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Surgical treatment of the domestic dog (*Canis familiaris*) for gallbladder mucocele (a clinical case study)

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Abstract. The relevance of this study is determined by the rapid increase in cases of gallbladder mucocele in dogs, a condition characterised by the accumulation of excessive mucin and bile within the gallbladder. This pathology causes partial or complete extrahepatic biliary obstruction through the spread of bile-saturated mucus into the common bile ducts, which can be life-threatening. Accordingly, this study aimed to identify the clinical symptoms and effective diagnostic and treatment methods for animals with gallbladder mucocele. A clinical case of gallbladder mucocele was examined in a Chihuahua that developed hepatobiliary insufficiency. The sequence of diagnostic procedures, including laboratory tests and ultrasound examination, as well as the surgical treatment, is presented. The condition in the affected dog manifested as non-specific clinical signs such as frequent vomiting, anorexia, and lethargy. The most common physical examination findings included abdominal pain, jaundice of the skin and visible mucous membranes, and hyperthermia. The biochemical markers of this condition in the affected dog included elevated serum concentrations of total bilirubin and increased activities of alkaline phosphatase, alanine aminotransferase, and gamma glutamyltransferase. Ultrasound imaging was used to visualise changes in the gallbladder tissue. The diagnosis of gallbladder mucocele was established based on the presence of characteristic stellate or finely striated bile patterns. The condition was differentiated from biliary sludge by the absence of gravity-dependent bile movement. Ultrasound examination revealed no specific changes in the thickness or appearance of the gallbladder wall. Based on the diagnostic findings, cholecystectomy was selected as the surgical treatment method for affected dogs. The sterility of the bile sample in bacteriological testing indicated the non-infectious nature of the mucocele. The results obtained have significant practical relevance for both researchers and practising veterinary surgeons, contributing to the improvement of treatment protocols for animals with gallbladder mucocele

Keywords: hepatobiliary pathology; cholecystitis; cholecystectomy; haematological indicators; miniature breeds

Introduction

The digestive system is one of the largest systems in the body and comprises organs responsible for food intake, propulsion, mechanical and chemical processing, absorption of nutrients essential for the organism, and the elimination of undigested residues. According to T.M. Suprovych *et al*. (2024), diseases of the digestive system in dogs account for 64.7% of all internal non-contagious animal diseases. Such disorders may arise from inadequate diet quality or feeding regime, poor housing and management conditions, infectious or parasitic diseases, poisoning, or dysfunction of other organs and systems.

The digestive system consists of the alimentary canal and accessory organs, including the liver. The liver participates in metabolic processes and performs storage, filtration, and detoxification functions. These activities are ensured by hepatic cells and the organ's specific connection to the circulatory system, whereby oxygen is supplied via the hepatic artery passing through the hepatic portal, while the portal vein carries blood from the digestive organs for filtration and metabolic exchange. In the study by J.L. Gookin (2025), it was noted that liver cells, or hepatocytes, produce bile, which enters the bile ducts and, during intervals between

digestive processes, accumulates in a specialised storage reservoir – the gallbladder – whose primary function is bile storage. Within the gallbladder, bile may become concentrated up to tenfold. Through the secretion of epithelial acid, it becomes acidified and modified before entering the gastrointestinal tract via the major duodenal papilla, where mucin and immunoglobulins are added.

K. Azuma *et al*. (2024) reported a rapid increase in the number of extrahepatic biliary pathologies in veterinary medicine. According to R. Fujiwara *et al*. (2025), gallbladder mucocele and cholelithiasis are the most common gallbladder diseases in dogs; however, A. Noguchi *et al*. (2023) noted that these conditions are relatively rare in cats. The formation of gallbladder mucocele in dogs is characterised by excessive secretion of thick mucus by the gallbladder epithelium. Hyperplastic and inflammatory conditions may lead to obstruction or rupture of the gallbladder, followed by the development of bile peritonitis, whereas neoplastic forms are rare and often asymptomatic.

As established by K. Jana-Pitre & G.S. Hennig (2025), the clinical signs of gallbladder mucocele in patients are often non-specific and include vomiting, lethargy, fever, anorexia, diarrhoea, and polyuria-polydipsia. On physical examination, animals typically exhibit abdominal pain upon palpation and jaundice. For an accurate diagnosis, in addition to the animal's medical history and clinical examination findings, S. Renaud *et al*. (2025) recommended considering the results of complete blood count and biochemical analyses (including elevated serum liver enzyme activity and hyperbilirubinaemia), along with the characteristic ultrasound appearance of the affected area. According to S.H. Lee *et al*. (2025), during ultrasonographic examination, gallbladder mucus does not move with changes in the patient's position. The bile becomes concentrated and extends linearly from the gallbladder wall towards the lumen, with the peripheral area appearing anechoic and the centre of the mucus mass demonstrating high echogenicity, forming characteristic stellate or finely striated bile patterns.

