Microbiological profile of spontaneous bacterial peritonitis in a Southern Brazilian City

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Abstract

Introduction: Spontaneous bacterial peritonitis (SBP), one of the most frequent infectious complications experienced by patients with decompensated cirrhosis and ascites, has a high mortality rate.

Objective: Our objective was to identify the main agents causing SBP at a University Hospital between 2008 and 2011.

Methods: A cross-sectional study of positive results from ascitic fluid cultures was carried out. Clinical and laboratory variables were extracted from the medical records.

Results: 47 patients with positive ascitic fluid cultures were included. Average age was 55.7 years ± 15.5 years, 70.2% were men, and 53.6% of patients presented cirrhosis. All cirrhotic patients presented GASA ≥ 1.1 and mean neutrophil count in the ascitic fluid of 3,260.8 ± 5,122.9 cells. The most frequent germs found were *Escherichia coli* (25.5%), *Klebsiella* (14.9%), *Enterococcus* (8.5%) and *Streptococcus* (8.5%). No significant differences were observed between cirrhotic and non-cirrhotic patients regarding the prevalence of *E.coli* (19.2% *vs.* 33.3%; P=0.270), *Klebsiella* (19.2% *vs.* 9.5%; P=0,436), *Enterococcus* (7.7% *vs.* 9.5%; P=1.000) or *Streptococcus* (15.4% *vs.* 0.0%; P=0.117). The presence of infection by two or more germs was more common among individuals without cirrhosis (11.5% *vs.* 38.1%; P=0.047).

Conclusion: The microbiological profile of ascitic fluid cultures showed a prevalence of gram-negative bacteria similar to other studies related to spontaneous bacterial peritonitis.

Keywords

Hepatic cirrhosis, peritonitis, ascitic fluid.

INTRODUCTION

Spontaneous Bacterial Peritonitis (SBP) is a frequently occurring infectious complication in patients with decompensated cirrhosis and ascites (1). This disease is characterized by an infection of the ascitic fluid and an intra-abdominal inflammatory focus similar to acute pancreatitis and cholecystitis, but without evidence of a visceral perforation (2-4). SBP normally occurs in the final stage of liver diseases and has a high rate of recurrence, about 70% in one year (5-7). In addition to decompensated cirrhosis there are other factors that predispose for SBP including jaundice, malnutrition, and upper gastrointestinal bleeding (8). Some studies also suggest high in-hospital mortality rates for patients with cirrhosis and ascites (20% to 40%) (9, 10). However, this rate has decreased in the last four decades because of early diagnosis and immediate use of proper antibiotherapy (11).

The criteria for the diagnosis of SBP require paracentesis to collect ascitic fluid for analysis. The bacterial culture test positive and/or the fluid must have a neutrophil count that exceeds 250 cells/mm^3 (12). Clinical manifestations are nonspecific. The most frequent signs and symptoms include fever, abdominal pain, hepatic encephalopathy, pain or abrupt abdominal decompression, diarrhea, paralytic ileum and hypothermia. Normally, SBP is suspected when

the patient begins to show signs of hepatic encephalopathy or a drastic decrease in renal functioning without any precipitating factor. Approximately 10% of patients with SBP have no signs or symptoms (13-16).

The translocation of bacteria through the intestinal cavity to mesenteric lymph nodes should be the main mechanism for developing bacteremia which precedes SBP manifestations. In individuals with cirrhosis, there are three mechanisms involved in this infection's pathogenesis: deficient local immune response (decline of phagocytic activity by hepatic macrophages), bacterial overgrowth in the intestinal lumen, and functional and structural alterations in the intestinal mucosal barrier (14, 17). Most of the microorganisms responsible for SBP derive from the intestinal flora and are mainly aerobic gram-negative bacteria. *Escherichia coli* and *Klebsiella pneumoniae* are the most frequently isolated agents (18-20). In approximately 25% of the cases, gram-positive bacteria such as Streptococcus and Enterococcus are found. *Streptococcus pneumoniae* is the most common (21, 22). On the other hand, anaerobic bacteria are never the cause of SBP because of their inability to move on the intestinal mucosa and because of the high levels of oxygen on the gut wall (23).

Based on the above considerations, this study's goals were to identify the microorganisms found in ascitic fluid cultures and to describe the clinical characteristics related to the presence of infections in the ascitic fluid of patients with cirrhosis.

