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COMPARATIVE EVALUATION OF SERUM-ASCITES ALBUMIN GRADIENT AND ASCITIC FLUID TOTAL PROTEIN IN THE DIAGNOSIS OF ASCITES ETIOLOGY

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ABSTRACT

Background: Ascites is a common clinical condition with diverse etiologies, most commonly due to portal hypertension secondary to liver cirrhosis. Accurate differentiation between portal and non-portal causes is essential for appropriate management. Serum Ascites Albumin Gradient (SAAG) has been proposed as a more reliable diagnostic parameter compared to Ascitic Fluid Total Protein (AFTP). **Objective:** To compare the diagnostic utility of SAAG and AFTP in determining the etiology of ascites. **Methods:** This hospital-based observational study was conducted among 140 patients with clinically and radiologically confirmed ascites at MGM Medical College, Navi Mumbai. Serum and ascitic fluid samples were analyzed for albumin and total protein levels. SAAG was calculated and patients were categorized into portal (≥1.1 g/dL) and non-portal (<1.1 g/dL) ascites. Diagnostic performance of SAAG and AFTP was assessed using sensitivity, specificity, predictive values, and accuracy. **Results:** The mean age of patients was 44.7 ± 13.2 years with male predominance (58.6%). Cirrhosis was the most common etiology (73.6%). SAAG classified 73.6% cases as portal hypertension-related compared to 55.7% by AFTP. SAAG demonstrated higher sensitivity (95%), specificity (92%), and diagnostic accuracy (94.3%) compared to AFTP (83%, 63%, and 68%, respectively). A significant association was observed between SAAG and etiology ($p < 0.001$). **Conclusion:** SAAG is a superior, reliable, and cost-effective parameter compared to AFTP in differentiating ascites etiology. It should be routinely used as the primary diagnostic tool in the evaluation of ascites.

KEYWORDS : Ascites, SAAG, Ascitic Fluid Total Protein, Portal Hypertension, Diagnostic Accuracy

INTRODUCTION

Ascites, defined as the abnormal accumulation of fluid within the peritoneal cavity, is a common clinical condition associated with significant morbidity and mortality. Portal hypertension accounts for nearly 80–85% of cases, most commonly due to liver cirrhosis, while other causes include malignancy, tuberculosis, cardiac failure, and pancreatic diseases [1, 2]. Accurate identification of the underlying cause is essential for appropriate management, treatment decisions, and prognosis.

Traditionally, ascitic fluid has been classified as transudate or exudate based on Ascitic Fluid Total Protein (AFTP) levels, using a cut-off of 2.5 g/dL [3]. However, this method has important limitations and may lead to diagnostic errors, particularly in cardiac ascites, malignant ascites, and mixed etiologies [4, 5]. Thus, AFTP alone may not reliably reflect the underlying pathophysiology of ascites.

The Serum Ascites Albumin Gradient (SAAG) was introduced as a more accurate and physiologically relevant parameter. SAAG correlates with portal venous pressure and effectively distinguishes portal hypertension-related ascites from non-portal causes [6, 7]. Previous studies have shown higher diagnostic sensitivity and specificity for SAAG compared with AFTP [8, 9]. However, AFTP still has value in certain conditions such as malignant and tuberculous ascites [10]. Therefore, comparative evaluation of SAAG and AFTP remains important in clinical practice.

MATERIALS AND METHODS

This hospital-based observational study was conducted in the Department of General Medicine at MGM Medical College among patients with clinically and radiologically confirmed ascites. Patients aged ≥18 years with confirmed ascites were included. Those on long-term diuretic therapy, with incomplete laboratory data, or unwilling to participate were excluded.

Clinical details and relevant investigations were recorded. Ascitic fluid was collected under aseptic precautions, and serum as well as ascitic fluid samples were analyzed for albumin levels. SAAG was calculated as: Serum Albumin – Ascitic Fluid Albumin. Ascitic Fluid Total Protein (AFTP) was also measured. Patients with SAAG ≥1.1 g/dL were classified as portal hypertension-related ascites, while those with SAAG <1.1 g/dL were considered non-portal ascites.

Statistical analysis was performed using IBM SPSS Statistics version 26.0. Data were expressed as mean ± SD and frequency (%). Sensitivity, specificity, PPV, NPV, and diagnostic accuracy were calculated. Chi-square test was applied, with $p < 0.05$ considered statistically significant.

RESULTS

A total of 140 patients with clinically and radiologically confirmed ascites were included in the study. The demographic characteristics, biochemical parameters, and etiological distribution of ascites were analyzed. The diagnostic performance of Serum Ascites Albumin Gradient (SAAG) and Ascitic Fluid Total Protein (AFTP) was evaluated in differentiating portal hypertension-related ascites from non-portal causes. The results are presented in a series of tables, highlighting baseline characteristics, distribution of laboratory parameters, classification patterns, diagnostic accuracy, and their association with underlying etiologies.

