

## Evaluation of ascitic fluid polymorphonuclear count & ascitic fluid pH in early diagnosis of spontaneous bacterial peritonitis

R.R. Rai, S.K. Acharya, V. Kambam, B.M. Gandhi & B.N. Tandon

*Department of Gastroenterology & Human Nutrition, All India Institute of Medical Sciences, New Delhi*

Accepted February 19, 1988

**Role of ascitic fluid culture, arterial-ascitic fluid pH gradient (A-AF pH), ascitic fluid polymorphonuclear count (AF-PMN) and ascitic fluid pH were evaluated for the early diagnosis of spontaneous bacterial peritonitis (SBP). Of 92 patients with ascites due to liver disease, 7 had SBP with AF-PMN count of 250/cmm or more and positive ascitic fluid culture. Five patients with clinical features suggestive of SBP and AF-PMN count of 250/cmm or more did not reveal any organism on ascitic fluid culture and were termed as patients of probable SBP (PSBP). Specificity, sensitivity and diagnostic accuracy of AF-PMN of 250/cmm or more and A-AF pH gradient of 0.1 or more were found to be between 98 to 100 per cent, while that of ascitic fluid pH was 65 to 86 per cent.**

Early detection and prompt institution of therapy in patients of ascites with spontaneous bacterial peritonitis (SBP) is universally recommended<sup>1-3</sup>. Culture of ascitic fluid, the confirmatory test for ascitic fluid infection, is time consuming and may not grow any organism in a proportion of patients in spite of the infection<sup>4</sup>. Various other ascitic fluid parameters<sup>1,2</sup> like ascitic fluid polymorphonuclear count (AF-PMN), ascitic fluid pH (AF-pH) and ascitic fluid lactate<sup>5</sup> have been recently evaluated in the diagnosis of SBP with promising results.

The present study was undertaken to determine the prevalence of SBP in northern Indian subjects and to evaluate the role of

AF-PMN and AF-pH in the early diagnosis of SBP.

### Material & Methods

Ninety two patients of ascites due to liver diseases registered in the Gastroenterology service of the All India Institute of Medical Sciences, New Delhi, between February 1985 and June 1986, were included in the study. Etiology of ascites was established by appropriate investigations which included, liver function profile, HBsAg status, upper gastrointestinal endoscopy for esophageal varices, liver biopsy, laparoscopy and examination of ascitic fluid. Sixty nine patients

had cirrhosis of liver (16 alcoholic, 43 post-hepatic and 10 cryptogenic), 17 had non-cirrhotic portal fibrosis (NCPF) and the remaining 6 had subacute hepatic failure.

A detailed clinical assessment of the patients was undertaken. Particularly, the signs and symptoms suggestive of SBP *i.e.*, fever, chills, abdominal pain, rebound tenderness, diminished bowel sounds or evidence of encephalopathy were recorded.

A total of 102 paracentesis were performed in the 92 patients, which included repeat paracentesis in 10 patients after therapy for ascitic fluid infection. None of the patients had received antibiotics at least 7 days prior to the paracentesis.

The ascitic fluid was aseptically aspirated and immediately transferred to aerobic and anaerobic culture (CO<sub>2</sub> containing) vials. Five ml of the fluid was aspirated into a non-heparinised syringe anaerobically, immediately capped and put on ice for the measurement of pH. The fluid was centrifuged and Gram's staining of the sediment was performed. The remaining fluid was used for polymorphonuclear (PMN) cell count, total protein estimation and cytopathological examination for malignant cells.

Immediately after paracentesis, 2 ml of arterial blood was drawn into a heparinised plastic syringe, capped and put on ice for arterial blood pH. The ascitic fluid pH (AF-pH) and arterial blood pH (A-pH) were estimated within 15 min of collection of the sample, by using the ABL-3, acid-base laboratory radiometer (Copenhagen, Denmark). The arterial-ascitic fluid pH (A-AF pH) gradient was estimated.