As reported by J.L. Gookin (2025), the treatment of dogs with gallbladder pathology depends on the diagnosis and may include medical therapy (such as hepatoprotective agents and antibiotics), adherence to a special diet to support the liver and biliary system, and, in severe cases, surgical intervention. Surgical options include stone removal, gallbladder drainage, or complete excision (cholecystectomy). Surgical intervention in dogs with gallbladder mucocele remains the therapeutic gold standard, with cholecystectomy recognised as the current standard and recommended treatment method.

Thus, the digestive system ensures nutrient absorption and the elimination of metabolic byproducts, and its dysfunction often results in internal non-contagious diseases in dogs. The liver plays a crucial role in this system by filtering blood and producing bile, which accumulates in the gallbladder. Among gallbladder pathologies, the most common are mucocele and cholelithiasis, both of which may lead to obstruction or inflammation. Their diagnosis is based on clinical, laboratory, and ultrasonographic findings, while treatment involves medical therapy, dietary management, and, in severe cases, surgical intervention – most notably cholecystectomy as the principal method. Therefore, this study aimed to identify prognostic indicators and provide recommendations for the treatment of dogs that had undergone surgical management for gallbladder mucocele.

Literature Review

Among extrahepatic gallbladder diseases in dogs that may result in obstruction or rupture, mucocele is most frequently diagnosed.

This pathology is characterised by progressive accumulation of bile rich in mucin and by hyperplasia of the biliary mucosa. According to S.J. Mehler & P.D. Mayhew (2023), gallbladder mucocele can generally be defined as the accumulation of biliary mucus caused by hypersecretion of mucus due to hyperplasia of the gallbladder wall. Under normal conditions, the gallbladder mucosa is capable of reabsorbing compounds such as water and electrolytes to concentrate the bile. This disorder is associated with high morbidity and mortality, and its pathogenesis remains unclear. Affected dogs have a significantly increased likelihood of concurrent diagnoses of hyperadrenocorticism, hypothyroidism, and hyperlipidaemia.

S.A. Jablonski *et al*. (2024) suggested that chronic accumulation of thickened mucoid bile may lead to delayed gallbladder emptying and the development of conditions such as extrahepatic biliary obstruction, pancreatitis, gallbladder wall distension, necrotising cholecystitis, and subsequent gallbladder rupture. S. Mizutani *et al*. (2017) found that gallbladder mucocele and biliary sludge share the same pathophysiological basis and, rather than being distinct diseases, may represent a continuous pathological process. Thus, biliary sludge may be considered a precursor stage in the development of gallbladder mucocele.

F.I. Hill *et al*. (2022) established that gallbladder mucocele most commonly affects miniature or purebred dogs, including Poodles, Pomeranians, Schnauzers, Bichon Frisés, and Chihuahuas. However, the annual rate of hospital admissions for this condition was not dependent on breed. The findings of F.A. Teixeira *et al*. (2024) demonstrated that small-breed dogs possess a genetic predisposition to the development of mucocele. The authors suggested that hyperplasia of the gallbladder mucosa and disturbances in mucin secretion may have a hereditary origin, and that endocrine disorders such as hypo-adrenocorticism, hypothyroidism, and Cushing's syndrome are frequently concurrent conditions. K. Jana-Pitre & G.S. Hennig (2025) reported that the most common clinical signs observed during physical examination of dogs with gallbladder mucocele include vomiting, anorexia, loss of appetite, lethargy, abdominal pain, jaundice, and fever.

To refine diagnosis in clinical practice, additional diagnostic techniques are widely employed. According to S. Kim *et al*. (2024), ultrasonographic evaluation of pathological gallbladders frequently reveals mucosal hyperplasia. M. Itani *et al*. (2023) noted that magnetic resonance cholangiopancreatography has become a widely recognised non-invasive diagnostic tool for assessing diseases not only of the pancreas but also of the biliary tract. Furthermore, Y. Lee *et al*. (2024) demonstrated that information regarding biliary tract abnormalities, portal hypertension, portal collaterals, and hepatic lobe agenesis – which may occur concurrently with gallbladder agenesis – can be obtained through computed tomography imaging.

