Original Article

Diagnostic Sensitivity and Specificity of Serum Ascites Albumin Gradient (SAAG) in Patients with Ascites

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ABSTRACT

OBJECTIVE: To determine the sensitivity and specificity of SAAG in predicting the presence of esophageal varices and to find out the association between level of SAAG and increase in portal vein diameter.

STUDY DESIGN: Prospective-observational study.

PLACE AND DURATION OF STUDY: Medical Unit III, JPMC Karachi from August 1999 to March 2000.

PATIENTS AND METHODS: Patients with ascites were selected on the basis of selection criteria demonstrated by history, physical examination and ultrasonography. Ascitic fluid aspirated for DR and albumin, and simultaneously blood sample taken for total protein and albumin estimation at the time of paracentasis. After determining the level of SAAG upper GI endoscopy was performed. To determine the cause of ascites detailed history was taken and relevant investigations were carried out. At the end of our study sensitivity and specificity of serum ascites albumin gradient were determined in comparison of endoscopy findings.

RESULTS: Among 50 subjects SAAG more than 1.1-g/dl was found in 30 (60%) patients and less than 1.1-g/dl in 20 patients (40%) of total 50 patients. Out of 30 patients with gradient more than 1.1-g/dl oesophageal varices present in 27 patients and portal vein diameter more than 1.3-cm present in 24 patients. The commonest cause of ascites among subjects with SAAG more than 1.1-g/dl was chronic liver disease with portal hypertension and the commonest cause of ascites among SAAG less than 1.1-g/dl was abdominal tuberculosis. The sensitivity and specificity of SAAG were 100% and 87.8% respectively.

CONCLUSION: Serum ascites albumin gradient is a reliable marker to differentiate ascites into portal hypertensive and non-portal hypertensive etiology. Based upon our finding we conclude that the presence of oesophageal varices is significantly associated with high SAAG levels.

KEY WORDS: Sensitivity, Specificity, Upper GI Endoscopy, SAAG, Ascites.

INTRODUCTION

Ascites, the pathologic accumulation of excess fluid within the peritoneal cavity has important diagnostic prognostic and therapeutic implications (1).There are various causes of ascites the primary care physician needs to identify the underlying cause in a systemic manner. Approximately 85 percent of patients with ascites have cirrhosis and the remaining 15 percent have a non hepatic cause of fluid retention (2). Because appropriate treatment depends upon accurate diagnosis, Paracentasis should be performed in every patient with new onset ascites to determine the cause and detect potential complications. The American Association for the Study of Liver Diseases recommends a diagnostic abdominal paracentasis be performed and ascitic fluid obtained from patients with clinically apparent new onset ascites (3).Portal hypertension secondary to chronic liver disease being the commonest cause accounts for 78% of patients with ascites (4). Early detection of portal hypertension before development of its dreadful complications such as oesophageal varices can reduce morbidity and mortality. Traditionally, ascites has been classified as being either transudative or exudative, based upon the ascitic fluid total protein concentration (5), the ascitic fluid to serum ratio of total protein or the ascitic fluid to serum ratio of lactate dehydrogenase (6). Unfortunately none of these parameters has been found to be completely discriminating. Several investigators have demonstrated the superiority of the serum ascites albumin concentration gradient (SAAG) in the discrimination of ascitic fluid compared with the exudate transudate concept. It was shown that such a classification has a validity rate of 90% or more in detecting the ascites of portal hypertension. The SAAG is minimally invasive method that is highly precise and allows for classification of ascitic fluid according to the absence and presence of portal hypertension (5,7). Pare and coworkers reported that serum ascites albumin gradient was good biochemical marker of portal hypertension (8). The SAAG based on oncotic hydrostatic balance,

it is an index of the serum ascites oncotic pressure difference correlates directly with the pressure gradient between the portal capillaries and the peritoneal cavity (9). The SAAG is calculated by measuring the albumin concentration of ascitic fluid and subtracting it from the serum value obtained at the same time (10).

If the SAAG is 1.1-g/dl (1.1-g/litre) or greater then there is a high likelihood of portal hypertension, if it is less than 1.1-g/dl other causes of the ascites should be explored including peritoneal carcinomatosis, Tuberculous peritonitis and pancreatic ascites. The accuracy of such determination is 97 percent (2,5,9,10).

It is pointed out in literature that the SAAG is an indicator of portal hypertension (5,11), and that a direct relationship probably exists between SAAG and different portal hypertension measurements such as the portal pressure gradient (12), net portal pressure (9), or corrected portal pressure. These measurements are obtained only by invasive methods which are not feasible in most centres in the resource constrained countries. The indirect way to assess portal hypertension is by detection of oesophageal varices. The upper gastrointestinal endoscopy is currently the best reliable method available to diagnose presence of oesophageal varices and hence portal hypertension (7).

