Diagnostic Exercise

From The Davis-Thompson Foundation*

Case #:**203**; Month: **December**; Year: **2022**

Answer Sheet

Title: Septicemic salmonellosis in calves

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Clinical History:

In the period between December 2018 and February 2019, a farm owner recorded the death of five six-month-old Angus calves, from a group of 117. The herd was kept in native pastures. Cattle were vaccinated against foot-and-mouth disease, rabies, and against pathogenic *Clostridium* ssp. Affected calves presented similar clinical signs, including fever, apathy, severe respiratory distress, nasal discharge, and diarrhea. The clinical course lasted approximately three days, and calves died spontaneously, despite being treated with antibiotic therapy. One of the dead calves was submitted for postmortem examination.

Necropsy Findings:

The calf was in good body condition. The subcutaneous tissue, oral mucosa, and ocular conjunctiva showed mild icterus. The lung did not collapse at the opening at the thoracic cavity (Figure 1), and presented a rubbery texture, fleshy aspect and interlobular edema (Figure 2). The spleen was severely enlarged. The liver was markedly enlarged with a diffuse orange discoloration. The gallbladder was distended and filled with grumous bile and fibrin deposition on the mucosa (Figure 3). No alterations were observed in other organs.

Macroscopic Images:

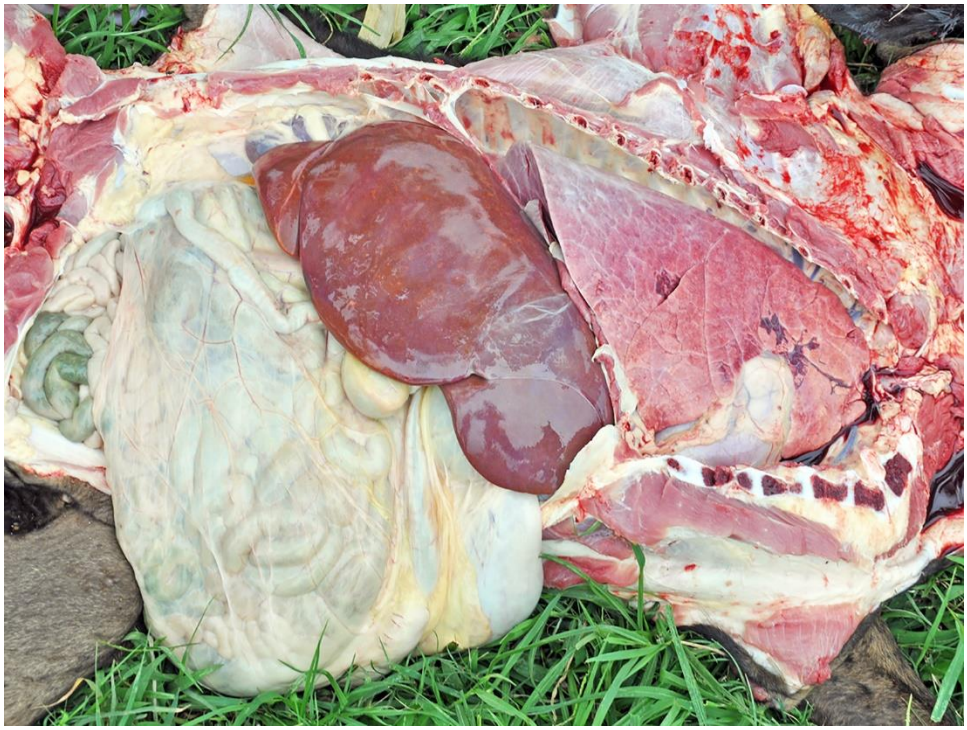
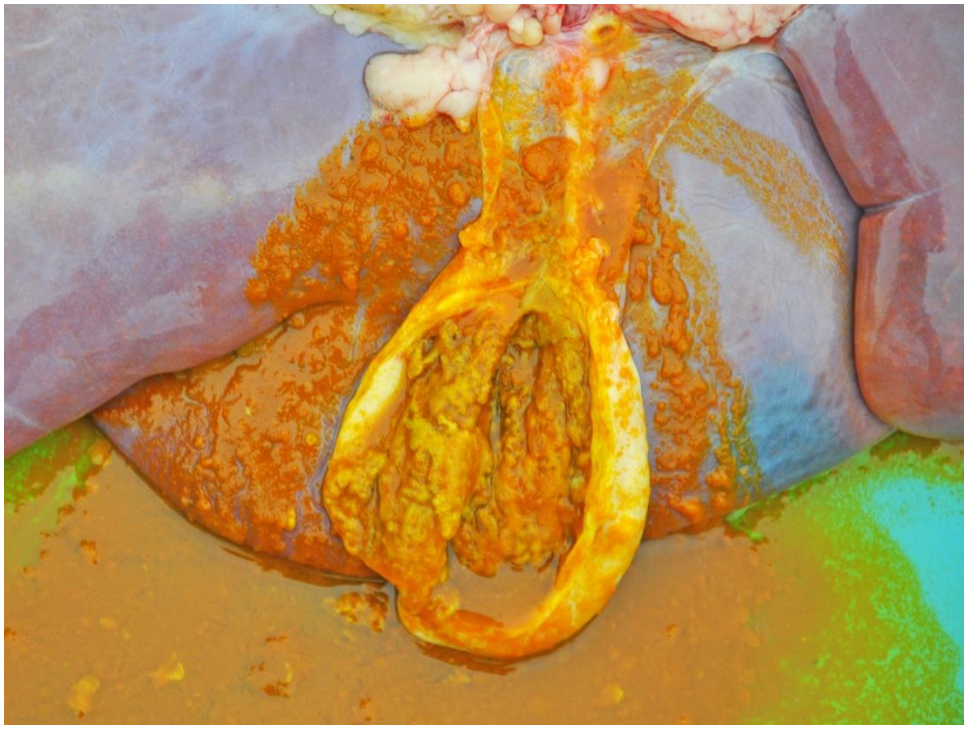


