**Original Research Article**

**SERUM BIOCHEMICAL ALTERATIONS IN DOGS AFFECTED BY HEPATIC DYSFUNCTION**

**ABSTRACT**

Hepatic dysfunction is a prevalent disorder of dogs leading to major clinical complications and mortality. Prompt diagnosis and treatment are crucial in order to enhance prognosis and minimize liver-related complications. The present study was aimed to assess biochemical changes in dogs with hepatic dysfunction. During the period from August 2024 to January 2025, a total of 200 dogs with suspected hepatic dysfunction on the basis of clinical signs were screened in this study. Serum Alanine Aminotransferase (ALT), Aspartate Aminotransferase (AST), Alkaline Phosphatase (ALP), Gamma-Glutamyl Transferase (GGT), total bilirubin, blood glucose and total protein biochemical parameters were measured on an automated biochemical analyzer and compared with 10 healthy control dogs. Among 200 suspected dogs, 12 were diagnosed with hepatic dysfunction. Relevant biochemical changes found in these dogs were increased activities of ALT, AST, ALP, GGT and total bilirubin, with reduction in the levels of total protein and glucose. These observations indicate that biochemical profiling is a useful method for diagnosing and monitoring hepatic dysfunction in dogs.

**KEYWORDS:** Dogs, Hepatic Dysfunction, Biochemical Parameters, Diagnosing, Clinical signs

**INTRODUCTION**

The liver is the second largest and most metabolically active organ of the body and is the central organ of protein, carbohydrate, fat, mineral and vitamin metabolism, detoxification and regulation of immunity (Kozat and Sepehrizadeh, 2017; Bexfield & Watson, 2006). Liver is mainly composed of hepatocytes, in conjunction with sinusoidal and biliary epithelial cells and plays vital role in the regulation of systemic homeostasis.

Hepatic insufficiency occurs as a result of loss or failure of hepatocytes to perform normal functions resulting in compromised metabolic, excretory and detoxifying functions. Clinical signs observed in dogs affected with hepatic dysfunction includes inappetence, vomiting, diarrhea, icterus, ascites, neurologic signs, altered coagulation, polyuria and polydipsia. Usually, dogs with hepatic dysfunction are asymptomatic until disease reaches at advance stages or clinical signs observed are typically non-specific in nature (Verma *et al.,* 2024).

Biochemical profiling is a valuable diagnostic tool for hepatic diseases as serum ALT, AST, ALP, GGT, bilirubin, glucose, total protein and albumin provides important insights into hepatocellular injury, cholestasis and synthetic dysfunction. However, certain liver diseases are linked to mild enzyme changes, in the absence of accompanying clinical evidence, making the diagnosis even more difficult (Singh *et al.,* 2019). Therefore, careful biochemical examination is still necessary for early diagnosis and monitoring of hepatic dysfunction in dogs.

**MATERIALS AND METHODS**

A total of 200 dogs suspected of hepatic dysfunction presenting clinical signs such as inappetence/anorexia, vomiting, diarrhea/constipation, icterus, ascites, pyrexia, lethargy, melena, polyuria, polydipsia, weight gain, weight loss or combinations thereof were screened during the period of August 2024 to January 2025 at the Veterinary Clinical Complex (VCC) of PGIVER and Government Veterinary Polyclinic Hospital, Panchbatti, Jaipur, Rajasthan. Additionally, 10 clinically healthy dogs were included as the control group for comparative evaluation. In all animals, 7 ml of venous blood was collected aseptically from the cephalic or saphenous vein out of which 5 ml was transferred into plain vials, allowed to clot and centrifuged at 2500 rpm for 30 minutes to obtain serum. Biochemical parameters, including alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP), gamma-glutamyl transferase (GGT), total bilirubin, total protein and glucose were estimated using commercially available diagnostic kits (CPC Diagnostics) on an automated blood biochemistry analyzer. ALT, AST, ALP, and GGT activities were determined by IFCC methodology. Total bilirubin was measured by the Sulfanilic Diazotization (SDA) method, glucose by the GOD-PAP method and total protein by the direct Biuret method. Statistical analysis was performed using standard methods (Snedecor & Cochran, 2004).

**RESULTS AND DISCUSSION**

Among the 200 dogs, 12 were diagnosed with hepatic dysfunction based on clinical signs and biochemical evaluation. The biochemical parameters assessed in these dogs revealed significant deviations from those of healthy controls indicating varying degrees of hepatocellular injury, cholestasis, metabolic disturbances and impaired hepatic synthetic function in the dogs. These alterations in parameters as compared to healthy controls are listed in Table 1.

**Table 1: Mean ± SE values of biochemical parameters in healthy control and
 dogs affected with hepatic dysfunction**

|  |  |  |  |
| --- | --- | --- | --- |
| **S. No** | **parameter** | **Healthy Control group****(n=10)** | **Dogs affected with hepatic dysfunction (n=12)** |
| 1 | ALT (IU/L) (\*\*) | 41.67±2.24 | 162.16±5.61 |
| 2 | AST (IU/L) (\*\*) | 38.36±2.90 | 148.87±7.14 |
| 3 | ALP(IU/L) (\*\*) | 76.89±5.46 | 301.28±29.27 |
| 4 | GGT(IU/L) (\*\*) | 5.19±0.40 | 17.72±2.74 |
| 5 | Total Protein (g/dl) (\*\*) | 6.26±0.18 | 4.64±0.38 |
| 6 | Total bilirubin (mg/dl) (\*) | 0.20±0.04 | 1.20±0.38 |
| 7 | Glucose (mg/dl) (\*\*) | 95.11±3.39 | 64.16±6.48 |

\* The variations in mean value were significant (p<0.05) when compared with the
 mean value of healthy control group.

