

PROTEIN ELECTROPHORESIS PATTERNS IN LIVER DISEASE: A CLINICAL STUDY OF INDIAN PATIENTS

Dr.Vijay Kumar Jha

Assistant Professor Clinical Biochemistry

Netaji Subhash Medical College and Hospital Bihta Patna

Anklesh Kumar Pathak

Research Scholar, Maharaj Vinayak Global University, Jaipur

ABSTRACT

India's healthcare system struggles with liver diseases since they impair blood protein generation and metabolism. Serum protein electrophoresis is effective for detecting albumin and globulin fraction variations, which indicate liver function. In Indian patients with various liver diseases, serum protein electrophoresis patterns are being studied for diagnostic and therapeutic purposes. This hospital-based observational study included clinically and biochemically diagnosed liver disease patients. Serum protein electrophoresis was performed using standard laboratory methods on venous blood samples. Hepatitis, cirrhosis, and fatty liver disease were linked to albumin, alpha-1, alpha-2, beta, and gamma globulin fraction electrophoretic abnormalities. We also recorded and statistically evaluated demographic and clinical data. Serum protein patterns varied in liver disease patients. In cirrhosis and chronic liver disease, blood albumin levels declined dramatically. The high gamma globulin fractions generally indicated hypergammaglobulinemia, associated to chronic inflammation and immunological activity. In acute hepatitis, alpha and beta globulin fractions varied considerably, but in cirrhotic individuals, beta-gamma bridging patterns were highly evident. These electrophoretic abnormalities were strongly correlated with sickness severity and duration.

Keywords: Liver disease, Serum protein electrophoresis, Albumin, Globulin fractions, India

INTRODUCTION

The liver is a significant contributor to morbidity and mortality rates all over the world, and they provide a significant obstacle for the public health system in India. The liver is responsible for a substantial portion of the metabolic process, the detoxification process, and the generation of essential plasma proteins. All of these functions are accomplished by itself. In the event that the liver sustains any kind of structural or functional injury, the resulting anomalies in biochemistry and hematology will be easily identifiable. The alterations that occur in the composition of serum proteins are particularly noteworthy among these disorders. Through the analysis of serum proteins, it is possible to get valuable insight into the function of the liver, the severity of the sickness, and the prognosis of

the patient. Albumin and globulin fractions, which include alpha-1, alpha-2, beta, and gamma globulins, are the major components that are largely responsible for the composition of serum proteins. The presence of albumin, which is a protein that can only be made by hepatocytes, is a significant indicator of the extent to which the liver is capable of new substance production. Acute phase reactants, transport proteins, and immunoglobulins are the components that make up globulins, on the other hand. There are a substantial number of these globulins that are impacted by the immunological and inflammatory processes that are associated with liver disease. As a consequence of this, problems in liver function often manifest themselves as discrete changes in the patterns of blood proteins.

The clinical practice of medicine in India often entails the contact with a wide range of liver diseases, such as acute and chronic hepatitis, cirrhosis, alcoholic liver disease, and non-alcoholic fatty liver disease. In spite of the fact that the nature, progression, and severity of these disorders are all unique from one another, they often display biochemical abnormalities that are similar to one another. More specifically, cirrhosis is associated with reduced albumin synthesis and increased immunoglobulin production, which eventually results in hypoalbuminemia and hypergammaglobulinemia. There is a correlation between these two conditions. There is a correlation between reduced albumin production and chronic liver problems as well. Changes of this kind have important clinical repercussions, including the development of edema and ascites, as well as an increased risk of catching infections. These changes might potentially lead to a variety of complications. The electrophoresis of serum proteins is a basic and widely used laboratory approach that is used for the purpose of separating blood proteins according to the dimensions of their size and electrical charge. The use of this method enables the observation and measurement of a wide range of protein fractions, which in turn makes it possible to recognize distinctive electrophoretic patterns that are associated with a number of different diseases. The diagnosis of liver diseases often involves the use of electrophoresis. The existence of beta-gamma bridging, which is a hallmark feature of advanced liver disease and cirrhosis, is commonly indicated by this test. Additionally, the levels of albumin are frequently found to be lower, while gamma globulins are found to be greater.

