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Research Article

Diagnostic and epidemiological investigation of hepatobiliary ascites in dogs using ultrasonography and hematobiochemical parameters

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Abstract

Thirty dogs of varying age, breed, and sex with hepatobiliary-associated ascites were evaluated at University Referral Veterinary Hospital from January to June 2019 using clinical, hematobiochemical, radiographic, and ultrasonographic findings. Ultrasonography confirmed anechoic peritoneal fluid and enabled categorization into hepatomegaly (n=13), portal hypertension (n=7), cholecystitis (n=5), and hepatic tumors (n=5), with healthy controls (n=5). Hepatomegaly was most prevalent (43.33%), followed by portal hypertension (23.33%). Dogs aged 6–10 years were most affected (40.0%), with higher incidence in Labrador Retrievers (23.33%) and male dogs (53.33%). Common clinical signs included anorexia and lethargy (90%), vomiting (73.33%), jaundice and discoloured urine (33.33%), and diarrhoea (26.67%). Significant reductions ($P<0.01$) in haemoglobin concentration, packed cell volume, and erythrocyte count suggested the presence of mild to moderate anaemia. Decreased total protein and globulin suggested impaired hepatic synthetic function. Elevated ($P<0.05$) alkaline phosphatase and bilirubin levels indicated hepatocellular damage and biliary dysfunction. The findings highlight the utility of ultrasonography combined with hematobiochemical parameters for accurate diagnosis and characterization of hepatobiliary disorders in dogs.

Keywords: Ascites, Hepatobiliary, USG, Hematobiochemical, Dogs

Highlights

- Hepatomegaly was the most common cause (43.33%) of hepatobiliary ascites in dogs.
- Dogs aged 6–10 years, Labradors, and males were most affected by hepatobiliary ascites.
- Common signs included anorexia, lethargy, vomiting, jaundice, and diarrhoea.
- Anaemia, hypoproteinemia, higher ALP, and bilirubin were key hematobiochemical findings.

INTRODUCTION

Ascites, defined as the accumulation of serous or serosanguinous fluid within the peritoneal cavity, is a clinical manifestation rather than a primary disease entity and reflects a spectrum of underlying pathological conditions (Pradhan et al., 2008). It may result from disorders of cardiac, hepatic, or renal origin (Kumar & Srikala, 2014; Mukherjee et al., 2017), although hepatic and cardiac causes are reported to be the most prevalent in companion animals (Nwoha, 2020). Among hepatobiliary disorders, cirrhosis, portal hypertension, and hepatitis are commonly implicated in the development of ascites (Bharata & Shah, 2017), with cirrhotic ascites accounting for a major proportion of cases, particularly in humans (Guevara et al., 2005). These hepatobiliary affections significantly influence survival and overall well-being in dogs and cats, underscoring their importance in small animal practice (Kumar et al., 2012; Nantasanti et al., 2023).

Since ascites is a consequence of diverse underlying pathologies, its management must be guided by accurate etiological diagnosis (Burgos & Thornburg, 2018). However, the complex structural and functional interrelationships within the liver often lead to overlapping diagnostic features among hepatic, portal, and extrahepatic conditions, thereby complicating clinical interpretation (Kozat et al., 2017). Although liver enzyme estimations are widely used in clinical evaluation, their diagnostic specificity is limited, showing only moderate sensitivity (60–76%) in differentiating specific hepatobiliary disorders (Kozat et al., 2017). In contrast, ultrasonography serves as a valuable non-invasive imaging modality that facilitates assessment of hepatic architecture, portal

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vasculature, and associated structural abnormalities (Nyland & Mattoon, 2015).

Considering the clinical importance of ascites of hepatobiliary origin in small animal practice and the limitations of conventional diagnostic approaches, the present study was undertaken to classify ascites associated with hepatobiliary disorders using ultrasonographic evaluation and to correlate these findings with hematological and biochemical parameters. This integrated approach is expected to enhance diagnostic accuracy, enable better differentiation of underlying hepatic pathologies, and support improved prognostic evaluation.

MATERIALS AND METHODS

Ethical approval: The present study was conducted using samples received from the referral Veterinary Hospital of the West Bengal University of Animal and Fishery Sciences; therefore, formal ethical approval was not required. Nonetheless, all samples were collected by trained veterinarians to ensure proper handling and standard procedures.