A course of antibiotics was started in patients diagnosed to have SBP.

Statistical analysis was performed by Student's 't' test and unpaired 't' test. Sensitivity, specificity and diagnostic accuracy were calculated. Results were expressed as mean  $\pm$  SD.

## Results

Of the 92 patients studied, there were 83 males and 9 females. The age varied from 14 to 68 yr (mean 43 yr). The patients were divided into 3 groups based on the results of ascitic fluid examination.

*Group I* : Confirmed spontaneous bacterial peritonitis (SBP, n=7), having clinical signs suggestive of SBP, PMN cell count more than 250 cells/cmm and ascitic fluid culture positive for bacterial growth.

*Group II* : Probable SBP (PSBP, n=5), having clinical features suggestive of SBP, PMN count more than 250 cells/cmm but ascitic fluid culture negative for bacteria.

*Group III* : No SBP or sterile ascites (SA, n=80) without any clinical features of SBP, PMN cell count less than 250 cells/cmm and sterile ascitic fluid culture.

Mean age of the patients of groups I and II was 41.2 yr (range 18 to 60 yr). Out of these 12 patients, 3 had NCPF, one had subacute hepatic failure and the remaining 8 patients had cirrhosis of liver including 2 patients having alcoholic cirrhosis.

*Ascitic fluid pH measurement* : Mean ascitic fluid pH (AF-pH) in patients of groups I and II was significantly lower ( $P < 0.001$ ) than the mean arterial pH (Table I). The arterial ascitic fluid pH gradient of 0.1 or more was detected in all the patients of groups I and II (Fig.). In contrast only one patient

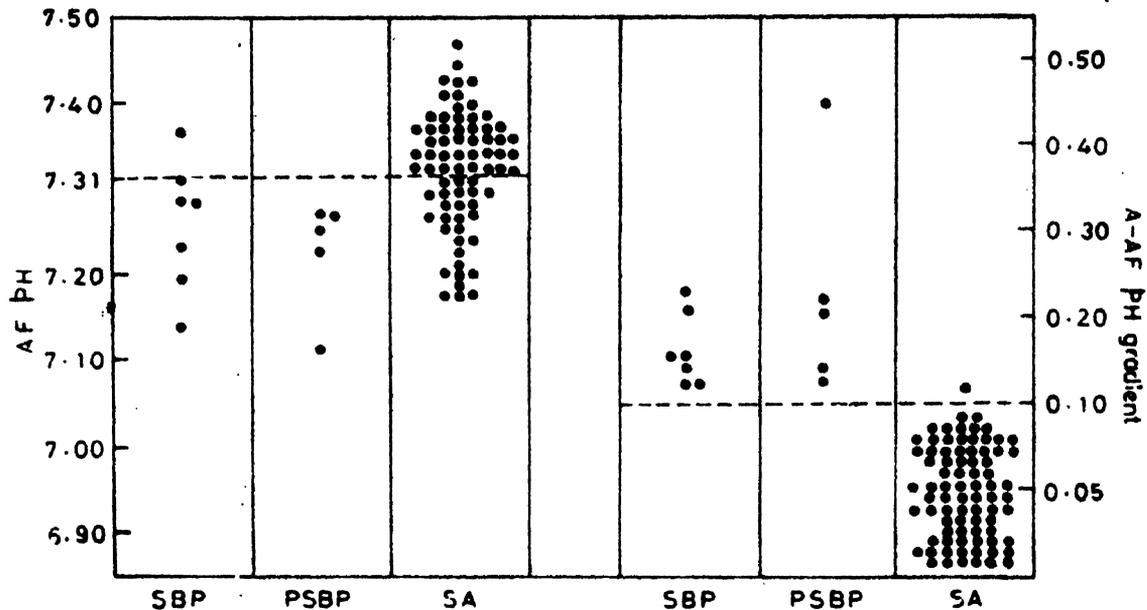


Fig. Ascitic fluid pH and arterial ascitic fluid pH gradient in patients of ascitis.

