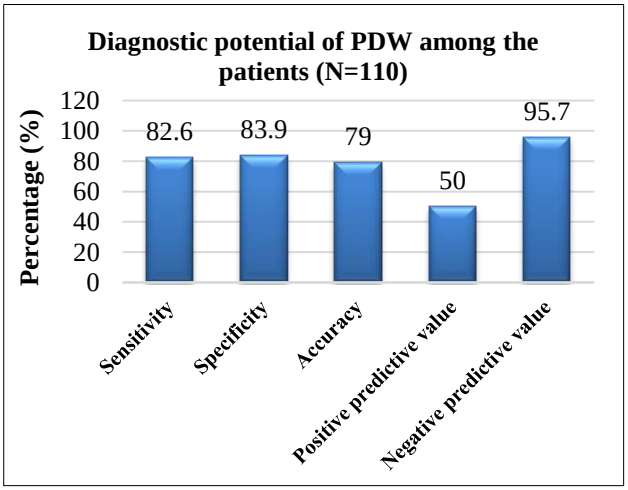


**Figure 5: Bar diagram showing performance characteristics of PDW in the diagnosis of spontaneous bacterial peritonitis (N=110).**

**Table 1: Distribution of SBP and non-SBP patients according to their age and gender (N=110).**

| Age and gender | Ascitic fluid PMN >250 cells/cmm=SBP | | Total | P value |
|---|---|---|---|---|
| | SBP (n=23), n (%) | Non-SBP (n=87), n (%) | | |
| **Age** | | | | |
| Below 40 | 2 (8.7) | 4 (4.6) | 6 (5.5) | |
| 41-50 | 2 (8.7) | 13 (14.9) | 15 (13.6) | |
| 51-60 | 7 (30.4) | 30 (34.5) | 37 (33.6) | 0.28 |
| 61-70 | 5 (21.7) | 27 (31.1) | 32 (29.1) | |
| 71-80 | 5 (21.7) | 12 (13.8) | 17 (15.5) | |
| Above 80 | 2 (8.7) | 1 (1.1) | 3 (2.7) | |
| Mean±SD | 62.83±14.16 | 59.75±10.72 | 60.39±11.52 | |
| **Gender** | | | | |
| Male | 17 (73.9) | 51 (58.6) | 68 (61.8) | 0.18 |
| Female | 6 (26.1) | 36 (41.4) | 42 (38.2) | |

P value determined by $\chi^2$ test; SBP: spontaneous bacterial peritonitis; PMN: polymorphonuclear leukocyte

**Table 2: Distribution of the patients according to history suggestive of SBP and etiology of liver cirrhosis (N=110).**

| Parameters | Ascitic fluid PMN >250 cells/cmm=SBP | | Total | P value |
|---|---|---|---|---|
| | SBP, n (%) | Non-SBP, n (%) | | |
| **History suggestive of SBP** | | | | |
| Abdominal pain | 23 (57.5) | 17 (42.5) | 40 (33.4) | <0.001 |
| Fever | 20 (54.1) | 17 (46) | 37 (33.6) | <0.001 |
| Altered mental status | 8 (80) | 02 (20) | 10 (9.9) | <0.001 |
| Hematamesis | 8 (72.7) | 03 (27.3) | 11 (10) | <0.001 |
| Melena | 7 (70) | 03 (30) | 10 (9.9) | <0.001 |
| **Etiology of liver cirrhosis** | | | | |
| HBV | 16 (69.6) | 49 (56.3) | 65 (59.1) | |
| HCV | 4 (17.4) | 8 (9.2) | 12 (10.9) | |
| Non B, non C | 2 (8.7) | 29 (33.3) | 31 (28.2) | 0.047 |
| Hemochromatosis | 1 (4.3) | 0 (0.0) | 1 (0.9) | |
| Alcohol related | 0 (0.0) | 1 (1.1) | 1 (0.9) | |
| Total | 23 (100.0) | 87 (100.0) | 110 (100.0) | |

P value determined by $\chi^2$ test; SBP: spontaneous bacterial peritonitis; PMN: polymorphonuclear leukocyte

