

INTRAOPERATIVE DEATH OF TWO DOGS WITH NON-NEOPLASTIC HEMOPERITONEUM

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Introduction

Hemoperitoneum, the presence of blood in the peritoneal cavity, occurs in the dog mostly as a result of rupture of hemangiosarcoma or well-vascularized abdominal organs. Possible causes of organ rupture are trauma, infection, neoplasm, external cardiac massage, or organomegaly by infiltrating neoplasm, hepatic lipidosis, or amyloidosis.¹⁾

Necropsy of two dogs that died independently during elective surgery revealed hemoperitoneum derived from hepatic capsular damage centered around the porta hepatis (hepatic hilum). Previously undescribed pathogenesis of hemoperitoneum is speculated based on clinicopathological findings of these dogs.

Materials and methods

The author performed on-site cosmetic necropsy of a Toy Poodle and a French Bulldog at 26 and 30 hours postmortem, respectively. Mild autolysis was confined to the superficial mucosa of the Toy Poodle's small intestine since the carcasses had been kept under cool condition. Various organs were collected and fixed in 20% formalin. Hematoxylin-eosin-stained, 4µm-thick sections were routinely prepared for microscopic examination. Clinical information was obtained from each veterinary hospital via interview and exchange of e-mails.

Results

Please see Table 1 and Fig. 1-16.

Discussion

Cause of death of the patients was likely either hypovolemic shock secondary to hemoperitoneum, cardiopulmonary arrest of unknown mechanism, or combination of these. With regard to hypovolemia, mean circulatory blood volume of laboratory Beagles is 85ml/kg.⁴⁾ Intra-abdominal blood of the Toy Poodle and the French Bulldog then corresponds to 89% (220ml/246.5ml) and 39% (330ml/850ml) of whole blood, respectively. Acute loss of at least one-third of whole blood from circulation is anecdotally life-threatening. Acute renal tubular necrosis in both dogs and cerebral neuronal necrosis in the French Bulldog were attributed to hypoxia.

Intra-abdominal bleeding in both patients did not seem to be associated with surgery. The Toy Poodle received no surgical manipulation of intra-abdominal organs. Five ligated wounds made during ovariohysterectomy were not loose to cause hemorrhage in the French Bulldog. Since no signs of coagulopathy had been detected, hepatic capsular damage was judged the source of bleeding.



Figure 1. There was 220ml of blood in the abdomen.



Figure 2. Skin incision (arrow) did not cause subcutaneous hemorrhage or penetrating wound.

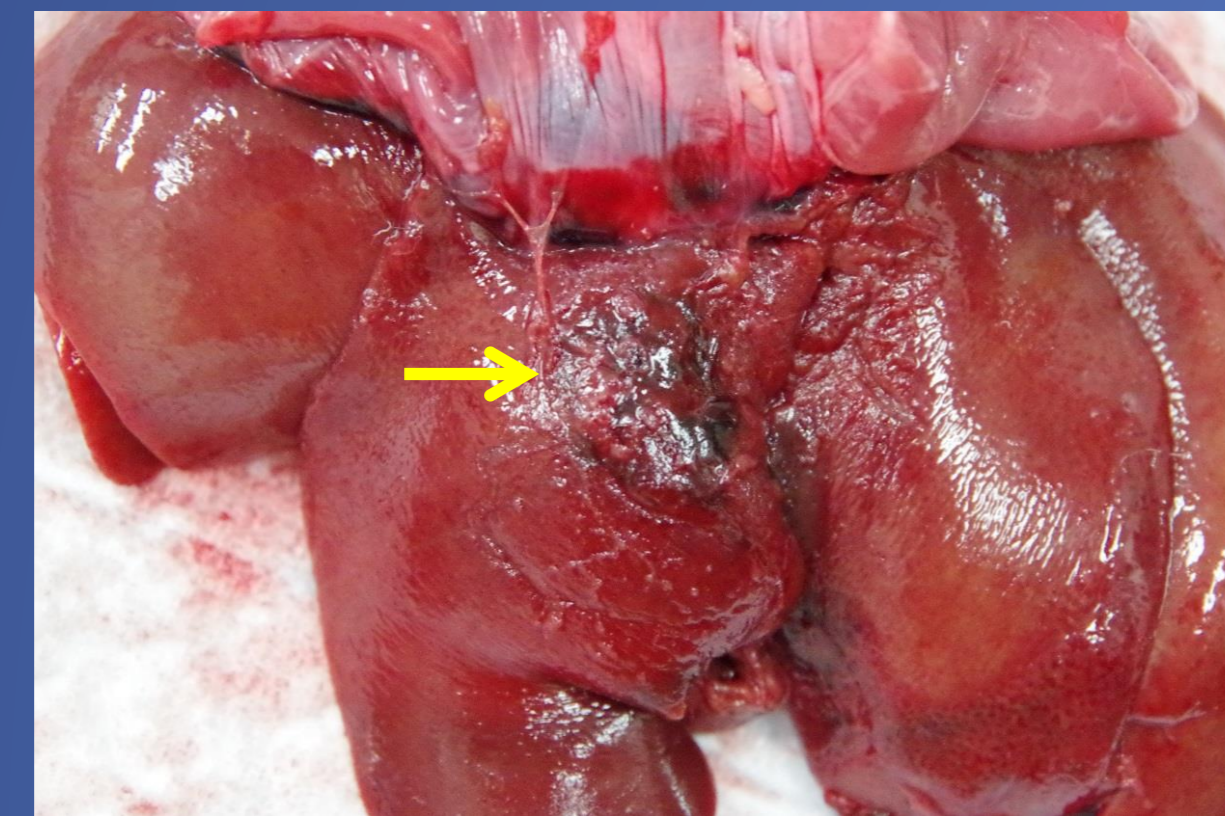


Figure 3. Diaphragmatic surface of the liver. Capsular lysis (arrow) is close to the porta hepatis.