Case selection: Thirty canine patients of both sexes, representing various breeds and age groups, were included in the study. These animals presented with ascites associated with hepatobiliary disorders were examined over a six-month period from January 2019 to June 2019 at the referral Veterinary Hospital of the West Bengal University of Animal and Fishery Sciences. The diagnosis of hepatogenic ascites was based on clinical signs, findings from physical examination, hematobiochemical parameters, radiographic evaluation, and whole abdominal ultrasonography. Table 1 represents different breeds included in this study.

Hematobiochemical evaluation: Approximately 2 mL of blood was collected from the cephalic or recurrent tarsal vein into sterile EDTA-containing vials for hematological analysis. An additional 4 mL of blood was drawn into clot activator vacutainers for serum biochemical evaluation. The samples were centrifuged at 2000 rpm for 5 minutes, and the separated serum was stored at –20°C until analysis. Hematological parameters were determined using standard procedures, while biochemical parameters were analyzed using commercially available kits (Transasia Bio-Medicals Ltd., India) following the manufacturer's guidelines.

Ultrasonographic evaluation of hepato-biliary system: Ultrasonographic examination was carried out using a Mindray DP-30 Power Vet ultrasound machine equipped with a multifrequency 35C20EA convex transducer (5–10 MHz). The probe frequency was adjusted according to the size of the dog, with preference given to the highest feasible frequency to achieve optimal image resolution. The abdominal area was clipped, and acoustic coupling gel was applied to ensure proper contact. Animals were positioned in left lateral recumbency, and the gallbladder was visualized using a right intercostal approach (Martinez et al., 2023).

Statistical analysis: All analyses were performed using the SYSTAT software package. Statistical significance was determined through one-way ANOVA, with groups (control and diseased) considered as factors. Data from various animals are expressed as mean±SE.

Table 1. Age-, breed-, and sex-wise distribution of hepatobiliary disorders in dogs

Parameters		Total	Cholecystitis	Hepatomegaly	Hepatic tumors	Portal hypertension
Cases		30	5(16.67%)	13(43.33%)	5 (16.67%)	7(23.33%)
Age group	<5 years	10(33.33%)	2(20.0%)	6(60.0%)	0(0)	2(20.0%)
	6–10 years	12 (40.0%)	2(16.67%)	4(33.33%)	4(33.33%)	2(16.67%)
	>10 years	8(26.67%)	1(12.5%)	3(37.5%)	1(12.5%)	3(37.5%)
Breed	Lab	7(23.33%)	1(14.28%)	3(42.86%)	1(14.28%)	2(28.57%)
	Pug	2(6.66%)	1(50.0%)	0(0%)	0(0%)	1(50.0%)
	Spitz	6(20.0%)	1(16.67%)	1(16.67%)	2(33.33%)	2(33.33%)
	Doberman	3(10.0%)	1(33.33%)	1(33.33%)	0(0%)	1(33.33%)
	Rottweiler	3(10.0%)	0(0%)	2(66.67%)	1(33.33%)	0(0%)
	German Shepherd	5(16.67%)	1(20.0%)	3(60.0%)	1(20.0%)	0(0%)
	Cocker Spaniel	4(13.33%)	0(0%)	3(75.0%)	0(0%)	1(25.0%)
Gender	Male	16(53.33%)	3(18.75%)	7(43.75%)	2(12.5%)	4(25.0%)
	Female	14(46.67%)	2(14.28%)	6(42.86%)	3(21.43%)	3(21.43%)

RESULTS

Ultrasonographic evaluation of hepato-biliary system: A systematic ultrasonographic evaluation was performed in dogs suspected of ascites, which revealed the presence of anechoic (black) fluid within the peritoneal cavity surrounding the abdominal organs (Fig. 1). Based on imaging of the hepatobiliary system, cases were categorized as cholecystitis (n=5), hepatomegaly (n=13), hepatic tumors (n=5), and portal hypertension (n=7), and were compared with healthy control dogs (n=5).

