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Original article

Procalcitonin in Diagnosis of Spontaneous Bacterial Peritonitis and Culture Negative Neutrocytic Ascites in Patients with Liver Cirrhosis

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Abstract

Background: Patients with liver cirrhosis (LC) are at high risk for developing bacterial infections. Serum Procalcitonin (PCT) level increases during bacterial infections but usually remains low during viral infections and nonspecific inflammatory diseases. **Objective:** evaluate the diagnostic role of procalcitonin in discrimination between SBP and culture negative neutrocytic ascites. **Methods:** This study was done on fifty four (54) patients with liver cirrhosis, Twenty seven (27) (Group I) of them suffering from classic SBP on top of cirrhosis and the other twenty seven (27) (Group II) suffering from liver cirrhosis with culture negative neutrocytic ascites. They were chosen from those who were admitted to Hepatology and Gastroenterology Department, Benha University. CBC, liver enzymes, HCVAb, HBsAg, ascitic fluid analysis and serum procalcitonin was done to patients. .**Results:** There was statistically significant difference between Procalcitonin as regard discrimination group I from group II. The mean Procalcitonin in group I was 1.63 (±0.68) SD with range (0.30 – 2.50). The mean Procalcitonin in group II was 0.58 (±0.45 SD) with range (0.02 – 1.80) The P value was <0.001. Using roc curve for procalcitonin to discriminate group I from group II it showed high significance above 0.8 with area under curve of 0.894, sensitivity 85.19, specificity 70.37, positive predictive value 74.2 and negative predictive value 82.6. According to relation between procalcitonin and different parameters in group II, there was statistically significant difference between procalcitonin as regard encephalopathy, in group II. **Conclusion:** PCT level was higher in liver cirrhosis patients with SBP than CNNA which indicated it may represent as a simple biomarker for differentiating SBP(Spontaneous Bacterial Peritonitis) from CNNA(Culture Negative Neutrocytic Ascites)

Keywords: Procalcitonin; Spontaneous Bacterial Peritonitis; Culture Negative Neutrocytic Ascites; Liver Cirrhosis

Introduction

Patients with liver cirrhosis (LC) are at high risk for developing bacterial infections, as LC leads to hypoactive phagocytic cells or opsonic activity in the hepatic reticuloendothelial system and bacterial influx into the general circulation through portacaval shunts.[(1)]. The most common bacterial infection in LC patients is Spontaneous Bacterial Peritonitis (SBP), followed by urinary tract infection, pneumonia, soft tissue infection, and bacteremia [(2)].All patients with cirrhosis and ascites are at increased risk of SBP and the prevalence of SBP is 1.5–3.5% in outpatients and 10% inpatients admitted to the hospital. Approximately, 50% of the episodes of SBP are present at the time of hospital admission while the rest are acquired during hospitalization.[(3)] Spontaneous bacterial peritonitis (SBP) is defined as bacterial infections that occur in patients with cirrhosis and ascites without any significant intraperitoneal infection. .[(4)] The onset of SBP and bacteremia in LC patients occurs due to changes in the composition of the intestinal bacterial flora, breakdown of the intestinal mucosal barrier, or the translocation of pathological bacterial from the intestine to mesenteric lymph nodes . Bacterial translocation is reportedly common among patients with LC and severe liver dysfunction [(5)]. There are three variants of SBP that are also "spontaneous" (i.e. there is no surgically treatable source for the infection), Culture negative neutrocytic ascites, monomicrobial non neutrocytic bacteracites, polymicrobial bacteracites, These variants are distinguished from classic SBP largely by ascitic fluid analysis, [(6)] .Culture negative neutrocytic ascites: its diagnosis was made when a patient had an elevated ascitic fluid absolute PMN count (≥250 cells/mm3) with a negative ascitic fluid culture (in the absence of antibiotic therapy or pancreatitis) and no evident intraabdominal surgically treatable source of infection. A PMN threshold of 500/mm3 was initially used, but this was subsequently revised to 250/mm3 persons [(7)]. Procalcitonin (PCT), a 116-amino acid prohormone of calcitonin, is normally synthesized in the C cells of the thyroid gland, and the current reference value (cut-off value) is estimated to be approximately 0.5 ng/mL in healthy populations [(8)]. Serum Procalcitonin (PCT) level increases during bacterial infections but usually remains low during viral infections and nonspecific inflammatory diseases. As such, serum PCT is recognized to be an important biomarker for bacterial infections. For example, PCT has diagnostic value for bacterial infections in advanced liver disease and spontaneous bacterial peritonitis (SBP) [(9).]This work aimed to evaluate the diagnostic role of procalcitonin in discrimination between SBP and culture negative neutrocytic ascites.

