

## Investigation of clinical presentations and clinicohistopathological correlations of spontaneous hepatic lobe torsion and clinical outcomes after hepatic lobectomy in domestic rabbits (*Oryctolagus cuniculus*)

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### INTRODUCTION & AIM

Hepatic lobe torsion is an uncommon disease that has been described in various species, such as humans, dogs, and rabbits. Hepatic torsion leads to vascular occlusion that results in hepatic necrosis and death worst cases. Predisposing factors for hepatic lobe torsion in rabbits include external trauma, congenital absence of hepatic ligaments, gastrointestinal syndromes, infectious hepatitis, or environmental stress.

The objectives of this study are to describe the histopathology grading scores, clinicopathologic findings, and clinical presentations associated with hepatic lobe torsion.

Rabbits involved were diagnosed from September 2022 to January 2023 (n = 20). The diagnosis was made at clinical presentation using physical examinations, colour flow doppler (CFD), complete blood count (CBC), and serum biochemistry. Surgical lobectomy was performed to remove the affected hepatic lobe and sample tissues were processed for histopathology and stained with Hematoxylin and Eosin (H&E). All rabbits had acute onset with depression, pale mucous membrane, and abnormal gut sounds. The use of CFD revealed a decreased or absent blood flow in all cases. Macroscopic findings revealed severe acute hemorrhage and hematoma. Average BUN, creatinine, ALT, AST, and heterophil levels were elevated. Hb, HCT, MCHC, platelets, and lymphocytes were lower than normal. All rabbits were diagnosed with severe acute diffuse necrohemorrhagic hepatitis and severe coagulative necrosis. Anaemia and thrombocytopenia were commonly presented (90%).

The survival rate in rabbits after hepatic lobectomy was 80% (16/20). The present study demonstrated that early detection using gastrointestinal sign, CFD, clinicopathologic, and hepatic lobectomy was crucial for the successful treatment and using histopathologic scores for describing the severity was important.

For further investigation, the relationship with environmental stress from climate change, viral transmission from humans to rabbits, and other zoonotic diseases that relate to hepatic lobe torsion from hepatitis, will prove important for finding preventive measures in the future.