Table I. Comparison of ascitic fluid parameters between SBP, PSBP and sterile groups  
(Data are mean  $\pm$  SD)

	SBP (n=7)	Sterile (n=80)	PSBP (n=5)
AF-PMN	597 $\pm$ 337*	23 $\pm$ 18	618 $\pm$ 191*
A-pH	7.406 $\pm$ 0.041**	7.361 $\pm$ 0.059	7.435 $\pm$ 0.062††
AF-pH	7.261 $\pm$ 0.076*†	7.320 $\pm$ 0.061	7.211 $\pm$ 0.124*†
A-AF pH gradient	0.145 $\pm$ 0.045*	0.062 $\pm$ 0.024	0.221 $\pm$ 0.138*

\* $P < 0.001$ , when compared with sterile group; †† $P < 0.05$ , when compared with sterile group; \*\*NS, when compared with sterile group; † $P < 0.001$ , when compared with A-pH in the same group. The differences between the SBP and PSBP groups were not significant. AF-PMN, ascitic fluid polymorphonuclear count; A-pH, arterial pH; AF-pH; ascitic fluid pH; A-AF pH gradient, arterial-ascitic fluid pH gradient; SBP, spontaneous bacterial peritonitis; PSBP, probable SBP

of group III had A-AF pH gradient and AF-pH similar to that of A-pH (Fig.).

**Ascitic fluid PMN (AF-PMN) cell count :**  
The mean AF-PMN count in group I (597  $\pm$  337, range 280 to 1080 cells/cmm) and group II patients (618  $\pm$  191, range 450 to

900 cells/cmm) were significantly higher ( $P < 0.001$ ) than that of group III patients (23  $\pm$  18, range 20 to 150 cell/cmm). All the patients of former two groups had AF-PMN count more than 250 cells/cmm whereas none of the group III patients had such a high counts.

**Bacteriological studies :** In 7 patients ascitic fluid cultures were positive. Single organism could be identified in 4 patients (*Escherichia coli*, 1; *Klebsiella pneumoniae*, 3) while both organisms were isolated in the remaining 3 culture positive patients. Anaerobic organisms could not be isolated in any of the ascitic fluid.

**Specificity, sensitivity and diagnostic accuracy of laboratory tests in SBP :** The sensitivity, specificity and diagnostic accuracy of AF-PMN count was found to be 100 per cent, when its diagnostic level for SBP was 250 or more cells/cmm. The specificity, sensitivity and diagnostic accuracy of A-AF pH gradient at a cut off point of  $>0.1$  were between 98 to 100 per cent. The AF-pH at a cut off level of  $\geq 7.31$  had a sensitivity of 86 per cent in diagnosing SBP, however its specificity and diagnostic accuracy were low (65 and 67%, respectively).

**Pre-and post-therapy comparison of ascitic fluid parameters :** Ten patients belonging to groups I and II showed significant improvement in their clinical parameters, AF-PMN count, and A-AF pH gradient (Table II), after antibiotic therapy. The other two

patients of SBP died of hepatic encephalopathy, one had subacute hepatic failure and the other alcoholic cirrhosis. Both these patients could be categorised to Child's C category, whereas 8 of the 10 living patients belonged to Child's B category.

### Discussion

The prevalence of SBP in the present series was 13 per cent (12 of 92), which is somewhat lower than the reported prevalence of 14 to 45 per cent<sup>2,4,5</sup>. These later series from western countries however, mainly comprised patients of advanced age with alcoholic cirrhosis and poor hepatic reserve, making them more susceptible to the infection. On the other hand, patients in our series were younger, most of them had nonalcoholic cirrhosis and non-cirrhotic portal fibrosis with better hepatic functions, which could have been responsible for the lower rate of SBP.