**Table 3: Comparison of complete blood counts in patients with and without SBP (N=110).**

| Parameters | Ascitic fluid PMN >250 cells/cmm=SBP | | P value |
|---|---|---|---|
| | SBP, mean±SD | Non-SBP, mean±SD | |
| **Hemoglobin (gm/dl)** | 9.01±1.77 (4.2-11.8) | 9.62±1.81 (6.0-14.4) | 0.149 |
| **ESR (mm in 1st hour)** | 72.5±21.1 (24.0-120.0) | 48.5±27.6 (5.0-136.0) | <0.001 |
| **Total WBCs ($10^3$/cmm)** | 12.5±5.5 (4.3-29.1) | 7.96±3.69 (0.006-18.98) | <0.001 |
| **Neutrophil (%)** | 84.9±3.5 (77.1-91.6) | 72.3±9.3 (42.0-89.6) | <0.001 |
| **Platelets ($10^3$/l)** | 103.26±28.29 (45.0-145.0) | 151.55±73.72 (42.0-390.0) | 0.003 |
| **CRP (mg/l)** | 92.8±29.5 (52.0-193.0) | 20.9±21.2 (3.0-139.0) | <0.001 |

P value determined by independent sample t-test; ESR: erythrocyte sedimentation rate; WBC: white blood cells; CRP: C-reactive protein; SBP: spontaneous bacterial peritonitis; PMN: polymorphonuclear leukocyte

**Table 4: Comparison of platelet indices in patients with and without SBP (N=110).**

| Parameters | Ascitic fluid PMN>250 cells/cmm=SBP | | P value |
|---|---|---|---|
| | SBP, mean±SD | Non-SBP, mean±SD | |
| **MPV (fl)** | 13.5±1.5 (10-15.8) | 10.94±1.1 (8.4-13) | <0.001 |
| **PDW (%)** | 18.8±1.1 (16-20.4) | 10.94±1.1 (8.4-13) | <0.001 |

Continued.

**Table 5: Comparison of LER strip test color grades in patients with and without SBP (N=110).**

| Leukocyte esterase reagent strip test | Ascitic fluid PMN>250 cells/cmm=SBP | | Total N (%) | P value |
|---|---|---|---|---|
| | SBP, (n=23), n (%) | Non-SBP, (n=87), n (%) | | |
| **Grade 0** | 0 (0.0) | 9 (10.3) | 9 (8.2) | |
| **Grade 1** | 0 (0.0) | 41 (47.1) | 41 (37.3) | |
| **Grade 2** | 1 (4.3) | 23 (26.4) | 24 (21.8) | <0.001 |
| **Grade 3** | 1 (4.3) | 6 (6.9) | 07 (6.4) | |
| **Grade 4** | 21 (91.3) | 8 (9.2) | 29 (26.36) | |
| **Total** | 23 (100.0) | 87 (100.0) | 110 (100.0) | |

**Table 6: Sensitivity and specificity corresponding to the cut-off values of MPV, PDW and LER strip test as obtained from the ROC curve.**

| Cut-off value | Sensitivity (%) | Specificity (%) |
|---|---|---|
| **MPV (fl)** | | |
| 12.25 | 82.6 | 87.4 |
| 12.35 | 82.6 | 89.7 |
| 12.45 | 82.6 | 90.8 |
| 12.65 | 69.6 | 96.6 |
| 12.85 | 52.2 | 97.7 |
| **PDW (%)** | | |
| 17.55 | 87 | 79.3 |
| 17.80 | 87 | 80.5 |
| 18.10 | 82.6 | 83.9 |
| 18.20 | 73.9 | 85.1 |
| 18.30 | 73.9 | 88.5 |
| **LER strip test (color grade)** | | |
| Grade 1 | 100.0 | 10.3 |
| Grade 2 | 100.0 | 57.5 |
| Grade 3 | 95.7 | 83.9 |
| Grade 4 | 91.3 | 90.8 |

**Table 7: Cross-tabulation showing the concurrent diagnosis by MPV (cutoff value: 12.45 fl) and PMN cell cytology (N=110).**

| Test result | Diagnosis based on ascitic fluid PMN cell count (standard diagnosis) | | Total |
|---|---|---|---|
| **Diagnosed by MPV SBP (MPV ≥12.45 fl)** | SBP<br>True positive (TP)*=20 | Non-SBP<br>False positive (FP)*=10 | Patients with SBP as diagnosed by MPV (TP+FP) |
| **Non-SBP (MPV <12.45fl)** | False negative (FN)*=3 | True negative (TN)*=77 | Patients without SBP as suggested by MPV (TN+FN) |
| **Total** | All patients with true SBP (TP+FN)=23 | All patients without SBP (FP+TN)=87 | |