Patients and methods

This is a cross sectional study was done from April 2022 to March 2023. The study had been approved by the ethical committee Benha Faculty of Medicine. Fifty -four patients with liver cirrhosis, recruited among individuals admitted to in-patient's

wards of Gastroenterology and Hepatology Unit. Collected from Benha Gastroenterology and Hepatology Department, Faculty of Medicine, Benha University.

Ethical approval:

All enrolled participants gave their agreement in a written consent as well as Benha Faculty of Medicine's research ethics committee authorized the project **{M.S. 19.1.2022}.**

Inclusion criteria:

This study involved 54 patients with liver cirrhosis divided into two groups

Group (1): (27 cases) patients with liver cirrhosis with classic SBP

Group (2): (27 cases) patients with liver cirrhosis with culture negative neutrocytic ascites.

Exclusion criteria:

- Age less than 18 years.
- Other causes of bacterial sepsis that lead to increase of procalcitonin level
- End stage renal failure
- Sever noninfectious inflammatory stimuli (major burn, sever trauma, acute multi organ failure or cardiothoracic surgery).
- Medullary thyroid carcinoma.

All patients subjected to:

- Complete history taking.
- Complete physical examination include: general examination (Temperature, heart rate, blood pressure…)
- Local examination for the abdomen.
- Laboratory testing: CBC, CRP, ESR, renal function tests, HCV antibodies, HBsAg, and liver function tests (Albumin, total and direct bilirubin, PT and INR) , urine analysis , stool analysis, to exclude other sources of infections).
- Assess presence of procalcitonin and its level in blood of the patients by ELISA kits.
- Chest X-ray: to exclude other sources of infections.
- Ultrasonography done for all patients to confirm criteria of liver cirrhosis (shrunken liver, coarse texture and irregular border and ascites).
- Ascetic fluid analysis; biochemical tests (SAAG, LDH, amylase and Glucose) and non-biochemical test (cell count and culture).
- The presence of ascitic fluid infection was determined based on white blood cell (WBC) / polymorphonuclear leukocyte (PMNL) counts and the culture positivity in ascitic fluids (AF). Accordingly patients were classified into four groups with respect to ascitic fluid infection including SBP (WBC count ≥ 500/mm3 and PMNL >250/mm3 in AF with a positive bacterial culture), culture-negative SBP (WBC count ≥ 500/mm3 and PMNL >250/mm3 in AF but the culture is negative),

  serum-ascites albumin gradient (SAAG) =serum albumin - ascitic fluid albumin[9].
- CHILD Pugh Score to assess severity of cirrhosis.

Table 1 Child Pugh score [10].

Clinical and Lab Criteria	Points*		
	1	2	3
Encephalopathy	None	Mild to moderate (grade 1 or 2)	Severe (grade 3 or 4)
Ascites	None	Mild to moderate (diuretic responsive)	Severe (diuretic refractory)
Bilirubin (mg/dL)	< 2	2-3	>3
Albumin (g/dL)	> 3.5	2.8-3.5	<2.8
Prothrombin time			
Seconds prolonged	<4	4-6	>6
International normalized ratio	<1.7	1.7-2.3	>2.3
Child-Turcotte-Pugh Class obtained by adding score for each parameter (total points) Class A = 5 to 6 points (least severe liver disease) Class B = 7 to 9 points (moderately severe liver disease) Class C = 10 to 15 points (most severe liver disease)			

Statistical methodology

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0**. (**Armonk, NY: IBM Corp**)**. Qualitative data were described using number and percent. Quantitative data were described using range (minimum and maximum), mean, standard deviation, median and interquartile range (IQR). Significance of the obtained results was judged at the 5% level.