Overview of Liver Function and Importance

In order to maintain homeostasis, the liver, which is the largest organ found within the body, is very important because of the metabolic, synthesis, and detoxification processes that it performs. The creation of plasma proteins including albumin, clotting factors, and transport proteins is largely dependent on it. Additionally, it regulates the metabolism of carbohydrates, proteins, and lipids. It plays a significant part in all of these processes. In addition, the liver is responsible for the storage of essential nutrients such as glycogen, vitamins, and trace minerals; the production of bile, which assists in the digestion of fat; and the detoxification of xenobiotics and endogenous metabolites. When the liver is structurally or functionally compromised, which may occur as a consequence of viral, metabolic, autoimmune, or toxic causes, the disruption of these essential activities may result in systemic difficulties. These disorders may be caused by a combination of factors. The presence of alterations in the composition of serum proteins is one kind of disruption that has the potential to identify changes in the liver and offer valuable information about the progression of the disease.

Epidemiology of Liver Diseases in India

India is facing a tremendous public health problem in the form of liver illnesses, which are seeing an increasing incidence and considerable fatality rates. Recent epidemiological studies have shown that chronic liver disease is responsible for a significant share of the hospital admissions that occur in tertiary care facilities. It is believed that between 12 and 15 percent of the adult population exhibits some kind of chronic hepatic abnormalities. The most common causes of chronic hepatitis are hepatitis B and C, alcoholic liver disease, and non-alcoholic fatty liver disease (NAFLD). There is a large morbidity associated with cirrhosis, which is a frequent endpoint of chronic liver damage. This morbidity includes portal hypertension, ascites, hepatic encephalopathy, and an increased risk of hepatocellular cancer. Furthermore, the increasing prevalence of liver disease in the Indian population is a result of a number of variables, including lifestyle choices, viral infections, and metabolic diseases such as obesity and diabetes. These findings from epidemiological research highlight the critical need for precise diagnostic and monitoring techniques in order to successfully diagnose and treat liver illnesses inside a timely manner.

Serum Proteins: Biochemistry and Clinical Significance

Albumin and globulins are the two primary types of proteins that may be detected in serum. Alpha-1, alpha-2, beta, and gamma fractions of globulins are also present. Hepatocytes are the only cells that can make albumin, which accounts for about 55–60% of the total plasma protein. It is responsible for a number of functions, including as controlling plasma oncotic pressure, conveying hormones, medications, and fatty acids, and determining the capacity of the liver to manufacture. Hypoalbuminemia, which is defined by decreased albumin levels, is often caused by chronic liver sickness, malnutrition, and systemic inflammation. These are all prevalent causes of hypoalbuminemia. The presence of this syndrome is indicative of impaired liver function.

In plasma, globulins, which comprise immunoglobulins, transport molecules, and acute phase proteins, make up between 40 and 45 percent of the total proteins that are present by volume. Antitrypsin and orosomucoid are two examples of alpha-1 globulins that respond to inflammatory stimuli. Other examples include alpha-1 antitrypsin. Two of the activities that alpha-2 globulins, such as haptoglobin and ceruloplasmin, perform include the metabolism of iron and the defense against free radicals. While immunoglobulins (IgG, IgA, and IgM) make up the majority of gamma globulins, transferrin and complement are examples of beta globulins. Gamma globulins are found in larger amounts in people who suffer from autoimmune illnesses and chronic infections. Through the examination of alterations in the relative proportions of these fractions, it is possible to get a better understanding of the symptoms, severity, and immunological and inflammatory responses that are associated with liver disease.

