

COMPARISON OF SERUM-ASCITES ALBUMIN GRADIENT (SAAG) IN PORTAL HYPERTENSIVE AND NON-PORTAL HYPERTENSIVE ASCITES

Faisal Khan ¹, Abdul Malik ², Asma Hameed ³, Zaheer Ahmed ⁴, Hasil Khan ⁵, Fazal Ur Rehman ⁶

^{1,2,3,4,5,6}

General Medicine Sandeman Provincial Hospital / Bolan Medical College/Hospital, Quetta, Balochistan, Pakistan.

ABSTRACT

Background: Ascites is a frequent clinical presentation of several different underlying disorders, the most common of which is liver cirrhosis. To manage acute ascites, it is essential to differentiate portal hypertensive and non-portal hypertensive ascites. The Serum-Ascites Albumin Gradient (SAAG) has proven to be highly sensitive and specific as a diagnostic tool compared to preceding protein-based grading.

Objective: To compare the diagnostic value of SAAG and the study of clinical and biochemical characteristics related to portal hypertensive and non-portal hypertensive ascites.

Study Design: A Cross-sectional comparative Study.

Place and Duration of Study: A study was conducted in the Department of General Medicine at Sandeman Provincial Hospital/Bolan Medical College, Quetta, Pakistan, between July and December 2024.

Methodology: Twenty-eight adult patients with confirmed ascites, as determined by both radiological and clinical findings, were recruited for the study. They were categorized into either a portal hypertensive or a non-portal hypertensive group in equal numbers. SAAG was made equal to the difference between albumin in serum and ascitic fluid. The clinical characteristics, comorbidities, and laboratory tests were recorded. Data analysis involved independent t-tests and chi-square tests, as $p < 0.05$ was considered statistically significant.

Results: The average age was 57.8 years, with a standard deviation of 14.0, and the average ascites duration was 13.4 months, with a standard deviation of 6.8. The portal hypertensive group showed a significantly higher average SAAG (mean difference= 1.50 g/dL; 95% CI: 1.16-1.85; $p < 0.001$). Portal hypertension was significantly related to pallor ($\chi^2 = 4.094$; $p = 0.043$); however, other symptoms were not related to it.

Conclusion: SAAG has become a resource-friendly, resource-friendly, economical, and non-invasive method for differentiating portal hypertensive and non-portal hypertensive ascites, especially in resource-poor areas. It is also recommended that future multicenter studies be conducted to further validate this finding.

Keywords: Albumin Gradient, Ascites, Cirrhosis, Diagnostic Accuracy, Peritoneal Fluid, Portal Hypertension, SAAG

How To Cite This Article: Khan F, Malik A, Hameed A, Ahmed Z, Khan H, Rehman FU. Comparison of serum-ascites albumin gradient (SAAG) in portal hypertensive and non-portal hypertensive ascites: original article. J Bacha Khan Med Coll. 2025;6(1),27-32.

Corresponding Author: Faisal Khan
General Medicine Sandeman Provincial Hospital / Bolan
Medical College/Hospital, Quetta, Pakistan.
Email: faisaltareen2017@gmail.com

Received: 28th April, 2025
Revision: 25th May, 2025
Accepted: 23rd June, 2025
Published: 10th July, 2025
DOI: [10.69830/jbkmc.v6i1.219](https://doi.org/10.69830/jbkmc.v6i1.219)