Portal vein diameter larger than 1.3 cm diameter on ultrasonography is a non invasive tool in the diagnosis of portal hypertension (13).Although the absolute size of the portal vein may not be reliable indicator of portal hypertension, its relative change in size with respiration is more sensitive, if somewhat rarely assessed finding. An increase of less than 20% in the diameter of the PV with deep inspiration indicates portal hypertension with a sensitivity of up to 80% and specificity of up to 100% (14, 15,16).

The present study was conducted to determine the sensitivity and specificity of SAAG in diagnosing complication of portal hypertension, in order to validate the use of SAAG as a preliminary indirect parameter for presence of esophageal varices and also increased portal vein diameter in portal hypertension. Thus, reducing the use of expensive invasive method by narrowing the selection of true candidates for endosocpy in the interest of physician as well as our poor patient.

PATIENTS AND METHODS

The objectives of this study were to determine the sensitivity and specificity of SAAG in predicting the presence of esophageal varices and to find out the association between level of SAAG and increase in portal vein diameter. This was a prospective and observational hospital based study of 50 patients diagnosed with ascites who were hospitalized in the medical ward of JPMC Karachi from August 1999 to March 2000.

Subjects for this study were selected by non-probability convenient sampling technique from the patients of either sex between age of 15-years and 55-years who were newly diagnosed cases of ascites.

After obtaining an informed consent, detailed history and clinical examinations were performed in all patients, in particular those with a history of abdominal distension, abdominal pain, jaundice, fever, stigmata of liver disease, heart failure and abdominal mass. Blood was drawn from the anticubetal vein and ascitic fluid was obtained by paracentasis, performed by using the standard technique. Determination of the concentration of the albumin in both the serum and ascitic fluid were carried out simultaneously. The concentration of albumin in both serum and ascitic fluid was determined using bromcresol method. With these results SAAG was calculated. According to previous reports we considered a SAAG value of ≥ 1.1-g/dl as high and a SAAG value <1.1-g/dl as low, the high SAAG being associated with portal hypertension. All patients underwent ultrasonography; presence of portal vein diameter 1.3-cm or above with respiratory variation was taken as an evidence of portal hypertension along with coarse echotexture of liver, splenomegaly and presence of ascites. During upper GI endoscopy all patient were assessed for the presence of oesophageal varices. Diagnosis of different causes of ascites was reached by clinical assessment, laboratory findings, ultrasonography and when possible by histopathology. Relevant specialized investigations were carried out accordingly for specific cause to confirm the diagnosis. The sensitivity and specificity of serum ascites albumin gradient in detecting portal hypertensive ascites and non-portal hypertensive ascites was calculated with the following formula.(17)

$$\text{Sensitivity} = \frac{\text{Number testing positive who have the disease TP}}{\text{Total no tested who have the disease (TP+ FN)}} \times 100$$

$$\text{Specificity} = \frac{\text{Number testing negative who do not have disease TN}}{\text{Total number who do not have the disease (TN + FP)}} \times 100$$

***True Positive*:** True positive case for portal hypertension was taken when SAAG was more than 1.1-g/dl and oesophageal varices were present on endoscopy

***True Negative*:** True negative case for portal hypertension was taken when SAAG was less 1.1-g/dl and oesophageal varices were absent on endoscopy

***False Positive*:** When SAAG was more than 1.1-g/dl and oesophageal varices were absent on endoscopy

***False Negative*:** When SAAG was less than 1.1-g/dl and oesophageal varices were present on endoscopy

***Estimation of Sample Size*:** The sample size was estimated by taking the required proportion ≤0.6 for 95% confidence interval with target error rate of 0.5 and actual error rate of 0.45 (18). Adding 10% by

researcher the sample size of 42 turned out to 46.2, which was rounded up to 50 cases.

***Statistical Analysis*:** The association of SAAG levels with increased portal vein diameter was analysed by applying Chi-square test. P-value up to 0.05 was considered significant. Data were recorded on a predesigned proforma and analysed by SPSS version 14.

RESULTS

Among 50 study subjects 26 (52%) were males and 24 (48%) were females with their respective mean±SD ages of 37.83±10.28 years and 34.50±13.21 years. High level of SAAG (>1.1-g/dL) was found in 30 (60%) cases and low level of SAAG (<1.1-g/dL) in 20 (40%) cases. Among 30 subjects with high SAAG levels, esophageal varices were present in 27 (90%) subjects, whereas among 20 subjects with low SAAG none presented esophageal varices upon endoscopic examination. Sensitivity and specificity of SAAG were 100% and 87.8% respectively **(Table I)**. SAAG was found to be associated with increased portal vein diameter at highly significant level statistically with P<0.001 **(Table II)**. Chronic liver disease was found to be the most common cause of ascites present in 27 (90%) subjects with high SAAG level, whereas abdominal tuberculosis was present in 10 (50%) subjects with low SAAG level **(Table III)**.