METHODS

Casuistic

A cross-sectional study of positive results from tests for SBP of ascitic fluid cultures in the microbiology laboratory of the Polydoro Ernani de São Thiago University Hospital at the Federal University of Santa Catarina (UFSC) was conducted from January 2008 to December 2011. Patients with data missing from their medical charts were excluded, and only the first culture of those that presented more than one positive result was included.

This study's protocol is in compliance with the ethical rules of the Helsinki Declaration and was approved by the UFSC Committee on the Ethics of Research on Human Beings (certificate N. 948).

Methods

Information on all individuals submitted to paracentesis, and had positive results on the ascitic fluid culture, was reviewed. Clinical, demographic, and laboratorial variables were gathered from medical reports. The following variables were examined: age (years), gender, length of stay (days), isolated germs on cultures, positive serologies for HBsAg, anti-HCV, and anti-HIV, creatinine, hemoglobin, platelet count, aspartate aminotransferase (AST), alanine aminotransferase (ALT), alkaline phosphatase (AP), gamma glutamyltransferase (GGT), serum albumin, bilirubin, international normalization ratio (INR) and prothrombin activity (PA). The AST, ALT, FA and GGT hepatic biochemical tests were expressed on times the upper limit of normal (xULN). The other variables were expressed in absolute values. Bilirubin, INR, and creatinine were used to find the MELD (*Model for End-stage Liver Disease*) (24) on individuals with cirrhosis. Only laboratory tests performed within six months after the development of the culture were included in this study. These cultures were collected and plated at the bedside in vials of blood cultures (BacT/ALERT®, bioMérieux) or collected in dry tubes and plated at the laboratory on Blood Agar, MacConkey Agar and Thioglycollate Broth.

Static Analysis

Continuous variables were described with measures of central tendency and dispersion, while the categorical variables were described in absolute numbers and proportions. Continuous variables were compared using Student's *t*-test or Mann-Whitney as appropriate, and the categorical variables were assessed using chi-squared test or Fisher exact test, as appropriate. The p values smaller than 0.05 were considered statically significant. All tests were two-tailed and carried out using the *Statistical Package for Social Science* software, version 17.0 (SPSS, Chicago, IL, USA).

RESULTS

Case-by-case examination

From January 2008 to December 2011, 660 ascitic fluid cultures were assessed. Among these 53 (8.03%) were positive for SBP and were evaluated for inclusion in the study. Four cultures were excluded because the medical records were insufficient and two were excluded because of repeated reactive results (Figure 1).

A total of 47 patients with positive ascitic fluid cultures were included. Their mean age was 55.7 years (standard deviation ± 15.5 years). 70.2% were male and 26 patients (55.3%) had cirrhosis.

The most commonly found pathologies among the non-cirrhotic patients were acute appendicitis, dialytic chronic renal failure, and acute cholecystitis.

Among individuals with cirrhosis, the mean MELD score was 16.3 ± 9.3 and the mean SAAG score was 1.6 ±

0.7: all had SAAG ≥ 1.1. Regarding the albumin and the neutrophil count in this group's ascitic fluid, the mean, standard deviation, and median were 0.3 ± 0.2 (0.3) g/dL and 3260.8 ± 5122.9 (892) cells, respectively. No differences were observed when comparing the median of ascitic fluid neutrophils of cirrhotic patients to infections by one or more germs (892.0 *vs.* 322.5; P= 0.407).

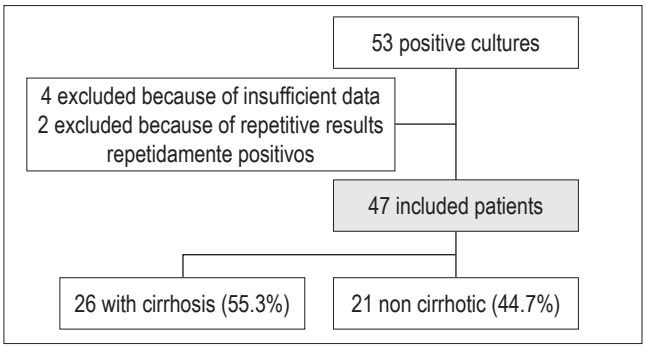

Figure 1. Distribution of patients assessed for this study.