Table 1 indicates baseline characteristics of study participants. The mean age of 44.7 ± 13.2 years, indicating a predominantly middle-aged population. There was a male predominance, with 82 (58.6%) males compared to 58 (41.4%) females. Regarding the etiology of ascites, cirrhosis (chronic liver disease) was the most common cause, accounting for 103 (73.6%) cases, highlighting portal hypertension as the leading underlying mechanism. Other causes included malignancy in 12 (8.6%) patients, tuberculosis in 9 (6.4%), cardiac causes in 8 (5.7%), and miscellaneous causes in 8 (5.7%) cases. This distribution reflects the typical clinical pattern of ascites, with cirrhosis being the predominant etiology followed by non-portal causes such as malignancy and tuberculosis.

Table 1: Baseline Characteristics of Study Participants

Variable	Category	n (%) / Mean ± SD
Age (years)	Mean ± SD	44.7 ± 13.2
Gender	Male	82 (58.6%)
	Female	58 (41.4%)
Etiology of Ascites	Cirrhosis (CLD)	103 (73.6%)
	Malignancy	12 (8.6%)

	Tuberculosis	9 (6.4%)
	Cardiac	8 (5.7%)
	Others	8 (5.7%)

Table 2 indicates Distribution of SAAG and AFTP Values. The mean serum albumin level among the study participants was 3.21 ± 0.68 g/dL, while the mean ascitic fluid albumin was 1.73 ± 0.59 g/dL. The calculated mean Serum Ascites Albumin Gradient (SAAG) was 1.48 ± 0.72 g/dL, with values ranging from 0.4 to 2.8 g/dL, indicating that a substantial proportion of patients had SAAG values suggestive of portal hypertension. The mean Ascitic Fluid Total Protein (AFTP) was 2.36 ± 0.84 g/dL, with a wide range (0.9–4.8 g/dL), reflecting overlap between transudative and exudative ascites. Overall, the higher mean SAAG values compared to AFTP support the predominance of portal hypertension-related ascites in the study population and demonstrate the variability of protein levels across different etiologies.

Table 2: Distribution of SAAG and AFTP Values (n = 140)		
Parameter	Mean ± SD	Min–Max
Serum Albumin (g/dL)	3.21 ± 0.68	1.8 – 4.6
Ascitic Fluid Albumin (g/dL)	1.73 ± 0.59	0.5 – 3.2
SAAG (g/dL)	1.48 ± 0.72	0.4 – 2.8
AFTP (g/dL)	2.36 ± 0.84	0.9 – 4.8

Table 3 indicates that SAAG classified a higher proportion of patients as having portal hypertension-related ascites (73.6%) compared to AFTP (55.7%). In contrast, AFTP identified a greater number of cases as non-portal hypertension-related ascites (44.3%) than SAAG (26.4%). This variation suggests that AFTP may lead to misclassification, particularly by overestimating non-portal causes. Overall, the findings indicate that SAAG provides a more accurate and clinically consistent classification of ascites etiology compared to AFTP.

Table 3: Classification of Ascites by SAAG and AFTP (n = 140)		
Classification	SAAG n (%)	AFTP n (%)
Portal Hypertension	103 (73.6%)	78 (55.7%)
Non-Portal Hypertension	37 (26.4%)	62 (44.3%)
Total	140 (100%)	140 (100%)

Table 4 demonstrates that SAAG has superior diagnostic performance compared to AFTP in differentiating the etiology of ascites. SAAG showed higher sensitivity (95% vs 83%) and specificity (92% vs 63%), indicating its greater ability to correctly identify both portal and non-portal hypertension-related ascites. Additionally, SAAG exhibited better positive predictive value (96.3% vs 82.1%) and negative predictive value (89.5% vs 64.5%), reflecting higher reliability in clinical decision-making. The overall diagnostic accuracy of SAAG was also markedly higher (94.3%) compared to AFTP (68%). These findings clearly highlight the superiority of SAAG over AFTP as a diagnostic tool in the evaluation of ascites.

Table 4: Diagnostic Performance of SAAG vs AFTP (n = 140)					
Parameter	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
SAAG	95	92	96.3	89.5	94.3
AFTP	83	63	82.1	64.5	68

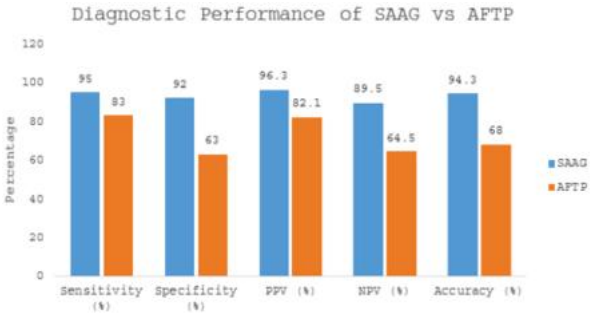

Table 5 and figure 1 shows a statistically significant association between SAAG classification and the underlying etiology of ascites (χ^2 = 72.4, p < 0.001). A large majority of patients with cirrhosis (95.1%) and cardiac causes (87.5%) had SAAG ≥1.1 g/dL, indicating portal hypertension, whereas most patients with malignancy (75.0%) and tuberculosis (77.8%) had SAAG <1.1 g/dL, suggesting non-portal causes. Overall, 78.6% of patients were classified as portal hypertension-related based on SAAG. These findings demonstrate that SAAG correlates strongly with the pathophysiological basis of ascites and is highly effective in differentiating portal from non-portal hypertension-related etiologies.