The used tests were

1 - Chi-square test

For categorical variables, to compare between different groups

2 - Fisher's Exact

Correction for chi-square when more than 20% of the cells have expected count less than 5

3 - Student t-test

For normally distributed quantitative variables, to compare between two studied groups

4- Mann Whitney test

For abnormally distributed quantitative variables, to compare between two studied groups

5 - Spearman coefficient

To correlate between two distributed abnormally quantitative variables

6 - Receiver operating characteristic curve (ROC)

It is generated by plotting sensitivity (TP) on Y axis versus 1-specificity (FP) on X axis at different cut off values. The area under the ROC curve denotes the diagnostic performance of the test. Area more than 50% gives acceptable performance and area about 100% is the best performance for the test. The ROC curve allows also a comparison of performance between two tests.

Sample size:

We use Steven K. Thompson equation to calculate the sample size

Where

n: Sample Size (53)

N: Population Size (60)

Z: Confidence level at 95 %(1.96)

d: Error Proportion (0.05)

P: Probability (50%)

Results

In the current study, Fifty four (54) patients with liver cirrhosis were enrolled in this study, Twenty seven (27) (Group I) of them suffering from classic SBP on top of cirrhosis and the other twenty seven (27) (Group II) suffering from liver cirrhosis with culture negative neutrocytic ascites.

The patient range age from (40-77), there was no statistically significant difference between the two studied groups as regard sex and age. There were 44.4% in group I were males and 55.6% were females and in group II, there were 51.9% were males and 48.1% were females. The mean age in group I was 54.20 ± 12.96 SD with range (40.0 – 77.0) and the mean age in group II was 55.67 ± 9.53 SD with range (40.0 – 77.0). As regard clinical presentation there was highly statistically significant difference between the two studied groups as regard Fever. There was no statistically significant difference between the two studied groups as regard abdominal pain, bleeding and encephalopathy. As regard child score there was no statistically significant difference between the two studied groups as regard child score. There were 55.6% in group I had child score B and 44.4% had child score C. There were 66.7% in group II had child score B and 33.3% had child score C .**Table 2**

As regard CBC there was no statistically significant difference between the two studied groups as regard HGB, WBCS and PLT. Regarding to lab results there was statistically significant difference between the two studied groups as regard urea, ALT, AST and Albumin. There was no statistically significant difference between the two studied groups as regard HCVAb, HBsAg, s.creatinine, sodium , K, total and direct bilirubin. **Table 3**

Regarding to serum procalcitonin there was a statistically significant difference between the two studied, procalcitonin was higher in group I than group II . The mean Procalcitonin in group I was 1.63 (±0.68) SD. The mean Procalcitonin in group II was 0.58 (±0.45 SD). The P value was <0.001. **Table 4**

As regard correlation to procalcitonin there was statistically significant difference with negative correlation between procalcitonin group I as regard albumin, There was statistically significant difference with positive correlation between procalcitonin group I as regard AST, ascitic fluid TLC, glucose ascitic fluid , LDH ascitic fluid and protein ascitic fluid.

There was statistically significant difference with negative correlation between procalcitonin group II as regard PLT and albumin. , There was statistically significant difference with positive correlation between procalcitonin group II as regard urea, creatinine and ascitic fluid TLC. **Table 5**

According to **figure 1** there was statistically significant difference between procalcitonin as regards discrimination group I from group II. The mean procalcitonin in group I was 1.63 and the mean procalcitonin in group II was 0.58

According to roc curve for procalcitonin in **figure 2 and table 6** using diagnostic performance for procalcitonin to discriminate group I from group II showed high significance above 0.8 with area under curve of 0.894, sensitivity 85.19, specificity 70.37, positive predictive value

74.2 and negative predictive value 82.6.