Assessment of patients included according to the diagnosis of cirrhosis

When comparing hepatic cirrhotic patients with others (Table 1), we noted a larger proportion of males (84.6% *vs.* 52.4%; P = 0.016); larger AST medians (2.0 *vs.* 1.0 xULN; P = 0.021), higher levels of bilirubin (2.7 *vs.* 0.7 g/dL; P = 0.008) and smaller platelet medians (1,095,000 *vs.* 2,470,000 /mm^3; P = 0.001). No differences were found in terms of age, length of hospital stay, infection by one or more germs, or for positive results for HBsAg, anti-HCV and anti-HIV. Regarding laboratory variables, no differences were found for creatinine, hemoglobin, platelets, ALT, AP, GGT, albumin and PA values.

Assessment of culture results according to the presence of cirrhosis

Escherichia coli (25.5%) were the most frequently found germs, followed by *Klebsiella* (14.9%), *Enterococcus* (8.5%) and *Streptococcus* (8.5%). The detailed microbial profile is described in table 2. When comparing the frequency of these germs in the ascitic fluid cultures of cirrhotic patients to other germs (Figure 2), it was impossible to note great differences in the prevalence of *E.coli* (19.2% *vs.* 33.3%; P = 0.270), *Klebsiella* (19.2% *vs.* 9.5%; P = 0.436), *Enterococcus* (7.7% *vs.* 9.5%; P = 1.000) and *Streptococcus* (15.4% *vs.* 0.0%; P = 0.117). Infection by two or more germs was most commonly found among individuals without cirrhosis (P = 0.047).

Table 1. Distribution of clinical and laboratorial variables in relation to the presence of cirrhosis for 47 individuals with positive ascitic fluid cultures.

Characteristics	Total n = 47	Cirrhosis n = 26	Non Cirrhosis n = 21	P
Age (years) [§]	55,7 ± 15,5	56,6 ± 11,6	54,3 ± 16,8	0,380[t]
Males (%)	70,2	84,6	52,4	0,016[q]
Hospital Stay (d) [#]	15,0	15,0	15,0	0,323[m]
Hospital Stay ≥ 48 h (%)	89,4	84,6	95,2	0,362[f]
Two or more germs (%)	25,5	15,4	38,1	0,076[q]
HbsAg-positive (%)	50,0	52,4	52,9	1,000[f]
anti-HCV-positive (%)	46,7	56,5	14,3	0,086[f]
anti-HIV-positive (%)	9,1	0,0	9,1	0,091[f]
Creatinine (mg/dL) [#]	1,3	1,3	2,0	0,433[m]
Hemoglobin (g/dL) [#]	10,2	10,5	9,5	0,864[m]
Platelets (/mm^3)[#]	147.000.0	109.500.0	247.000.0	0,001[m]
AST (xULN)[#]	1,8	2,0	1,0	0,021[m]
ALT (xULN)[#]	0,8	0,9	0,7	0,390[m]
AP (xULN)[#]	1,1	1,2	1,3	0,805[m]
GGT (xULN)[#]	1,6	1,0	2,4	0,121[m]
Serum albumin (g/dL) [§]	2,0 ± 0,7	2,1 ± 0,6	2,1 ± 0,8	0,900[t]
Bilirubin (mg/dL) [#]	2,3	2,7	0,7	0,008[m]
PA (%)[§]	46,2 ± 18,3	42,7 ± 16,4	50,9 ± 20,7	0,107[t]

AST = aspartate aminotransferase, ALT = alanine aminotransferase, AP = alkaline phosphatase, GGT = gamma glutamil transferase, xULN = times upper limit of normal, PA = prothrombin activity, AF = ascitic fluid, HBsAg = Hepatitis B surface antigen, Anti-HCV = Antibodies to hepatitis C virus, Anti-HIV = Antibodies to human immunodeficiency virus, [§] = Mean; ± standard deviation, [#] = median, [t] = Student's *t* Test, [m] = Mann-Whitney, [q] = Chi-square test , [f] Fisher's exact test.

DISCUSSION

The mean age of the individuals suffering from cirrhosis with SBP ranges between 54.3 ± 10 years and 58.3 ± 13.1 years (25-27) which is quite similar to what was found in this study. Nonetheless, lower mean ages ranging between 48.3 ± 1.8 and 49 years-old have been reported by other authors (28, 29). Higher prevalences of males have been reported by several authors. It can vary from 52.3 to 78.2% (25, 29) and has been emphasized in up to 100% of the cases (29).