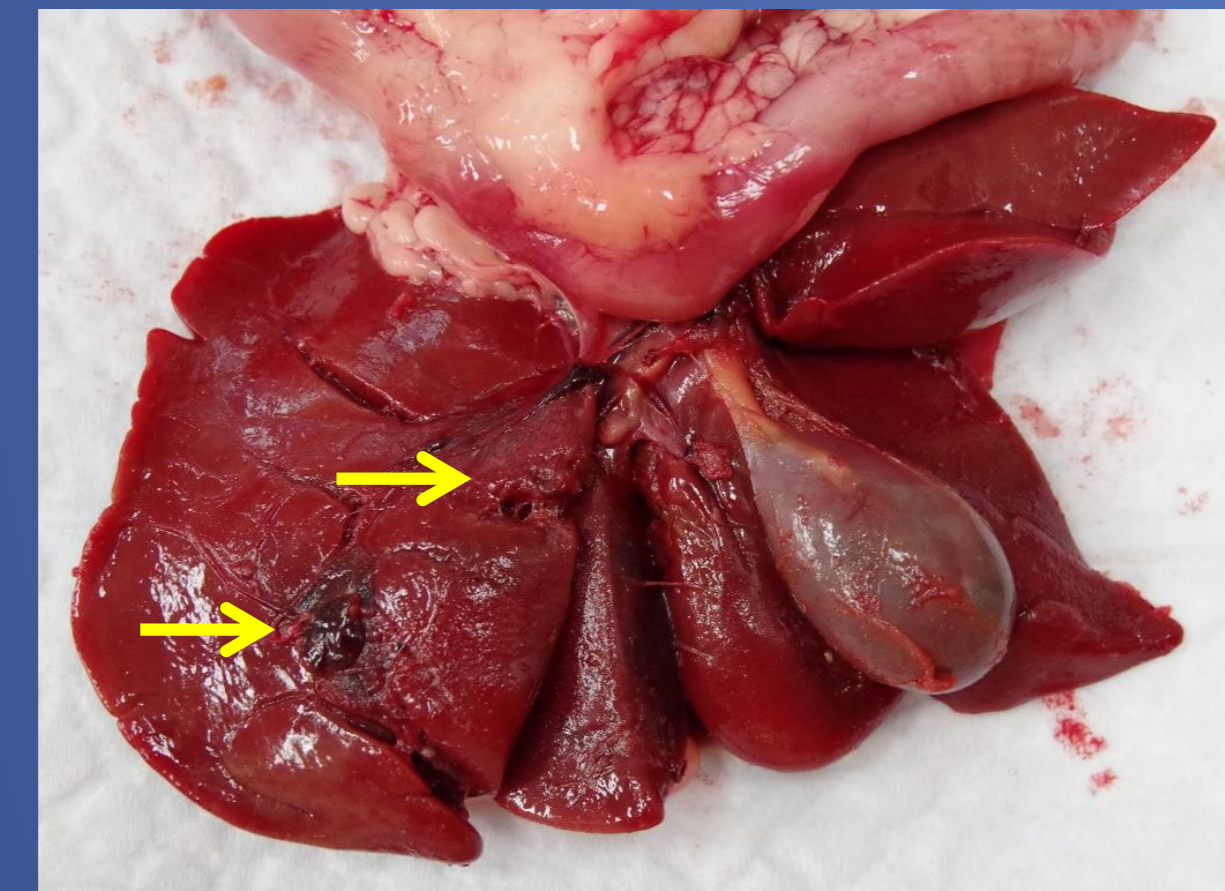


Figure 4. Visceral surface of the liver. Multifocal capsular lysis (arrow).

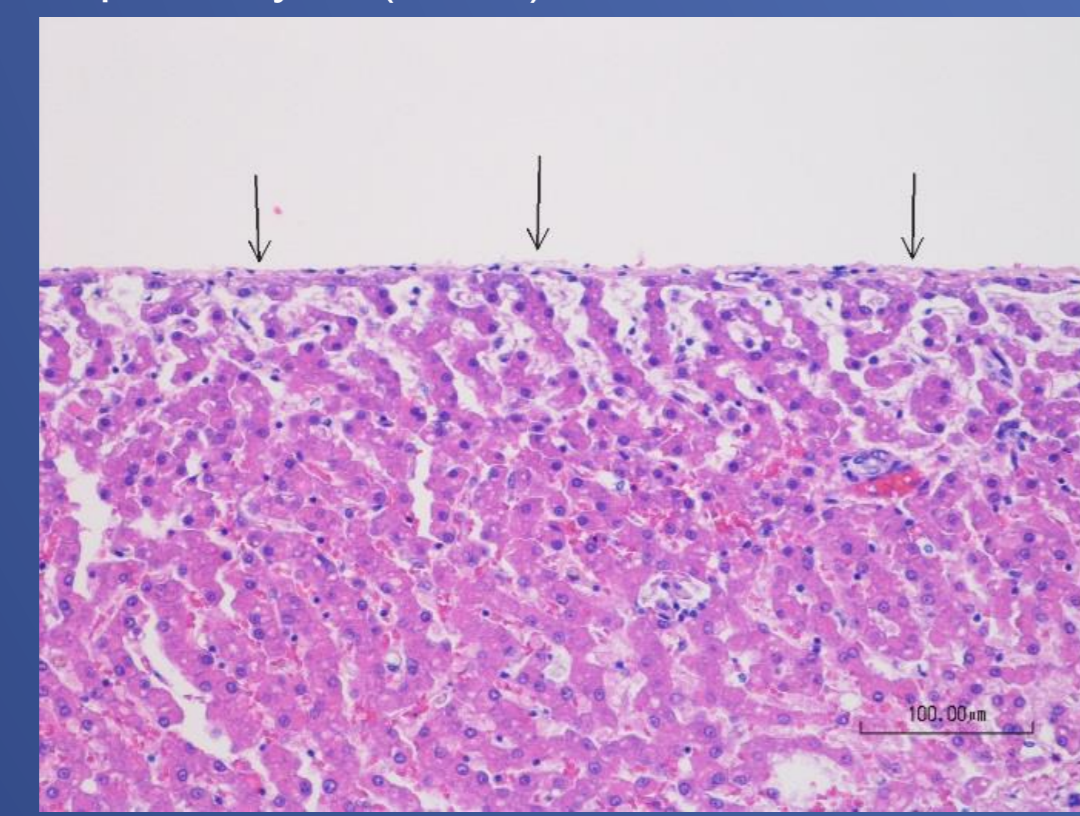


Figure 5. Unaffected area of the liver. The capsule is intact (arrow).