Regarding medical management of dogs with gallbladder mucocele, S.A. Jablonski *et al*. (2024) noted that it is associated with a shorter survival time compared with surgical treatment, although it remains a reasonable alternative when surgery is not feasible. According to H. Saunders *et al*. (2017), the foundation of medical therapy involves the use of choleretics and hepatoprotective agents. A low-fat diet is also recommended, particularly for animals with dyslipidaemia, as dietary correction may stimulate bile flow; concurrent endocrinopathies should be appropriately managed.

The principal treatment for gallbladder mucocele in dogs is surgical intervention. When determining the surgical technique to be used for cholecystectomy, histopathological changes in the layers of the gallbladder wall affected by disease should be taken into

account. Elective cholecystectomy in dogs with gallbladder mucocele, as established by S.L. Friesen *et al*. (2021), is associated with a low mortality rate and a low incidence of minor complications. Y. Kim & S. Lee (2025) were the first to apply and describe the use of indocyanine green for intraoperative cholangiography during laparoscopic hepatobiliary surgery, aimed at confirming the patency of the common bile duct in a dog with gallbladder rupture. Their findings indicated that such surgical procedures should be performed by specialists experienced in biliary surgery to minimise complications. B. Sambugaro *et al*. (2022) demonstrated that in emergency cases in dogs, when prolonged anaesthesia is undesirable, the use of extradural anaesthesia is advisable to reduce the need for inhalation anaesthetics and intraoperative opioids, as well as to minimise the stress response. Therefore, due to the typical clinical presentation of gallbladder mucocele, it is likely that this condition may have been previously misdiagnosed. The increasing incidence of the disease establishes it as an emerging syndrome in veterinary medicine, warranting further investigation.

Materials and Methods

The research was conducted from January 2024 to March 2025 in scientific laboratories based at the National University of Life and Environmental Sciences of Ukraine and at the private veterinary clinic SHANTY (Kyiv, Ukraine). The subject of the study was a Chihuahua diagnosed with gallbladder mucocele accompanied by the development of hepatobiliary insufficiency. Blood samples were collected from the lateral saphenous vein of the forelimb for morphological and biochemical analyses to assess the general condition of the patient. The diagnostic value of the blood test results for hepatobiliary pathology was determined by comparing the obtained values with reference ranges.

For the complete blood count, biological samples were collected into tubes containing the anticoagulant ethylenediaminetetraacetic acid (EDTA) and analysed using a veterinary haematology analyser, the Heska Element HT (USA). The parameters measured included red and white blood cell counts, platelet count, haemoglobin concentration, and haematocrit level. For the biochemical analysis, blood samples were stabilised with heparin and then centrifuged for 10-15 minutes at a speed of 1,500-2,500 revolutions per minute. After centrifugation, the supernatant – blood plasma – was collected for the determination of biochemical parameters, including the activity of aspartate aminotransferase (AST), alanine aminotransferase (ALT), and alkaline phosphatase (ALP), as well as total protein and bilirubin levels. The measurements were carried out using an automatic veterinary biochemical analyser, Fujifilm DRI-CHEM NX600 (Japan).

To visualise pathological changes in the gallbladder, an ultrasound examination of the liver was performed. Abdominal ultrasonography was carried out using the MyLab X7 VET device (Esaote, Italy). Following confirmation of the diagnosis of gallbladder mucocele, surgical intervention was undertaken. Under general anaesthesia (AAHA Anaesthesia and Monitoring Guidelines for Dogs and Cats, 2020), laparotomy was performed to carry out a cholecystectomy. A bile sample obtained during the operation was sent to the laboratory for bacteriological analysis to identify pathogens and determine their antibiotic sensitivity. During the postoperative period, the animal was kept under observation in an inpatient facility for three days. Treatment included analgesia, antibiotic therapy, and hepatoprotective medication. On the third day, a follow-up ultrasound examination was performed.

The research involving the animal complied with the requirements of the European

Convention for the Protection of Vertebrate Animals Used for Research and Other Scientific Purposes (1986) and the Law of Ukraine No. 3447-IV (2006). All necessary procedures involving the animal were carried out in accordance with the guidelines of the European Parliament and of the Council 2010/63/EU (2010) on the protection of animals used for scientific purposes. Statistical processing of the haematological data was performed using a personal computer with the BAF – Veterinary Medicine software and individual patient dental records. To determine statistical significance, Student's t-test was applied at $P < 0.05$, $P < 0.01$, and $P < 0.001$.