Due to the reduction of endotoxins and bacteria, liver insufficiency results in greater susceptibility to infections.

It can even cause immunosuppression in some patients. Although Shaw *et al.* have described that SBP is linked to HIV (*Human Immunodeficiency Virus*) infection in cirrhotic patients (30), in this study none of the patients with cirrhosis and SBP were infected with HIV. Accordingly, it was observed that 9% of the non-cirrhotic patients were HIV positive, possibly because the immunosuppression derived from HIV is a risk factor for infection, regardless of the presence of cirrhosis.

Table 2. Microbial profile of 47 individuals with positive ascitic fluid cultures at the University Hospital Polydoro Ernani de São Thiago from January 2008 to December 2011 (P=0.326).

Germ	Total n = 47		Cirrhosis n = 26		Non Cirrhosis n = 21	
	n	%	n	%	n	%
Escherichia coli	12	25,5	5	19,2	7	33,3
Klebsiella pneumoniae	7	14,9	5	19,2	2	9,5
Enterococcus	4	8,5	2	7,7	2	9,5
Streptococcus	4	8,5	4	15,4	0	0,0
Staphylococcus aureus	5	10,6	4	15,4	1	4,8
Acinetobacter baumanii	2	4,3	1	3,8	1	4,8
Enterobacter cloacae	1	2,1	1	3,8	0	0,0
Serratia marcescens	1	2,1	1	3,8	0	0,0
E. coli + Enterococcus	2	4,3	0	0,0	2	9,5
E. coli + Klebisiella	1	2,1	0	0,0	1	4,8
E. coli + Acinetobacter baumanii	1	2,1	1	3,8	0	0,0
Enterobacter Clocae + Candida albicans	1	2,1	0,0	0,0	1	4,8
Enterobacter Cloacae + Pseudomonas	1	2,1	1	3,8	0	0,0
Enterococcus faecalis + Pantora spp,	1	2,1	0	0,0	1	4,8
Enterococcus + Staphylococcus	1	2,1	1	3,8	0	0,0
Klebsiella + Enterococcus	1	2,1	0	0,0	1	4,8
Klebsiella + Pseudomonas	1	2,1	0	0,0	1	4,8
E. coli + Kleibisiella + Enterococcus	1	2,1	0	0,0	1	4,8

This study shows that patients with cirrhosis and SBP presented liver dysfunction accompanied by low platelet counts, low concentrations of serum albumin, low Pas, high MELD scores, and low albumin concentrations in the ascitic fluid. All of these variables are associated with poor prognoses for patients with cirrhosis (31, 32). It is clear that SBP generally occurs in patients with advanced cirrhosis. The higher the patient's MELD score the greater the risk for developing ascitic fluid infections (33). The mean MELD in this study was 16.3 ± 9.3 for cirrhotic patients which is similar to that of 16.5 ± 5.1 found by Shi *et al* (27) buy less than the 23.8 ± 8.4 found by Desai *et al* (26). In this study, low platelet counts were evident. The mean was 129,650.0 ± 97,739.0/mm^3 for cirrhotic patients which is higher than those found in other studies in which mean platelet counts ranged from 77,960.0 ± 48,370.0 to 109,000.0 ± 73,000.0/mm^3 (27, 34). In this research, the average prothrombin activity in patients with cirrhosis was 42.7 ± 16.4 % which is lower than that of 55.4 ± 14.2 % described by Shi *et al* (27). Mean serum albumin for patients with cirrhosis ranges from 2.0 ± 0.4 to 2.8 ± 0.3 g/dL (28, 34-36) which is similar to that found in our study. Solá *et al.* acknowledged the tendency of a higher incidence of SBP in individuals with low protein concentrations in the ascitic fluid (37). The mean of 1.0 ± 0,5 g/dL of proteins in the ascitic fluid that we found in this study is similar to that of 1.2± 1.0 g/dL found by Kim *et al* (35) The amount of albumin in the ascitic fluid ranges between 0.6 ± 0.3 g/dL and 1.0 ± 1.0 g/dL (35, 25). The mean number of neutrophils in the ascitic fluid among patients with cirrhosis and SBP is compatible with the one described in the literature, with values that vary from 529 to 4,900 cells/mm^3 (25, 28, 34, 38).