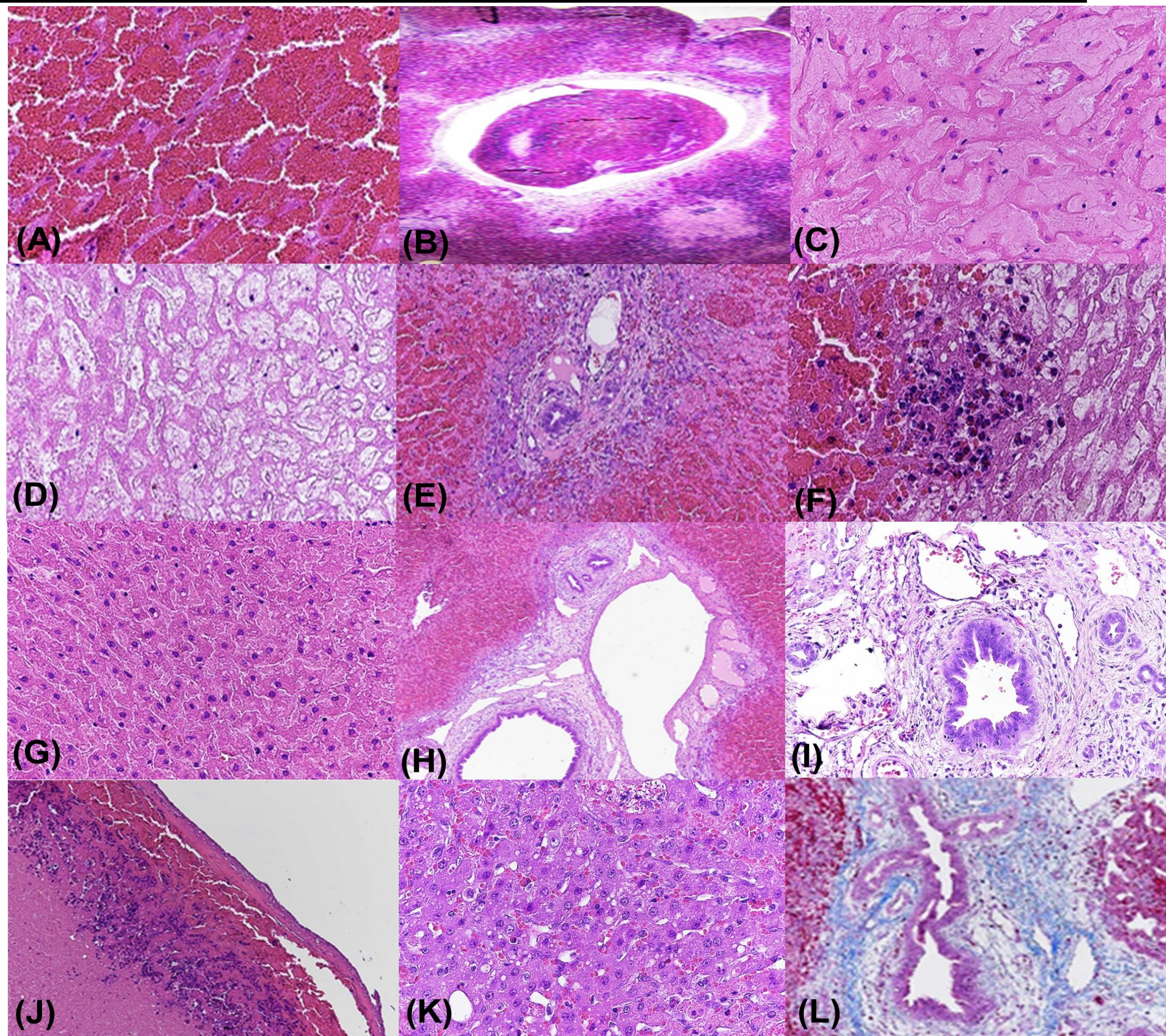


Figure 1A-L Each Histopathologic feature from H&E stained (A-K), Masson's trichrome stained (L)

### METHOD

Rabbits diagnosed with liver lobe torsion at Animal Space Exotic Pet Hospital (Bangkok, Thailand) from September 2022 to January 2023 (n=20). The diagnosis was based on clinical presentations, physical examinations (PE) and abdominal ultrasound (U/S) including colour flow Doppler. A complete blood count was performed using the Abaxis HM5C (CA, USA), and serum biochemical profiles were analyzed using the Abaxis VetScan VS2 (CA, USA). Hepatic lobectomy was performed to remove the affected hepatic lobe. Samples of resected liver lobe were fixed in 10% neutral-buffered formalin for histologic examination. Tissue specimens were processed routinely, embedded in paraffin wax, sectioned and stained with hematoxylin and eosin, as well as Masson's trichrome stain to detect fibrosis tissue. Data were examined graphically and expressed as mean ( $\bar{x}$ ), standard deviation (SD), and percentage (%).

### RESULTS & DISCUSSION

Overall, 20 rabbits that met the inclusion criteria were included in the study.

**Signalment:** Mean age was 34.5 months (range: 10 to 110 months). Male rabbits were predominately affected (12/20, 60%) and the remaining females were primarily of Holland Lop breed (19/20, 95%), with 1 rabbit (5%) being a Netherland dwarf.

**Physical examinations:** All rabbits were noted to have an acute onset of clinical signs, including depression, pale pink mucous membrane, decreased gut sounds, and moderate cranial abdominal pain (20/20, 100%).

**Ultrasonographic Findings:** The affected lobe exhibited blunt lobar margins, hepatomegaly, heterogeneous liver parenchymal echogenicity, and hyperechoic regions within the parenchyma, as well as hyperechoic perihepatic mesentery. Colour flow Doppler revealed decreased or absent blood flow in the affected liver lobe in all cases.