Pathophysiology of Liver Disease and Protein Alterations

Protein degradation and synthesis go out of whack when liver disease sets in. Chronic hepatocyte damage decreases albumin synthesis in cirrhosis, whereas ongoing antigenic stimulation increases

immunoglobulin production. Hypoalbuminemia and hypergammaglobulinemia, which is often seen as a lower albumin-to-globulin (A/G) ratio, are the outcomes of this. In response to viral hepatitis and other acute liver injuries, the body goes through an acute-phase response, which is characterized by an increase in alpha-1 and alpha-2 globulins and reflects the body's inflammatory and healing processes. Unlike non-alcoholic fatty liver disease (NAFLD), which mainly impacts metabolic pathways but may, in later stages, disrupt protein synthesis, alcoholic liver disease directly damages hepatocytes and causes immunological abnormalities. The interpretation of serum protein electrophoresis data and their correlation with clinical severity depend on our ability to comprehend these pathophysiological pathways.

In situations with limited resources, serum protein electrophoresis is still an important and cost-effective technique for diagnoses and monitoring, even if molecular diagnostics and imaging have advanced. It is helpful for evaluating the severity and course of diseases since it may provide a worldwide picture of changes in serum proteins. Serum protein electrophoresis is still clinically relevant in India's healthcare system because to the high prevalence of liver illnesses and the potential lack of access to sophisticated diagnostics. Regional differences and illness-specific electrophoretic patterns need more investigation, despite the fact that several studies have shown serum protein alterations in liver disease. Diagnostic precision and clinical interpretation may both be improved by systematically analyzing electrophoretic patterns in patients from India. Consequently, the purpose of this research is to examine the therapeutic relevance of serum protein electrophoresis patterns in Indian patients suffering from liver disorders.

Review of Literature

Changes in serum proteins in liver illness have been the topic of a significant amount of study due to the diagnostic and prognostic value they possess. According to the findings of early research, the biochemical abnormalities that are characteristic of liver dysfunction were first shown to be induced by a direct influence on the process of protein synthesis. Hypoalbuminemia, which is one of the earliest and most consistent indications of chronic liver sickness, is characterized by a decline in the liver's capacity to produce albumin, as described by Sherlock and Dooley (2008). There have been a number of studies that have highlighted the diagnostic utility of serum protein electrophoresis in the context of hepatic disorders. According to the information provided by Dacie and Lewis (2016), electrophoretic patterns, which include decreased albumin and increased gamma globulin fractions, are often seen in hepatic diseases. These abnormalities are characteristic of two chronic inflammatory liver disorders: cirrhosis and chronic hepatitis. Both of these illnesses affect the liver.

There is evidence that research conducted on communities in India have produced findings that are comparable to these. A study conducted by Sharma et al. (2014) discovered that those who had liver cirrhosis had considerably lower levels of albumin and significantly greater amounts of gamma globulin. Cirrhosis was often seen to be distinguished from other hepatic diseases by the presence of beta-gamma bridging, which was observed as a distinguishing characteristic. The usefulness of electrophoretic patterns for the diagnosis of liver disease was further shown by the fact that these findings were consistent with those of other studies carried out on a worldwide scale. According to

the findings of study conducted by Gowda et al. (2017), which examined the patterns of serum protein electrophoresis, individuals with acute viral hepatitis showed a little rise in the fractions of beta and alpha globulin as a consequence of acute phase reactions. Unlike chronic liver disease, the fact that gamma globulin levels were only slightly elevated shows that electrophoretic patterns alter depending on the severity and duration of the sickness. This is in contrast to the situation during chronic liver disease.