Table 5: Association Between SAAG Classification and Etiology (n = 140)				
Etiology	SAAG ≥1.1 n (%)	SAAG <1.1 n (%)	χ^2	p-value
Cirrhosis (n = 103)	98 (95.1%)	5 (4.9%)	χ^2 = 72.4	<0.001*
Malignancy (n = 12)	3 (25.0%)	9 (75.0%)		
Tuberculosis (n = 9)	2 (22.2%)	7 (77.8%)		
Cardiac (n = 8)	7 (87.5%)	1 (12.5%)		
Total	110 (78.6%)	22 (21.4%)		

Table 6 demonstrates a statistically significant difference in mean SAAG values across different etiological groups (F = 68.5, p < 0.001). Patients with cirrhosis had the highest mean SAAG (1.62 ± 0.38 g/dL), followed by those with cardiac causes (1.48 ± 0.21 g/dL), both indicative of portal hypertension. In contrast, patients with malignancy (0.82 ± 0.19 g/dL) and tuberculosis (0.76 ± 0.17 g/dL) had markedly lower mean SAAG values, consistent with non-portal hypertension-related ascites. These findings highlight that SAAG not only differentiates ascites categorically but also shows significant quantitative variation across etiologies, reinforcing its diagnostic reliability.

Table 6: Comparison of Mean SAAG Across Etiologies (ANOVA) (n = 140)			
Etiology	Mean SAAG ± SD (g/dL)	F-value	p-value
Cirrhosis	1.62 ± 0.38	F = 68.5	<0.001*
Cardiac	1.48 ± 0.21		
Malignancy	0.82 ± 0.19		
Tuberculosis	0.76 ± 0.17		

Overall, the findings of the present study demonstrate that SAAG is a superior and more reliable parameter compared to AFTP in the evaluation and classification of ascites. SAAG showed higher diagnostic accuracy and a strong statistically significant association with the underlying etiology of ascites. The results consistently indicate that SAAG effectively differentiates portal hypertension-related ascites from non-portal causes, supporting its routine use as a primary diagnostic tool in clinical practice.

DISCUSSION

The present study demonstrated that the Serum Ascites Albumin Gradient (SAAG) is a highly reliable parameter in differentiating ascites due to portal hypertension from non-portal causes. In our study, cirrhosis was the predominant etiology (73.6%), which is consistent with previous studies reporting chronic liver disease as the leading cause of ascites [2, 6]. Similar observations were made by Mandal et al. and Aravindan et al., where cirrhosis accounted for the majority of cases, reinforcing the strong association between portal hypertension and ascites formation [11, 12]. The mean SAAG values were significantly higher in cirrhotic and cardiac ascites compared to malignant and tuberculous ascites, which aligns with the pathophysiological basis that SAAG reflects portal venous pressure [6].

The diagnostic performance analysis in the present study revealed that SAAG had higher sensitivity (95%) and specificity (92%) compared to AFTP (83% and 63%, respectively), with an overall diagnostic accuracy of 94.3%. These findings are in agreement with earlier studies by Runyon et al., who reported SAAG sensitivity of approximately 97% in identifying portal hypertension-related ascites [13].

Similarly, studies by Subhani et al. and Gomaa et al. have demonstrated superior diagnostic accuracy of SAAG over AFTP, with SAAG showing significantly better predictive values [9, 14]. In contrast, AFTP has been shown to have limited specificity due to overlap between transudative and exudative ascites, particularly in mixed clinical conditions such as cardiac ascites and malignancy, which was also observed in our study [15].

Furthermore, a statistically significant association was found between SAAG classification and the etiology of ascites ($p < 0.001$), confirming its strong diagnostic correlation. Most patients with cirrhosis and cardiac causes had SAAG ≥1.1 g/dL, while malignancy and tuberculosis were predominantly associated with lower SAAG values. These findings are comparable to studies by Tiu et al. and Mathew et al., which also highlighted the effectiveness of SAAG in accurately categorizing ascites based on underlying pathology [15, 16]. Overall, the results of the present study support the growing body of evidence that SAAG is superior to AFTP and should be considered the standard initial diagnostic tool in the evaluation of ascites.

CONCLUSION

In conclusion, the present study demonstrates that the Serum Ascites Albumin Gradient (SAAG) is a superior and reliable parameter compared to Ascitic Fluid Total Protein (AFTP) in the evaluation of ascites. SAAG showed higher diagnostic accuracy and a strong correlation with the underlying etiology, effectively differentiating portal hypertension-related ascites from non-portal causes. Given its simplicity, cost-effectiveness, and strong diagnostic performance, SAAG should be routinely used as the primary investigation in the clinical assessment of patients with ascites.

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