Results and Discussion

An analysis of the medical history of the canine patient revealed that the clinical presentation covered a wide range of symptoms. These included lethargy, general depression, abdominal pain, a characteristic "prayer posture", vomiting containing bile, diarrhoea, and jaundice of the skin and visible mucous membranes. The body temperature was recorded at 39.9°C. Similar symptoms in such cases have been reported by other researchers. In particular, S.J. Mehler & P.D. Mayhew (2023) found that patients with gallbladder mucocele may be asymptomatic; however, most present with vomiting, anorexia, lethargy, and diarrhoea. During physical examination, affected animals exhibit abdominal pain upon palpation and signs of jaundice. Rectal temperature tends to increase in cases of mucocele perforation. Proteinuria has been identified as a common finding associated with gallbladder mucocele, highlighting the need for blood testing to assess renal function.

J.L. Gookin *et al*. (2025) demonstrated that, in addition to the previously mentioned signs, animals with gallbladder mucocele may exhibit a variable range of symptoms, which can manifest as non-specific gastrointestinal disturbances progressing to cholestasis or acute peritonitis. According to the authors, these signs are secondary to gallbladder pain, rupture, infarction, infection, or obstruction of the common bile duct. S.A. Jablonski *et al*. (2024) noted that the clinical signs of this condition are often acute and rather vague, making them indistinguishable from more common differential diagnoses such as pancreatitis or acute gastroenteritis. E. Rogers *et al*. (2020) reported that cholecystitis is frequently diagnosed as a concurrent condition in dogs with gallbladder mucocele.

To assess the general condition of the animal and evaluate the functional state of its internal organs, comprehensive clinical (general) and biochemical blood tests were performed to obtain complete information on the dog's health and establish an accurate diagnosis for appropriate treatment (Tables 1, 2). The biochemical profile revealed marked increases in the activity of alanine aminotransferase – by 3.7-fold, aspartate aminotransferase – by 3.4-fold, alkaline phosphatase – by 2.4-fold, and total bilirubin – by 4.9-fold. Conversely, total protein levels decreased by 9.2%. These results indicate pronounced alterations in both the biochemical and haematological parameters of blood in dogs with hepatobiliary disorders. An increase in transaminase and alkaline phosphatase activity, together with elevated bilirubin levels, confirms the development of cytolytic and cholestatic syndromes, which are typical in hepatic disorders. The reduction in total protein levels indicates suppression of the liver's protein-synthesising function. According to the findings of J.A. Jaffey *et al*. (2022), an elevated concentration of total bilirubin in blood plasma is a negative prognostic indicator; however, it is considered an unreliable biomarker for predicting mortality in dogs with glioblastoma during cholecystectomy.

Table 1. Biochemical parameters of blood serum in a dog with gallbladder mucocele

Parameter	Normal range	Dog with gallbladder mucocele
Glucose, mmol/L	3.4-6	3.93
Bilirubin, μmol/L	0-5	27.21*
Potassium, mmol/L	4-5.6	4.35
Calcium, mmol/L	1.87-2.8	2.25
Phosphorus, mmol/L	0.68-2	1.54
Magnesium, mmol/L	0.8-1	0.84
Alkaline phosphatase, U/L	10-150	439.71*
Alanine aminotransferase, U/L	9-75	180.42*
Aspartate aminotransferase, U/L	5-55	131.14*
Urea, mmol/L	3.5-9.2	4.52
Creatinine, mmol/L	26-120	58.64
Alkaline phosphatase, U/L	10-150	439.72*
Total protein, g/L	5,178	63.51*

***Note**: * indicates values that differ from the normal range*
***Source**: authors' data*

Table 2. Complete blood count of a dog with gallbladder mucocele

Parameter	Normal range	Dog with gallbladder mucocele
Erythrocytes, 10^{12}/L	5.5-8.5	4.90*
Haemoglobin, g/L	120-180	117.1*
Haematocrit, %	37-55	35.2*
Leucocytes, 10^{9}/L	8.5-10,5	15.6*
Platelets, 10^{9}/L	150-500	171.2*
ESR, mm/h	2.0-5.0	20.5*

***Note**: ESR – erythrocyte sedimentation rate; * indicates values that differ from the normal range*
***Source**: authors' data*

The complete blood count revealed an anaemic syndrome, characterised by a 21% reduction in erythrocyte count, a 16% decrease in haemoglobin, and a 16% decline in haematocrit, corresponding to reductions of 1.27, 1.2, and 1.2 times, respectively, compared with the reference values. At the same time, leucocytosis was observed (an increase in leucocyte count by 1.7 times) along with an accelerated ESR, which was 3.1 times higher than normal. The platelet count decreased by 1.3 times, representing a 23.4% reduction compared with the reference range. Changes in the complete blood count (anaemia, leucocytosis, thrombocytopenia, and elevated ESR) indicate systemic disturbances arising from chronic inflammation, intoxication, and hepatic dysfunction, given the liver's central role in metabolism. The concurrent presence of anaemia and thrombocytopenia is particularly significant, as it may suggest the development of hypersplenism syndrome or DIC in severe cases. H. Itoh *et al*. (2022) also demonstrated that gallbladder mucocele is often associated with both acute and chronic inflammation, and haematological abnormalities may indicate partial necrosis of the gallbladder wall, leading to disease progression.