In normal dogs, the liver parenchyma appeared homogeneous with uniform echogenicity and smooth, sharply defined margins that did not extend significantly beyond the costal arch (Fig. 2). Hepatomegaly was identified by rounded liver margins and decreased hepatic echogenicity (Fig. 3). Hepatic tumors typically presented as focal or diffuse lesions, often appearing hypoechoic or exhibiting mixed echogenicity (Fig. 4). Cases of cholecystitis were characterized by increased gallbladder wall thickness (0.392±0.02 cm) with irregular margins (Fig. 5). Multiple tortuous vessels (collaterals) replacing the portal vein were seen in some cases suggestive of portal vascular involvement as seen in portal hypertension (Fig. 6)

Incidence study: The age-, breed-, and sex-wise distribution of hepatobiliary disorders in dogs is summarized in Table 1. A total of 30 affected cases were evaluated, among which hepatomegaly was the most prevalent condition (43.33%), followed by portal hypertension (23.33%), while cholecystitis and hepatic tumors each accounted for 16.67% of cases.

Dogs aged 6–10 years were most frequently affected (40.0%), followed by those below 5 years (33.33%) and those above 10 years (26.67%). Across all age groups, hepatomegaly remained the most commonly observed condition.

Breed-wise analysis revealed the highest incidence in Labrador Retrievers (23.33%), followed by Spitz (20.0% each) and German Shepherds (16.67). Portal hypertension was most frequently observed in Pugs (50.0%), whereas hepatic tumors were more common in Spitz (2 out of 5 cases). Hepatomegaly was predominantly recorded in Cocker Spaniels and Lab (3 each out of 13 cases).

Sex-wise distribution indicated a higher occurrence of hepatobiliary disorders in male dogs (53.33%) compared to females.

Clinical signs: All affected dogs exhibited between two and six clinical signs, with anorexia and lethargy being the most common (90%), followed by emesis (73.33%), jaundice (33.33%), discoloured urine (33.33%), and diarrhoea (26.67%) (Table 2). In cases of cholecystitis, diarrhoea (80%) and vomiting (80%) were frequently observed in addition to anorexia and lethargy (80%). Dogs with hepatomegaly commonly showed vomiting (76.92%) along with anorexia and lethargy (84.61%). Abnormally coloured urine was most frequently noted in dogs with cholecystitis (40%) and portal hypertension (42.86%). Jaundice was predominantly observed in cases of cholecystitis (60%) and hepatic tumors (60%).

Haematological examination: The comparative evaluation of haematological parameters between dogs affected with various hepato-biliary disorders and healthy controls is presented in Table 3. Statistical analysis demonstrated significant differences in haemoglobin (Hb), packed cell volume (PCV), and total erythrocyte count (TEC) between control and diseased groups. The haemoglobin concentration was significantly ($P<0.001$) higher in the control group compared to all diseased groups, although no significant differences were observed among the diseased groups. Similarly, PCV values were significantly ($P<0.01$) elevated in healthy dogs relative to affected animals, with no appreciable variation among the different disease groups. Notably, both Hb and PCV values in diseased dogs were below the normal physiological reference range, suggesting the presence of mild to moderate anaemia. The total

Table 2. Clinical manifestations observed in dogs with various hepatobiliary disorders

Parameters	Total	Cholecystitis	Hepatomegaly	Hepatic tumors	Portal hypertension
Cases	30	5(16.67%)	13(43.33%)	5 (16.67%)	7(23.33%)
Anorexia and lethargy	27(90%)	4(80%)	11(84.61%)	5(100%)	7(100%)
Vomiting	22(73.33%)	4(80%)	10(76.92%)	4(80%)	4(57.14%)
Jaundice	10(33.33%)	3(60%)	3(23.07%)	3(60%)	1(14.28%)
Abnormally colored urine	10(33.33%)	2(40%)	4(30.77%)	1(20%)	3(42.86%)
Diarrhea	8(26.67%)	4(80%)	3(23.07%)	2(40%)	1(14.28%)

erythrocyte count was also significantly (P<0.05) higher in control dogs compared to diseased counterparts; however, no statistically significant differences were detected among the diseased groups. In contrast, other haematological parameters, including total leukocyte count (TLC) and differential leukocyte count (DLC), did not exhibit any significant variation between control and diseased animals.