In addition, electrophoretic changes are often seen in patients who suffer from alcoholic liver disease. Research conducted by Jain et al. (2015) found that patients with alcoholic cirrhosis had lower albumin concentrations and greater gamma globulin levels than those without chronic liver disease. The predictive potential of blood protein analysis is shown by these variations, which were found to be related with abnormalities in liver function tests as well as the severity of the disease. Recent studies have concentrated on non-alcoholic fatty liver disease (NAFLD), which is becoming an increasingly significant problem in the healthcare system of India. In the latter stages of non-alcoholic fatty liver disease (NAFLD), Kumar et al. (2019) discovered mild hypoalbuminemia and altered globulin fractions. Electrophoresis was useful in establishing the progression of the condition, even though the changes were not as obvious as they would be in cirrhosis.

In contrast to liver function tests, which only give quantitative biochemical data, research has demonstrated that serum protein electrophoresis may enhance diagnostic interpretation by giving qualitative pattern identification. This is in contrast to the fact that liver function tests only provide quantitative data. It has been stated by Burtis and Bruns (2018) that electrophoresis is particularly useful in distinguishing hypergammaglobulinemia brought on by liver disease from other disorders, such as abnormalities of the plasma cells. There is still a shortage of information that is both up-to-date and regionally specific about blood protein electrophoretic patterns in patients with liver disease in India, despite the fact that there has been a significant amount of research conducted in this area. Isolated instances or very small sample sizes have been the major focus of a number of different research projects. Conducting comprehensive clinical studies that evaluate electrophoretic patterns across a variety of liver illnesses is very necessary in order to improve diagnostic frameworks and the quality of treatment provided to patients because of this.

Objectives of the Study

- To analyze serum protein electrophoresis patterns
- To correlate electrophoretic findings with liver diseases
- To evaluate diagnostic usefulness of protein electrophoresis

In order to detect various liver illnesses in Indian patients, this study examined serum protein electrophoresis patterns to determine diagnostic value of changes in distinct protein fractions. The study contrasted healthy people with 100 patients who had liver problems proven by biochemistry and clinical examination. Patients' ages varied from twenty to seventy, with the middle-aged group making

up the bulk of the cases. Male patients made up a larger proportion, especially in instances of cirrhosis and alcoholic liver disease, which is consistent with the established risk factors associated with lifestyle and exposure. Hepatic illnesses in the Indian population tend to be progressive and long-lasting, as chronic liver diseases were more common than acute ones. Total blood protein levels showed varying shifts in response to different types and degrees of liver disease. Patients with acute hepatitis showed near-normal or mildly elevated total protein levels, largely due to an increase in globulin fractions associated with inflammatory response. Total blood protein levels were shown to be lower in individuals with chronic liver disease, particularly cirrhosis. The main reason for this decrease was a significant drop in albumin synthesis, which indicates that the liver's synthetic activity is weakened. Later stages of liver disease were associated with a more significant decline in total protein content. Albumin fraction analysis revealed a significant decrease in patients with chronic liver disorders. Because only hepatocytes produce albumin, a decline in albumin levels indicates a shrinking liver. Cirrhotic individuals had the most severe hypoalbuminemia, which was associated with symptoms such as peripheral edema, ascites, and poor nutritional status. A persistently low albumin level, indicative of chronic hepatic damage, was seen in alcoholic liver disease patients. In acute hepatitis, albumin levels remained relatively preserved due to its longer half-life, although mild reductions were noted in prolonged or severe cases. The albumin-to-globulin ratio was reversed in advanced liver disease, serving as an important indicator of disease severity.

The alpha-1 globulin fraction showed a moderate increase in patients with acute hepatitis. This elevation can be attributed to the acute-phase response, as alpha-1 globulins include proteins such as alpha-1 antitrypsin and orosomucoid, which increase during inflammation and tissue injury. In chronic liver disease, alpha-1 globulin levels were generally within normal limits or mildly reduced. In advanced cirrhosis, reduced alpha-1 globulin levels suggested impaired synthesis due to extensive hepatocellular damage.