INTRODUCTION

The abnormal retention of fluid in the peritoneal cavity is known as ascites and it appears due to several underlying causes. The leading cause among these is liver cirrhosis, which comprises roughly 75 percent of cases in developed areas ^(1, 2). Additional causes are peritoneal cancer (10 percent), congestive heart failure (3 percent), tuberculosis (2 percent), and pancreatitis (1 percent) ⁽³⁾. The development of ascites in cirrhotic patients marks a significant turning point in disease progression, with five-year survival declining from approximately 80% in compensated cirrhosis to around 30% once ascites develops ⁽⁴⁾. Therefore, proper recognition of the root cause is critical in informing treatment. Historically, ascitic fluid was classified as transudative or exudative based on ascitic fluid total protein (AFTP). Transudates (AFTP <2.5 g/dL) were associated with cirrhosis or cardiac failure, while exudates (AFTP >2.5 g/dL) were linked to infectious or malignant causes ^(5, 6). The practice, however, has proved restrictive, particularly in circumstances that relate to the use of diuretics, spontaneous bacterial peritonitis, or combined causes such as cardiac or malignant ascites in patients ⁽⁷⁾. In overcoming such challenges, the Serum-Ascites Albumin Gradient (SAAG) was brought up as a better diagnostic marker. SAAG = serum albumin - ascitic fluid albumin. A SAAG value ≥ 1.1 g/dL reliably identifies portal hypertension as the cause of ascites, while values below this threshold point toward non-portal etiologies such as malignancy, tuberculosis, or pancreatitis ^(8, 9). SAAG has a diagnostic specificity of about 97 percent in discriminating between portal and non-portal hypertensive ascites even in patients taking diuretics ⁽¹⁰⁾. However, there are restrictions. A low SAAG level can be seen in both tuberculous peritonitis and malignant ascites, and it is difficult to distinguish between the two conditions ⁽¹¹⁾. Moreover, cytology of ascitic fluid, which is commonly deployed to check malignancy, is

insensitive, especially in early stages of the disease ⁽¹²⁾. With these challenges to diagnostics, additional studies are necessary to evaluate the effectiveness of SAAG, particularly in under-supplied facilities where more advanced diagnostics might not be accessible. Evaluating SAAG performance across diverse patient populations, particularly in low-resource settings like Pakistan, is essential to guide evidence-based clinical decision-making. This work seeks to review the diagnostic worth of SAAG in the differentiation of portal hypertensive and non-portal hypertensive ascites in a tertiary care facility of Quetta, Pakistan.

METHODOLOGY

To assess the diagnostic efficacy of the Serum-Ascites Albumin Gradient (SAAG) in distinguishing between portal hypertensive and non-portal hypertensive ascites, this comparative cross-sectional study was conducted in a tertiary care hospital in Quetta, Balochistan. Eligible participants were adults aged ≥ 18 years with clinically or radiologically confirmed ascites. Patients were classified into two equal groups: portal hypertensive ascites (e.g., cirrhosis, alcoholic liver disease) and non-portal hypertensive ascites (e.g., malignancy, tuberculous peritonitis). A convenience (non-probability) sampling technique was employed.

Ethical approval was obtained from Ethical Review Board of Bolan Medical College, Ref No. 176/ERB/BMC Dated. 11 Jan 2024.

Given the past study, hypothetically assuming a difference in the mean SAAG of 1.1 g/dL, a standard deviation of 1.0, an alpha of 0.05, and a power of 80%, the necessary sample size was 12 per group. Based on the assumption of a 20% dropout rate, the remaining sample power of 14 individuals per group (n = 28) was achieved.

Patients aged ≥ 18 years with clinically or

radiologically confirmed ascites, willing to participate, and classified as having either portal hypertensive or non-portal hypertensive ascites based on clinical evaluation.

Patients with mixed etiology ascites, recent abdominal surgery, incomplete clinical data, or those already undergoing therapeutic paracentesis or albumin therapy at enrollment were excluded from the study.

SAAG was calculated as the difference between serum albumin and ascitic fluid albumin. A structured proforma was used to record demographic, clinical, and biochemical data. Analysis of the statistics was conducted in SPSS 22.0. The data were summarised using descriptive statistics; the means of each group were compared using t-tests, and the comparison of categories was performed using the chi-square or Fisher's exact test. A P-value less than 0.05 was deemed significant.

RESULTS

A sample size of 28 participants was recruited, equally divided into portal and non-portal hypertensive ascites groups (n = 14 in each group). The average age was 57.8 +/- 14.0 years, and the mean duration of ascites was 13.4 +/- 6.8 months. The mean SAAG was 1.37 ± 0.88 g/dL. Mean serum albumin was 2.67 +/- 0.85 g/dl, mean ascitic albumin was 1.29 +/- 0.48 g/dl. Pallor (67.9%), pedal edema (57.1%), jaundice (25.0%), abdominal distension (50.0%), and limb swelling (X%) were the most frequent clinical features. Liver disease (42.9%), kidney disease (53.6%), heart disease (35.7%), and tuberculosis (39.3%) were observed as comorbidities. Chi-square testing did not reveal any significant relationships between the majority of clinical characteristics and the type of ascites. Pallor, however, was strongly associated with portal hypertensive ascites($\chi^2 = 4.094, p = 0.043$). T-test on independent samples revealed a significant difference between the SAAG of the groups (t = 8.920, p < 0.001), with a mean difference of 1.50 g/dL (95% CI: 1.16 -

1.85), which affirmed SAAG ≥ 1.1 g/dL as a good indicator of portal hypertension.