\*\* The variations in mean value were highly significant (p<0.01) when compared with
 the mean value of healthy control group.

The mean ± SE value of alanine aminotransferase (ALT) in the hepatic dysfunction group (162.16 ± 5.61 IU/L) was significantly (p<0.01) higher in comparison to healthy controls (41.67 ± 2.24 IU/L). ALT is a cytosolic enzyme predominantly found in hepatocytes and its elevated levels of activity suggests the hepatocellular damage due to irreversible necrosis or reversible injury resulting in cytoplasmic leakage or blebbing. Common contributing factors includes inflammation, hypoxia, toxins, drugs and neoplasia (Lawrence and Steiner, 2017). These findings aligns with Tantary *et al.*, (2014) and Pandya *et al.*, (2022), who observed similar ALT elevations in dogs with hepatic disorders. Similarly, aspartate aminotransferase (AST), a leakage enzyme presents in both cytoplasm and mitochondria showed a significant (p<0.01) increase in affected dogs (148.87 ± 7.14 IU/L) as compared to healthy controls (38.36 ± 2.90 IU/L). Elevated AST levels are a hallmark of both acute and chronic hepatocellular injury and necrosis (Webster, 2010). These results are consistent with findings of Lakshmi and Padmaja (2021) and Verma *et al.*, (2024), highlighting AST as a useful biomarker in hepatobiliary disorders.

In addition to hepatocellular injury, cholestasis indicators were also significantly altered. Alkaline phosphatase (ALP) activity was markedly elevated (p<0.01) in affected dogs (301.28 ± 29.27 IU/L) in comparison to healthy controls (76.89 ± 5.46 IU/L). Elevated levels of ALP is an indicative of both acute and chronic liver diseases, with significantly higher elevations indicating cholestasis. The most marked increases are generally seen in cases of cholangitis, biliary cirrhosis, or obstruction of the extrahepatic bile ducts (Tennant and Center, 2008). Similar findings were also recorded by Elhiblu *et al.*, (2015) and Das and Lodh (2024). Gamma-glutamyl transferase (GGT) a sensitive marker of cholestasis and hepatic oxidative stress was also significantly increased (p<0.01) in affected dogs (17.72 ± 2.74 IU/L) as compared to healthy controls (5.19 ± 0.40 IU/L). Its elevation may be linked to endocrine disorders, neoplasia, benign nodular hyperplasia, drug-induced hepatic changes or idiopathic breed predispositions (Alvarez and Whittemore, 2009). These results are corroborated with findings of Bhadesiya *et al.*, (2015) and Assawarachan *et al.*, (2021).

There was significant elevation(p<0.05) of Total bilirubin concentration was observed in dogs with hepatic dysfunction (1.20 ± 0.38 mg/dL) as compared to healthy controls (0.20 ± 0.04 mg/dL). This hyperbilirubinemia reflects impaired excretion of bilirubin due to hepatocellular damage or biliary obstruction, indicating decreased hepatic excretory function or impaired bile flow (Vijayakumar *et al.*, 2008). The finding of increased total bilirubin was also reported by Saravanan *et al.*, (2014) and Verma *et al.*, (2024).

In current study metabolic disturbances were evident as blood glucose levels were significantly decreased (p<0.01) in affected dogs (64.16 ± 6.48 mg/dL) in comparison to controls (95.11 ± 3.39 mg/dL). Hypoglycemia in hepatic disease is attributed to loss of hepatic functional mass due to conditions like portosystemic shunts or acute and chronic liver failure. The liver diseases also prevent the breakdown of insulin, and this further exacerbates the hypoglycemia. (Schoemann, 2012). These observations agree with findings by Lathamani and Nalinikumari (2015) and Hassan *et al.*, (2022).

Finally, total protein concentration was significantly reduced (p<0.01) in diseased dogs (4.64 ± 0.38 g/dL) compared to controls (6.26 ± 0.18 g/dL). Hypoproteinaemia is commonly seen in chronic hepatic conditions such as cirrhosis or portosystemic shunting due to diminished hepatic synthetic capacity because of compromised hepatic synthetic function. Albumin, serum protein made exclusively in the liver, act as a sensitive marker of chronic liver disease (Tennant, 1997). Similar results have been reported by Chaturvedi *et al.*, (2013) and Lakshmi *et al.*, (2018).

**CONCLUSION**

The study demonstrates that liver dysfunction in the dogs results in marked biochemical alterations. These are elevated levels of ALT, AST, ALP, GGT and total bilirubin, while glucose and total protein levels are decreased. These alterations reflect the damage of liver cells, cholestasis and impaired liver functions. It is suggested that biochemical profiling is an effective approach for early diagnosis, monitoring and treatment of liver diseases in dogs.

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