Ultrasound examination of the liver in the studied dog revealed the following findings: the organ was in its typical anatomical position but enlarged, with smooth and well-defined margins that appeared slightly rounded. Echogenicity was reduced, and the structure was homogeneous and finely granular. The intensity of the ultrasound beam was uniform throughout the parenchyma. The vascular pattern was within physiological limits, with no neoplasms detected. Major vessels showed no abnormalities, and regional lymph nodes appeared unaltered. Biliary system: the gallbladder was moderately filled, with a typical shape and echogenic content showing multiple hyperechoic strands indicative of a mucocele (Fig. 1).

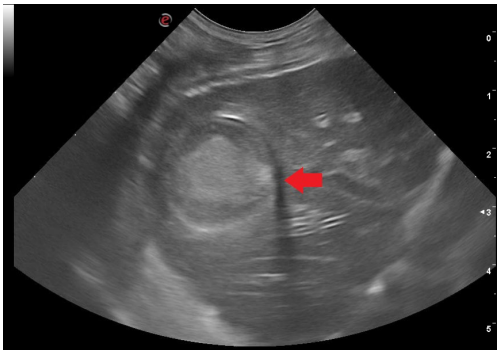

Figure 1. Gallbladder mucocele in a dog
***Note**: the arrow indicates the pathological change in the gallbladder tissue. Numerous hyperechoic strands are visible, occupying approximately 90% of the gallbladder cavity – the so-called "kiwi" type*
***Source**: authors' photo*

The gallbladder wall was diffusely thickened to 3.6 mm, with distinct echogenicity and a clearly defined three-layer structure. The cystic duct was dilated to 3.5 mm, while the wall of the common bile duct appeared hyperechoic. Intrahepatic bile ducts were visualised and found to be dilated. According to the findings of J.A. Jaffey *et al*. (2022), ultrasonographic features of mucocele include the presence of stellate or finely striated bile patterns, differing from biliary sludge by the absence of gravity-dependent movement of bile. The thickness and external appearance of the gallbladder wall on ultrasound are variable and nonspecific. H.J. Piegols *et al*. (2021) reported that gallbladder mucoceles are often detected incidentally during abdominal ultrasonography performed for tumour staging or adrenal gland evaluation in dogs with hyperadrenocorticism. A characteristic ultrasonographic appearance of the gallbladder, in combination with clinical history, physical examination findings, and biochemical blood parameters, facilitates a relatively straightforward diagnosis. However, as demonstrated by R. Fujiwara *et al*. (2025), ultrasonography – although commonly used for diagnosing biliary tract diseases in dogs – provides inferior visualisation of the bile ducts compared with magnetic resonance cholangiopancreatography in cases of hepatobiliary pathology. At the time of diagnosis, S.L. Friesen *et al*. (2021) found that dogs frequently presented with concurrent conditions, including pancreatitis, hyperlipidaemia, corticosteroid excess, hypothyroidism, protein-losing nephropathy, diabetes mellitus, cholestasis, and impaired gallbladder motility.

Following confirmation of the diagnosis, the animal underwent surgical treatment – cholecystectomy, a procedure typically performed in dogs with extrahepatic biliary obstruction, gallbladder mucocele, or gallbladder rupture. The surgical technique involved preparation of the operative field according to standard aseptic procedures: the hair coat was clipped, the skin was washed with antibacterial soap, and the site was disinfected with a betadine solution. The animal was positioned in dorsal recumbency. A ventral midline laparotomy was performed, allowing inspection of the abdominal organs. In this case, the gallbladder wall was firmly adherent to the hepatic parenchyma, and

areas of ischaemia covering approximately 30% of the gallbladder surface showed necrosis. The gallbladder contents were not aspirated, as this could subsequently lead to bile leakage through the wall. According to H.J. Piegols *et al*. (2021), suspension of the gallbladder on a stay suture is possible, although this technique carries a risk of wall perforation. Therefore, dissection of the gallbladder wall began from its fundus, using sterile cotton swabs and gentle rotational movements to avoid trauma to the hepatic parenchyma. The cystic duct and cystic artery were then isolated. Before ligation, catheterisation and flushing of the common bile duct were performed using a sterile 0.9% sodium chloride solution. Three ligatures of absorbable suture material (polyglycolic acid) were applied. The abdominal cavity was subsequently irrigated with a warm sterile 0.9% sodium chloride solution. After cholecystectomy, bile was collected for bacterial culture, and the external surface of the removed gallbladder was examined (Fig. 2).

