NOTE *Pathology*

Intrathoracic Ectopic Liver in a Cow

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ABSTRACT. A solitary spherical mass was found in the caudal part of the cranial lobe of the left lung of a 28-month-old Japanese Black cow. The mass was circumscribed, embedded in the lung parenchyma and not connected to the liver or diaphragm. Histologically, the mass comprised hepatocytes, portal structures consisting of interlobular bile ducts, interlobular arteries and interlobular veins, and central veins. Based on the histological findings, a diagnosis of intrathoracic ectopic liver was made. Considering the absence of any previous history of traumatic diaphragmatic hernia or surgery, the mass might have resulted from a congenital abnormality. To our knowledge, this is the first report of intrathoracic ectopic liver in a cow that might have resulted from a congenital abnormality.
KEY WORDS: cattle, congenital abnormality, ectopic liver, thoracic cavity.

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An ectopic liver is generally asymptomatic and an incidental finding discovered during surgery or necropsy [9]. In humans, an ectopic liver is often located adjacent to the pancreas [6], gallbladder [8], spleen [4] or native liver [1]. However, very rarely, it is found in the thoracic cavity [2]. In veterinary medicine, intrathoracic ectopic liver caused by traumatic injury has previously been reported in a cat [5], but no reports have described intrathoracic ectopic liver in cattle. This study describes an intrathoracic ectopic liver in a cow that might have resulted from a congenital abnormality.

A 28-month-old Japanese Black cow weighing 794 kg was brought to a meat inspection center in good condition. The cow had no previous history of traumatic diaphragmatic hernia or surgery and showed no clinical abnormalities before being submitted for meat inspection. On gross inspection, a solitary spherical mass (6 × 6× 5 cm) was found in the caudal part of the cranial lobe of the left lung, enveloped by the serous membrane and embedded in the lung parenchyma. The gross cut surface of the formalin-fixed mass was elastic, firm, well-circumscribed and brown in color (Fig. 1). The mass was not connected to the liver or diaphragm. No gross abnormalities were evident in any other organ.

The mass was fixed in 10% neutral-buffered formalin, embedded in paraffin and sectioned and was then stained with hematoxylin and eosin (HE), Hall's method and Watanabe's silver impregnation. The EnVision Polymer Method (DAKO Cytomation, Kyoto, Japan) was used for immunohistochemical staining. Anti-hepatocyte monoclonal antibody (1:25, clone OCH1E5; DAKO Cytomation) and anti-cytokeratin monoclonal antibody (1:50, clone AE1/AE3; DAKO Cytomation) were used as primary antibodies. Endogenous peroxidase was inactivated with 3% H_2O_2-methanol. Autoclaving (121°C for 15 min) was used for antigen retrieval. Detected antigens were visualized with 3, 3′-diaminobenzidine tetrahydrochloride reagent. Sections were counterstained with Mayer's hematoxylin. Normal bovine liver was used as a positive control.

Histologically, the mass was circumscribed, surrounded by fibrous connective tissue and separated from lung tissue (Fig. 2). It comprised sheets of polygonal hepatocytes arranged uniformly and radially (Fig. 3). Portal areas consisting of interlobular bile ducts, interlobular arteries and interlobular veins were present. Central veins were also seen at the center of hepatic lobules. The histological structures and streams of interlobular arteries, interlobular veins, central veins and sublobular veins showed no significant differences in comparison to normal bovine liver tissues. No blood vessels could be seen connecting the mass with the lung tissue. Hall's method revealed no bile production. Watanabe's silver impregnation revealed clear hepatic cords and abundant reticular fibers lining sinusoids. Immunohistochemically, hepatocytes were positive for anti-hepatocyte monoclonal antibody and negative for anti-cytokeratin monoclonal antibody (Fig. 4). Interlobular bile ducts were positive for anti-cytokeratin monoclonal antibody and negative for anti-hepatocyte monoclonal antibody. These results were the same as in the normal bovine liver tissues used as positive controls. Based on the histological findings, intrathoracic ectopic liver was diagnosed.

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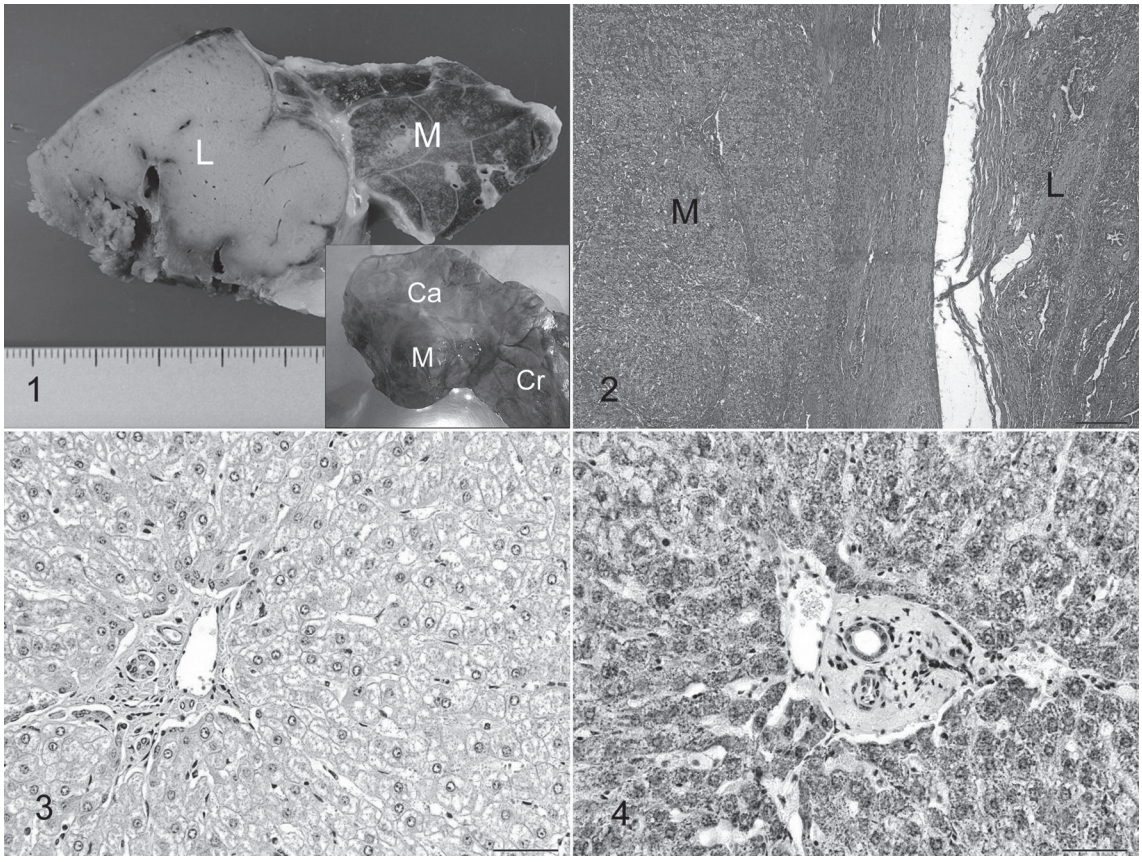