Table 2: Comparison between the two studied groups according to demographic data and Special habits and past history and clinical presentation and child score

	Group I (n = 27) (classic SBP)		**Group II (n = 27) (CNNA)**		**Test of sig.**	**p**
	No.	**%**	**No.**	**%**		
Sex						
Male	12	44.4	14	51.9	χ^2= 0.297	0.586
Female	15	55.6	13	48.1		
Age (years) Mean ± SD.	54.22 ± 12.96		55.67 ± 9.53		t= 0.467	0.643
Smoking	13	48.1	12	44.4	0.074	0.785
Jaundice	23	85.2	19	70.6	0.307	0.580
DM	14	51.9	13	48.1	0.074	0.785
Clinical presentation	**Group I (n = 27) (classic SBP)**		**Group II (n = 27) (CNNA)**		**χ^2**	**p**
	No.	**%**	**No.**	**%**		
Abdominal pain	24	88.9	23	85.2	0.164	**^{FE}p**=1.000
Bleeding	15	55.6	13	48.1	0.297	0.586
Fever	23	85.2	7	25.9	19.200*	<0.001*
Encephalopathy	5	18.5	6	22.2	0.114	0.735
Child score						
Child B	15	55.6	18	66.7	0.701	0.402
Child C	12	44.4	9	33.3		

SD: **Standard deviation**
χ^2: **Chi square test** **t: Student t-test** FE**: Fisher Exact**
p: p value for comparing between the two studied groups
*: Statistically significant at $p \leq 0.05$

Group I: Patients with liver cirrhosis with classic SBP
Group II: Patients with liver cirrhosis with culture negative neutrocytic ascites

Table 3: Comparison between the two studied groups according to CBC and Lab

CBC		Group I(Classic SBP) (n = 27)	Group II(CNNA) (n =27)	t	P
Hb (g/dl)					
Mean ± SD.		9.32 ± 1.42	9.66 ± 1.44	0.867	0.390
WBCS (10^3/cmm)					
Mean ± SD		8.22 ± 3.26	7.56 ± 3.69	0.700	0.487
PLT (10^3/cmm)					
Mean ± SD		174.4 ± 71.36	171.4 ± 79.38	0.144	0.886
Lab		Group I (n = 27)	Group II (n =27)	Test of Sig	P
HCVAb		22(81.5%)	24(88.9%)	□2=0.587	FEp=0.704
HBsAg		8(29.6%)	3(11.1%)	□2=2.854	0.091
Renal function	**Urea (mg/dl)** Mean ± SD.	88.52 ± 55.87	60.48 ± 22.26	U= 238.0*	0.028*
	Creatinine (mg/dl) Mean ± SD.	1.41 ± 0.67	1.24 ± 0.81	U= 278.0	0.133
Serum electroly	**Na (mmol\L)** Mean ± SD.	139.6 ± 16.45	137.5 ± 3.48	t= 0.664	0.512
	K (mmol\L) Mean ± SD.	3.90 ± 0.88	3.85 ± 0.35	t= 0.243	0.809
Liver function	**ALT (U/L)** Mean ± SD.	101.9 ± 52.94	70.96 ± 41.02	U= 213.0*	0.009*
	AST (U/L) Mean ± SD.	94.15 ± 57.04	66.96 ± 44.57	U= 235.50*	0.026*
	Albumin (g/dl) Mean ± SD.	2.86 ± 0.68	3.26 ± 0.63	U= 214.0*	0.009*
	Total bilirubin(mg/dl) Mean ± SD.	1.57 ± 1.05	1.75 ± 1.27	U= 351.0	0.815
	Direct bilirubin(mg/dl) Mean ± SD.	1.10 ± 1.33	1.11 ± 1.19	U= 352.50	0.835

SD: **Standard deviation** **t: Student t-test**
p: p value for comparing between the two studied groups
Group I: Patients with liver cirrhosis with classic SBP
Group II: Patients with liver cirrhosis with culture negative neutrocytic ascites

