Diagnostic Exercise

From The Davis-Thompson Foundation*

Case #: 131 Month: October Year: 2019

Answer Sheet

Title: Bronchopneumonia associated with *Bordetella bronchiseptica* infection in a domestic rabbit.

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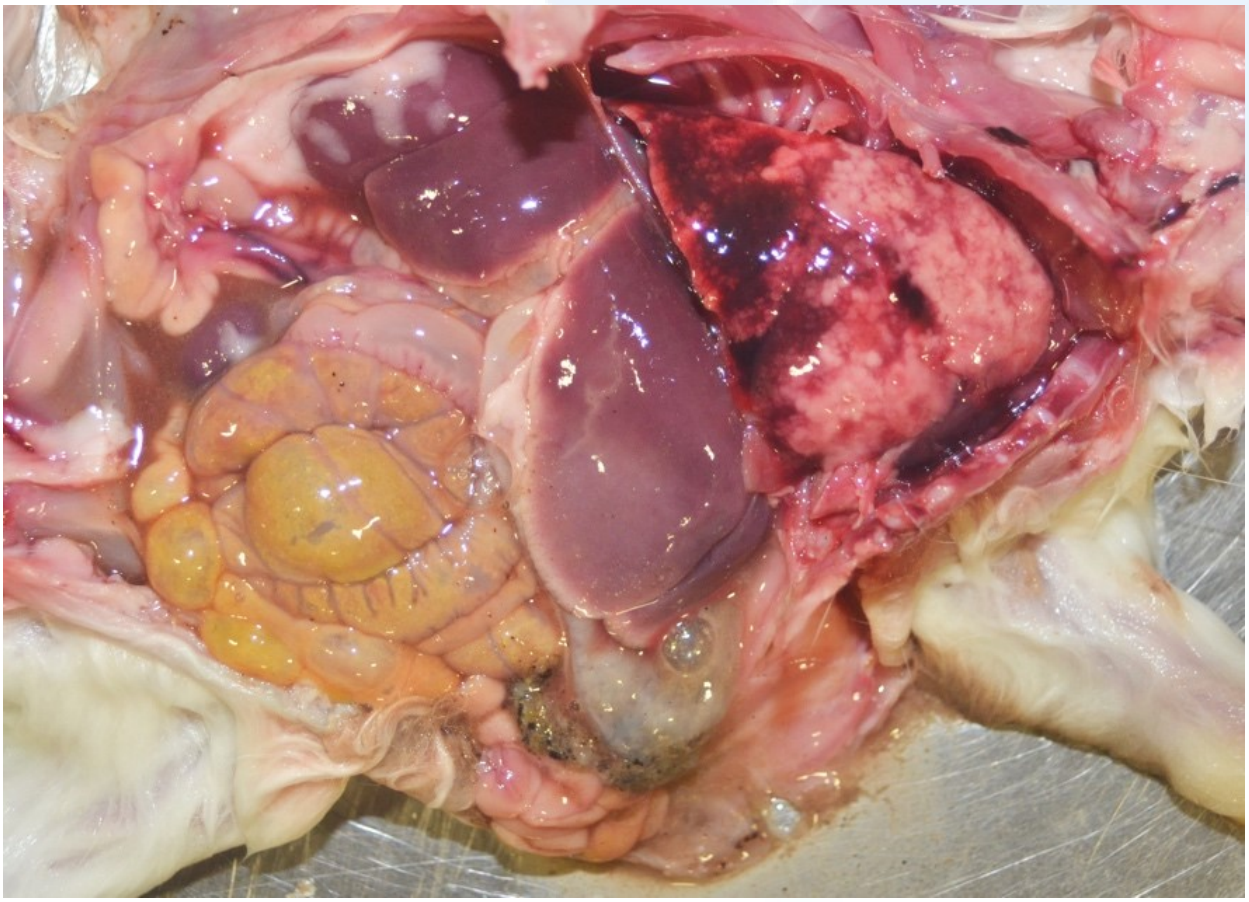

Figure 1. Thoracic and abdominal cavities, lateral view.