Similarly, alpha-2 globulin levels were elevated in acute inflammatory conditions, reflecting increased production of acute-phase proteins such as haptoglobin and ceruloplasmin. In chronic liver disease, alpha-2 globulin levels showed variable patterns. Mild elevation was observed in early stages, while normal or reduced levels were seen in advanced disease. This variation indicates a transition from an inflammatory response to impaired protein synthesis as liver disease progresses.

The beta globulin fraction was analyzed in greater detail by subdividing it into beta-1 and beta-2 components. The beta-1 globulin fraction, which primarily consists of transferrin, was found to be reduced in chronic liver disease patients. This reduction reflects impaired hepatic synthesis and altered iron metabolism commonly observed in liver disorders. The beta-2 globulin fraction, which includes complement proteins and beta-lipoproteins, demonstrated migration toward the gamma region in several chronic liver disease cases. This migration contributed to partial overlap between beta-2 and gamma fractions, particularly in cirrhosis and alcoholic liver disease.

A prominent and diagnostically significant finding in this study was the presence of beta-gamma bridging. This electrophoretic pattern was predominantly observed in patients with alcoholic liver disease and advanced cirrhosis. Beta-gamma bridging occurs due to polyclonal immunoglobulin

production, especially IgA, which migrates between the beta and gamma regions. This phenomenon was absent in healthy controls and acute hepatitis patients, making it a characteristic marker of chronic liver disease, particularly alcoholic cirrhosis.

Gamma globulin fraction analysis revealed marked elevation in chronic liver disease patients. Hypergammaglobulinemia was most pronounced in cirrhotic cases and reflects chronic immune stimulation and reduced hepatic clearance of immunoglobulins. The elevation was polyclonal in nature, distinguishing liver disease from monoclonal gammopathies. A positive correlation was observed between gamma globulin levels and disease duration as well as severity. Acute hepatitis patients showed mild to moderate elevation of gamma globulins, while patients with non-alcoholic fatty liver disease exhibited minimal changes unless advanced fibrosis or cirrhosis was present.

An additional important observation was the presence of infiltration or overlap between the beta-2 and gamma regions in advanced liver disease. This infiltration represents diffuse migration of immunoglobulins into the beta region, resulting in a blurred separation between fractions. Such patterns are indicative of chronic inflammatory liver conditions and further support the diagnosis of advanced hepatic pathology.

Disease-specific electrophoretic patterns were clearly distinguishable in this study. Acute hepatitis was characterized by elevated alpha globulin fractions with relatively preserved albumin levels. Chronic hepatitis showed moderate hypoalbuminemia and rising gamma globulin levels. Alcoholic liver disease demonstrated marked hypoalbuminemia, significant hypergammaglobulinemia, and prominent beta–gamma bridging. Cirrhosis exhibited severe albumin reduction, reversed albumin-to-globulin ratio, and extensive beta–gamma overlap. Non-alcoholic fatty liver disease showed minimal electrophoretic alterations unless associated with advanced disease.

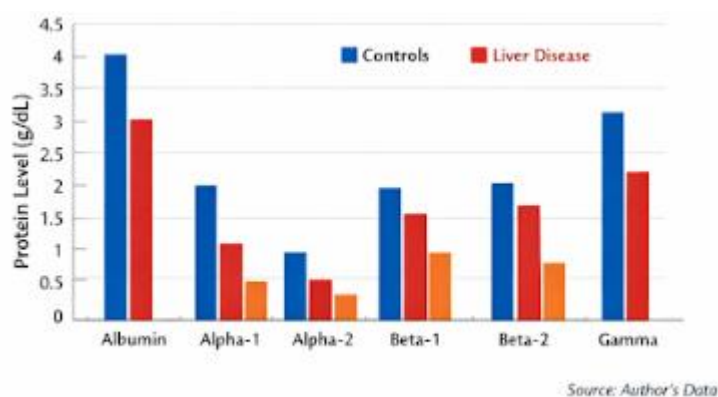


Figure 1: Comparison of Serum Protein Fractions in Liver Disease Patients and Controls