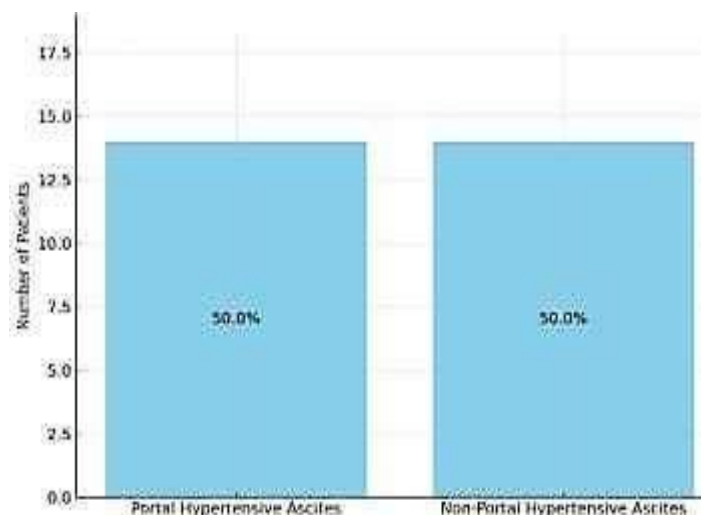


Figure 01. Diagnostic Outcome Based On SAAG

Table 1: Descriptive Summary of Study Population

Variable	N	Mean	SD
Age (years)	28	57.82	14.03
Duration of Ascites (months)	28	13.39	6.78
SAAG	28	1.37	0.88
Serum Albumin (g/dL)	28	2.67	0.84
Ascitic Albumin (g/dL)	28	1.29	0.48

Table 2: Frequency Distribution of Clinical Variables

Variable	Frequency	(%)
Gender (Male)	11	39.3
Gender (Female)	17	60.7
Portal Hypertensive Ascites	14	50.0
Non-Portal Hypertensive Ascites	14	50.0
Abdominal Distension (Yes)	14	50.0

DISCUSSION

A resurgence of serum-ascites albumin gradient (SAAG) as a diagnostic investigative tool has been acquired to distinguish portal hypertensive ascites from non-portal hypertensive causes. In this study, the mean SAAG value was considerably higher in patients with portal hypertension (mean difference = 1.50 g/dL, 95% CI: 1.16-185, p < 0.001). This demonstrates that even when standardised, SAAG has the potential to become a valuable diagnostic tool. This conclusion is consistent

with the knowledge that portal hypertension is an important predictor of SAAG 1.1 g/dL and should never be abandoned in clinical practice. Additionally, more pallor was noted in the portal hypertensive group ($\chi^2=4.094$, $p = 0.043$), which may represent a higher burden of anaemia or chronic disease in this group. These results align with the palatability of SAAG. For example, Fares et al. reported that the sensitivity of SAAG was 96.7% and 100% in ascertaining portal hypertension-induced ascites⁽¹³⁾. On the same note, Ameen and Aravindan concluded that SAAG was better in determining the cause of ascites than ascitic fluid total protein (AFTP)⁽¹⁴⁾. Nevertheless, the diagnostic value of SAAG has been reported to vary in certain studies, which can be attributed to differences in the patient population and the aetiology of underlying diseases⁽¹⁵⁾. Nevertheless, the current results reestablish the usefulness of SAAG as a non-invasive, low-cost, readily available measure, particularly in distinguishing between portal and non-portal causes of ascites. Its use is especially vital in low-resource conditions, where complicated diagnostic modalities might not be available^(16, 17). Timely and early detection of portal hypertension by measuring SAAG can easily lead to successful intervention and improved clinical outcomes⁽¹⁸⁻²⁰⁾. Therefore, it is practical and evidence-based to consider incorporating SAAG into the standard assessment procedure for ascites.