**Table 8: Cross-tabulation showing the concurrent diagnosis by PDW (cutoff value:18.10%) and PMN cell cytology (N=110).**

| Test result | Diagnosis based on ascitic fluid PMN cell count (standard diagnosis) | | Total |
|---|---|---|---|
| **Diagnosed by PDW SBP (PDW ≥18.10%)** | SBP<br>True positive (TP)*=20 | Non-SBP<br>False positive (FP)*=20 | Patients with SBP as diagnosed by PDW (TP+FP) |
| **Non-SBP (PDW <18.10%)** | False negative (FN)*=3 | True negative (TN)*=67 | Patients without SBP as suggested by PDW (TN+FN) |
| **Total** | All patients with true SBP (TP+FN)=23 | All patients without SBP (FP+TN)=87 | |

**Table 9: Cross-tabulation showing the concurrent diagnosis by LER strip test (cutoff value: grade 4) and PMN cell cytology (N=110).**

| Test result | Diagnosis based on ascitic fluid PMN cell count (standard diagnosis) | | Total |
|---|---|---|---|
| **Diagnosed by LER strip test SBP (≥LER grade 4)** | SBP True positive (TP)*=21 | Non-SBP False positive (FP)*=9 | Patients with SBP as diagnosed by MPV (TP+FP)=30 |
| **Non-SBP (<LER grade 4** | False negative (FN)*=2 | True negative (TN)*=78 | Patients without SBP as suggested by MPV (TN+FN)=80 |
| **Total** | All patients with true SBP (TP+FN)=23 | All patients without SBP (FP+TN)=87 | 110 |

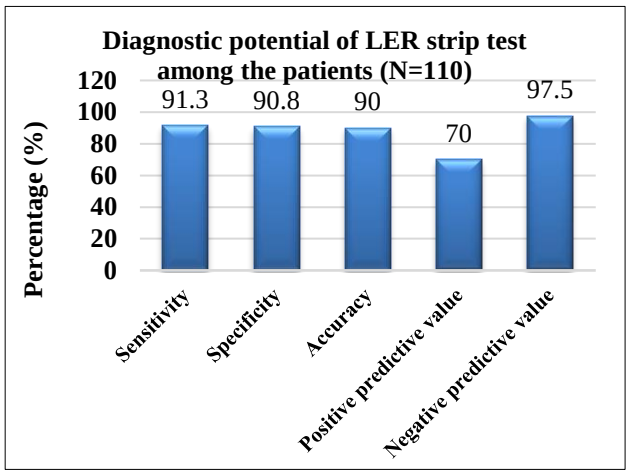


**Figure 6: Performance characteristics of LER strip test in the diagnosis of spontaneous bacterial peritonitis (N=110).**

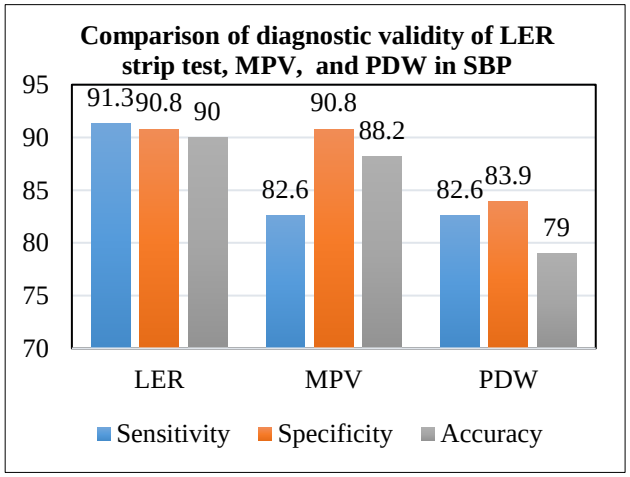


**Figure 7: Comparative performance characteristics of the LER strip test, MPV and PDW in the diagnosis of spontaneous bacterial peritonitis (N=110).**