Table 4: Comparison between the two studied groups according to serum procalcitonin

Procalcitonin (ng/ml)	Group I(classic SBP) (n = 27)	Group II(CNNA) (n =27)	U	p
			77.0*	<0.001*
Mean ± SD.	1.63 ± 0.68	0.58 ± 0.45		

SD: **Standard deviation** **U: Mann Whitney test**
p: p value for comparing between the two studied groups *: Statistically significant at $p \leq 0.05$
Group I: Patients with liver cirrhosis with classic SBP
Group II: Patients with liver cirrhosis with culture negative neutrocytic ascites

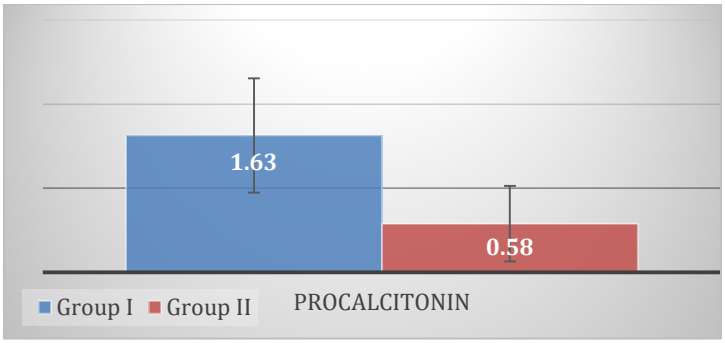

Figure 1: Comparison between studied cases according to serum procalcitonin

Table 5: Correlation between Procalcitonin and different parameters in Group I & Group II

	Procalcitonin			
	Group I(Classic SBP) (n = 27)		**Group II(CNNA) (n = 27)**	
	r_s	**p**	**r_s**	**p**
Age (years)	0.355	0.070	0.003	0.988
Child score	-0.111	0.581	-0.030	0.880
CBC				
Hb	0.153	0.445	-0.080	0.690
WBCS	0.160	0.424	-0.151	0.452
PLT	0.231	0.246	-0.640	<0.001*
Renal function				
Urea	0.074	0.715	0.516	0.006
Creatinine	-0.365	0.061	0.554	0.003*
Serum electrolytes				
Na	-0.014	0.944	0.178	0.373
K	0.136	0.500	0.227	0.256
Liver function				
ALT	0.375	0.054	0.161	0.422
AST	0.412	0.033*	0.111	0.583
Albumin	-0.391	0.044*	-0.497	0.008*
Total bilirubin	0.293	0.138	0.330	0.093
Direct bilirubin	0.150	0.455	-0.048	0.812
Ascitic fluid TLC	0.754	<0.001*	0.423	0.028*
Glucose ascitic fluid	0.344	0.079	-0.181	0.365
LDH ascitic fluid	0.626	<0.001*	0.092	0.647
Albumin ascitic fluid	0.388	0.045*	-0.301	0.128
Protein ascitic fluid	0.432	0.025*	-0.189	0.346

r: Pearson coefficient **r_s: Spearman coefficient** *: Statistically significant at $p \leq 0.05$
Group I: Patients with liver cirrhosis with classic SBP
Group II: Patients with liver cirrhosis with culture negative neutrocytic ascites

Table 6: Diagnostic performance for procalcitonin to discriminate group I from group II

	AUC	p	95% C.I	Cut off	Sensitivity	Specificity	PPV	NPV
Procalcitonin	0.894	<0.001*	0.811 – 0.978	>0.8	85.19	70.37	74.2	82.6

AUC: Area Under a Curve p value: Probability value CI: Confidence Intervals NPV: Negative predictive value PPV: Positive predictive value
*: Statistically significant at $p \leq 0.05$
Group I: Patients with liver cirrhosis with classic SBP
Group II: Patients with liver cirrhosis with culture negative neutrocytic ascites