When using conventional techniques of microbiological diagnosis for SBP, the ascitic fluid culture tests negative in more than 60% of the cases. This is true even in the presence of suggestive clinical manifestations such as fever, abdominal pain, unexplained encephalopathy, acidosis, azotemia, hypotension or hypothermia. This occurs due to deficient culturing techniques. Inoculation of with at least 10mL of ascitic fluid in vials of blood culture at bedside makes it possible to increase chances of obtaining a positive culture test up to 90%. Transporting fluid to the laboratory using nonspecific containers such as syringes or tubes is also a factor that can decrease the sensitivity of the test. In our milieu, we still frequently collect ascitic fluid in a dry tube which might explain in part why only 8% of the ascitic fluid samples test positive for SBP (although the cellularity of the ascitic fluid of these individuals is not known since this fact that was not assessed in this study) (39-41).

In the United States, Desai *et al* (26) examined 55 patients with SBP and found that 40% of cultures tested positive for SBP with 20% testing positive for gram-negative bacteria and 5.5% testing positive for more than one microorganism. Singh *et al* (29) assessed 61 individuals with SBP and found that 42 positive cultures tested positive for SBP with 48% testing positive for gram-positive bacteria, and 40% for gram-negative bacteria. *Candida* species were found in 12% of the cases. With regard to the bacteria found, *Escherichia coli* was detected in 21.4% of the cultures, *Enterococcus faecalis* in 16.7%, *Streptococcus viridans* in 14.3%, *Staphylococcus aureus* in 11.9%, *Klebsiella*

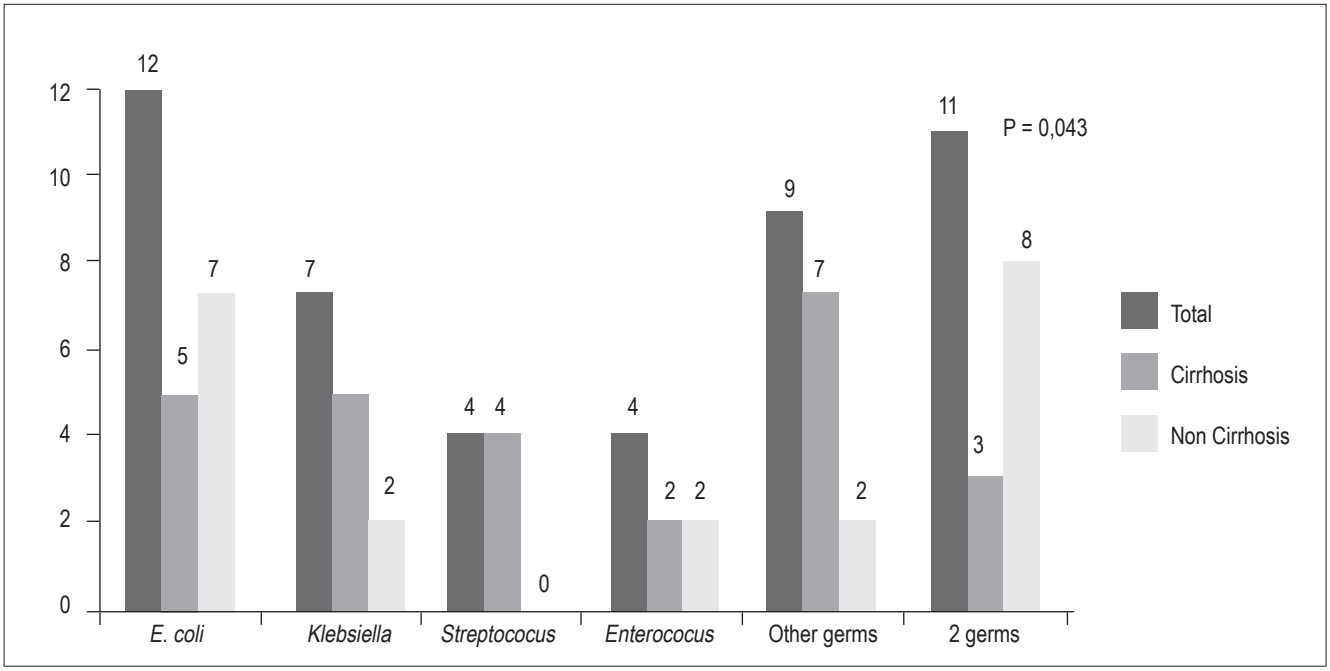

Figure 2. Distribution of germs that caused ascitic fluid infections in 47 individuals according to the occurrence of cirrhosis.