## DISCUSSION

This cross-sectional study was carried out in the GHPD Department of BIRDEM, from January 2018 to October 2019. A total of 110 indoor diagnosed cases of liver cirrhosis with ascites were admitted into the hospital. According to ascitic fluid analysis and clinical data, patients were included in the study and they were divided into SBP group including 23 patients (17 men and 6 women) and a non-SBP group of 87 patients (51 men and 36 women). The mean age was 60.39±11.52 years (age range: 30-90 years) and the most prominent age group involved was 51–60 years (33.6%) Males (61.8%) were predominant than females (38.2%) with a male-female ratio of 1.6:1 One of the studies reported that the mean and standard deviation of the age was 55.7±10.3 years.[17] In this current analysis, clinical features suggestive of SBP were abdominal pain (57.5%), fever (54%), altered mental status (80%), hematemesis (72.7%), melena (70%) in SBP groups. These differences in clinical features between SBP and non-SBP groups were significant. In a previous study showed a wide variation in presenting features of SBP. In another study, found (89%) of the patients had fever, upper gastrointestinal bleeding (42%), abdominal pain (53%), and hepatic encephalopathy (50%) of cases.[18] In the present study, HBV-related cirrhosis was the most common 65 (59.1%) diagnosed etiology of cirrhosis, 12 (10.9%) patients had cirrhosis related to HCV infection, while 31 (28.2%) of the cirrhotic patients were non-B/non-C. Sarker et al observed more or less the same in their study with 22 (60%) patients being HBsAg positive, 2 (5.7%) patients having anti-HCV, and 12 patients being non-B/non-C.[19] The most common causes of liver cirrhosis globally are thought to be HBV, HCV, and alcohol but the causes vary from country to country and from region to region. This is similar to other studies done in Africa but differs from reports from the western countries.[20] Moreover, the prevalence of SBP in the latter study was 25.24% which is comparable to the prevalence of SBP in the present study (20.9%). This is similar to a prevalence of 10-30% of SBP in cirrhotic patients found by most studies around the world.[21] In our study neutrophil count compared between the SBP and non-SBP groups was 84.9±3.5 and 72.3±9.3, which was highly significant (p<0.001). Similar results were echoed in a study by Gálvez-Martínez et al which found a significantly greater count of leucocytes, (p<0.001) in the SBP group of patients.[17] In our study, the difference between platelet count was 103.26±28.29 and 151.55±73.72 in SBP and non-SBP groups respectively which was significant (p=0.003). Several study found the difference of platelet