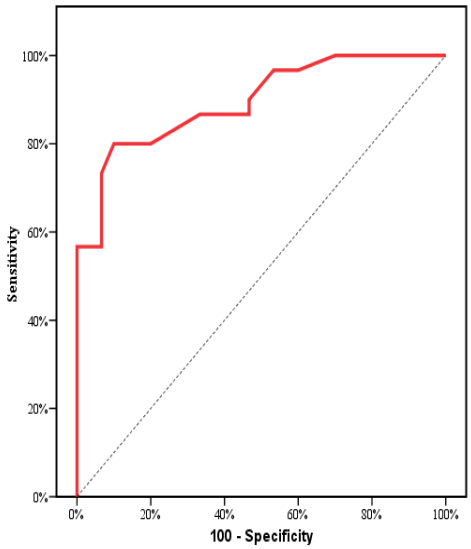

Figure (2):ROC curve for procalcitonin to discriminate group I from group II

Discussion

In the current study according to demographic data, there was no statistically significant difference between the two studied groups as regard sex and age. There were 44.4% in group I were males and 55.6% were females, and in group II 55.6% were males and 48.1% were females. The mean ± SD age in group I was 54.20 ± 12.96 years and the mean ± SD age in group II was 55.67 ± 9.53 years.

Similarly in a study done previously, **(11)** a total of 88 patients (40 SBP and 48 CNNA) with advanced liver cirrhosis had been identified with SBP. There were no significant differences in age and gender, between the two groups. (Group I SBP group II CNNA).

In the current study according to CBC, there was no statistically significant difference between the two studied groups as regard HGB, WBCS and PLT. (11).
Similarly, in a former study, there was no statistically significant difference between the two studied groups regarding CBC. Group I (18) patients with SBP, group II (19) patients with CNNA) as regard Hb, WBC and PLT (12).

In the current study according to laboratory findings, there was no

statistically significant difference between the two studied groups as regard S. creatinine, Na, K, Total bilirubin and direct bilirubin.

Reversely, some researchers revealed significant difference between the two groups as regard creatinine, they found s. creatinine in SBP compared to CNNA (1.95 ± 1.0 vs. 1.44 ± 0.85), (p = 0.003). This difference may be due to higher sample size in study, comparing to the small sample size in currant study [13]

In the current study according to Child-Pugh score, there was no statistically significant difference between the two studied groups as regard child score. There were 55.6% in group I had child score B and 44.4% had child score C. There were 66.7% in group II had child score B and 33.3% had child score C.

In contrast, a study showed that there was a difference between the two groups in regard to child score which is significantly better in CNNA group (P value = 0.01) [12]. The previous difference in the present results and the results of other study may be due to different etiology in the AL AMRI study**,** only few cases had liver cirrhosis secondary to HCV infection others secondary to HBV, hemochromatosis and alcoholic that makes the groups had different scores [12].

In the current study there was statistically significant difference between the two studied groups as regard ascitic fluid TLC, LDH ascitic fluid, protein ascitic fluid and albumin ascitic fluid. There was no statistically significant difference between the two studied groups as regard glucose ascetic fluid.

In a study by, a total of 101 patients hospitalized due to cirrhosis (n=88) or malignancy related (n=13) ascites were included in this study. Spontaneous bacterial peritonitis (SBP, 19.8%), culture-negative SBP (38.6%), bacterascites (4.9%), sterile ascites (23.8%) and malignant ascites (12.9%) groups were compared in terms of procalcitonin levels in predicting ascites infection. [14]

Also, conducted ascetic fluid analysis that revealed WBC count (cell/mm3) of 6035 ± 1738.4 in SBP, 2041 ± 450.4 in culture-negative SBP, 368 ± 43.1 in bacterascites, 243 ± 23.8 in sterile ascites while 2685 ± 417.0 in malignant ascites. Serum-ascites albumin gradient was 1.6 ± 0.1 in culture-positive SBP and culture-negative SBP, 1.7 ± 0.1 in bacterascites and sterile ascites while 1.0 ± 0.1 in malignant ascites [14].