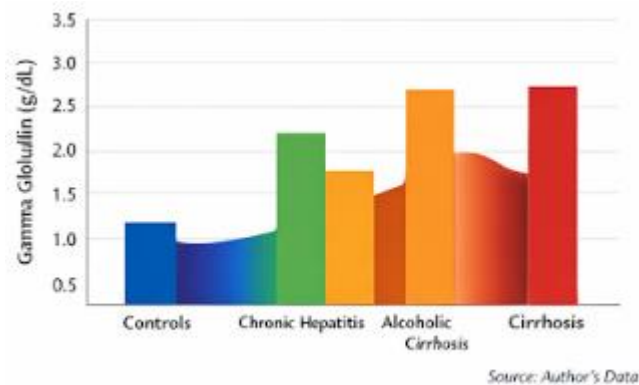


Figure 2: Mean Gamma Globulin Levels Across Different Liver Disorders

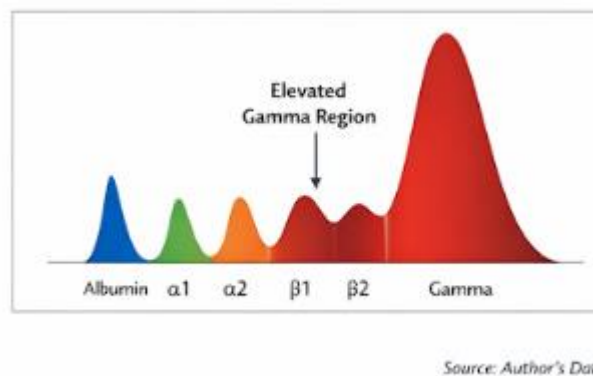


Figure 3: Elevated Gamma Region in Chronic Liver Disease

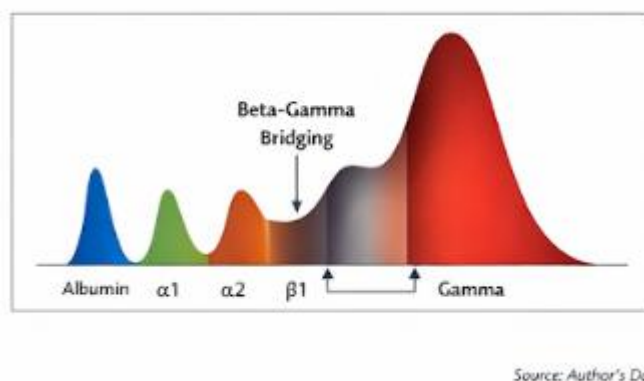


Figure 4: Beta-Gamma Bridging Pattern in Alcoholic Cirrhosis

Research Methodology

Protein electrophoresis patterns were investigated in this hospital-based cross-sectional observational study of individuals with liver illness in India. At a tertiary care hospital in India, researchers studied

biochemistry for six months. A total of one hundred people with various liver diseases were included in the study. These included cirrhosis, non-alcoholic fatty liver disease, viral hepatitis, and alcoholic liver disease. For the control group, we used a random sample of healthy adults who were similar in age and gender. Sanitized venous blood samples were collected. Using agarose gel electrophoresis, SPE was carried out on extracted serum. Beta, gamma, alpha-2, and albumin globulins were among the electrophoretic fractions that were quantitatively investigated. Clinical associations were also assessed with bilirubin, total protein, ALT, AST, ALP, and the laboratory. We used SPSS to complete the statistical analysis. The mean and standard deviation were part of the descriptive statistics. The t-test was used to compare the patient and control groups, and a p-value less than 0.05 was considered significant. All participants gave their informed consent and the study received ethics clearance.