STRENGTHS AND LIMITATIONS

The key strength of this study lies in its comprehensive nature, which combines clinical assessment, biochemical examination, and statistical analysis to evaluate the accuracy of the serum-ascites albumin gradient (SAAG) as a diagnostic tool. The fact that the same methodology was applied and the diagnostic groups are clearly defined contributes to strengthening the internal validity of the study. Nonetheless, some limitations should be

recognized. Since the sample size is small and the study was conducted at only one centre, the generalizability of the study is limited. Moreover, possible confounding factors, including nutritional status, alterations in serum albumin, and the presence of comorbidities, were not controlled for, and these factors can also affect SAAG levels. These elements might create a bias and diminish the diagnostic accuracy of conclusions.

FUTURE RESEARCH DIRECTIONS

A study should be conducted in multiple centres involving a greater number of centres with more diverse patients in the future to determine the broader clinical applicability of SAAG. Including variables such as nutritional markers and comorbid disease status, the diagnostic model will be strengthened. In addition, the diagnostic sensitivity and specificity can also be improved by combining SAAG with other parameters, such as ascitic fluid total protein levels, radiology findings, or innovative biomarkers. To further provide insight into the utility of SAAG in providing prognostic

IMPLICATIONS

Randomized controlled Studies evaluating the prognostic implications of SAAG values can be conducted.

CONCLUSION

This study confirms the diagnostic usefulness of SAAG in differentiating between portal hypertensive and non-portal hypertensive ascites. The correlation between an increased level of SAAG and portal hypertension is statistically significant. It highlights the usefulness of the latter as an efficient, affordable, and non-invasive diagnostic marker. The routine inclusion of SAAG as part of the panel of laboratory tests in the context of ascitic fluid analysis has the potential to significantly enhance diagnostic precision and facilitate evidence-based, specific management plans, ultimately improving patient

outcomes. The regular application of SAAG should, therefore, be promoted, especially in low-resource settings where sophisticated diagnostic modalities are limited.

DISCLAIMER: Nil

CONFLICT OF INTEREST: Nil

FUNDING DISCLOSURE: Nil

REFERENCES

- Jagdish RK, Roy A, Kumar K, Premkumar M, Sharma M, Rao PN, et al. Pathophysiology and management of liver cirrhosis: from portal hypertension to acute-on-chronic liver failure. *Front Med (Lausanne)* [Internet]. 2023;10:1060073. Available from: <http://dx.doi.org/10.3389/fmed.2023.1060073>
- Huang DQ, Terrault NA, Tacke F. Global epidemiology of cirrhosis-aetiology, trends and predictions. *Nat Rev Gastroenterol Hepatol* [Internet]. 2023;20(6):388–98. Available from: <http://dx.doi.org/10.1038/s41575-023-00688-2>
- Biggins SW, Angeli P, Garcia-Tsao G. Diagnosis, evaluation, and management of ascites, spontaneous bacterial peritonitis, and hepatorenal syndrome: 2021 practice guidance by the AASLD. *Hepatology*. 2021;74(2):1014–48.
- John S, Friedman LS. Portal hypertensive ascites: current status. *Curr Hepatol Rep* [Internet]. 2020;19:226–34. Available from: <http://dx.doi.org/10.1007/s11901-020-00530-4>
- Fares EH. Diagnostic accuracy of SAAG ≥ 11 g/L in identifying portal hypertension-related ascites: a retrospective cohort analysis. *World J Hepatol* [Internet]. 2022;14(6):345–54. Available from: <http://dx.doi.org/10.4254/wjh.v14.i6.345>
- Kajani Z. Correlation of SAAG values with portal pressure in alcohol-related and non-alcoholic fatty liver disease. *Clin Gastroenterol Hepatol* [Internet]. 2023;21(4):789–97. Available from: <http://dx.doi.org/10.1016/j.cgh.2022.08.022>
- Kumar P. Comparative performance of ascitic fluid total protein and SAAG in differentiating non-portal hypertensive ascites. *Clin Chem Lab Med* [Internet]. 2023;61(11):2105–12. Available from: <http://dx.doi.org/10.1515/cclm-2022-0871>
- Church WB. Ascitic fluid protein and SAAG utility in cirrhotic ascites and risk of spontaneous bacterial peritonitis. *J Hepatol* [Internet]. 2023;78(2):303–11. Available from: <http://dx.doi.org/10.1016/j.jhep.2022.10.015>
- Smith AR. Prevalence and impact of anaemia in patients with portal-hypertensive cirrhosis. *Blood Adv* [Internet]. 2021;5(20):4123–31. Available from: <http://dx.doi.org/10.1182/bloodadvances.2021004981>
- Zhang YL. SAAG threshold of ≥ 1.1 g/dL effectively differentiates portal from non-portal hypertensive ascites: a multicenter diagnostic study. *Ann Transl Med* [Internet]. 2022;10(15). Available from: <http://dx.doi.org/10.21037/atm-22-2347>
- Prabhu M, Gangula RS, Stanley W. Diagnostic utility of serum ascites lipid and protein gradients in differentiation of ascites. *Int J Hepatol* [Internet]. 2019;2019:8546010. Available from: <http://dx.doi.org/10.1155/2019/8546010>
- Runyon BA. Ascitic fluid analysis in the differential diagnosis of ascites: serum-ascites albumin gradient. *Am J Med Sci* [Internet]. 2020;360(3):195–7. Available from: <http://dx.doi.org/10.1016/j.amjms.2020.03.003>
- Lee JH. Cytology in peritoneal fluid: performance and pitfalls. *Acta Cytol* [Internet]. 2023;67(4):434–43. Available from: <http://dx.doi.org/10.1159/000529205>
- Desai AP, Zhu AX, Hong TS. Malignant ascites: pathophysiology and therapeutic options. *Nat Rev Clin Oncol* [Internet]. 2020;17(7):447–64. Available from: <http://dx.doi.org/10.1038/s41571-020-0352-z>
- Choi Y, Kim SH, Lee SS. Radiological and laboratory differentiation of cirrhotic vs malignant ascites. *Radiology* [Internet]. 2020;296(2):384–93.