**Gross Lesion:** Most liver lobe torsions involved the caudate process of caudate lobe (17/20, 85%). Two cases (2/20, 10%) involved the left lateral lobe, and one case (5%) affected the papillary process of caudate lobe. Gross lesions revealed severe acute hemorrhage and hematoma in the affected hepatic lobes.

**Clinical Pathology Results:** The average values for BUN, Creatinine (Cr), ALT, AST, heterophils and the heterophil-to-lymphocyte ratio (HLR) were higher than normal, while hemoglobin, hematocrit (HCT), MCHC, platelet count, and lymphocyte were lower than normal.

**Histopathological Findings and Scorings:** All rabbits were diagnosed with severe acute diffuse necrotic hemorrhagic hepatitis and severe coagulative necrosis. Histopathological examination revealed varying degrees of coagulative necrosis, hemorrhage, portal congestion, hepatic cell cord atrophy, and infiltration of heterophils (20/20, 100%). Some rabbits also exhibited portal triaditis (40%), lymphangiectasia (15%), bile duct proliferation (20%), perihepatitis (45%), fatty hepatopathy (15%) and portal fibrosis (15%).

Condition	Score 0 (%)	Score 1 (%)	Score 2 (%)	Score 3 (%)
Hemorrhage (A)	0	30	30	40
Portal congestion (B)	0	10	40	50
Hepatic cell cord atrophy (C)	0	25	20	55
Coagulative necrosis (D)	0	0	0	100
Portal triaditis (E)	60	25	10	5
Parenchyma inflammation (F)	0	55	45	0
Remain normal hepatic cord (G)	85	10	5	0
Lymphangiectasia (H)	85	5	5	5
Bile duct proliferation (I)	80	10	5	5
Fibrinous perihepatitis (J)	55	15	15	15
Fatty hepatopathy (K)	85	15	0	0
Portal fibrosis (L)	85	10	5	0

Table 1. Histopathological grading score of 20 rabbits. (0: no sign, 1: mild, 2: moderate, 3: severe)

The present study demonstrated that the hepatic lobe torsion affected younger rabbits compared to a previous study (5). Clinical signs and physical examination (PE) findings associated with RGIS were non-specific, as noted in previous research (5). Colour flow Doppler was found to be very useful in diagnosing a torsed liver lobe. Anemia, indicated by lower RBC count (40%), and HCT (75%) was observed. Thrombocytopenia was commonly presented (90%), likely due to consumption in the affected lobe. The HLR was increased due to heterophilia and lymphopenia, which were associated with stress leukogram (6). All rabbits in this study had elevated serum levels of hepatic enzymes: AST (85%), ALT (100%) and both AST and ALT (85%), which were consistent with hepatocellular injury and necrosis, while ALP values remained within normal limits. Acute azotemia was observed in 9/20 rabbits (45%), with increased BUN (40%), Cr (30%), and both parameters elevated in 25%, likely secondary to prerenal azotemia, a pattern commonly seen in rabbits with anorexia and gastrointestinal stasis (7). The caudate process of the caudate lobe was most commonly affected (85%). Coagulative necrosis of the hepatic parenchyma indicated ischemia in the affected lobe. The survival rate following hepatic lobectomy was 80% (16/20), with followed-up until the end of February 2023.

### CONCLUSION

In conclusion, the present study demonstrated that the early detection using gastrointestinal sign, U/S, the clinicopathologic parameter of hepatic lobe torsion and hepatic lobectomy is the crucial point in the successful treatment and also using histopathologic grading scores for describing the severity of hepatic lobe torsion tissues.

### REFERENCES

- Ozawa et al., 2022. JAVMA. 260: 1334-1342.
- Graham et al., 2014. Vet. Clin. N. Am. 17: 195-202.
- Meredith, 2013. In Practice. 35: 291-301.
- Pignon et al., 2013. Pratique Médicale et Chirurgicale de l'Animal de Compagnie. 48: 91-98.
- Sheen et al., 2022. Vet. Rec. 191
- Varga, 2014. Rabbit Medicine. 111-134.
- Jennifer et al., 2014. J. Exot. Pet Med. 23: 258-265.