NATIONAL CENTER FOR CASE STUDY TEACHING IN SCIENCE

Paws and Reflect:

A Veterinary Case Study on Neonatal Puppy Loss

by

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Part I – The Dropoff

Carey made her way into the veterinary diagnostic lab early one Tuesday morning to begin her shift at the facility she had worked at for 15 years. After a few hours, the bell rang at the front desk indicating a visitor had arrived. As she entered the lobby, Carey noticed a man holding a small Styrofoam cooler in his arms.

"Good morning. What brings you in today?" Carey inquired.

"Morning," the man greeted her. "The name's Henry. I need diagnostics run on a recently deceased puppy, please."

Henry proceeded to inform Carey about the situation. The man was from the Happy Tails animal shelter about half an hour away. He reported that a heavily pregnant Rhodesian Ridgeback stray was brought into the Happy Tails shelter a few weeks ago. Ten days ago, the dog, which they named Rose, gave birth to a litter of eleven puppies. Of the eleven puppies, six puppies had died as of that morning. The animal shelter was requesting that the most recently deceased puppy, a ten-day-old female, undergo a general investigation to determine the cause of death.

"Was there any abnormal behavior exhibited by the mother and puppies?" Carey inquired.

Henry paused to think, "Rose was acting restless and moving her puppies around fairly frequently over the past few days. She was kept with her puppies from the moment of their birth. Some of the puppies were also exhibiting signs of nasal discharge and were crying persistently."

Henry requested that the general investigation begin as soon as possible out of concern for the remaining five puppies of the litter. Carey took the deceased puppy and performed an autopsy with tissue microscopy and laboratory testing to follow as needed.

During the autopsy, Carey noted abnormalities in the puppy's kidney, liver, and lungs (Figure 1, next page). Subsequent histologic (or microscopic) images sent to Carey by a board-certified veterinary pathologist from the same three organs also exhibited abnormalities in the tissue architecture and cell structure (Figure 2, next page).

Questions

1. What do you note about the regions of each organ pointed to with green arrows in Figure 1 (the green arrows point to abnormal tissue surrounded by normal tissue)? Include a few observations about what you think these areas indicate. (You do not need to use outside references or sources.)

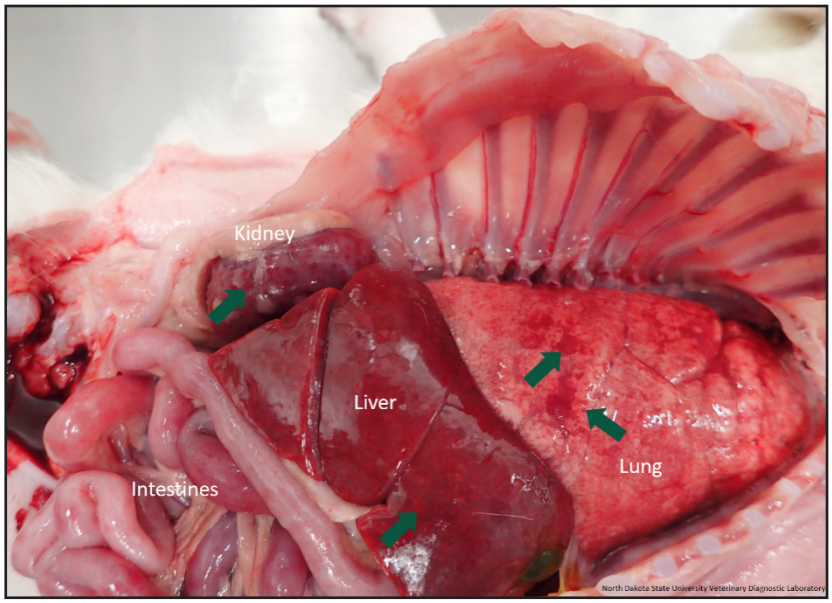

Figure 1. Puppy autopsy of kidney, liver, and lung. *Note:* Recommended viewing on computer/color images.

