

# Significance of Serum Ascites Albumin Gradient and Ascitic Fluid Cholesterol in Classification of Ascites

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## ABSTRACT

The ascitic fluid examination forms an important and integral part of diagnosis. The present study aims to know the use of serum ascites albumin gradient and ascitic fluid cholesterol levels in the classification of type of ascites. The study consists of 60 samples collected from ascetic fluid and also serum and the protein levels are estimated by Biuret method and albumin levels by BromoCresol Dye (BCG) dye method. The difference in the levels of serum albumin and ascitic fluid albumin is given as Serum Ascitic Albumin Gradient(SAAG). The cholesterol levels in serum and ascetic fluid is estimated by Zak's method. There is no any significant change in the value of total protein and albumin between ascetic fluid and serum samples. The SAAG > 1.1 indicates portal hypertension and there is a significant change in the value of ascetic fluid obtained with portal hypertension when compared to without portal hypertension. There is also significant difference in the levels of ascitic fluid cholesterol with portal hypertension and without portal hypertension.

**KEY WORDS:** Ascetic fluid, SAAG, Portal hypertension, cholesterol.

## Introduction

Ascites can be defined as an abnormal collection of free fluid in the peritoneal cavity [1]. The peritoneal cavity is lined by the visceral and peritoneal layers. Normally 1500ml of fluid is present in peritoneal cavity for lubrication. When the collection of this fluid reaches above 1500ml, then ascites become clinically evident [2].

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The various factors that contribute to accumulation of fluid in the abdominal cavity. [3 –4].

1. Elevated levels of epinephrine and nor – epinephrine.
2. Increased central sympathetic out flow.
3. Increased hydrostatic pressure within splanchnic capillary bed as seen in patients with portal hypertension.
4. Hypo albuminaemia and reduced plasma oncotic pressure.
5. Elevation of pressure in hepatic sinusoids.
6. Renal factors.

The ascitic fluid is collected by a relatively easy invasive procedure called as ‘paracentesis’. The collected ascetic fluid is routinely tested for

Cell count – to diagnose ascetic infection.

Culture – to confirm presence of bacteria which helps in antibiotic therapy.

Total protein – to categorise the fluid into exudates and transudate types

If the protein levels are more than 2.5gm% it is exudates and if it is less than 2.5gm% then it is transudate type. This exudates – transudate concept was based on the fact that exudates fluid is from the inflamed and tumor laden peritoneal surface hence it is high in protein. The transudate fluid is from normal peritoneal surface is low in protein because of imbalance in Starling forces. [5] This exudates – transudate type of classification is based on total protein cutoff value 2.5gm% is proved wrong in cases like malignancy / multiple infections, sometimes even in the absence of infection it came in exudates range. To overcome this, the concept of SAAG was introduced. This classifies ascites as portal hypertension related and non portal hypertension related.

The SAAG is accurate in 96.7% cases even in the presence of diuresis, albumin infusion and it is inaccurate in mixed ascites, hypoalbuminaemia. The presence of increased albumin gradient indicates portal hypertension. The ascitic fluid cholesterol levels are sensitive in diagnosing malignant related ascites.

**Table 1 : Causes of High and low gradients [6]**

High Gradient(>1.1 gm%)	Low Gradient(<1.1 gm%)
Cirrhosis	Peritoneal carcinomatosis
Alcoholic Hepatitis	Tubercular peritonitis
Cardiac Ascites	Carcinomas of organs covered by peritoneum
Fulminant Hepatic failure	Pancreatitis
Portal Vein thrombosis	

The present study helps to know the significance of SAAG and serum and ascitic fluid cholesterol in classification of ascitic fluid.

### Materials And Methods

The present study includes 60 patients diagnosed to have ascites and undergoing treatment

at general hospital at Chalmeda Ananda Rao Institute of Medical Sciences (CAIMS), Bommakal, Karimnagar.

The 60 patients with ascites were divided into 2 groups

#### Group I

Ascites with cirrhosis and portal hypertension – 30

Alcoholic induced liver cirrhosis – 15

Hepatitis – 15

#### Group II

Ascites with cirrhosis and without hypertension – 30

Cancer of colon – 9

Cancer of ovary – 9

Multiple lymphoma – 1

abdomin of Koch – 8

Infective pancreatitis – 2

Cancer of stomach – 1

### Inclusion criteria

Ascites with portal hypertension:

Splenomegaly h/o GI bleeding distended veins over abdomen portal vein dilatation

Ascites without portal hypertension:

Oesophageal varices

### Exclusion criteria

Coagulation abnormalities

Hemodynamic instability

Tense ascites

### Anterior abdominal wall infection

The ascitic fluid is collected by paracentesis and is collected in EDTA bottle. 5ml venous blood sample is also collected in a plain tube and is allowed to clot at room temperature. The

clot was retracted and serum was separated by centrifugation at 3000rpm. Ascitic fluid and serum samples were subjected to following investigations:

1. Serum and ascitic fluid albumin levels
2. Serum and ascitic fluid protein levels
3. Serum and ascitic fluid cholesterol levels.