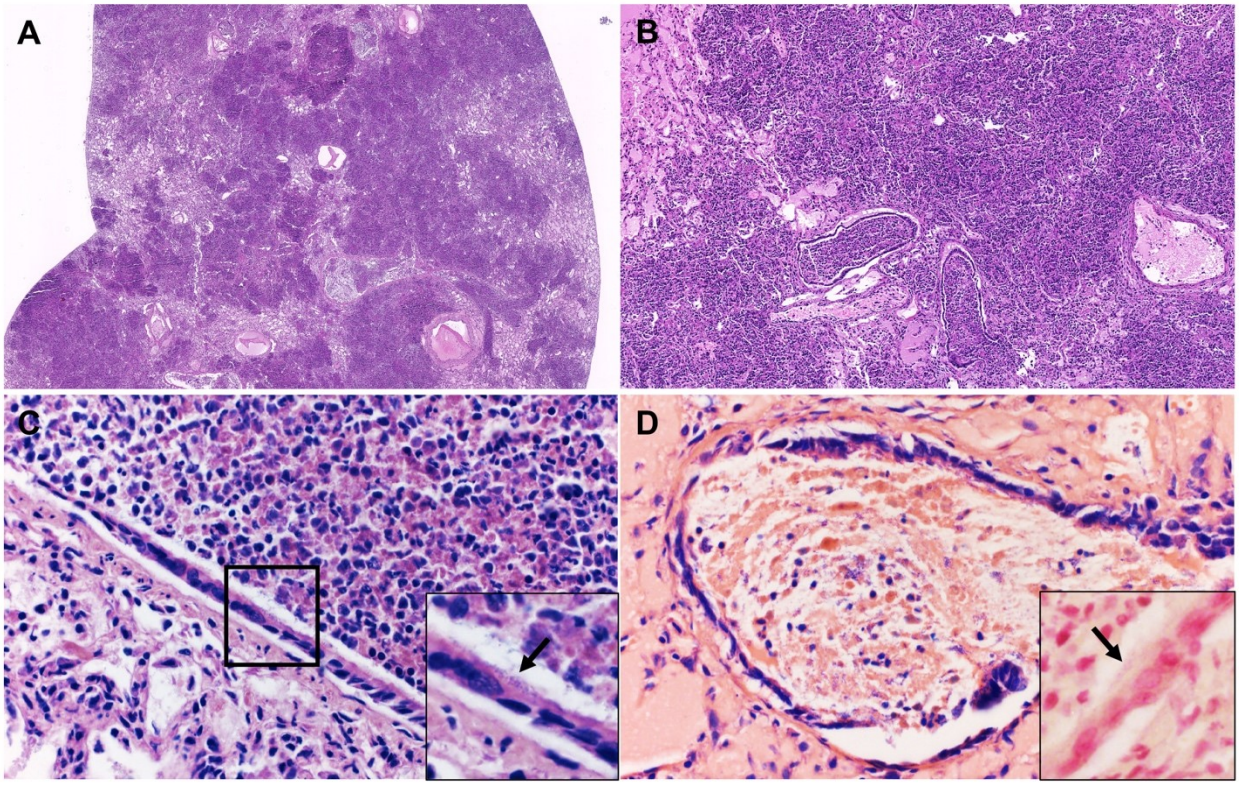

Figure 2. Lung. Hematoxylin and eosin; 2X (A), 10X (B) and 40X (C). Giemsa and Gram (inset) stains, 40X (D)

Diagnosis:

1) Microscopic description: The pulmonary parenchyma is effaced by coalescing areas of liquefactive necrosis characterized by numerous degenerate heterophils, abundant karyorrhectic cell debris, fibrin exudation, and gram-negative coccobacilli. The lumina of multifocal bronchioles and bronchi are filled with a similar exudate. The apical surface of the bronchial and bronchiolar epithelium is frequently lined by bacteria, accompanied by multifocal loss of cilia and epithelial attenuation. The remaining areas of the pulmonary parenchyma are comprised of alveolar spaces filled with edema fluid.
2) Morphologic diagnosis: Bronchopneumonia, heterophilic, coalescing, severe, acute to subacute, with intralesional gram-negative coccobacilli
3) Cause: *Bordetella bronchiseptica* (heavy growth obtained from lung tissue).

Typical gross findings:

- Purulent bronchopneumonia with a cranioventral distribution that can affect multiple lung lobes. The affected pulmonary parenchyma has multifocal to coalescing, red to tan areas of congestion and consolidation. Associated pleuritis occurs occasionally.