On the other hand, our finding regarding the ascetic fluid analysis had higher levels and counts, WBC count was 3084.3 ± 2694.0 in SBP group and 1002.1 ± 702.0 in CNNA group, and albumin level was 1.75 ± 0.85 in SBP group and 1.03 ± 1.04 in CNNA group. Glucose was 165.6 ± 53.74 in SBP group and 175.63 ± 58.25 in CNNA group; protein was 3.30 ± 1.50 in SBP group and 2.34 ± 2.24 in CNNA group.

In the current study according to procalcitonin, there was highly statistically significant difference between the two studied groups as regard Procalcitonin. The mean procalcitonin in group I was 1.63 ± 0.68 SD with range (0.30 – 2.50). The mean procalcitonin in group II was 0.58 ± 0.45 SD with range (0.02 – 1.80).

In line with the current study had higher significant difference in Procalcitonin (2.81±2.59 vs. 0.43±0.48 ng/mL; P=0.0032), in SBP group than non-SBP group [15].

Also, Serum procalcitonin levels were determined to be significantly higher in patients with positive bacterial culture in ascitic fluid compared to patients without culture positivity (median (min-max): 4.1 (0.2-36.4) vs. 0.4 (0.04-15.8), p<0.001) in a study by [14].

In the current study according to Correlation between Procalcitonin and different parameters in Group I & Group II (n = 27), There was statistically significant difference with negative correlation between procalcitonin group I as regard albumin. There was statistically significant difference with positive correlation between procalcitonin groups I as regard Ascitic fluid TLC, Glucose ascitic fluid, LDH ascitic fluid and protein ascitic fluid. There was statistically significant difference with negative correlation between procalcitonin group II as regard PLT and albumin. There was statistically significant difference with positive correlation between procalcitonin group II as regard urea, creatinine and ascitic fluid TLC.

In a study it was proved that, a correlation was found between procalcitonin and different parameters in Group I & Group II, (group I SBP, group II CNNA), ascitic fluid WBC count and PCT had a significant positive correlation between PCT and ascitic fluid WBC count (rs=0.404, *P*<0.01) [11].

In the current study according to relation between procalcitonin and different parameters in group I, there was statistically significant difference between procalcitonin as regard encephalopathy in group I.

In the current study according to relation between procalcitonin and different parameters in group II, there was statistically significant difference between procalcitonin as regard encephalopathy in group II.

In a study done in 2020, a 236 patients diagnosed with liver cirrhosis, serum procalcitonin was higher (>0.05) in 151 patients, and it was significantly higher in patients with encephalopathy. [16]

In the current study, there was statistically significant difference between procalcitonin in discrimination between group I and group I it showed high significance above 0.8 with area under curve of 0.894, sensitivity 85.19, specificity 70.37, positive predictive value 74.2 and negative predictive value 82.6. .

This comes in accordance with a study in which there was highly statistically significant difference between procalcitonin as regard diagnostic performance in discriminating group I from group II. Procalcitonin were higher in classic SBP than CNNA group cut off value were 0.78, sensitivity was 77.5 specificity 60.4 and the area under curve (AUC) was 0.706 [11].

In a study performed 2020, 14 patients diagnosed with SBP, 4 (28.6%) were found to have classic SBP, 5 (35.7%) had CNNA and remaining 5 (35.7%) had

monomicrobial non-neutrocytic bacterascites. Three out of four patients with classic SBP and 4 out of 5 patients with CNNA were found to have elevated procalcitonin (cut-off 2.0 ng/mL) while all 5 patients with MNB had normal procalcitonin levels (P=0.0476). All 31 patients without SBP had procalcitonin within normal range (≤2 ng/mL) [15].

Conclusion

In conclusion, PCT level was higher in Liver cirrhosis patients with SBP than CNNA which indicated it may represent as a simple biomarker for differentiating SBP from CNNA.