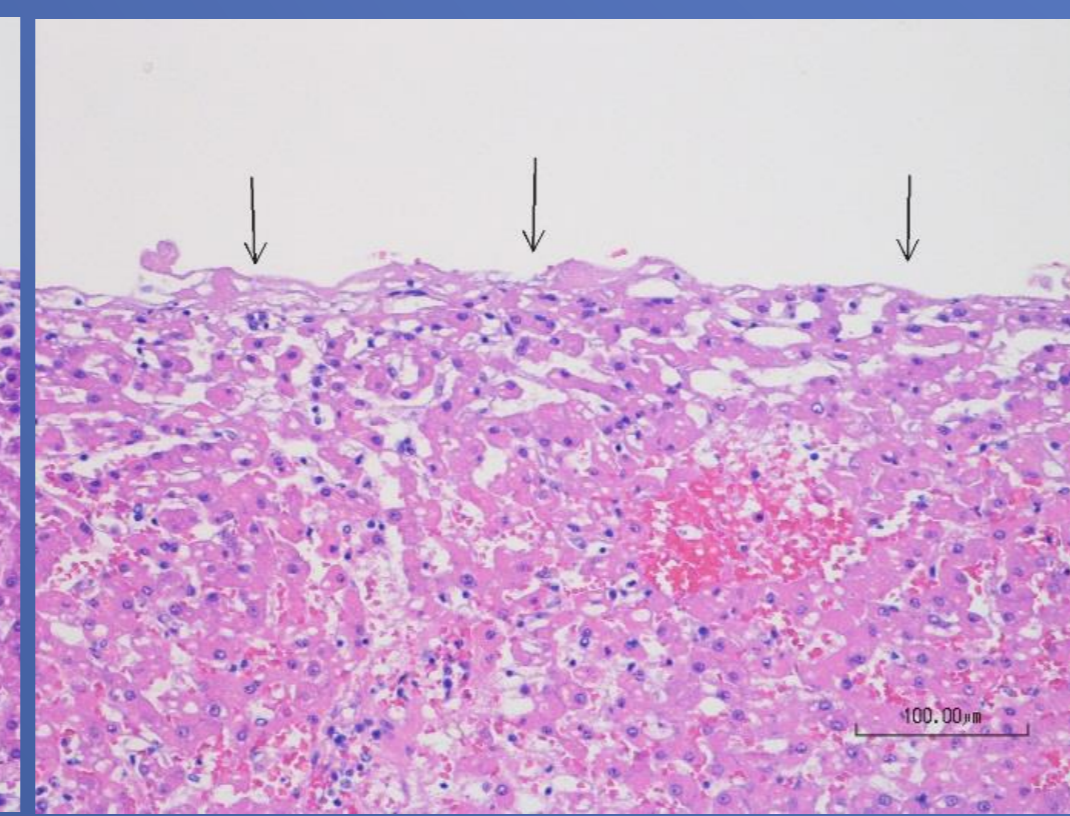


Figure 6. Affected area of the liver. The capsule is lysed (arrow).

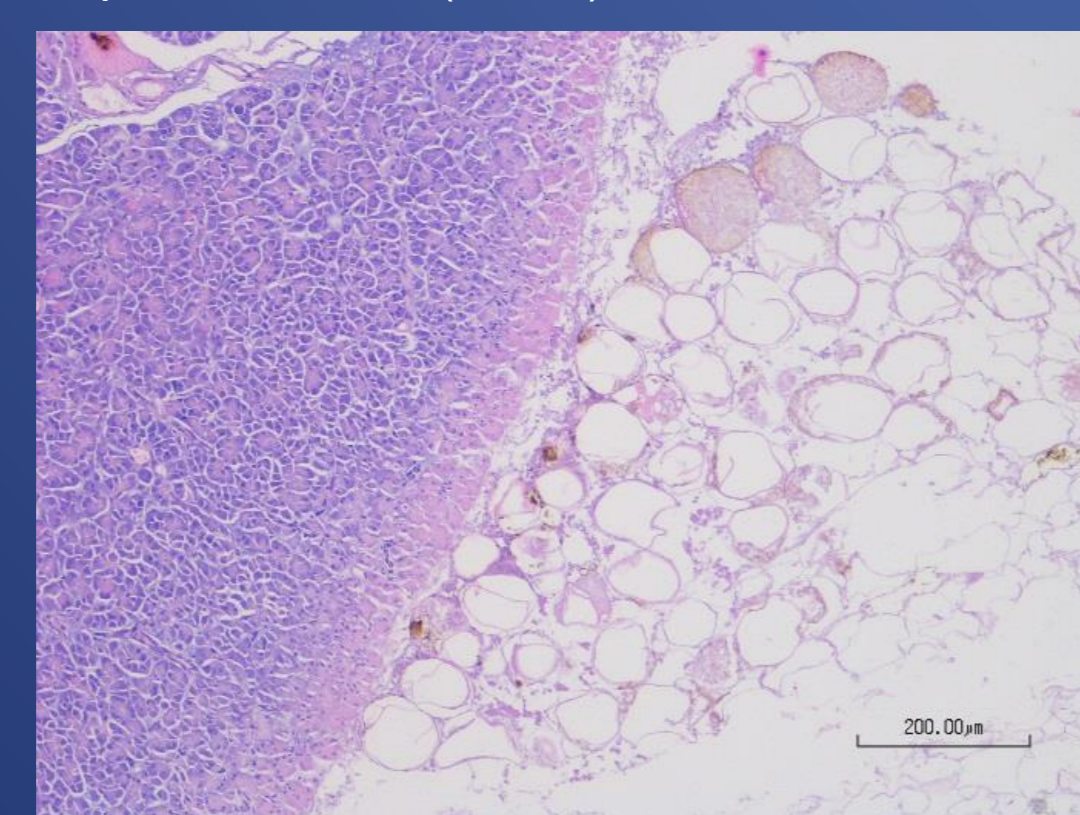


Figure 7. Perilobular degeneration of pancreatic acini and necrosis (saponification) of peripancreatic fat. No autolysis is seen.