- Mucopurulent exudate within upper airways including nasal passages, trachea and tympanic bullae.
- Mucopurulent crusts around the eyes.

Typical microscopic findings:

- Suppurative bronchopneumonia that tends to extensively affect the pulmonary parenchyma.
- The respiratory epithelium lining bronchioles and bronchi may be coated by a layer of gram-negative coccobacilli that can be highlighted using a Giemsa or silver stain.
- Occasional necrotizing tracheitis.

Discussion:

Bordetella bronchiseptica is a gram-negative coccobacillus present in the upper respiratory tract of dogs, cats and other domestic animal species. *B. bronchiseptica* has the ability to cause tracheobronchitis and pneumonia in a large variety of species, including dogs, cats, rabbits, pigs, humans, and several species of rodents.[1,3,5,6] While *B. bronchiseptica* typically causes a self-limiting tracheobronchitis, it can cause fatal suppurative bronchopneumonia in susceptible animals.[7] Interestingly, expression of virulence factors is dependent on environmental conditions and is regulated by the expression of the *Bordetella virulence gene* (*bvg*) operon.[3,4,6] Initial infection is mediated by expression of specific *bvg* operon genes, including fimbriae, filamentous hemagglutinin (FHA) and pertactin, which mediate attachment to the respiratory cilia. These adhesion factors allow the bacterium to adhere to ciliated epithelial cells (causing ciliostasis) and to neutrophils and macrophages. Following the attachment phase, additional *bvg*-regulated virulence genes are expressed, such as exotoxins. Among these, the adenylate cyclase toxin is an RTX (repeats in toxin) family toxin with similarities to the leukotoxin and Apx toxins of *Mannheimia haemolytica* and *Actinobacillus pleuropneumoniae,* respectively, that mediate pore formation in target cell membranes and transfer of the adenylate cyclase component that, in turn, leads to intracellular increase in cAMP with disruption of cellular phagocytosis and intracellular killing mediated by oxidative burst.[2-4,6,7] *B. bronchiseptica* has a greater effect on younger animals, impacting rabbits most significantly at 4-6 weeks of age, puppies at 7-35 weeks of age, and kittens less than 12 weeks of age.[5,7] Guinea pigs are particularly susceptible to *B. bronchiseptica*. It is therefore recommended to avoid housing guinea pigs and rabbits together or within close quarters to avoid transmission of the bacterium.[2] Differential diagnoses include *Pasteurella multocida, Staphylococcus aureus, Streptococcus pneumoniae, Streptococcus equi* subsp. *zooepidemicus,* and *Klebsiella pneumoniae.*[5]

References and Recommended literature:

1 Bemis DA, Shek WR, Clifford CB. Bordetella bronchiseptica infection of rats and mice. *Comp Med.* 2003;53(1):11-20.

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3 Caswell JL, Williams KJ. Respiratory System. In: Maxie MG, ed. *Jubb, Kennedy, and Palmer's Patholgy of Domestic Animals*. San Diego, CA: Elsevier; 2016. Vol 2: p. 578.

4 Mattoo S, Foreman-Wykert AK, Cotter PA, Miller JF. Mechanisms of Bordetella pathogenesis. *Front Biosci.* 2001;6:E168-186.

5 Percy DH, Barthold SW. *Pathology of laboratory rodents and rabbits*. Ames, IA: Blackwell Publishing Professional, 2007. p. 267-268.

6 Quinn PJ, Markey BK, Leonard FC, FitzPatrick ES, Fanning S, Hartigan PJ. *Veterinary Microbiology and Microbial Disease*. Oxford, UK: Wiley-Blackwell, 2011. p. 325-329.

7 Taha-Abdelaziz K, Bassel LL, Harness ML, Clark ME, Register KB, Caswell JL. Cilia-associated bacteria in fatal Bordetella bronchiseptica pneumonia of dogs and cats. *J Vet Diagn Invest.* 2016;28(4):369-376.

*The Diagnostic Exercises are an initiative of the **Latin Comparative Pathology Group (LCPG)**, the Latin American subdivision of The Davis-Thompson Foundation. These exercises are contributed by members and non-members from any country of residence. Consider submitting an exercise! A final document containing this material with answers and a brief discussion will be posted on the CL Davis website (http://www.cldavis.org/diagnostic_exercises.html).

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