Table 3. Comparison of haematological parameters between dogs affected with various hepato-biliary disorders and healthy controls

Group	Hb (g%)	PCV (%)	TEC ($X10^6$/µL)	TLC ($X10^3$/µL)	Neutrophils (%)	Eosinophils (%)	Monocytes (%)	Lymphocytes (%)
Control	14.47±0.31^a	34.34±0.36^a	7.28±0.15^a	13.38±1.90	72.33±1.25	5.5±0.42	4.33±0.42	17.83±1.10
Cholecystitis	8.66±0.84^b	31.24±1.18^b	5.496±0.35^b	12.05±3.20	70.4±2.30	5.6±0.24	4.6±0.40	19.4±2.19
Hepatomegaly	9.48±0.57^b	32.61±1.0^b	5.78±0.32^b	10.52±1.23	71.54±1.08	4.92±0.52	4.31±0.39	19.23±0.90
Hepatic tumor	9.1±1.39^b	32.5±2.80^b	5.97±0.57^b	9.05±0.98	71.5±1.26	5.0±1.22	4.25±0.85	19.25±1.03
Portal hypertension	9.14±0.81^b	32.57±1.42^b	5.70±0.35^b	11.67±2.21	71.0±1.40	5.43±0.68	4.57±0.53	19.0±1.25
P Value	0	0.003	0.027	0.622	0.936	0.911	0.984	0.925

(Values are expressed as mean ± standard error. Values with different superscripts within a column differ significantly, P<0.01)

Table 4. Comparison of blood biochemical parameters between dogs affected with various hepato-biliary disorders and healthy controls

Group	Total protein (g/dL)	Albumin (g/dL)	Globulin (g/dL)	A:G ratio	Blood urea nitrogen BUN (mg/dL)	Creatinine (mg/dL)	AST (IU/L)	ALT (IU/L)	ALP (IU/L)	Total Bilirubin (mg/dL)
Control	6.91±0.13^a	2.45±0.15	4.46±0.21^a	0.56±0.05	16.46±0.32	2.55±1.44	29.00±2.7	137.05±10.71	155.08±11.98^a	0.57±0.09^a
Cholecystitis	5.62±0.40^{ab}	2.62±0.28	3.0±0.24^b	0.9±0.12	19.02±4.10	1.14±0.13	138.2±5.63	405.2±18.2	1721.4±56.18^b	2.50±0.52^b
Hepatomegaly	5.19±0.4^b	2.17±0.18	3.01±0.30^b	0.76±0.07	17.6±1.77	1.84±0.68	94.91±2.52	202.92±8.06	1159.30±27.68^b	2.79±0.37^b
Hepatictumor	5.12±1.22^b	2.0±0.40	3.12±0.92^b	0.72±0.13	16.17±2.89	3.40±0.22	60.25±2.02	65.5±8.17	824.25±28.42^{ab}	2.96±0.73^b
Portal hypertension	4.27±0.38^b	1.9±0.24	2.37±0.23^b	0.83±0.10	21.94±2.10	1.23±0.09	126.5±4.16	253.14±14.04	1494.86±49.94^b	2.8±0.51^b
P Value	0.022	0.275	0.011	0.719	0.474	0.44	0.593	0.449	0.047	0.008

(Values are expressed as mean ± standard error. Values with different superscripts within a column differ significantly, (P<0.05)

Biochemical examinations: The comparative evaluation of biochemical parameters between dogs affected with various hepato-biliary disorders and healthy controls is presented in Table 4. Among different biochemical parameters, only total protein, globulin, alkaline phosphatase (ALP) and bilirubin were varied significantly between control and diseased groups. A significantly lower (P<0.05) total protein and globulin concentrations were observed in dogs affected with different hepato-biliary disorders compared to control. A significantly higher (P<0.05) ALP was reported in dogs having cholecystitis. Significantly higher (P<0.01) bilirubin concentration was reported in patients with hepato-biliary affections compared to control dogs. Other bio-chemical parameters such as aspartate aminotransferase (AST), alanine aminotransferase (ALT), blood urea nitrogen (BUN) and creatinine remained unaltered in control and diseased groups.