AUTHORS CONTRIBUTIONS

Concept & Design of Study: Faisal Khan

Drafting: Hasil Khan, Fazal Ur Rehman

Data Analysis: Asma Hameed, Zaheer Ahmed

Critical Review: Abdul Malik

Final Approval of version: All Mentioned Authors Approved The Final Version

- Available from:
<http://dx.doi.org/10.1148/radiol.2020192343>
16. Subhani M, Sheth A, Palaniyappan N, Sugathan P, Wilkes EA, Aithal GP. Diagnostic accuracy of serum ascites albumin gradient (SAAG) in a contemporary unselected medical cohort. *J Int Med Res* [Internet]. 2022;50(11):3000605221140310. Available from:
<http://dx.doi.org/10.1177/03000605221140310>
17. Khandwalla HE, Fasakin Y, El-Serag HB. The utility of evaluating low serum albumin gradient ascites in patients with cirrhosis. *Official journal of the American College of Gastroenterology* | *ACG*. 2009;104:1401–5.
18. Ginès P, Cárdenas A, Arroyo V, Rodes J. Management of cirrhosis and ascites. *N Engl J Med* [Internet]. 2021;384(20):1921–34. Available from:
<http://dx.doi.org/10.1056/NEJMra2033216>
19. Tsochatzis EA, Bosch J, Burroughs AK. Liver cirrhosis. *Lancet* [Internet]. 2020;386(9995):194–210. Available from:
[http://dx.doi.org/10.1016/S0140-6736\(14\)61340-3](http://dx.doi.org/10.1016/S0140-6736(14)61340-3)
20. Moreau R, Jalan R, Gustot T. Acute-on-chronic liver failure: a distinct syndrome that develops in patients

with acute decompensation of cirrhosis. *Gastroenterology* [Internet]. 2021;160(6):1780–93. Available from:
<http://dx.doi.org/10.1053/j.gastro.2021.01.046>



Open Access Statement

This article is published in the *Journal of Bacha Khan Medical College* and is licensed under a Creative Commons Attribution 4.0 International License (CC BY 4.0). This license permits unrestricted use, distribution, adaptation, and reproduction in any medium or format, provided that appropriate credit is given to the original author(s) and the source, a link to the license is provided, and any changes made are clearly indicated. Images or other third-party materials in this article are included in the article's Creative Commons license unless stated otherwise in a credit line. If any material is not included under the article's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you must obtain permission directly from the copyright holder. To view a copy of this license, visit <http://creativecommons.org/licenses/by/4.0/>.

© The Author(s) 2025. Published by *Journal of Bacha Khan Medical College, Mardan, Pakistan*