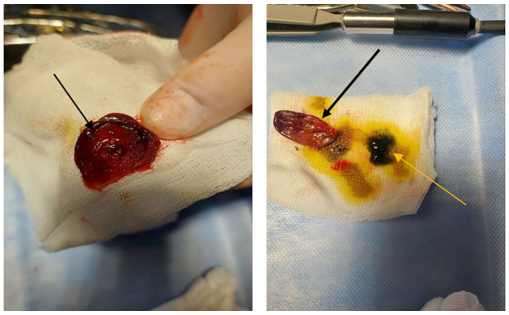

Figure 2. Dog's gallbladder after removal
***Note**: the black arrows indicate the excised gallbladder with a necrotic wall; the yellow arrow shows the gallbladder contents*
***Source**: authors' photo*

Examination of the excised gallbladder revealed pathological changes in its wall, characterised by areas of necrosis and haemorrhage resulting from tissue distension under increased pressure. According to I. Nagao *et al*. (2023), the underlying cause of this pathological condition may be abnormal mucus secretion rather than its overproduction. Alterations in the motility and fluidity of the biliary tract are increasingly identified in dogs and, as noted by J.A. Jaffey *et al*. (2022), are associated with the formation of biliary sludge – bile of higher viscosity caused by the slow sedimentation of dispersed particles. Consequently, macroscopic distension of the gallbladder walls occurs due to the accumulation of greenish-black gelatinous material, which may extend throughout the biliary tree and induce varying degrees of obstruction of the intrahepatic ducts. When such obstruction develops, gallbladder distension often leads to necrosis of its wall and, ultimately, to rupture followed by peritonitis. S. Mizutani *et al*. (2017) reported that the main components of gallbladder contents in both gallbladder mucocele and biliary sludge are mucins, and that both pathophysiological processes exhibit a low level of bacterial infection within the gallbladder. Therefore, it is plausible that gallbladder mucocele and biliary sludge share the same pathophysiology and, rather than representing separate diseases, may constitute a continuum of the same pathological process. Thus, biliary sludge may be regarded as a precursor stage in the development of gallbladder mucocele. L. Ciammaichella *et al*. (2023) noted that hepatobiliary disorders affecting the bile ducts and gallbladder in animals can present in various forms and share similar clinical signs with hepatic diseases, while also contributing to the development of gastroduodenal ulcers. According to the findings of T.-Y. Kim & Y.I. Oh (2025), chronic cholecystitis and factors such as biliary hyperplasia, mucin hypersecretion, and cystic duct obstruction may lead to fibrosis and calcification of the gallbladder wall, potentially resulting in the development of a porcelain gallbladder – a condition characterised by pronounced calcification and thickening of the

gallbladder wall. M. Galley *et al*. (2022) recommended that dogs undergoing cholecystectomy, owing to the possible effects of gallbladder rupture and biliary infection, should receive abdominal imaging, biliary culture, and empirical preoperative antimicrobial therapy.

In the dog under study, the postoperative period progressed without complications. The animal was monitored continuously in a clinical setting for three days, and an individual pain management plan was implemented (butorphanol at 0.5 mg/kg intramuscularly every 12 hours for three days). Antibiotic therapy, hepatoprotective agents (S-adenosylmethionine at 20 mg/kg once daily), omega-3 supplements, and the probiotic Florentero (Candioli Farmaceutici S.p.A, Italy) were prescribed. The antibiotics of choice were: Cefazolin at 25 mg/kg administered intravenously, slowly, once daily (to prevent bacterial complications); and Metronidazole at 10 mg/kg intravenously once daily (to suppress anaerobic flora). On the third day, the animal showed a gradual recovery of appetite and activity. Follow-up abdominal ultrasonography revealed no evidence of free fluid or secondary inflammation. The overall condition of the animal improved, and body temperature remained within the physiological range (37.9°C).