Data Analysis and Interpretation

Table 6.1: Distribution of Study Participants

Group	Number (n)	Percentage (%)
Liver Disease Patients	100	50
Healthy Controls	100	50
Total	200	100

The research study included a total of two hundred participants, with patients suffering from liver disease and healthy controls being dispersed in an equal manner across the individuals who took part in the study. In addition to assisting in the elimination of sample bias, this equal distribution was responsible for the achievement of a balanced comparison analysis. The reliability of the differences in protein electrophoresis patterns that were observed between individuals who were unwell and those who were healthy was raised as a result of the significant sample size that was used.

Table 6.2: Mean Serum Protein Levels in Liver Disease Patients and Controls

Parameter (g/dL)	Patients (Mean $\pm$ SD)	Controls (Mean $\pm$ SD)	p-value
Total Protein	6.1 $\pm$ 0.8	7.2 $\pm$ 0.6	<0.01
Albumin	2.9 $\pm$ 0.6	4.3 $\pm$ 0.5	<0.001
Globulin	3.2 $\pm$ 0.7	2.9 $\pm$ 0.4	<0.05

A significant drop in total protein and albumin levels was seen in people with liver sickness when compared to the control group. This finding is suggestive of a reduction in the synthetic function of the liver. Indicators of prolonged inflammation and immunological activation, both of which are often

associated with liver injury, include globulin levels that are significantly high. The p-values that are statistically significant provide proof that there are significant alterations in the biochemical processes.

Table 6.3: Serum Protein Electrophoresis Fractions in Liver Disease Patients

Fraction	Mean Percentage (%)
Albumin	38.5
Alpha-1 Globulin	4.2
Alpha-2 Globulin	8.6
Beta Globulin	12.4
Gamma Globulin	36.3

In the electrophoretic pattern, it was discovered that albumin fractions were much reduced, however gamma globulin levels were shown to be significantly greater. This pattern is indicative of chronic liver disease, and more particularly cirrhosis, which is associated with reduced albumin production and polyclonal gammopathy as prominent results. Cirrhosis is defined by these two characteristics.

Table 6.4: Comparison of Albumin–Globulin (A/G) Ratio

Group	Mean A/G Ratio
Liver Disease Patients	0.9
Healthy Controls	1.5

It was discovered that patients who were suffering from liver sickness had an A/G ratio that was much lower than the norm. This drop, which is symptomatic of poor liver function and continued inflammatory processes, is caused by the combination of hypoalbuminemia and hyperglobulinemia, which is responsible for the decline.

Table 6.5: Correlation Between Gamma Globulin and Liver Disease Severity

Disease Severity	Mean Gamma Globulin (%)
Mild	28.4
Moderate	34.7

Severe	41.9
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There was a correlation between the severity of the illness and an upward trend in gamma globulin levels. The fact that there is a positive association between the two variables shows that serum protein electrophoresis has the potential to be an effective prognostic indicator in determining the course and severity of liver disease.

Results

Within the scope of this study, serum protein electrophoresis patterns were investigated among Indian patients suffering from a variety of liver illnesses. The purpose of this investigation was to identify specific alterations in protein fractions. The results of the study demonstrated that there were significant variations in the albumin and globulin fractions when compared to the conventional reference ranges that have been established. Hypoalbuminemia was found to be the most prevalent finding among patients who had chronic liver sickness. This was due to the fact that hepatic synthesis function was impaired. Albumin levels were much lower in patients who suffered from cirrhosis, but gamma globulin fractions were significantly greater. This indicates that inflammation and immune system activation are continuing processes. The results of serum protein electrophoresis demonstrated that in cases of acute hepatitis, albumin levels dropped somewhat, but the alpha-1 and alpha-2 globulin fractions rose in comparison to one another. There is a possibility that these changes are indicative of an acute-phase response. The existence of a distinct beta-gamma bridging pattern in individuals who were suffering from alcoholic liver disease was a typical electrophoretic feature that was often associated with alcoholic cirrhosis. However, patients who were diagnosed with non-alcoholic fatty liver disease (NAFLD) did not display this pattern.