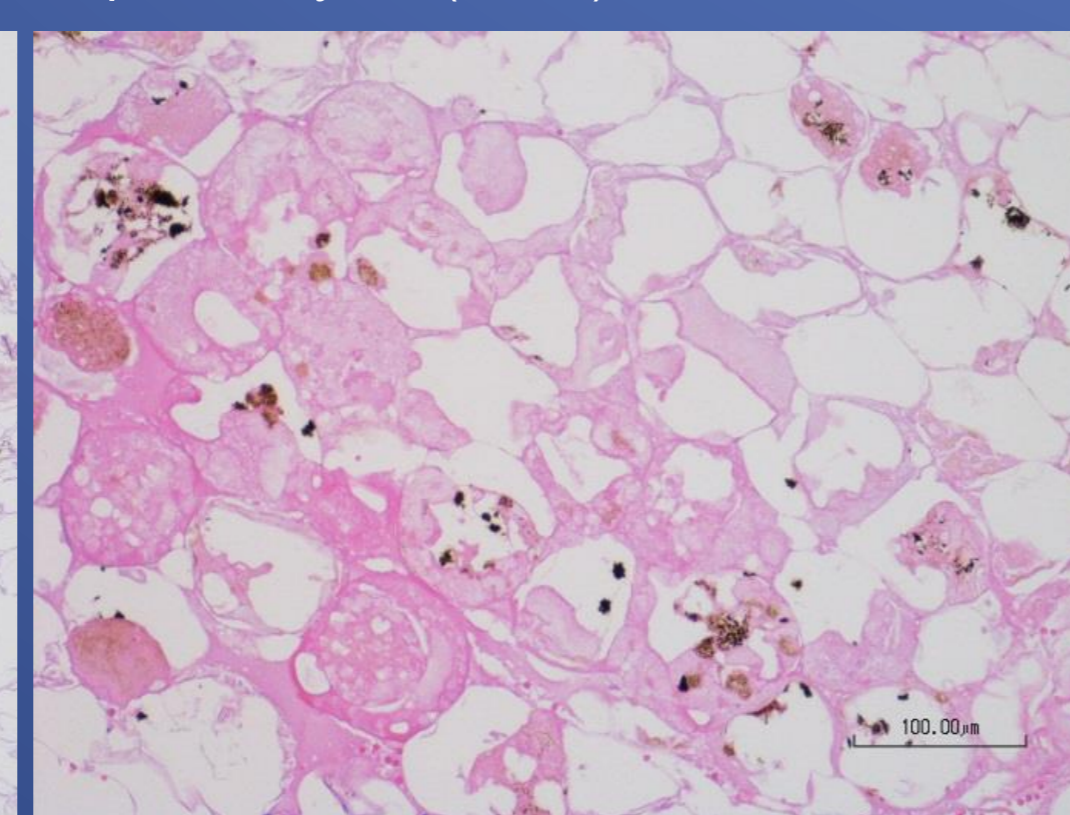


Figure 8. Necrosis (saponification) of peripancreatic fat. No autolysis is seen.

Toy Poodle, 6y 4m, intact male, BW 2.9kg	Patient	French Bulldog, 7m, intact female, BW 10kg
Castration (of descended testicles) and scaling	Aim of visit	Ovariohysterectomy
Dental tartar	History	None (healthy)
Physical examination found dental tartar. Results of chest X-ray, CBC, and blood chemistry (AST, ALT, T-Bil, BUN, Glu, T-Cho) were within normal limits.	Pre-op examination	Results of physical examination, chest X-ray, CBC, blood chemistry (AST, ALT, ALP, BUN, Cre, Glu, TP, Alb, NH ₃) were within normal limits. Mild hyponatremia, hypochloremia, and hypokalemia were detected by electrolyte analysis.
Preanesthetics were atropine and propofol (5mg/kg, injected in 1 minute). Intubation was followed by inhalation of isoflurane and oxygen. Voluntary breathing was assisted by a respiratory bag as necessary.	Anesthesia	Preanesthetics were butorphanol, propofol (5mg/kg, injected in 1-2 minutes), and medetomidine. Intubation was followed by inhalation of isoflurane and oxygen. Voluntary breathing was closely monitored.
5 minutes: Bradycardia developed when the 1 st testicle was removed. Atropine was administered. Respiration was fully assisted by a bag because of loss of voluntary breathing. 10 minutes: Unstable vital signs appeared when the 2 nd testicle was removed. Dopamine was administered. External cardiac massage was initiated and lasted about 20 minutes before death was confirmed.	Clinical course and treatment (time at the initiation of operation is defined as "0" minute)	18 minutes: When ovariohysterectomy was almost finished, unstable vital signs with apnea appeared. Respiration was assisted by a bag. 28 minutes: Apnea and bradycardia still existed. External cardiac massage and artificial ventilation were initiated. Epinephrine, atropine, doxaplam, atipamezole were administered. Cardiac massage continued for an extended period of time until the owner's arrival at the clinic. 3 hours 31 minutes: Death was finally declared.
<ul style="list-style-type: none"> ■ Hemoperitoneum (220ml; Fig.1) ■ Liver: Multifocal capsular lysis (Fig.3, 4) ■ Left pancreatic lobe: Focal hemorrhage ■ Lung: Mild edema and congestion ■ Oral cavity: Tartar ■ Heart: Mild mitral valvular myxomatous change 	Gross findings	<ul style="list-style-type: none"> ■ Hemoperitoneum (330ml; Fig.9) ■ Liver: Multifocal capsular lysis (Fig.11) ■ Pancreatic body: Focal hemorrhage (Fig. 12) ■ Lung: Mild edema and congestion
<ul style="list-style-type: none"> ■ Liver: Multifocal capsular lysis (Fig.6); sinusoidal congestion; focal fibrin thrombus ■ Pancreas: Acute pancreatitis (acute pancreatic necrosis; Fig.7, 8) ■ Kidney: Acute tubular necrosis ■ Lung: Slight, scattered, alveolar edema and hemorrhage 	Histologic findings	<ul style="list-style-type: none"> ■ Liver: Multifocal capsular lysis (Fig.14); sinusoidal congestion ■ Pancreas: Acute pancreatitis (acute pancreatic necrosis; Fig.15, 16) ■ Pancreatic lymph node: Hemoabsorption ■ Kidney: Scattered acute tubular necrosis ■ Lung: Diffuse congestion; scattered alveolar edema ■ Cerebrum: Scattered neuronal necrosis
Liver: <i>Streptococcus bovis</i> (judged insignificant)	Bacteriology	Liver: <i>α-Streptococcus</i> sp (judged insignificant)

Table 1. Summary of patient information and pre- and post-mortem findings.



Figure 9. There was 330ml of blood in the abdomen.