TABLE I:
SENSITIVITY AND SPECIFITY OF SAAG (n=50)

	Endoscopic findings			
SAAG	Presence of Esophageal Varices	Absence of Esophageal Varices	Total	Sensitivity =100% Specificity =87.8% Diagnostic accuracy =94%
>1.1	27	3	30	
<1.1	0	20	20	
Total	27	23	50	

TABLE II:
ASSOCIATION OF SAAG WITH ULTRASOUND FINDINGS OF PORTAL VEIN SIZE (n=50)

	Ultrasound findings		
SAAG	Portal vein daimeter >13mm	Portal vein daimeter <13mm	Total
>1.1	24	6	30
<1.1	0	20	20
Total	24	26	50
P<0.001			

TABLE III:
VARIOUS CAUSES OF ASCITES IN RELATION TO SAAG (n=50)

Causes of Ascites	SAAG	
	>1.1	**<1.1**
Chronic Liver disease with portal hypertension	27	0
Abdominal Tuberculosis	0	10
Abdominal malignancy	0	6
Nephrotic syndrome	0	4
Constrictive pericarditis	1	0
Hypoprotenemia secondary to renal amyloidosis	1	0
Congestive Cardiac failure & hperthyroidism	1	0

DISCUSSION

The presence of ascites has important diagnostic, prognostic and therapeutic implications. The patients with ascites are a common diagnostic and therapeutic challenge to the internist and gastroenterologist. Over 90% of the cases are caused by one of the four conditions: Liver Cirrhosis, Tuberculosis, Neoplasm, and Congestive Heart Failure (19). In this study the commonest cause of ascites according to number of patients are chronic liver disease, abdominal tuberculosis, abdominal malignancy and nephrotic syndrome which is comparable with the results of studies conducted previously (20,21,22,23).

This study showed that 60% of patients with ascites were having SAAG > 1.1-g/dl while 40% of patients with ascites were having SAAG < 1.1-g/dl. These results are quite comparable with the results of study conducted by Akriviadis et al (24). In this study the commonest cause of chronic liver disease is secondary to viral hepatitis B & C only one patient had the disease due to alcoholic hepatitis. This is because viral hepatitis is more prevalent in this part of the world unlike western world where chronic liver disease due to alcoholic hepatitis is more common. Tuberculosis is still a common health hazard throughout the world particularly in developing countries. Ascites is the most frequent sign of Tuberculous peritonitis as reported by Manohar (25). In patients with ascites having SAAG less than 1.1-g/dl, the commonest cause of ascites is tuberculosis peritonitis (1). This is quite comparable with the results of study conducted by Allam AR (20), where they showed abdominal tuberculosis as the commonest cause of ascites in non

cirrhotic patients.

Malignant ascites accounts for around 12 percent of all cases of ascites. It is a manifestation of advanced malignant disease and it is associated with poor prognosis. It is usually caused by intra abdominal tumours (23,24). Abdominal malignancy was the second commonest cause of ascites in patients with SAAG less than 1.1-g/dl these finding are comparable with the study conducted by Alknawy BA and Khan FY (23), the third commonest cause of ascites among patients with SAAG less than 1.1-g/dl was due to nephrotic syndrome these results are also comparable with the results of study conducted by Allam AR and Alknawy BA (20, 22).

Previous research indicates that the measurement of the portal pressure gradient (PP-GRAD) and the portal pressure (PP) are the most appropriate hemodynamic parameters for evaluating the development of portal hypertension (PHTN) and its complications (6,7,11,26). The SAAG has been found to correlate with different portal hypertension measurements such as PP-GRAD (12), net portal pressure (9) or corrected portal pressure (27), the SAAG is able to define the presence or absence of PHTN with an accuracy of 96.7% (5,6,10,11,28). This test is accurate despite ascitic fluid infection, diuresis, therapeutic paracentasis, albumin infusion, and etiology of liver disease (6,10).

In our study in patients with ascites there was an association between the level of SAAG and the development of oesophageal varices. With oesophageal varices present only in patients with high SAAG, there was a high probability of finding oesophageal varices in patients with higher values of high SAAG (6).

CONCLUSION

This study concludes that SAAG is an excellent biochemical parameter in differentiating ascites due to portal hypertension from other causes of ascites based upon our findings we conclude that the presence of oesophageal varices in patients with ascites is highly associated with patients with high SAAG. However the SAAG should be viewed as a preliminary and indirect measurement of portal hypertension due to different co-relations and limitations between SAAG and PHTN measurements as describe earlier.

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