DISCUSSION

Hepatogenic ascites has been reported as the most common form in dogs compared to cardiac and renal origins (Patowary et al., 2024; Mathur et al., 2025). In the present study, hepatomegaly was identified as the most prevalent hepatobiliary disorder, which is in agreement with the findings of Bandara et al. (2021). In contrast, Hirose et al. (2014) reported portal hypertension as the most common hepatobiliary disorder in dogs in Japan, followed by hepatomegaly. There are, however, inconsistencies in the literature regarding the influence of age, breed, and

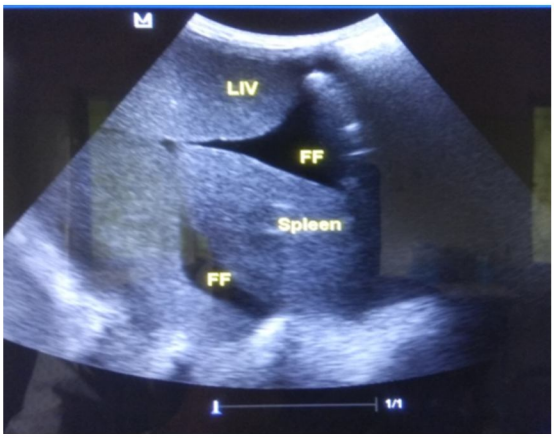


Fig. 1. Accumulation of free fluid (FF) in the abdomen



Fig. 2. Normal echotexture of liver and gall bladder



Fig. 3. Decreased hepatic echogenicity normal



Fig. 4. Hepatic tumor of mixed echogenicity

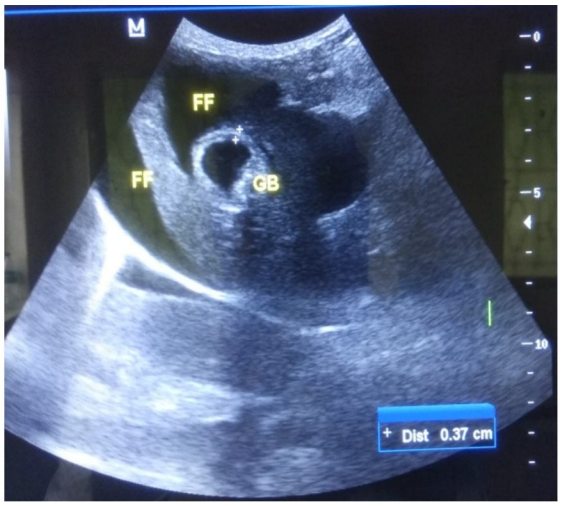


Fig. 5. Increased gall bladder wall thickness in cholecystitis



Fig. 6. Portal vascular involvement

sex on the occurrence of hepatobiliary disorders. Studies by Bandara et al. (2021) and Hirose et al. (2014) indicated that these factors did not significantly affect disease occurrence. Similarly, Loan et al. (2025) also reported no significant association of age, breed, or sex with hepatobiliary disorders in dogs. In the present study, dogs aged 6–10 years were most commonly affected, followed by those below 5 years of age. Earlier reports suggested a higher incidence of hepatogenic ascites in younger dogs, which may be attributed to indiscriminate use of drugs such as antibiotics and anthelmintics (Bexfield & Watson, 2009). Breed-wise, a higher incidence of hepatogenic ascites was observed in Labrador Retrievers, followed by German Shepherds and Spitz, which is consistent with the findings of Dhileep et al. (2025). This trend may be explained by the overrepresentation of these breeds in the study populations. Sex-wise analysis revealed a higher occurrence of hepatobiliary disorders in male dogs (53.33%) compared to females, which is in line with the reports of Saravanan et al. (2012) and Dilip et al. (2025). However, this finding contrasts with that of Loan et al. (2025), who reported no significant effect of sex on the occurrence of hepatobiliary disorders in dogs.

The clinical manifestations of hepatobiliary disorders are highly variable, ranging from anorexia and weight loss to abdominal effusion and respiratory distress (Saravanan & Ramkumar, 2024). The major clinical signs observed in hepatobiliary ascites in the present study were consistent with the findings of Varshney and Hoque (2002) and Tantary et al. (2014). Complete anorexia and inappetence were commonly reported in dogs with hepatic disorders (Tantary et al., 2014). In certain cases, clinical signs such as fever, anorexia, nausea, and weight loss may be associated with hepatic disorders due to the release of inflammatory mediators (Boomkens et al., 2004). Dyspnoea was also observed in some animals, likely resulting from excessive fluid accumulation exerting pressure on the diaphragm (Samad, 2019). Hepatobiliary disorders are frequently accompanied by diarrhoea, which may be attributed to impaired digestion caused by reduced bile secretion (Van den Ingh et al., 2006). The occurrence of vomiting may be linked to stimulation of the vomiting centre due to inadequate hepatic clearance of endotoxins (Sattasathuchana & Steiner, 2014). Jaundice results from elevated bilirubin levels, leading to visible yellow discoloration of the skin, mucous membranes, sclera, and pinnae (Gómez-Selgas et al., 2014).