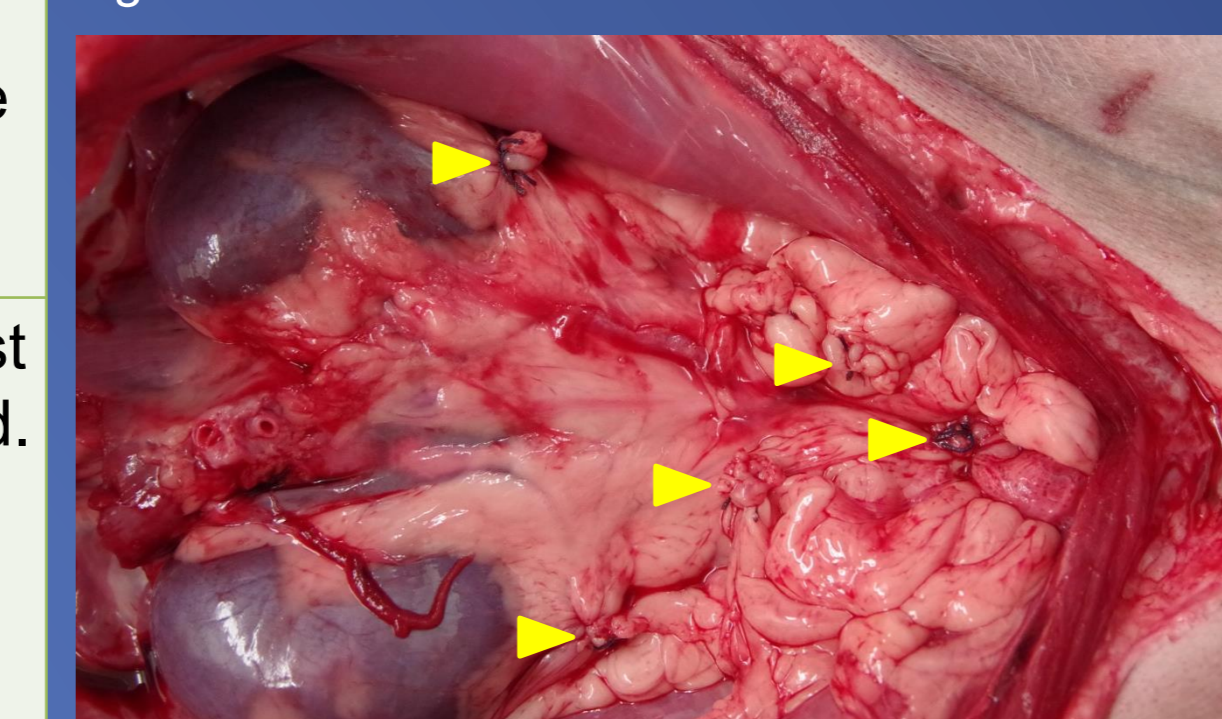


Figure 10. No dehiscence of ligature (arrow head).

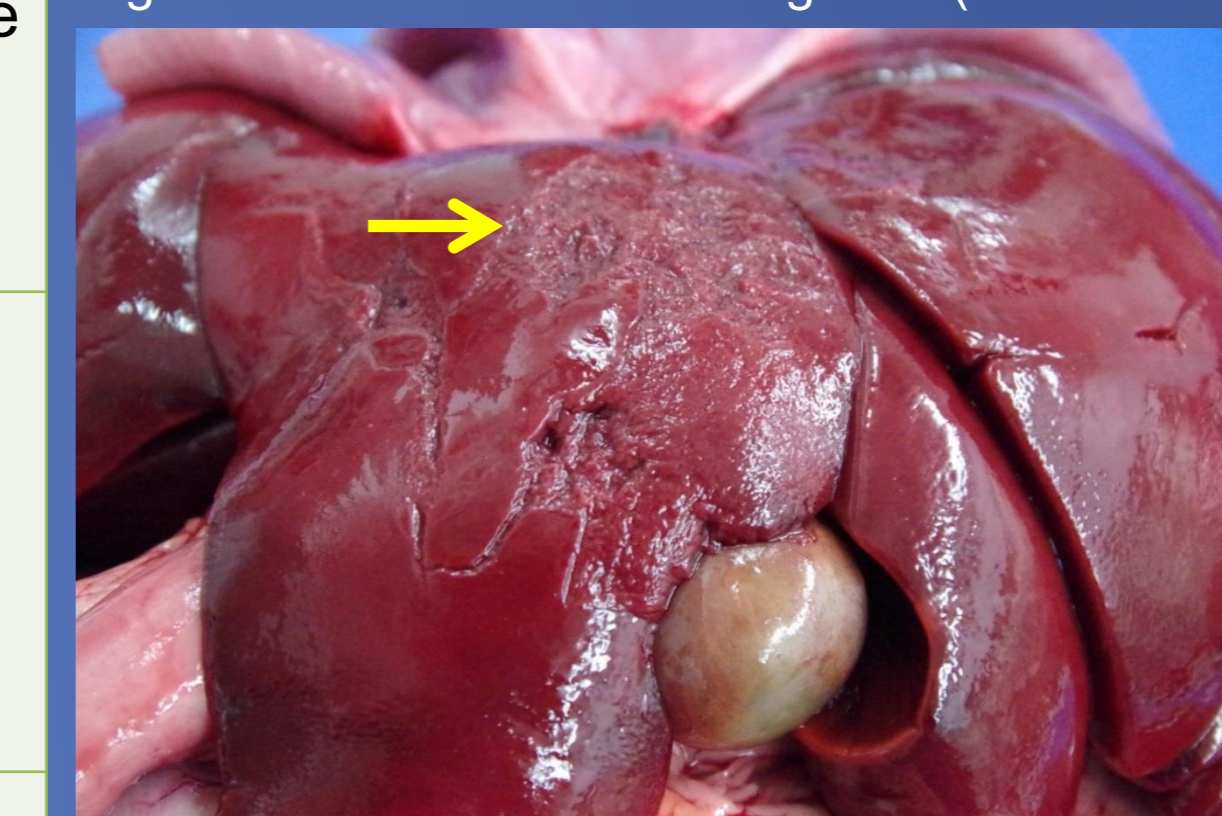


Figure 11. Diaphragmatic surface of the liver. Capsular lysis (arrow) is close to the porta hepatis.