count between SBP and the non-SBP group was 73.67±31.11 and 113.25±46.65 respectively.[22] In the present study, ESR also revealed a difference between the SBP and non-SBP groups 72.5±21.1 versus 48.5±27.6, and it was statistically significant (p<0.001)**.** Behiry et al found ESR difference between SBP and non-SBP groups seen 36.4±24.0 and 19.1±9.3 respectively.[23] In the present study, CRP showed a huge difference between the SBP and non-SBP groups (92.8±29.5 versus 20.9±21.2) and it was statistically significant (p<0.001). In a study by Elkafoury et al, differences in CRP among SBP, non-SBP, and control groups were reported to be statistically significant at a cut-off value of more than 6 mg/l (p<0.001), which was in agreement with other findings.[12,16,24,25] Ascitic fluid culture resulted in 2 (8.6%) positive culture cases among 23 SBP cases while all the non-SBP patients were culture negative. Among the 2 SBP cases with positive culture results, there were 2 (100%) cases of *Escherichia coli*. Keeping in line with our report, the rate of ascitic fluid bacterial growth was less in the study by Kamani et al (23%) as compared to other reports, where it usually ranges from 50% to 71%.[26] In the present study, the MPV level was significantly increased in cirrhotic patients with SBP compared with cirrhotic patients without SBP (mean±SD=13.5±1.5 versus 10.9±1.1) and the differences were highly significant (p<0.001). A cut-off MPV value of 12.45 fl, was the best to discriminate between cirrhotic patients with SBP and those without it (AUROC: 0.873, p<0.001). This value yielded a sensitivity, specificity, positive predictive value, negative predictive value, and accuracy of 82.6%, 90.8%, 66.6%, 96.2%, and 88.2%. Khorshed et al also observed likewise results in their study.[16] However, these studies used normal ranges of MPV which was lower than the one used in our setting 7.5-11.5 fl in our study versus 6.5-11.5 fl in the study by another author which could be the reason why the cutoff differed from other studies.[16] In the present study, PDW was statistically highly significant at (p<0.001) in cirrhotic patients with SBP (18.8±1.1) than in those without SBP (15.1±2.2) It was also reported that at a cutoff value of 18.10%. PDW had sensitivity, specificity, PPV, NPV, accuracy for detecting SBP of 82.6%, 83.9%, 50%, 95.7% and 79% respectively (AUROC: 0.881, p<0.001). However, this finding was not supported by Suvak et al who claimed no significant changes in PDW in cirrhotic patients with AFI than in those without infection.[24] In our study most of the patients out of 110 showed a color change to grade 1 (37.3%) followed by grade 4 (26.36%). However, when compared between 2 groups, grade 4 (91.3%) color change was more prominent in the SBP cases while grade 1 color change was observed more in non-SBP cases. The differences were statistically highly significant (p<0.001). From the ROC curve, a cutoff value of grade 4 color change was the best to discriminate between cirrhotic patients with ascitic fluid infection and those without it (AUROC: 0.940, p<0.001)**.** This value yielded a sensitivity, specificity, positive predictive value, negative predictive value, and accuracy of 91.3%, 90.8%, 70%, 97.5%, and 90%. Butani et al applied the Multistix 10SG to diagnose SBP in 136 specimens by using grade 2 as a cut off the scale and found the sensitivity, specificity, PPV, and NPV of the Multistix 10SG to be 83%, 99%, 91%, and 98% respectively.[27] These oucomes were in agreement with that of Castellote et al who demonstrated sensitivity (96%) and specificity (89%) for detecting SBP in cirrhotic patients with ascites.[28] In a study, the diagnostic performance of MPV with cut off value 9.2 fl showed as a good diagnostic marker for SBP with sensitivity 75%. The leukocyte esterase reagent strips showed that specificity 93%, sensitivity 80%, and accuracy 86.5%, but where PDW parameter was not included in that study.[29]

### *Limitations*

Sample size is relatively small. No definite calibration of 250 PMN's/mm$^3$ in the LER strip which is the gold standard of the diagnosis of SBP. There may b a possibility of inter-ovserver variation in the matching of the colors in LER strip test. After completion of treatement the follow-up of the measurement of indices was not done.

## CONCLUSION

To conclude, this study aimed at high sensitivity and specificity as well as high diagnostic accuracy of both LER strip tests and platelet indices in detecting SBP. LER strip test showed sensitivity, specificity, and accuracy of 91.3%, 90.8%, and 90% respectively. MPV found sensitivity, specificity and accuracy 82.6%, 90.8%, 88.2% respectively and PDW revealed sensitivity, specificity and accuracy 82.6%, 83.9%, 79% respectively. Among the LER strip test and platelet indices, the LER strip test revealed greater accuracy than platelet indices. Among the platelet indices, PDW showed lower accuracy than MPV. Several shreds of evidence support the use of these diagnostic tools in the early detection of SBP and initiation of treatment of SBP before ascitic fluid analysis. These tests can be beneficial alternative methods for early detection of SBP in the gastroenterology department.

### *Recommendations*

The study should be done in a multicentre with a large sample size in the available time. Follow-up after treatment with inflammatory markers also recommended.

*Funding: No funding sources*
*Conflict of interest: None declared*
*Ethical approval: The study was approved by the Institutional Ethics Committee*

## REFERENCES

1. Chowdhury R, Mukherjee A, Naskar S, Lahiri SK. A study on knowledge of animal bite management and rabies immunization among interns of government medical college in Kolkata. Int J Med Public Health. 2013;3(1):17-20.