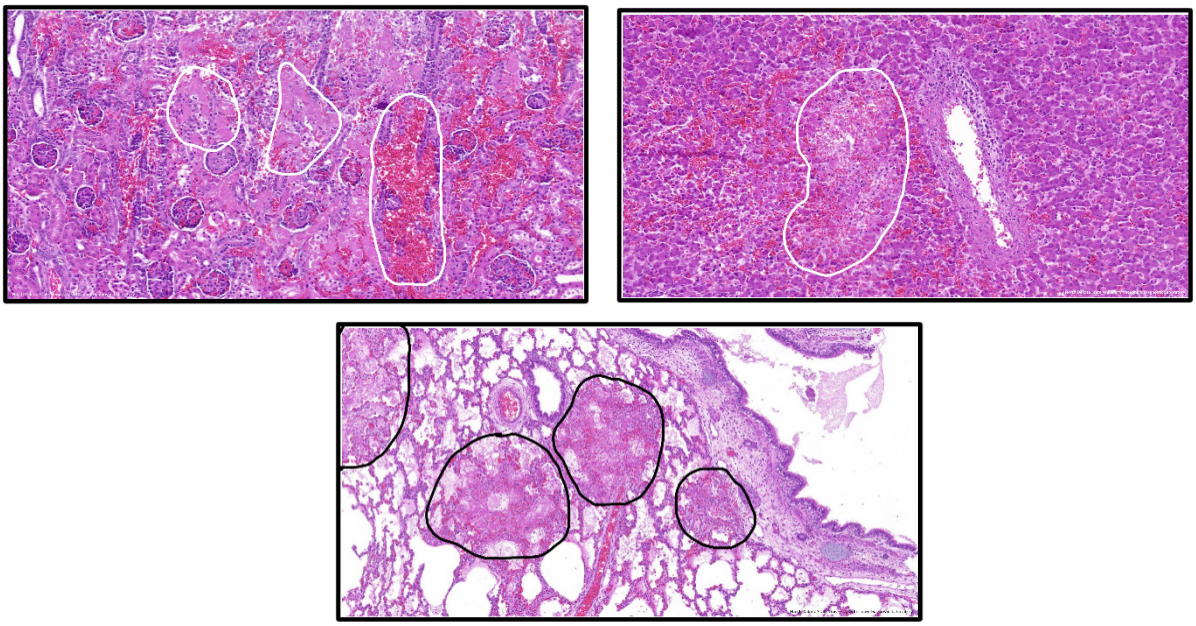

Figure 2. Histology images of puppy kidney (top left), liver (top right), and lung (bottom).

2. Using the histology images in Figure 2, give a short description of the encircled abnormalities compared to the normal tissue surrounding it.

3. Based on the above autopsy and histology results, what do you think the probable cause of death might be for the puppies? What pathogen or syndrome might these signs be associated with? Please list any references used.

Part II – A Diagnosis

Carey leaned back in her lab chair to think after analyzing the histopathology images from Rose's puppy. She drew the conclusion that the puppy had necrotizing nephritis, scattered bronchointerstitial pneumonia, and necrotizing hepatitis. This was not the first time that Carey had seen these signs in deceased puppies.

She thought back to a case several months ago where another animal shelter brought in recently deceased puppies with the same autopsy results. Those puppies had signs of a syndrome commonly called fading puppy syndrome. Carey wondered if these results from Rose's puppy might be similar to those seen in a few litters of puppies from the other local animal shelter.

The development of the signs associated with fading puppy syndrome was not a random event. Carey knew that she would need to continue to perform a few more tests to determine the exact cause of death. She decided to further analyze the lesions present on the liver, lung, and kidney to determine if they might aid in a more definitive diagnosis.

Questions

4. What is fading puppy syndrome and what are some common clinical signs?

5. What are some potential causes of fading puppy syndrome?

6. Carey's initial autopsy results in Figure 1 indicated that there are multiple lesions on the lungs, liver, and kidneys, as pointed out by the arrows. Use your initial descriptions in Questions 1 and 2, and look through one of the resources below on how to describe gross lesions in pathology, and make your best attempt at creating an autopsy report for the lesions found on the lung, liver, and kidney. In your description, include things such as shape, size, location, distribution, etc.
   - *Novice presentation:* Chapter 1 of "Gross Pathology Description and Interpretation" by Jeff Caswell, Department of Pathobiology, University of Guelph. ©2024, CC BY-NC-SA 4.0. (Size: ~1.8 MB.) **[Supplement 1]**
   - *Advanced presentation:* "Gross Pathology Description and Interpretation" by Jeff Caswell & Brandon Plattner, Department of Pathobiology, University of Guelph. ©2012, CC BY-NC 4.0. (Size: ~6.6 MB.) **[Supplement 2]**

7. Refer to your answers in Questions 3 and 5. Based on the description of the lesions in the gross anatomy report based on Figure 1, narrow down your possible pathological causes of these lesions. Please list any references used.

8. What are some possible diagnostic tests that should be run to determine the pathogen that infected the puppy?

Part III – The Results

Carey thought back to the other animal shelter in town and the cause of death in the litter of puppies that had died several months ago. The cause of death in those puppies was due to a viral infection transmitted from mother to offspring. She had determined that the viral infection infecting those puppies was canine herpesvirus-1 (CHV-1).

To determine if this was the same cause of death in these puppies, she ordered an additional test on the tissue from the deceased puppy. She thought the most appropriate test to run would be a quantitative polymerase chain reaction (qPCR) test to determine if CHV-1 might be the cause of death.