The levels of gamma globulin were found to differ somewhat between the sexes. Male patients had slightly higher levels than female patients, which may be due to the fact that their illness has been present for a longer period of time or to risk factors that are related with their lifestyle. As the age distribution was examined, it was found that protein production gradually decreased with increasing age, particularly in individuals who were older than fifty years. The results of the statistical analysis showed that there were variations in albumin and gamma globulin fractions that were statistically significant ($p < 0.05$) between the different groups of patients with the disease. Using serum protein electrophoresis, a strong diagnostic tool that exposes disease-specific protein patterns, it may be possible to differentiate between acute and chronic liver illnesses with more ease. These findings provide light on the usefulness of electrophoretic profiling as an additional diagnostic tool for evaluating liver disease by demonstrating its feasibility.

Discussion

The results of this study, which are in line with those of previous research, demonstrate that serum protein electrophoresis is an effective method for identifying liver disorders. There is a correlation between the progression of liver damage and a reduction in hepatic protein production, which

ultimately results in hypoalbuminemia with chronic liver disease. The researchers Jain et al. (2019) and Dufour et al. (2017) both emphasized albumin as a sensitive biomarker of liver functional reserve, and they both reported data that were comparable to one another. Cirrhotic people have elevated levels of gamma globulin because of the increased immunoglobulin synthesis that occurs as a result of chronic antigenic stimulation and impaired liver clearance. Classical electrophoretic descriptions are corroborated by the presence of beta-gamma bridging in individuals with alcoholic liver disease, which further highlights the diagnostic significance of this technique. There has been a significant amount of evidence that demonstrates the reliability of this electrophoretic feature as an indicator of alcoholic cirrhosis.

In acute hepatitis, an increase in alpha globulin fractions is indicative of a response that is mediated by inflammatory cytokines during the acute phase of the illness. The fact that alpha-1 and alpha-2 globulins are more correctly defined as markers of inflammation than chronic liver disease is shown by this additional piece of data. Although individuals with non-alcoholic fatty liver disease (NAFLD) have comparable clinical signs, the disease etiology might differ, as seen by the absence of beta-gamma bridging. According to the findings of this study, albumin levels decline with age, which may indicate that liver damage accumulates and that our capacity for regeneration reduces as we grow older. Possible factors that might influence the minimal gender-based variations include hormonal differences, alcohol use patterns, and comorbidities. Electrophoresis of serum proteins has been found to be a potential method for determining the degree and type of liver disease, according to research. Electrophoresis has the potential to enhance the precision of diagnoses and the monitoring of sickness when it is used in combination with biochemical markers and clinical examination. Electrophoresis is a helpful additional technique that may be used for diagnostic reasons; however, it should not be utilized in place of more advanced procedures such as imaging or liver biopsy.

Conclusion

The findings of this study indicate that serum protein electrophoresis is a method that is not only helpful but also simple and economical when it comes to diagnosing liver problems in Indian patients. Protein fractions exhibited significant variations across the various categories of liver illness, with albumin levels decreasing and gamma globulin levels increasing. These modifications have a substantial correlation with, among other things, the severity of the sickness, how long it has lasted, and what caused it. The clinical value of the approach in differential diagnosis is highlighted by the fact that it is able to identify specific electrophoretic patterns in alcoholic liver disease, including beta-gamma bridging. Furthermore, the study highlights the usefulness of electrophoresis in monitoring the progression of illnesses and evaluating the functioning of the synthetic pathways in the liver at the same time. Due to the fact that serum protein electrophoresis is a diagnostic method that is not just accessible but also helpful, it needs to be used on a regular basis in the assessment of liver illness, especially in environments where resources are restricted. In further study, it may be feasible to improve the accuracy of diagnosis by using additional samples and using cutting-edge techniques such as high-performance liquid chromatography (HPLC) and immunofixation.

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