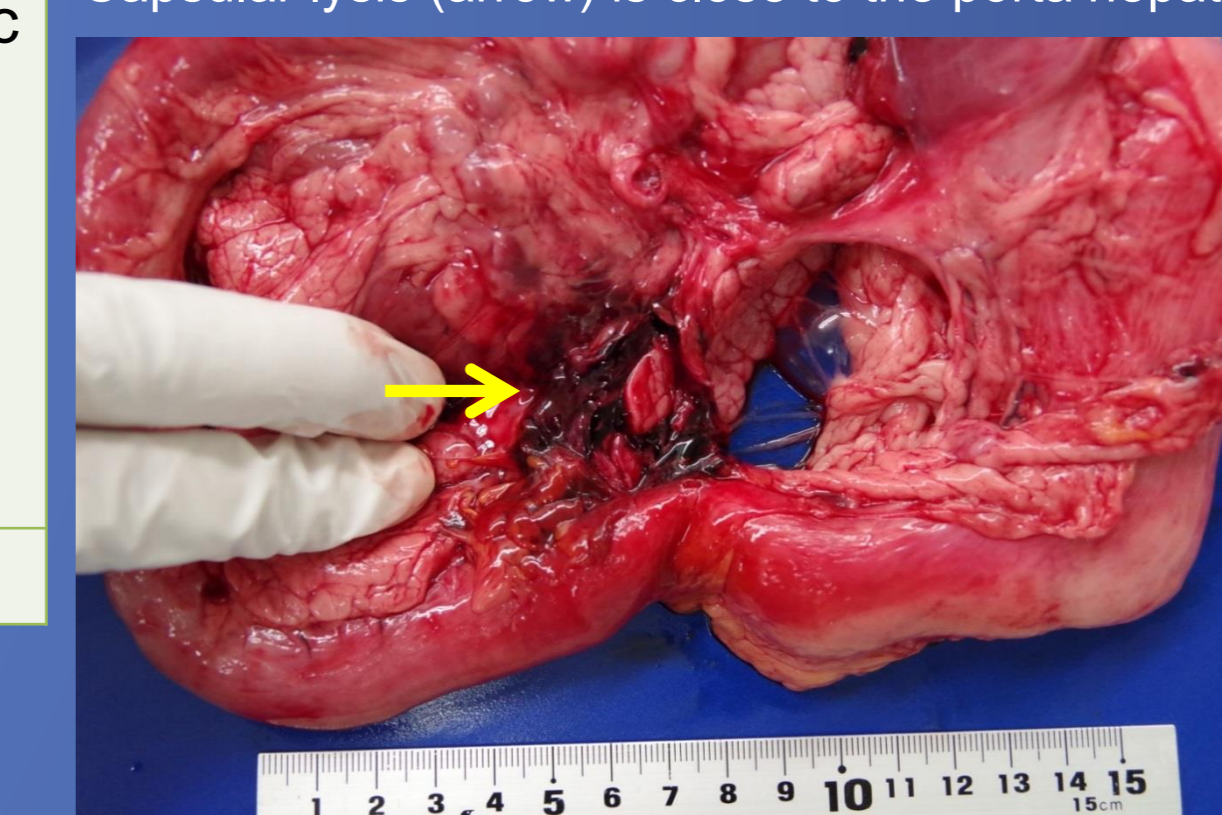


Figure 12. Focal hemorrhage in the pancreatic body (arrow).

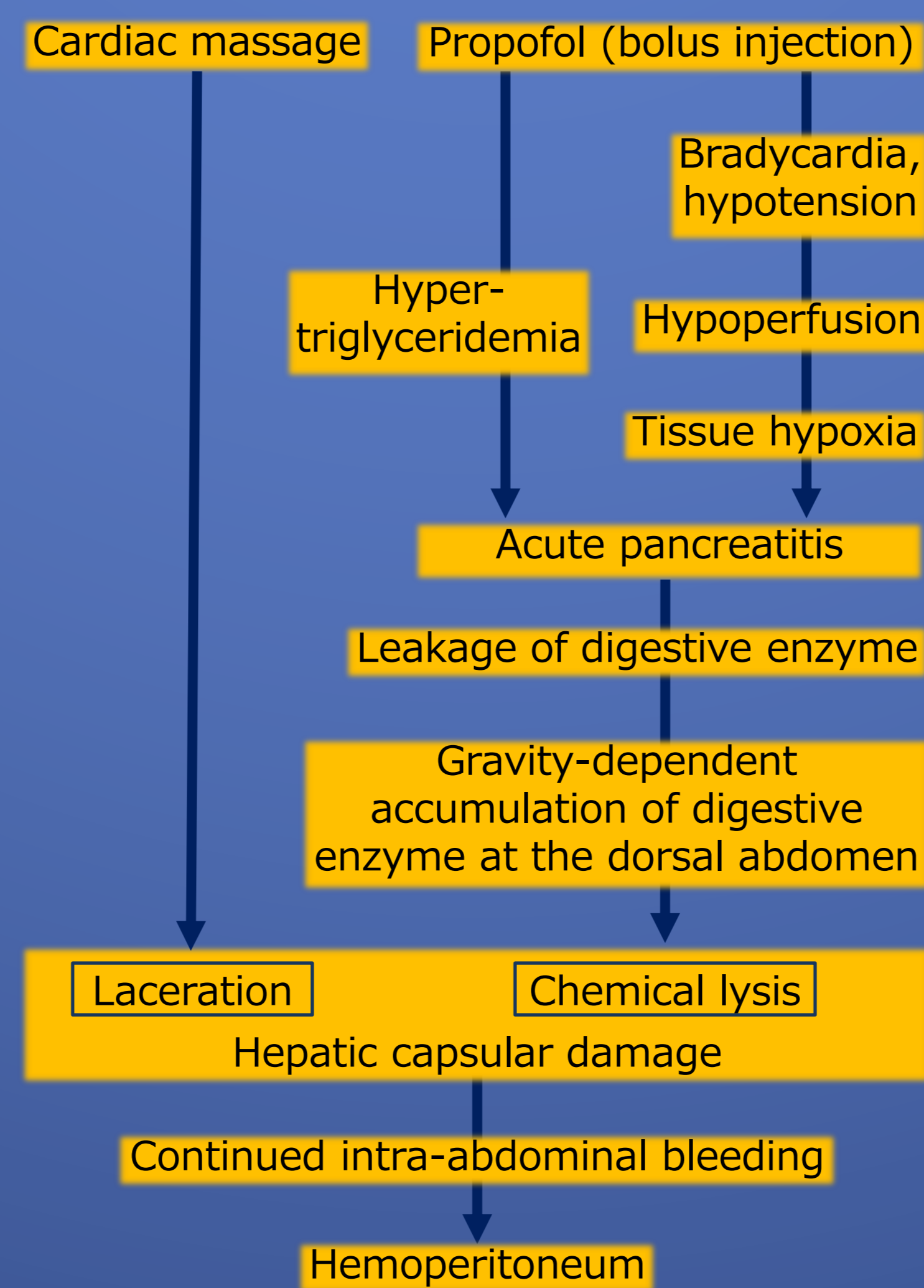


Figure 17. Proposed pathogenesis of hemoperitoneum of the present cases.