Previous studies have identified anaemia as a prominent clinical feature of hepatobiliary disorders (Bhatti, 2020). The development of anaemia in such conditions may be attributed to factors such as anorexia (Sultana et al., 2022), suppression of bone marrow activity (Dial, 1995), and impaired utilization of stored iron (Watson & Bunch, 2009). In hepatic disorders, reduced portal blood flow can prolong the transit time of erythrocytes within the spleen, along with decreased erythrocyte fragility influenced by bile acids (Bush, 2002; Chikazawa et al., 2013). In this investigation, total leukocyte count (TLC) and differential leukocyte count (DLC) showed no statistically significant differences between the control and diseased groups. This finding is corroborated with the earlier observations of Loan et al. (2025).

The liver serves as the principal site for plasma protein synthesis; therefore, hypoproteinaemia is a common manifestation of hepatic disorders (Tennant, 1997). Reduced serum albumin concentrations have also been previously documented in hepatopathies (Prasse et al., 1983), which may be attributed to impaired hepatic protein synthesis or secondary factors such as decreased nutrient intake, malabsorption, vomiting, and diarrhoea (Bexfield et al., 2011; Kanemoto et al., 2013; Assawarachan et al., 2020).

Alkaline phosphatase (ALP), a membrane-bound enzyme localized in hepatic tubules and biliary epithelial cells, has been reported to be significantly elevated in hepatobiliary diseases (Elhiblu et al., 2015). However, studies by Chapman and Hostutler (2013), and Mitsui et al. (2021) have suggested that increased ALP activity may also originate from extrahepatic sources, indicating that it is not a highly specific marker for hepatic disorders. This is consistent with the present findings, where elevated ALP levels were observed in dogs with cholecystitis, in agreement with earlier reports.

Furthermore, the increased total bilirubin concentration observed in affected dogs supports the occurrence of hyperbilirubinemia, which arises due to impaired bilirubin metabolism and excretion associated with hepatocellular damage or biliary obstruction (Brough et al., 2022; Prebavathy et al., 2020).

Overall, the findings indicate that hepato-biliary disorders in dogs are associated with distinct haematological and biochemical alterations. The observed reductions in haemoglobin, packed cell volume, and erythrocyte count suggest the presence of mild to moderate anaemia, likely reflecting the systemic impact of hepatic dysfunction. In parallel, decreased total protein and globulin concentrations point toward impaired synthetic capacity of the liver.

The significant elevation of alkaline phosphatase, particularly in cases of cholecystitis, along with increased bilirubin levels, further supports the occurrence of hepatocellular damage and biliary obstruction or dysfunction. In contrast, the lack of significant changes in leukocyte indices and certain biochemical markers such as SGOT, SGPT, BUN, and creatinine suggests that these parameters may be less sensitive indicators in the conditions studied.

Collectively, these results underscore the diagnostic relevance of selected haematological and biochemical parameters in identifying and characterizing hepato-biliary disorders in dogs, while also highlighting the need for a comprehensive approach for accurate clinical evaluation.

Conflict of interest: The authors declare that there was no conflict of interest between them.

Author's contribution: JM, SM: Conceived the idea; JM: Performed USG; PKD: Did the statistical analysis; SM: Performed clinic-pathological examination; JM, SM: Drafted the manuscript.

Data availability statement: Data set generated during research will be available from the corresponding author upon reasonable request.

Ethical approval: The present study was conducted using samples received from the referral Veterinary Hospital of the West Bengal University of Animal and Fishery Sciences; therefore, formal ethical approval was not required. Nonetheless, all samples were collected by trained veterinarians to ensure proper handling and standard procedures.

Use of artificial intelligence tools: During the preparation of this work, the author(s) used ChatGPT to paraphrase some sentences. After using this tool/service, the author(s) reviewed and edited the content as needed and took full responsibility for the content of the publication.

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