2. Singh US, Choudhary SK. Knowledge, attitude, behaviour and practice study on dog bites and its management in the context of prevention of rabies in a rural community of Gujarat. Indian J Community Med. 2005;30(3):81-3.
3. Ichhpujani RL, Chhabra M, Mittal V, Bhattacharya D, Singh J, Lal S. Knowledge, attitude and practices about animal bites and rabies in general community--a multi-centric study. J Communicable Dis. 2006;38(4):355-61.
4. Sekhon AS, Singh A, Kaur P, Gupta S. Misconceptions and Myths in the management of animal bite case. Indian J Community Med. 2002;27(1):9-11.
5. Agarval N, Reddaiah VP. Knowledge, Attitude and Practice following dog bite: a community based epidemiological study. Health Popul Persp Issues. 2003;26(4):154-61.
6. Rumana R, Sayeed AA, Basher A, Islam Z, Rahman MR, Faiz MA. Perceptions and treatment seeking behaviour for dog bites in rural Bangladesh. South-East Asian J Trop Med Public Health. 2013;44(2):1-5.
7. Sekhon AS, Singh A, Kaur P, Gupta S. Misconceptions and Myths in the management of animal Roll J, Boyer JL, Barry D, Klatskin G. The prognostic importance of clinical and histologic features in asymptomatic and symptomatic primary biliary cirrhosis. N Engl J Med. 1983;308(1):1-7.
8. Moore KP, Aithal GP. Guidelines on the management of ascites in cirrhosis. Gut. 2006;55(suppl 6):vi1-2.
9. Conn HO. Spontaneous peritonitis and bacteremia in Laennec's cirrhosis caused by enteric organisms: a relatively common but rarely recognized syndrome. Ann Int Med. 1964;60(4):568-80.
10. Ribeiro TC, Chebli JM, Kondo M, Gaburri PD, Chebli LA, Feldner AC. Spontaneous bacterial peritonitis: How to deal with this life-threatening cirrhosis complication? Therapeutics and clinical risk management. 2008;4(5):919.
11. Koulaouzidis A. Diagnosis of spontaneous bacterial peritonitis: an update on leucocyte esterase reagent strips. World J Gastroentero. 2011;17(9):1091.
12. Rimola A, García-Tsao G, Navasa M, Piddock LJ, Planas R, Bernard B, Inadomi JM. Diagnosis, treatment and prophylaxis of spontaneous bacterial peritonitis: a consensus document. J Hepatol. 2000;32(1):142-53.
13. Moore KP, Wong F, Gines P, Bernardi M, Ochs A, Salerno F, et al. The management of ascites in cirrhosis: report on the consensus conference of the International Ascites Club. Hepatology. 2003;38(1):258-66.
14. Filik L, Unal S. Clinical and laboratory features of spontaneous bacterial peritonitis. East Afr Med J. 2004;81(9):474-9.
15. Chinnock B, Afarian H, Minnigan H, Butler J, Hendey GW. Physician clinical impression does not rule out spontaneous bacterial peritonitis in patients undergoing emergency department paracentesis. Ann Emerg Med. 2008;52(3):268-73.
16. Thomas V. Routine analysis of cirrhotic ascites for evidence of infection–not worth the effort? Indian J Gastroenterol. 2011;30(5):201-3.
17. Balagopal SK, Sainu A, Thomas V. Evaluation of leucocyte esterase reagent strip test for the rapid bedside diagnosis of spontaneous bacterial peritonitis. Indian J Gastroenterol. 2010;29(2):74-7.
18. Abdel-Razik A, Eldars W, Rizk E. Platelet indices and inflammatory markers as diagnostic predictors for ascitic fluid infection. Eur J Gastroenterol Hepatol. 2014;26(12):1342-7.
19. Levy M, Tournot F, Muller C, Carbon C, Yeni P. Evaluation of screening tests for urinary infection in hospital patients. The Lancet. 1989;334:384-5.
20. Turhan O, Coban E, Inan D, Yalcin AN. Increased mean platelet volume in chronic hepatitis B patients with inactive disease. Med Sci Monit. 2010;16(4):205.
21. Castellote J, López C, Gornals J, Tremosa G, Fariña ER, Baliellas C, et al. Rapid diagnosis of spontaneous bacterial peritonitis by use of reagent strips. Hepatology. 2003;37(4):893-6.
22. Khorshed SE, Ibraheem HA, Awad SM. Macrophage Inflammatory Protein-1 Beta (MIP-1β) and Platelet Indices as Pre-dictors of Spontaneous Bacterial Peritoni-tis—MIP, MPV and PDW in SBP. Open J Gastroenterol. 2015;5(07):94.
23. Gálvez-Martínez M, Servín-Caamaño AI, Pérez-Torres E, Salas-Gordillo F, Rivera-Gutiérrez X, Higuera-de la Tijera F. Mean platelet volume as a novel predictor of systemic inflammatory response in cirrhotic patients with culture-negative neutrocytic ascites. World J Hepatol. 2015;7(7):1001.
24. Pelletier G, Lesur G, Ink O, Hagege H, Attali P, Buffet C, Etienne JP. Asymptomatic bacterascites: is it spontaneous bacterial peritonitis?. Hepatology. 1991;14(1):112-5.
25. Sarker D, Plummer R, Meyer T, Sodergren MH, Basu B, Chee CE, et al. MTL-CEBPA, a small activating RNA therapeutic upregulating C/EBP-α, in patients with advanced liver cancer: a first-in-human, multicenter, open-label, phase I trial. Clin Canc Res. 2020;26(15):3936-46.
26. Ayele AG, Gebre-Selassie S. Prevalence and risk factors of hepatitis B and hepatitis C virus infections among patients with chronic liver diseases in public hospitals in Addis Ababa, Ethiopia. Int Scholar Res Notices. 2013.
27. Tandon P, Garcia-Tsao G. Bacterial infections, sepsis, and multiorgan failure in cirrhosis. InSeminars in liver disease. 2008;28(1):26-42.
28. Metwally K, Fouad T, Assem M, Abdelsameea E, Yousery M. Predictors of spontaneous bacterial peritonitis in patients with cirrhotic ascites. J Clin Transl Hepatol. 2018;6(4):372.
29. Behairy BE, Sira MM, Zalata KR, Salama ES, Abd-Allah MA. Transient elastography compared to liver biopsy and morphometry for predicting fibrosis in