pneumoniae in 7.1%, and *Pseudomonas aeruginosa* in 4.7%. In addition, one positive case of each of the following germs was found: *Streptococcus pneumoniae, Rhodococcus spp., Klebsiella oxytoca, Enterobacter cloacae* and *Critrobacter freundii.*

In Mexico, Bobadilla *et al* (42) evaluated 31 cases of SBP and found 14 positive cultures and that *Escherichia coli* was the most common germ (71.4%) followed by *Klebsiella pneumoniae* (14.2%), *Pseudomonas aeruginosa* (7.1%), *Streptococcus faecalis* (7.1%) and *Serratia marcescens* (7.1%). In 13 cases in Barcelona, Solá *et al* (37) noticed 46.2% with *Escherichia coli*, 23.1% with *Pneumococcus*, 15.4% with *Klebsiella pneumoniae*, 7.7% with *Streptococcus viridans* and 7.7% with *Staphylococcus aureus.*

A Pakistani study of 44 individuals with SBP by Kamani *et al* (34) found that 14.9% had blood cultures that were positive for SBP and 23.5% had positive ascitic fluid cultures of which 72.7% were gram-negative. *Escherichia coli* was the most commonly found microorganism (61.3%), followed by *Streptococcus pneumoniae* (11.3%), *Pseudomonas species* (9.0%), *Staphylococcus species* (6.8%), *Enterococcus species* (6.8%), *Bacillus species* (2.2%) and Group D *Streptococcus* (2.2%).

In Egypt, Abd Elaal *et al* (36) evaluated 36 patients with SBP. Among these patients 12 patients had ascitic fluid cultures that were positive for SBP. The most commonly found germs in the study were *Escherichia coli* (75.0%), *Streptococcus faecalis* (16.6%), and *Klebsiella pneumoniae* (8.3%).

A study conducted in the city of Seoul, Korea by Kim *et al* (35) evaluated 130 patients diagnosed with SBP. Thirty seven (28.5%) had ascitic fluid cultures that tested positive for SBP. The majority of the samples collected were enteric gram-negative *Escherichia Coli* (62.1%). Other germs were also found, including *Aeromonas* (13.5%), *Streptococcus* (10.8%), *Klebsiella pneumoniae* (8.1%), and *Pseudomonas* in 5.4% in the positive samples. In another Korean study, Song *et al* (43) compared the infections in patients' ascitic fluid acquired in the community with those acquired in the hospital. From October 1998 to August 2003, a total of 106 patients whose ascitic fluid cultures had tested positive were studied. They discovered that 32 cases of SBP were caused in-hospital, and 74 were acquired in the community. Gram-negative bacilli, such as *Escherichia coli,* predominated in both the community and in-hospital group. In 58.5% of the total samples, *Escherichia coli* were detected as the agent causing the SBP. *Klebsiella Pneumoniae* was the cause in 11.3% of the cases. Germs, such as *Streptococcus pneumoniae* (7.5%), others species of *Streptococcus* (7.5%), *Enterococco* (5.6%), *Pseudomonas aeruginosa* (1.9%), *Acinetobacter baumanii* (5.6%) and *Aeromonas hydrophila* (1.9%) were also isolated.

In a study conducted from June 1987 to April 1991 in the Dutch city of Rotterdam, Siersema *et al* (38) compared the two methods most often used for culturing ascitic fluid: vials of blood culture and the conventional culturing method. In this period, 31 suspect cases of SBP were diagnosed in 28 patients. Employing the conventional culturing

method, the samples of ascitic fluid showed positive results for 11 of the 31 cases of SBP (35%) as against 26 positive results from the 31 cases (84%) by using the vials for blood cultures. Every sample in which there was no bacterial growth using the conventional method also had no bacterial growth when the blood culture method was used. From 26 positive cultures, gram-negative bacilli were detected in 17 cases (65%) and the gram-positive cocci were detected in 9 cases (35%). The same study isolated *Escherichia coli* in 38.5% of cultures, *Klebsiella Pneumoniae* in 7.7%, *Pseudomonas aeruginosa* in 7.7%, *Enterobacter cloacae* in 3.8%, *Acinetobacter sp*. in 3.8%, unspecified *Gram-negative* bacteria in 3.8%, *Streptococcus Alpha-hemolytic sp.* in 7.7%, *Enterococcus faecalis* in 7.7%, *Streptococcus pneumonia* in 11.5%, *Staphylococcus aureus* in 3.8% and *Staphylococcus epidermidis* in 3.8% of the cases.

