

## Pleuritis and pericarditis associated with *Klebsiella pneumoniae* in a Eurasian beaver (*Castor fiber*)

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**Abstract :** An adult one-year-old male Eurasian beaver (*Castor fiber*) died of a traumatic injury to its right leg from a fall. At necropsy, fibrinopurulent exudates were observed in the thoracic cavity. Histopathologic examination showed that the pericardium, thoracic wall, pulmonary pleura and the lungs were markedly thickened due to mixtures of necrotic cellular debris, neutrophils, fibrin, red blood cells, and bacterial aggregates. Pure culture of *Klebsiella* (*K.*) *pneumoniae* was isolated from the thoracic exudates, pleura and heart tissues. Based on these findings, this is the first report describing pleuritis and pericarditis associated to *K. pneumoniae* in a beaver.

**Keywords :** beaver, *Castor fiber*, *Klebsiella pneumoniae*, pericarditis, pleuritis

The Eurasian beaver (*Castor fiber*) was once widespread in Europe and Asia, inhabiting the forest zones and also wooded river valleys. At the beginning of the 20th century, only eight small populations with a total of 1,200 individuals remained and making it an endangered species. Due to the recovery policies of many countries, the Eurasian beaver now numbers an estimated 430,000 in Europe and Asia, and the numbers are still increasing, despite the fact that most of the natural habitat has disappeared [5]. A one-year old male Eurasian beaver weighing 12.5 kg imported from Russia was kept for almost a month at the private commercial aquarium in Seoul, Korea for indoor exhibition. After falling from a tree, the beaver sustained a traumatic injury to its knee of right hind limb and was brought to local veterinary clinic for treatment after three days. Briefly, after physical examination, no open wound or other abnormalities were observed except limping of right leg. X-ray examination showed right femoral fracture and fluids in the peritoneal cavity area. The beaver was injected with enrofloxacin (Baytril; Bayer HealthCare, USA) 10 mg/kg, once a day for 5 days, and later changed to cefazolin (Ancef; GlaxoSmithKline, UK) 10 mg/kg, three times a day for another 7 days of treatment by

subcutaneous injection. During the treatment period, the right leg joint was able to recover from limping and fluids in the peritoneal cavity area were gone based on the repeat X-ray examination. However, the beaver became anorexic and was unresponsive to food, fluid and antibiotic therapies and lost some weight. It was found dead after 12 days of treatment. Shortly after death, its body was submitted to the College of Veterinary Medicine, Seoul National University for postmortem examination.

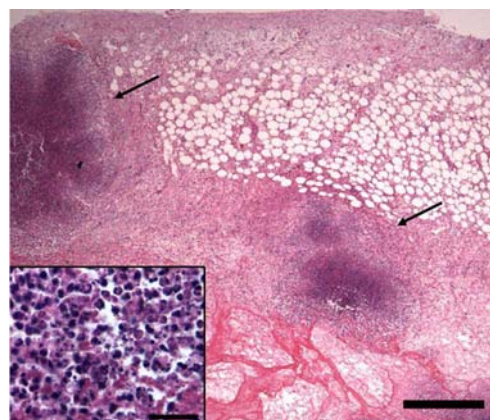
At necropsy, the thoracic cavity was filled with large amounts of dark yellowish fibrinopurulent exudates. Very thick, tenacious bands of fibrinopurulent adhesions were observed along the thoracic wall, the pleural surfaces of the lungs, and the pericardium, with the bands thicker along the right side (Fig. 1). The underlying pulmonary parenchyma was reddened and firm. There were no inflammatory exudates, hemorrhage, or fluid in the trachea and bronchi, but depressed dark purple atelectatic areas were detected. The pericardial sac was markedly dilated with fibrinopurulent exudates adhering to the parietal and visceral pericardium. Multiple well-demarcated pale yellowish foci, around 0.5 cm to 1 cm in diameter, were observed in the lungs, liver and kidneys.

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**Fig. 1.** Pleura from a beaver (*Castor fiber*). Severe thick tenacious bands of fibrinopurulent adhesions (stellate mark) among right thoracic wall, pleural surfaces of right lungs, and right pericardium were observed.



**Fig. 2.** Photomicrograph of Fig. 1. Majority area of thickened pleura was composed of multifocal aggregates of inflammatory cells (arrows) and fibrins with extensive necrosis. H&E. Bar = 400  $\mu$ m. Inset: Degenerate neutrophils and necrotic cellular and karyorrhetic debris were main components in the inflammatory foci.

Tissue samples from the representative parenchymal organ were fixed in 10% phosphate-buffered formalin, routinely processed for histopathology, stained with H&E, and examined under light microscopy. Tissue samples from the pleura, heart, and thoracic exudates were collected aseptically, inoculated onto a blood agar plate containing 5% defibrinated sheep blood, and cultured at 37°C under aerobic and microaerophilic conditions. After incubation, colonies were collected and identified using the Vitek System (BioMérieux, France). Finally, *Klebsiella* (*K.*) *pneumoniae* was isolated as a pure culture from the pleura, heart, and thoracic exudates. Microscopically, the thoracic wall, pulmonary pleura and pericardium were markedly thickened due to mixtures of necrotic cellular debris, neutrophils, fibrin, red blood cells, and bacterial aggregates (Fig. 2). In some areas of the lungs, the alveolar spaces were filled with necrotic cellular debris, neutrophils, and proteinaceous fluid. The alveolar septa were congested and distended due to infiltration of inflammatory cells. The liver and kidneys contained multifocal, randomly distributed areas of necrosis associated primarily with degenerated neutrophils, bacterial aggregates, and a few lymphocytes and plasma cells.

*K. pneumoniae* is a straight rod, capsulated, gram-negative, nonmotile bacterium in the family Enterobacteriaceae. It is normally found in the intestinal tracts of man and animals [1]. It is a causative agent of respiratory infections and is responsible for significant

morbidity and mortality in immunocompromised people [2]. *K. pneumoniae* infection has been shown to arise secondary to immunosuppression after surgery or trauma, particularly in ventilated patients [4]. *K. pneumoniae* infections have been reported in several animal species [3, 6, 7]. The primary clinical symptoms are peritonitis, septicemia, air sac infections, pneumonia, and meningitis. In Wistar rats, *K. pneumoniae* infection also causes pleuritis and pericarditis [3]. Disease associated with *K. pneumoniae* has not been reported in wild rodentidae.

We described here a case of *K. pneumoniae* infection in a Eurasian beaver kept at a private commercial aquarium in Korea which was diagnosed with pleuritis and pericarditis, with hepatic and renal involvement. Although the exact source and mode of infection of this animal could not be determined, it was speculated that prior to injury, there was an existing medical problem caused by *K. pneumoniae* which was not detected by the veterinarian. In addition to that, the present traumatic injury associated with anorexia, starvation, loss of weight and unresponsive to medical therapies may results to an immunocompromised state of the beaver which eventually leads to its death.

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