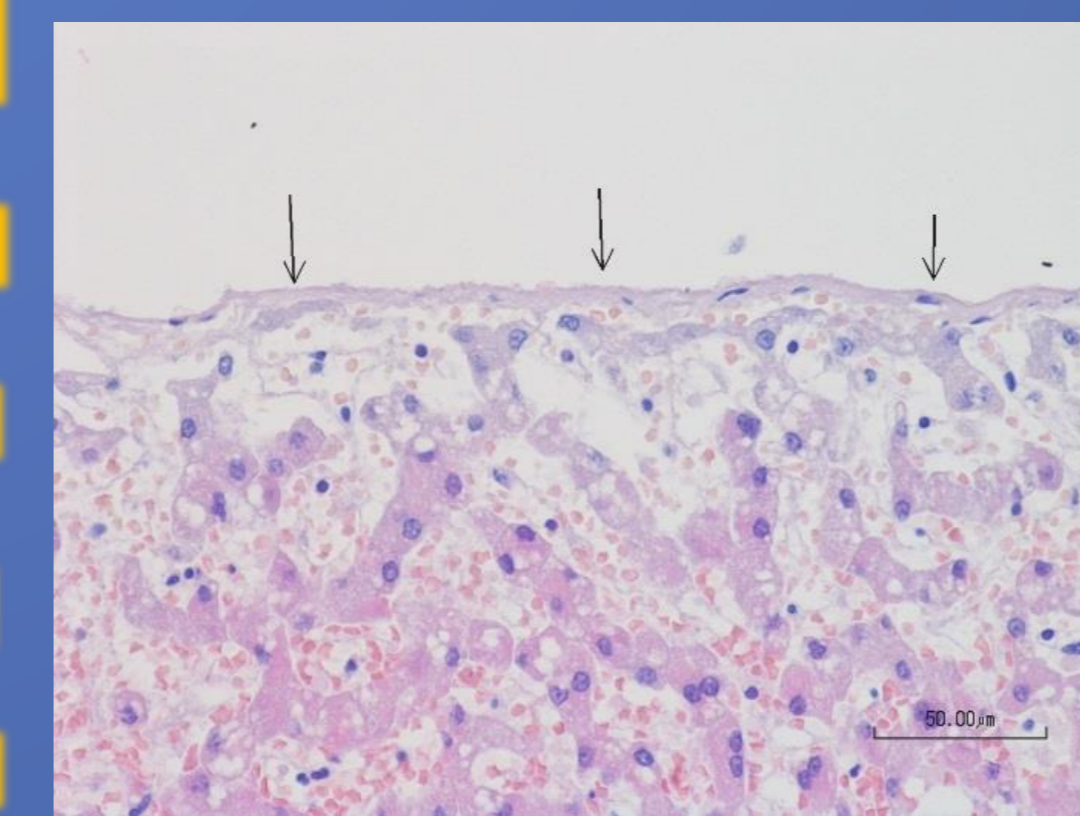


Figure 13. Unaffected area of the liver. The capsule is intact (arrow).

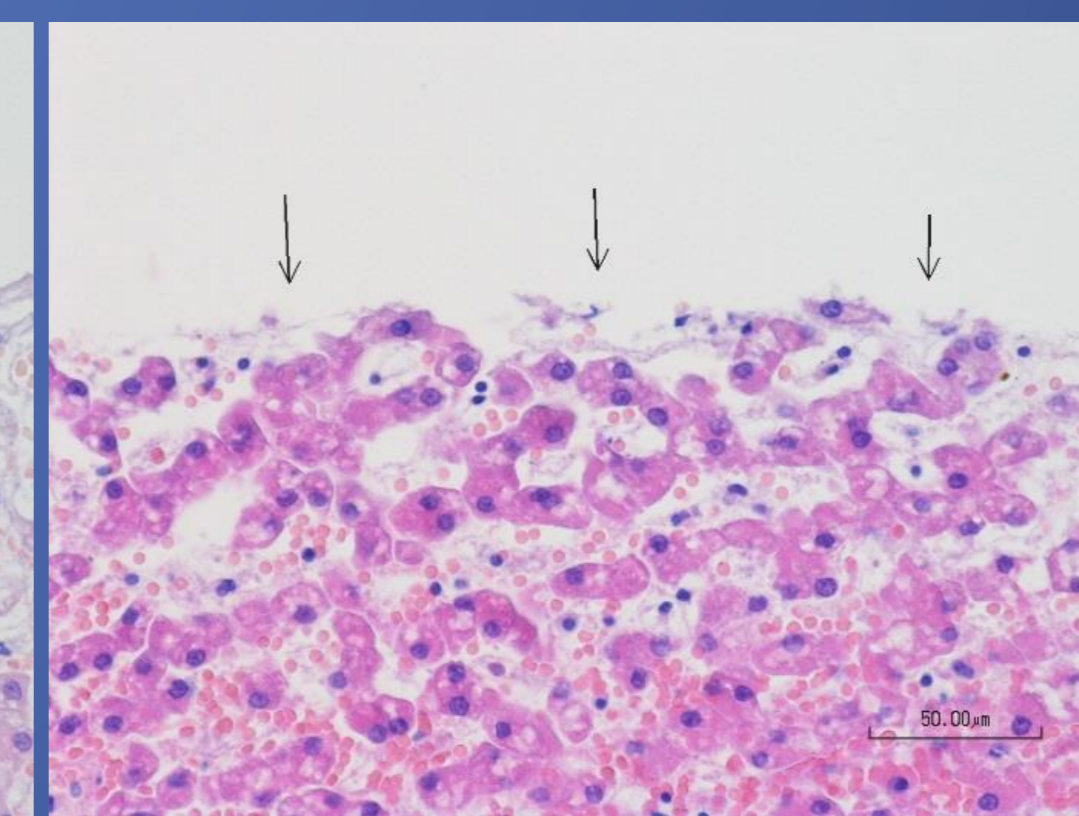


Figure 14. Affected area of the liver. The capsule is lysed (arrow).