The obtained results are consistent with the findings of H. Saunders *et al*. (2017), who investigated pharmacological therapy that included the administration of ursodeoxycholic acid (a natural hydrophilic bile acid functioning as a choleretic and hepatoprotective agent) at a dosage of 10-15 mg/kg orally, either once daily or divided into two doses, and S-adenosylmethionine (a natural analogue of cysteine essential for the production of the antioxidant glutathione, thereby acting as a hepatoprotective agent) at 18-20 mg/kg orally, administered once daily on an empty stomach. According to F.A. Teixeira *et al*. (2024), dietary factors are likely to play a crucial role in the pathogenesis, prevention, and even treatment of gallbladder diseases such as mucocele and cholelithiasis. Specific dietary interventions, including the use of omega-3 fatty acids, proteins, and fibre, can significantly influence biliary health. Nutritional recommendations include a balanced diet with adequate levels of vitamins and proteins, particularly methionine and tryptophan, along with a moderate content of fats and cholesterol.

Surgical intervention in the form of cholecystectomy proved to be the only appropriate decision in the given clinical situation. According to S. Renaud *et al*. (2025), delaying surgical treatment may result in gallbladder rupture, peritonitis, and fatal outcomes. The presence of hypocoagulation requires particular attention due to the increased risk of postoperative haemorrhage. The authors recommended the use of vitamin K1, antibacterial therapy, and hepatoprotective agents, which enabled successful stabilisation of the animals' condition. Based on the findings of H. Saunders *et al*. (2017), surgical removal of the gallbladder is essential for full recovery. Dogs with gallbladder mucocele that underwent cholecystectomy and survived the early postoperative period demonstrated an excellent long-term prognosis. Although cholecystectomy is not without risk, the approach to this condition requires reconsideration. The current trend is to postpone gallbladder removal while medical therapy remains effective. However, greater emphasis should be placed on performing cholecystectomy at the time of initial presentation, as the procedure at this stage can be carried out on a structurally intact gallbladder, with minimal wall damage. B. Sambugaro *et al*. (2022) noted that, compared with systemic analgesia, the use of epidural anaesthesia reduced the need for perioperative analgesics and promoted postoperative food intake in dogs that had undergone cholecystectomy. Animals that underwent cholecystectomy for gallbladder mucocele without catheterisation and lavage of

the biliary cavity recovered rapidly, according to M. Rossanese *et al*. (2022). S.A. Jablonski *et al*. (2024) also demonstrated that cholecystectomy is considered the treatment of choice for dogs with gallbladder mucocele, as this condition is characterised by the accumulation of dense, immobile mucus and bile within the gallbladder, and histologically by a hyperplastic gallbladder mucosa forming cystic spaces filled with mucus and papillary projections extending into the lumen, although the aetiopathogenesis of the disorder remains unclear. Further studies are required to elucidate the pathological mechanisms underlying posttraumatic gallbladder disease, gallbladder mucocele, and their potential interrelationship. A clearer understanding of these mechanisms could contribute to earlier disease prediction and improve diagnostic and therapeutic strategies.

The importance of postoperative monitoring should also be emphasised, as dogs that have undergone surgery for gallbladder mucocele, according to E. Rogers *et al*. (2020), often present with concurrent diseases requiring further diagnostic evaluation, such as endocrine testing and lipid profiling. In a study by K. Jana-Pitre & G.S. Hennig (2025) on the increased risk of gallbladder rupture and mortality in small-breed dogs with concurrent hypothyroidism or pancreatitis that underwent cholecystectomy for gallbladder mucocele, it was determined that elective cholecystectomy should be considered in dogs with gallbladder mucocele and concomitant endocrinopathies – particularly hypothyroidism and pancreatitis – to reduce the risk of gallbladder rupture and death. In the presented case, the dog did not exhibit any evident endocrinopathy; however, the owners were advised to continue monitoring the animal's health, with periodic assessment of thyroid and adrenal gland function.

It is important to note that the bacteriological examination of the bile confirmed the sterility of the sample, indicating the non-infectious nature of the mucocele in this patient. This finding suggests that the pathology likely developed as a result of physicochemical alterations in bile composition rather than microbial involvement. Nevertheless, sterility does not eliminate the need for postoperative antibiotic prophylaxis, given the potential risk of bacterial translocation and secondary complications. According to H. Itoh *et al*. (2022), the success rate of treating gallbladder mucocele by cholecystectomy exceeds 80% when surgery is performed before gallbladder wall perforation occurs. However, even following successful surgical intervention, patients require long-term monitoring, as the risk of recurrent metabolic disturbances and cholestasis remains.

Thus, this clinical case highlights the importance of early detection of gallbladder mucocele, particularly in small-breed dogs presenting with non-specific gastrointestinal symptoms. Cholecystectomy, combined with comprehensive therapy, ensured a favourable treatment outcome. Postoperative monitoring plays a crucial role in preventing recurrence or secondary complications.