The present study further confirms the recently reported observations<sup>3,6</sup> that a substantial proportion of patients (10 to 35%) with SBP do not reveal any organism on ascitic fluid culture. Five of the 12 (42%)

Table II. Pre-and post-therapy ascitic fluid parameters of groups I and II

Parameters	SBP (n=5)		PSBP (n=5)	
	Pre	Post	Pre	Post
AF-PMN	597±339	232±195*	618±191	245±109*
AF-pH	7.265±0.145	7.320±0.023	7.211±0.124	7.284±0.089
A-AF pH gradient	0.145±0.045	0.065±0.033*	0.223±0.138	0.089±0.016†

P values, \* $<0.01$ ; † $<0.001$ . AF-PMN, ascitic fluid polymorphonuclear count; AF-pH, ascitic fluid pH; A-AF pH gradient, arterial-ascitic fluid pH gradient

were culture negative SBP patients, in the present series, and these, termed as PSBP, have been considered to be a variant of the classical culture positive SBP<sup>2,3,5,7,8</sup>. Both the groups have a great deal of similarity in their clinical features, ascitic fluid, laboratory parameters and response to antibiotic therapy, as observed in the present series.

The present study as well as a few recent ones<sup>3,5,7,8</sup> clearly demonstrate that AF-PMN count and A-AF pH gradient are specific as well as sensitive tests for SBP, irrespective of the ascitic fluid culture status. Both the tests are inexpensive, quick and easy to perform, thus facilitating an early institution of specific therapy which may be an important determinant of survival in these patients with compromised liver functions. Even though ascitic fluid pH measurement alone has been claimed to be a very accurate index<sup>2</sup> to diagnose SBP, its specificity and diagnostic accuracy was found to be low by us and cannot be relied upon to diagnose all patients of SBP.

Ten of 12 SBP patients in the present series survived. SBP has been reported to be associated with high mortality rate<sup>2</sup>. The high rate of survival in the present study might have been because of three factors : (i) Early institution of therapy in these patients due to an early diagnosis of SBP by AF-PMN count and A-AF pH gradient; (ii) our patients were young and hence had a better immunity to fight infection; and (iii) the degree of hepatic decompensation in our

patients was probably less severe and most of them were nonalcoholic.

Thus, it appears that instead of ascitic fluid culture for the diagnosis of SBP, the use of AF-PMN count and A-AF pH gradient may be more rewarding.

#### References

1. Correia, J.P. and Conn, H.O. Spontaneous bacterial peritonitis in cirrhosis. *Med Clin N Am* 59 (1975) 963.
2. Gitlin, N., Stauffer, J.O. and Silverstri, R. The pH ascitic fluid in the diagnosis of spontaneous bacterial peritonitis in alcoholic cirrhosis. *Hepatology* 1 (1982) 408.
3. Cohn, H.O. Acidic ascitic fluid : a leap forward or a step? Editorial. *Hepatology* 2 (1982) 507.
4. Kao, H.W. and Reynolds, T.B. Ascitic pH and spontaneous bacterial peritonitis (correspondence). *Hepatology* 3 (1983) 275.
5. Garcia-Tsao, G., Conn, H.O. and Lerner, E. The diagnosis of bacterial peritonitis : Comparison of pH, lactate concentration and leukocyte count. *Hepatology* 5 (1985) 91.
6. Runyon, B.A. and Hoef, J.C. Culture negative neutrocytic ascites : a variant of spontaneous bacterial peritonitis. *Hepatology* 4 (1984) 1209.
7. Pinzello, G., Virdone, R., Lojacono, F., Ciambra, M., Dardanoni, G., Fiorentino, G., Riccobono, L. and Pagliaro, L. Is the acidity of ascitic fluid a reliable index in making the presumptive diagnosis of spontaneous bacterial peritonitis ? *Hepatology* 6 (1986) 244.
8. Attali, P., Turner, K., Palletier, G., Ink, O. and Etienne, J.P. pH of ascitic fluid: diagnostic and prognostic value in cirrhotic and noncirrhotic patients. *Gastroenterology* 90 (1986) 1255.