Fig. 1. Gross cut surface of the formalin-fixed mass and lung. The cut surface of the mass (M) is elastic and firm, well-circumscribed and brown. L: lung. (Inset) Gross photograph of the mass and lung after resection of the cranial lobe of the left lung. The mass (M) was located in the caudal part of the cranial lobe of the left lung, enveloped by the serous membrane and embedded in the lung parenchyma. The mass was not connected to the liver or diaphragm. Cr: cranial part, Ca: caudal part.

Fig. 2. The mass (M) is circumscribed, surrounded by fibrous connective tissue and separated from lung tissue (L). HE. Bar=200 μm.

Fig. 3. The mass comprises hepatocytes and portal structures consisting of interlobular bile ducts, interlobular arteries and interlobular veins. HE. Bar=50 μm

Fig. 4. Immunohistochemistry of hepatocytes and interlobular bile ducts using anti-hepatocyte monoclonal antibody. Hepatocytes are positive, and interlobular bile ducts are negative. Mayer's hematoxylin counterstaining. Bar=50 μm

Intrathoracic ectopic liver is a rare finding in humans and other animals [1, 4, 5]. The ectopic liver typically consists of histologically normal liver tissue in humans [2, 6, 8]. In this study, the mass likewise comprised histologically normal liver tissue. But, the ectopic liver has a higher neoplastic potential than the native liver [1, 3]. The anti-hepatocyte monoclonal antibody is a highly specific and sensitive marker for human and canine hepatocytes (including normal, hyperplastic and neoplastic hepatocytes), and hepatocytes show granular and diffuse intracytoplasmic immunoreactivity, but the bile duct epithelia do not react [7]. Similarly, in this case and normal bovine liver tissues used as positive controls, hepatocytes were positive for the anti-hepatocyte monoclonal antibody, and interlobular bile ducts were negative immunohistochemically.

According to one previous report about human intrathoracic ectopic liver [9], the intrathoracic ectopic liver had an autonomous vascular supply and a biliary system draining into other organs or no apparent drainage system. The vascular supply to the mass seemed to come from the aorta during surgery in another previous report about human intrathoracic ectopic liver [8], but no vascular supply to the mass could be recognized during meat inspection in the present case and the histological findings could not show any vascular supply from lung tissue. Given the long-term survival of the mass that comprised histologically normal liver tissue, the mass must have received the vascular supply from the surrounding tissues or blood vessels. But, the vascular supply to the mass in this case remains uncertain, because of the absence of clinical examinations, such as ultrasonographic techniques and angiography. Additionally, considering the absence of histological findings suggesting bile production, no biliary drainage system seemed to be present in this case. Although the histological findings were similar to those of the native

liver, the intrathoracic ectopic liver in this case might not have performed functions similar to the native liver.

The possible mechanisms of the development of an intrathoracic ectopic liver in humans may be congenital abnormality, as an abnormal development of both the liver and diaphragm during the embryonic period, acquisition secondary to traumatic diaphragmatic hernia and acquisition secondary to hematogenous dissemination of liver tissue following a heart transplantation procedure [6, 9]. One of the possible mechanisms reported previously in human intrathoracic ectopic liver resulting from a congenital abnormality is the development of another liver bud independent of the main hepatic diverticulum that remains sequestered in the thoracic cavity without connection to the native liver [4, 9]. In the present case, considering the necropsy findings and previous history, the mass might have resulted from a congenital abnormality, and the above-mentioned mechanism might explain the pathogenesis of the present case.

In conclusion, a solitary mass found in the lung of a cow was diagnosed as an intrathoracic ectopic liver. To our knowledge, this is the first report of an intrathoracic ectopic liver that might have resulted from a congenital abnormality in cattle. The anatomical site and appearance of the solitary mass embedded in the lung in this case of intrathoracic ectopic liver were extremely characteristic. Because intrathoracic ectopic liver is also a rare finding in veterinary medicine, this case report might provide useful information when correct diagnosis of intrathoracic ectopic liver in cattle is difficult during necropsy or meat inspection.

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