## Results

There is no any significant change in total protein levels between serum and ascetic fluid. But the total protein levels are less ( $1.38 \pm 0.68$ ) in group I (with portal hypertension) compared to group II (without portal hypertension) ( $3.76 \pm 0.91$ ). The total protein levels in serum and ascetic fluid are shown in table2

**Table2 : Levels of total protein in serum and ascetic fluid**

Group	S. Albumin (mean±SD)	A. Albumin (mean±SD)	SAAG (mean±SD)
Group I	$3.2 \pm 0.66^*$	$0.84 \pm 0.49^{**}$	$2.41 \pm 0.81^{***}$
Group II	$3.26 \pm 0.42^*$	$2.35 \pm 0.96^{**}$	$0.91 \pm 0.82^{***}$

\*  $p > 0.05$       \*\*  $p > 0.01$

There is no any significant difference in the values of serum total protein, serum albumin, serum cholesterol in group I and group II patients. The ascetic fluid albumin levels are significantly less in group I ( $0.84 \pm 0.49$ ) compared to group II ( $2.35 \pm 0.96$ ). The SAAG cut off value is  $1.1 \text{ gm\%}$  and in group II is  $0.91 \text{ gm\%}$ . The SAAG  $> 1.1$  indicates portal hypertension and  $< 1.1$  absence of portal hypertension. The levels of albumin in serum and ascetic fluid is shown in table3

There is gross elevation of cholesterol levels in group II ( $85.1 \pm 19.55$ ) and is almost double the value in group I. The levels of cholesterol in serum and ascetic fluid are shown in table4

**Table 3 : Levels of albumin in serum and ascetic fluid and value of SAAG**

Group	S. Albumin (mean±SD)	A. Albumin (mean±SD)	SAAG (mean±SD)
Group I	$3.2 \pm 0.66^*$	$0.84 \pm 0.49^{**}$	$2.41 \pm 0.81^{***}$
Group II	$3.26 \pm 0.42^*$	$2.35 \pm 0.96^{**}$	$0.91 \pm 0.82^{***}$

\*  $p > 0.05$       \*\*  $p < 0.01$       \*\*\*  $p < 0.001$

**Table4: Levels of cholesterol in serum and ascetic fluid**

Group	S. Cholesterol (mean± SD)	A. Cholesterol (mean ±SD)
Group I	$157.8 \pm 26.2^*$	$29.6 \pm 12.28^{**}$
Group II	$155.1 \pm 57.9^*$	$85.1 \pm 19.55^{**}$

\*  $p > 0.05$       \*\*  $p < 0.014$

## Discussion

Role of body fluid examination in the diagnosis of disease cannot be neglected. The examination of body fluid is easy because of the simplicity of body fluid analysis.

According to Starling's hypothesis, interchange of fluid between blood and tissue is controlled by the balance between

- i) Capillary blood pressure forcing the fluid into space
- ii) Osmotic pressure of plasma protein, which retains fluid in the intravascular compartment [7]

Important factors determining transudative or exudative nature of ascites[8]:

**TRANSUDATIVE** – When ascites is associated with increased hydrostatic pressure and decreased serum osmotic pressure or both.

**EXUDATIVE** – Ascites associated with inflammation of membrane lining peritoneal cavity, malignant metastasis of the membrane.

The easy test to differentiate exudate and transudate type of ascites is the level of ascetic

fluid total protein(AFTP). Transudative ascites is protein poor while exudative ascites is protein rich. Cut off value of AFTP widely used is 2.5gm% [9].

The presence of ascites and composition of ascetic fluid depends on process of formation of ascites and rate and mechanism of reabsorption of ascetic fluid[10]. But recently Rector W.G (1984) and Runyon BA (1992) noted that by using AFTP for differentiating ascites many patients are misclassified [11]. So, for proper differentiation an improved diagnostic approach to ascites has been described. This approach utilizes the level of albumin in serum and ascetic fluid to estimate a gradient between the two which is called as Serum Ascites Albumin Gradient(SAAG).

SAAG is a gradient and not a ratio. We know that albumin is major determinant of oncotic pressure in the serum, SAAG is directly related to oncotic pressure gradient and thus proportional to portal pressure gradient. Hoef J.C (1983) and Rector W G (1984) showed that this diagnostic approach of SAAG is directly related to oncotic pressure gradient between splanchnic vasculature and ascites [12]. The cut off value of SAAG is 1.1gm%, if it is <1.1gm% absence of portal hypertension and if it is > 1.1gm% it is due to portal hypertension.

SAAG is superior over AFTP because SAAG is directly related to portal pressure whereas AFTP is inversely related to portal pressure [13]. Thus the superiority of albumin gradient should replace total protein level as the initial factor used to classify ascites. Thus the superiority of albumin gradient should replace total protein level as the initial factor used to classify ascites. Thus ascetic fluid sample should be characterized by high or low gradient rather than as transudate / exudate type [14].

The variation in the protein levels of serum and ascetic fluid is due to an imbalance

between oncotic pressure and hydrostatic pressure. These pressures can be analyzed in terms described by Starling between serum and lymph [15]. The lymphatic fluids formed in the organs like liver and intestine respond to increase in capillary hydrostatic pressure by widening the oncotic pressure. The decreased protein levels in ascetic fluid of patients with liver cirrhosis, portal hypertension is due to widening of plasma-ascites-oncotic pressure gradient and vice versa .

The high cholesterol level in malignant related ascites is due to obstruction in lymph flow causing a rupture of lymphatic channel, chyle is secreted into peritoneal cavity. Thus there is increased cholesterol level of ascetic fluid. The other sources of ascetic fluid cholesterol is cell membrane of malignant cells which are shed into peritoneal cavity .

Thus, considering the advantages of measuring SAAG, and ascetic fluid cholesterol content in illuminating the pathogenic mechanism of ascites and the ease with which this test can be done with existing equipments and techniques, it is suggested that these parameters could be advocated in routine analysis of ascetic fluid.

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