She sent off the tissue samples for a CHV-1 qPCR test, the results of which are depicted in Figure 3. She analyzed the qPCR results carefully to determine if CHV-1 was detected. She then decided to call Henry at the Happy Tails animal shelter to relate her findings.

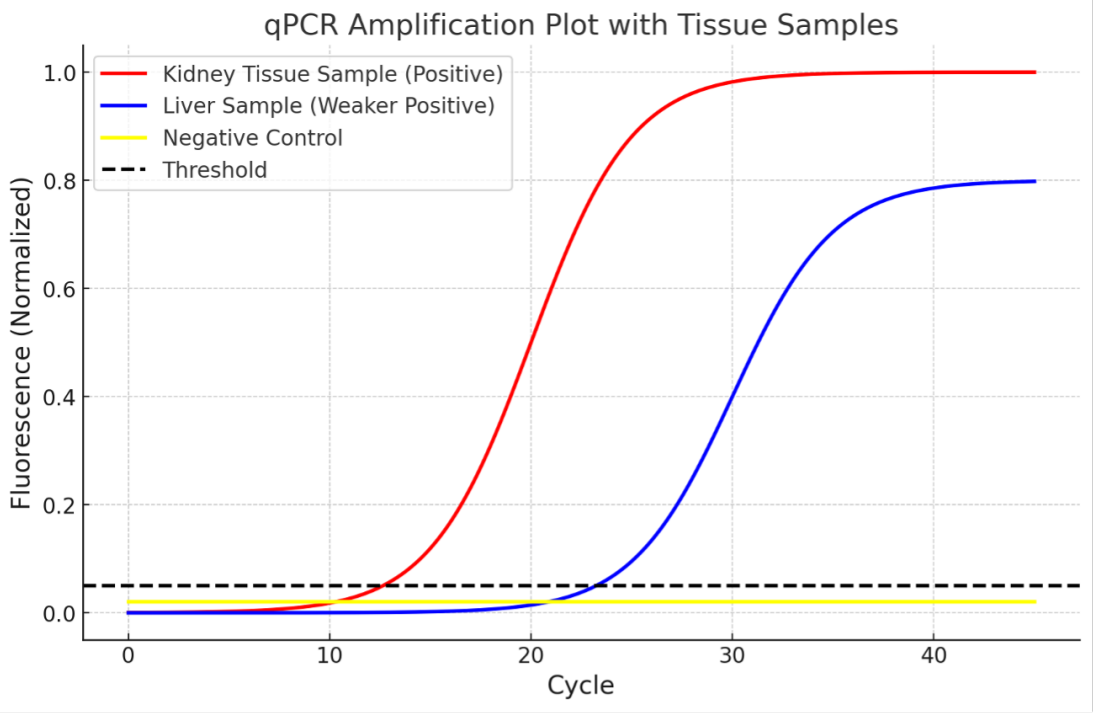

Figure 3. PCR test results for CHV-1 from puppy tissue samples.

The qPCR test result in Figure 3 indicates a cycle threshold (Ct) value of 12.66. Refer to the following resource to interpret the results:

- Stenger, B. (2022). Understanding PCR Ct values. NDSU Veteriary Diagnostic Laboratory. **[Supplement 3]**

Use the following resource to view a case of CHV-1:

- Joint Pathology Center, Veterinary Pathology Services, Wednesday Slide Conference, 2017–2018, Conference 3, September 6, 2017. Case II: 11-30435 (JPC 4020992). Pp. 5–11. **[Supplement 4]**

  Look at the two images of the puppy's liver on pp. 6 and 7. The arrows on the picture point towards intranuclear inclusions. The dark purple color around those nuclei is chromatin, which has all been pushed to the edge of each nucleus.

Read the following for more information on CHV-1:

- NDSU Veterinary Diagnostic Laboratory. (2023, March). Diagnosis: Canine herpesvirus-1. **[Supplement 5]**

Questions

9. Considering the puppy's qPCR results in Figure 3 (the red and blue lines), do you think CHV-1 was its cause of death? Why or why not?

10. Why is qPCR the best option for viral infections?

11. How does CHV-1 cause intranuclear inclusions?

12. How is CHV-1 normally transmitted?

13. Is this viral infection something that Henry should worry about being infected with since he was around Rose and her puppies? Should Henry worry about other dogs in the shelter being infected?

14. Upon hearing the diagnosis, the shelter that submitted the puppy reported that they planned to euthanize the mother and the rest of her pups. Discuss whether you believe euthanasia would be a necessary course of action, and what measures Happy Tails should take with any other dogs present in the shelter at that time. Justify your answer with references.

15. What practices can be done to prevent dogs from contracting CHV-1?

16. What practices can increase a puppy's chance of survival if its mother is diagnosed with CHV-1?