References

1. **Bunchorntavakul, C., and Chavalitdhamrong, D.** Bacterial infections other than spontaneous bacterial peritonitis in cirrhosis. World journal of hepatology 2012, 4(5), 158.
2. **Fernández, J., Acevedo, J., Castro, M., Garcia, O., Rodriguez de Lope, C., Roca, D., et al.** Prevalence and risk factors of infections by multiresistant bacteria in cirrhosis: a prospective study. *Hepatology 2012*, *55*(5), 1551-1561.
3. **Angeli, P., Bernardi, M., Villanueva, C., Francoz, C., Mookerjee, R. P., Trebicka, J., et al.** EASL Clinical Practice Guidelines for the management of patients with decompensated cirrhosis. *Journal of hepatology 2018*, *69*(2), 406-460.
4. **Fernández, J., Navasa, M., Gómez, J., Colmenero, J., Vila, J., Arroyo, V., et al.** Bacterial infections in cirrhosis: epidemiological changes with invasive procedures and norfloxacin prophylaxis. *Hepatology 2002*, *35*(1), 140-148.
5. **Bellot, P., Francés, R., and Such, J.** Bacterial translocation in cirrhosis. *Gastroenterologia y Hepatologia 2008*, *31*(8), 508-514.
6. **Sheer, T. A., and Runyon, B. A.** Spontaneous bacterial peritonitis. *Digestive diseases 2005*, *23*(1), 39-46.
7. **Runyon, B.** Spontaneous bacterial peritonitis in adults: Treatment and prophylaxis. *Up to date. Up to date, Waltham, MA. Accessed 2016*, *23*.
8. **Li, C. H., Yang, R. B., Pang, J. H. S., Chang, S. S., Lin, C. C., Chen, C. H., et al.** Procalcitonin as a biomarker for bacterial infections in patients with liver cirrhosis in the emergency department. *Academic Emergency Medicine 2012*, *18*(2), 121-126.
9. **Qu, J., Feng, P., Luo, Y., and Lü, X.** Impact of hepatic function on serum procalcitonin for the diagnosis of bacterial infections in patients with chronic liver disease: A retrospective analysis of 324 cases. *Medicine 2016*, *95*(30).
10. **Pugh RN, Murray-Lyon IM, Dawson JL, et al (2007).** Transection of the oesophagus for bleeding oesophageal varices. Br J Surg 1973; 60:646–649.
11. **Wu, H., Chen, L., Sun, Y., Meng, C., and Hou, W.** The role of serum procalcitonin and C-reactive protein levels in predicting spontaneous bacterial peritonitis in patients with advanced liver cirrhosis. *Pakistan Journal of Medical Sciences 2016*, *32*(6), 1484.
12. **AL AMRI, S. M., ALLAM, A. R., and AL MOFLEH, I. A.** Spontaneous bacterial peritonitis and culture negative neutrocytic ascites in patients with non-alcoholic liver cirrhosis. *Journal of gastroenterology and hepatology 1994*, *9*(5), 433-436.
13. **Kamani, L., Mumtaz, K., Ahmed, U. S., Ali, A. W., and Jafri, W.** Outcomes in culture positive and culture negative ascitic fluid infection in patients with viral cirrhosis: cohort study. *BMC gastroenterology 2008*, *8*, 1-6.
14. **Cekin, Y., Cekin, A. H., Duman, A., Yilmaz, U., Yesil, B., and Yolcular, B. O.** The role of serum procalcitonin levels in predicting ascitic fluid infection in hospitalized cirrhotic and non-cirrhotic patients. *International Journal of Medical Sciences 2013*, *10*(10), 1367.
15. **Verma, R., Satapathy, S. K., and Bilal, M.** Procalcitonin and C-reactive protein in the diagnosis of spontaneous bacterial peritonitis. *Translational Gastroenterology*

and Hepatology 2022, *7*.

16. **Sato, S., Sato, S., Tsuzura, H., Ikeda, Y., Hayashida, S., Takahashi, S., et al.** Elevated serum procalcitonin levels and their association with the prognosis of patients with liver cirrhosis. *European Journal of Gastroenterology & Hepatology 2020*, *32*(9), 1222-1228.

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