pediatric chronic liver disease: does etiology matter? World J Gastroenterol. 2016;22(16):4238.
30. Suvak B, Torun S, Yildiz H, Sayilir A, Yesil Y, Tas A, et al. Mean platelet volume is a useful indicator of systemic inflammation in cirrhotic patients with ascitic fluid infection. Ann Hepatol. 2015;12(2):294-300.
31. Elkafoury RM, Kobtan AA, Attia TE, Abdelhamed AH. Study of platelet indices in cirrhotic patients with spontaneous bacterial peritonitis. Tanta Med J. 2018;46(1):8.
32. Kamani L, Mumtaz K, Ahmed US, Ali AW, Jafri W. Outcomes in culture positive and culture negative ascitic fluid infection in patients with viral cirrhosis: cohort study. BMC Gastroenterol. 2008;8(1):1-6.
33. Butani RC, Shaffer RT, Szyjkowski RD, Weeks BE, Speights LG, Kadakia SC. Rapid diagnosis of infected ascitic fluid using leukocyte esterase dipstick testing. Off J Am Coll Gastroenterol. 2004;99(3):532-7.
34. Castellote J, Girbau A, Maisterra S, Charhi N, Ballester R, Xiol X. Spontaneous bacterial peritonitis and bacterascites prevalence in asymptomatic cirrhotic outpatients undergoing large-volume paracentesis. J Gastroenterol Hepatol. 2008;23(2):256-9.
35. Gomaa AAEH, Soliman AIA, Salim AHM, Ismaeil MB. Study of mean platelet volume versus leucocyte esterase as a marker in diagnosis of spontaneous bacterial peritonitis. Al-Azhar Med J. 2020;49(1):69-82 bite case. Indian J Community Med. 2002;27(1):9-11.
36. Agarval N, Reddaiah VP. Knowledge, Attitude and Practice following dog bite: a community based epidemiological study. Health Popul Persp Issues. 2003;26(4):154-61.
37. Rumana R, Sayeed AA, Basher A, Islam Z, Rahman MR, Faiz MA. Perceptions and treatment seeking behaviour for dog bites in rural Bangladesh. South-East Asian J Trop Med Pub Health. 2013;44(2):1-5.

**Cite this article as:** Dutta R, Rahman MM, Patwary RI, Imam I, Ahmad HI, Choudhury SD, et al. Accuracy of leukocyte esterase reagent strip test and platelet indices for early diagnosis of ascitic fluid infection in liver cirrhosis. Int J Adv Med 2023;10:502-10.