Conclusions

The presented case demonstrated a typical clinical manifestation of gallbladder mucocele in a Chihuahua, characterised by polymorphic and predominantly non-specific clinical signs associated with hepatobiliary disorders, along with a high likelihood of diagnostic challenges. Based on the medical history and clinical examination, the course of the disease was accompanied by systemic reactions and gastrointestinal disturbances, which complicated differential diagnosis. The results of the general and biochemical analyses revealed significant alterations in both biochemical and haematological blood parameters in the dog with hepatobiliary pathology. Increased transaminase and alkaline phosphatase

activity, together with elevated bilirubin concentration, confirmed the presence of cytolytic and cholestatic syndromes, which are typical of hepatic lesions. A decrease in total protein indicated suppression of the liver's protein-synthesising function. The complete blood count revealed systemic abnormalities arising from chronic inflammation, intoxication, and hepatic dysfunction. In particular, anaemia, leukocytosis, thrombocytopenia, and an increased ESR were observed. A particularly notable finding was the combination of anaemia and thrombocytopenia, which may indicate the development of hypersplenism or DIC in severe cases.

Thus, the comprehensive assessment of biochemical and haematological parameters was of great importance for the diagnosis, monitoring, and prognosis of hepatobiliary diseases in dogs. Ultrasonographic examination proved crucial for establishing the diagnosis, as mucoceles are characterised by the appearance of stellate or finely striated bile patterns and can be distinguished from biliary sludge by the absence of gravity-dependent bile movement. During the treatment of the animal with mucocele, a cholecystectomy was performed, which, in combination with comprehensive therapy, resulted in a favourable clinical outcome, rapid recovery, and the absence of postoperative complications. Bacteriological examination of the bile sample confirmed its sterility, thereby supporting the non-infectious nature of the pathology. The findings indicate that surgical removal of the gallbladder, combined with supportive therapy, promotes restoration of the animal's functional condition and improvement of clinical parameters in cases of mucocele. Further research will focus on refining the diagnostic value of instrumental and endoscopic methods for the early detection of internal organ pathologies in small companion animals.

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Conflict of Interest

None.

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Хірургічне лікування собаки свійського (*Canis familiaris*) за мукоцеле жовчного міхура (на прикладі клінічного випадку)

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Анотація. Актуальність дослідження зумовлена стрімким зростанням випадків захворювання собак на мукоцеле жовчного міхура, що характеризується накопиченням надлишку муцину та жовчі в жовчному міхурі. Ця патологія спричиняє часткову або повну позапечінкову біліарну обструкцію шляхом поширення слизу, насиченого жовчю, в загальні жовчні протоки і, що може бути небезпечним для життя тварин. У зв'язку з цим, мета роботи була спрямована на встановлення клінічних симптомів, ефективних методів діагностики та лікування тварин з мукоцеле жовчного міхура. Розглянуто клінічний випадок мукоцеле жовчного міхура у собаки породи чихуахуа, із розвитком гепатобіліарної недостатності. Наведено послідовність діагностичних заходів, включно з лабораторним аналізом та ультразвуковим обстеженням, а також опис хірургічного лікування. Встановлено, що ця патологія проявлялась у хворої собаки неспецифічними клінічними симптомами, такими як часте блювання, анорексія та млявість. Під час фізикального огляду тварин найпоширенішими симптомами були: біль в ділянці черевної порожнини, іктеричність шкіри та видимих слизових оболонок, гіпертермія. Біохімічними маркерами цієї хвороби

в хворої собаки були підвищення в сироватці крові концентрації загального білірубіну, активності лужної фосфатази, аланінамінотрансферази та гамма-глутамілтрансферази. Зміни у тканинах жовчного міхура візуалізували з використанням методу ультразвукового дослідження тварин. Діагностували мукоцеле жовчного міхура на підставі появи характерних зірчастих або дрібнопосмугованих жовчних візерунків. Диференціювали цю патологію від біліарного сладжу за відсутністю руху жовчі, залежного від сили тяжіння. На ультразвуковому дослідженні товщина та зовнішній вигляд стінки жовчного міхура не мали специфічних змін. За результатами дослідження обрали хірургічний метод лікування хворих собак – холецистектомію. Стерильність зразка жовчі при бактеріологічному дослідженні вказувала на неінфекційний характер мукоцеле. Отримані результати мають важливе прикладне значення як для науковців, так і для практикуючих ветеринарних лікарів, що сприятиме удосконаленню протоколу лікування тварин за мукоцелє жовчного міхура

Ключові слова: гепатобіліарна патологія; холецистит; холецистектомія; гематологічні показники; мініатюрні породи