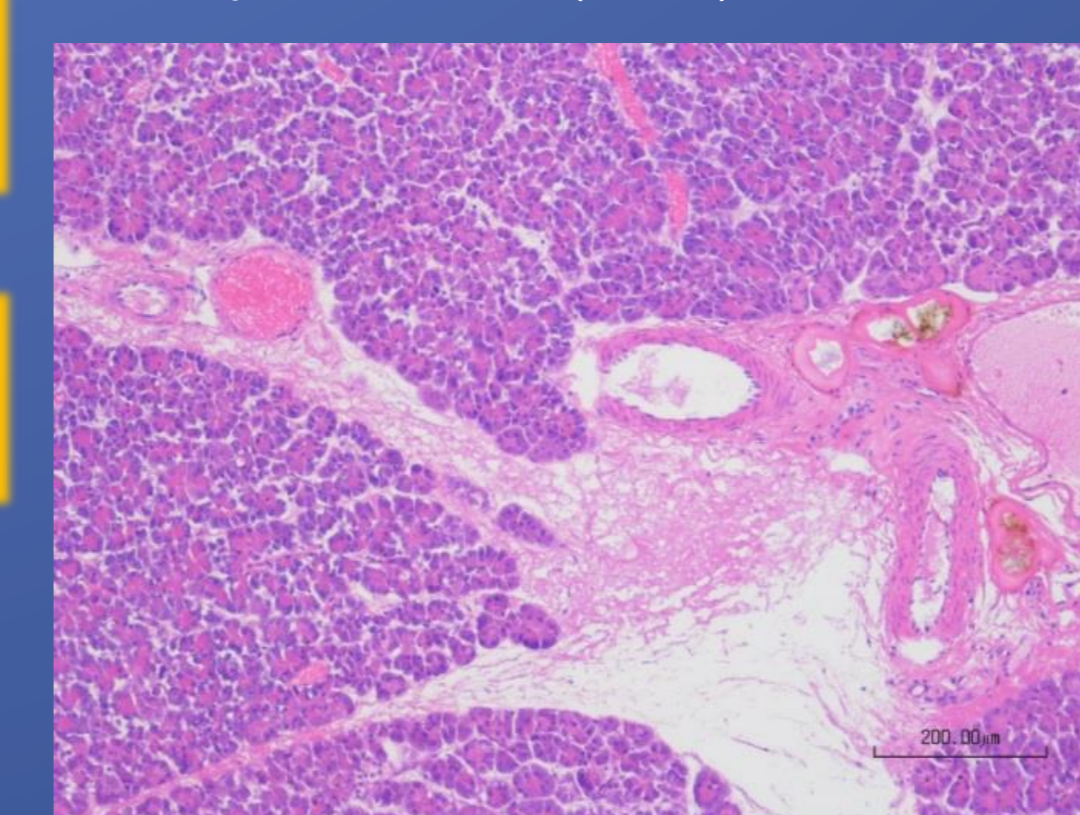


Figure 15. Hemorrhage and fibrin exudation within pancreatic interlobular space. No autolysis is seen.

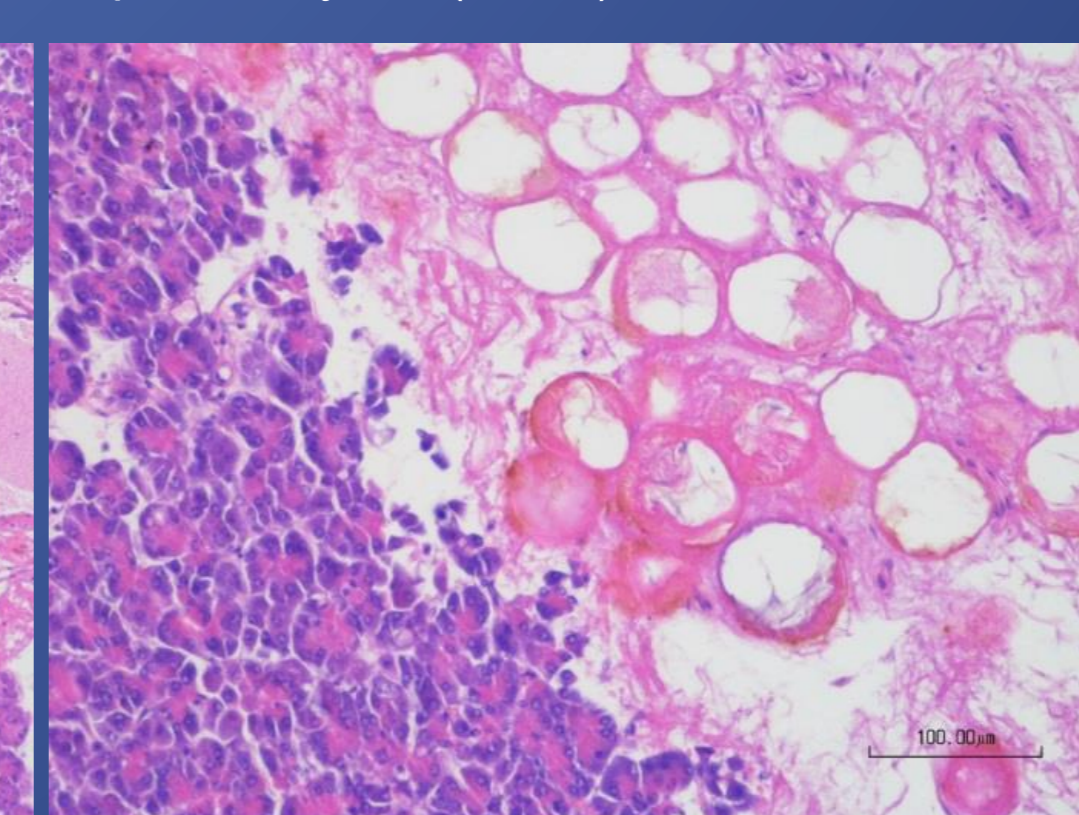


Figure 16. Necrosis (saponification) of peripancreatic fat. No autolysis is seen.

External cardiac massage aiming to recover spontaneous heart beat is integral to resuscitation attempts. Frequent complications associated with cardiac massage were rib and sternal fractures in a human retrospective study.²⁾ Rarely, upper-belly structures including the liver can be injured. Occurrence of liver injuries during cardiac massage was 0.6-2.1%.²⁾ The left liver lobe was most often injured in a cohort study of 15 human patients out of 2558 cardiac arrest victims.⁷⁾ Information on more detailed topography of such damage, however, is lacking.

Propofol, a potent intravenous hypnotic agent, contains 10% soybean oil corresponding to 0.1g of fat for every milliliter.⁶⁾ Though link between propofol usage and acute pancreatitis has been discussed with opposing conclusions, short-term usage of propofol resulted in significant elevation of serum triglyceride and pancreatic enzyme in children.⁵⁾

Acute pancreatitis is triggered by co-localization of zymogen granules and lysosomes, which is associated with sustained elevation of intracellular calcium and altered calcium signaling.³⁾ Such events occur with hypoxia, hypercalcemia, hyperlipidemia, and hypertension of pancreatic duct.³⁾ Acute pancreatitis seen in the patients could be caused by hypoxia and hyperlipidemia, both of which are possible sequelae of propofol administration.

Proposed pathogenesis of these dogs' hemoperitoneum is shown in Fig. 17.

Conclusions

Pathogenesis of hemoperitoneum can be complex. Screening of all possible causes and careful review of past caseload will be necessary for deeper understanding of this potentially multifactorial event.

Acknowledgements

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References

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