In France, Dupeyron *et al* (44) assessed a total of 240 cases of SBP over a 20 year period of time from April 1977 to April 1997. The study analyzed changes in the microbiological profile of the agents that cause SBP. At the end of the study, the majority of the ascitic fluid infections were caused by enterobacteria, with no significant change in the percentage between that in the initial period and that at the end of the study. The prevalence of *Escherichia Coli* was noted in 43.3% of the cases. Other bacteria found included *Klebsiella pneumoniae* (10%), Groupe D *Estreptococcus* (7.6%), *Enterococcus faecalis* (6.7%), *Serratia marcescens* (4.6%), *Staphylococcus aureus* (4.6%), *Enterobacter cloacae* (2.5%), *Streptococcus pneumoniae* (3.3%), *Streptococcus* (2.6%), *Streptococcus pneumoniae* (3.3%), among other agents. We also found in smaller quantity germs such as: *Morganella morganii* (0.8%), *Citrobacter freundii* (0.8%), *Providencia stuarttii* (0.4%), *Pseudomonas aeroginosa* (1.3%), *Streptococcus pyogenes*(0.8%) *Streptococcus agalatiae* (0.8%), *Enterococcus avium* (0.4%), *Enterococcus faecium* (0.4%), *Staphyloccocus coagulase negativo* (2.9%), *Listeria monocytogenes* (0.8%), *Bacterioides* (2.1%), *Clostridium* (1.7%), *Candida albicans* (0.4%), *Candida glabrata* (0.4%), *Fusobacterium* (0.4%), and *Aerococcus viridans* (0.4%).

A study conducted in São Paulo by Reginato *et al* (25) looked at 219 patients who had been diagnosed with SBP. Among them were 123 individuals who had had their ascitic fluids cultured. Sixty-three of them (33.8%) had positive culture results. The microbiological profile enumerated 31.7% *Escherichia coli*, 7.9% *Streptococcus pneumoniae*, 7.9% *Staphylococcus aureus* and 7.9% *Klebsiella pneumoniae*. In the state of Rio Grande do Sul Almeida *et al* (45) retrospectively evaluated cirrhotic individuals with SBP whose cultures ascitic fluids tested positive for SBP during two distinct periods: 1997-1998 and 2002-2003. In the first period (1997-1998) 33 cases were included. Three of them (9 %) had polymicrobial infections. The most frequent bacteria were *Escherichia coli* (13 patients, 36.1%), Coagulase negative Staphylococci in (6 patients, 16.7%), *Klebsiella pneumoniae* (5 patients, 13.9%), *Staphylococcus aureus* (4 patients, 11.1%) and *Streptococcus faecalis* (3 patients, 8.3%). From 2002 to 2003, there were 43 cases, and two (5.0 %) of them had polymicrobial infections. The most frequent bacteria were Coagulase negative Staphylococci in 16 patients (35.6%), *Staphylococcus aureus* in 8 (17.8%), *Escherichia coli* in 7 (15.6%) and *Klebsiella pneumoniae* in 3 patients (6.7%). There was a modification in the bacterial population that caused spontaneous bacterial peritonitis in the two periods analyzed. There was a predominance of gram-negative bacteria in the first period and a predominance of gram-positive bacteria in the second period.

In addition to suggesting contamination, the ascitic fluid cultures that were positive for more than one germ may suggest peritonitis secondary to intestinal perforation. For diagnostic elucidation of these cases, evaluations with imaging tests are indicated. In this study, three cirrhotic individuals presented SBP as the result of infections with two germs, but secondary peritonitis was not confirmed in either case (46).

The samples of individuals with cirrhosis and spontaneous bacterial peritonitis observed in this study exhibit characteristics similar to those described in the literature. This is true not only in relation to clinical characteristics, but also to hepatic functions and microbial profiles of the ascitic fluid. There was a high prevalence of enterobacteria which reflects the overall characteristics.

Conflicts of interest

None.

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