Figure 1: At the opening of the cavities, the subcutaneous tissue showed mild icterus; the lung did not collapse, was red, and presented a rubbery texture. Also, the liver was enlarged, orange with round edges.

Figure 2: Cut section of the lung showing fleshy aspect and interlobular edema.

Figure 3: The opening of the gallbladder revealed grumous bile and fibrin



deposition on the mucosa

Microscopic findings:

Diffusely, alveolar septa were markedly thickened and expanded by moderate inflammatory infiltrate of macrophages, lymphocytes and neutrophils, also, moderate to marked type II pneumocyte hyperplasia was seen (Figures 4 and 5). Similar inflammatory infiltrate composed of large foamy macrophages, lymphocytes, neutrophils, in addition to rare multinucleated syncytial cells, was observed filling alveolar spaces. Within alveoli, multifocal, moderate areas of fibrin deposition, hemorrhage and mild accumulation of necrotic cell debris were also observed. Additionally, multifocal areas of mild thrombosis, and marked edema in interlobular septa were seen.

In the liver, frequently in random areas of the parenchyma, there was moderate multifocal necrosis, with mild fibrin deposition and discrete infiltration of neutrophils (paratyphoid nodule) (Figure 6). Also, multifocal areas of moderate cholestasis were noted. The gallbladder presented marked mucosal necrosis with neutrophilic inflammation and fibrin deposition.

Microscopic Images:

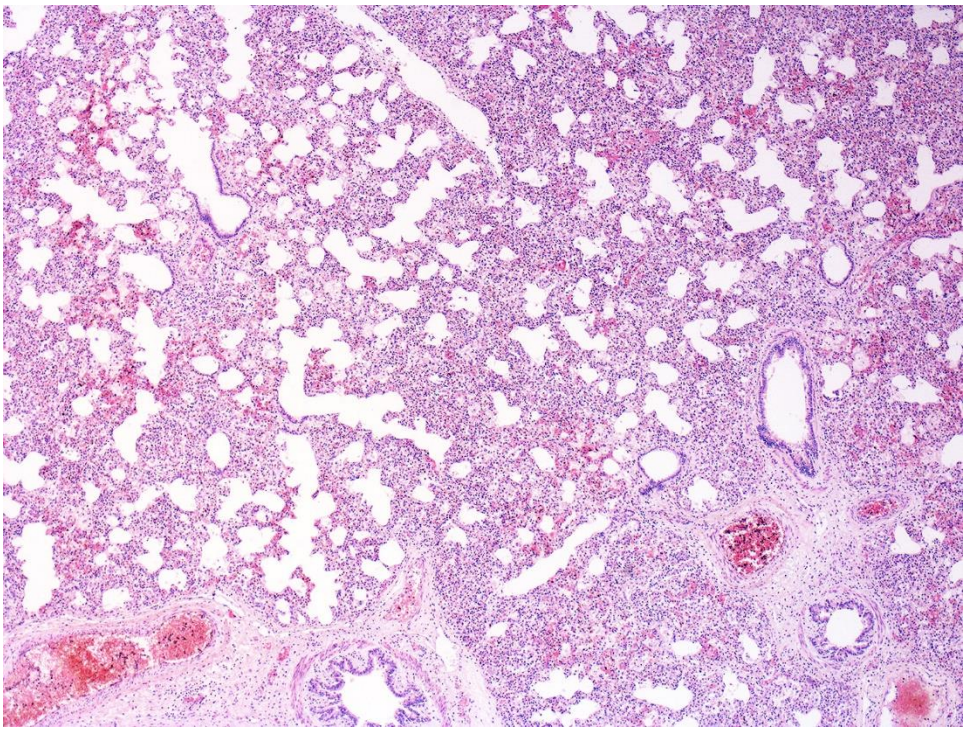
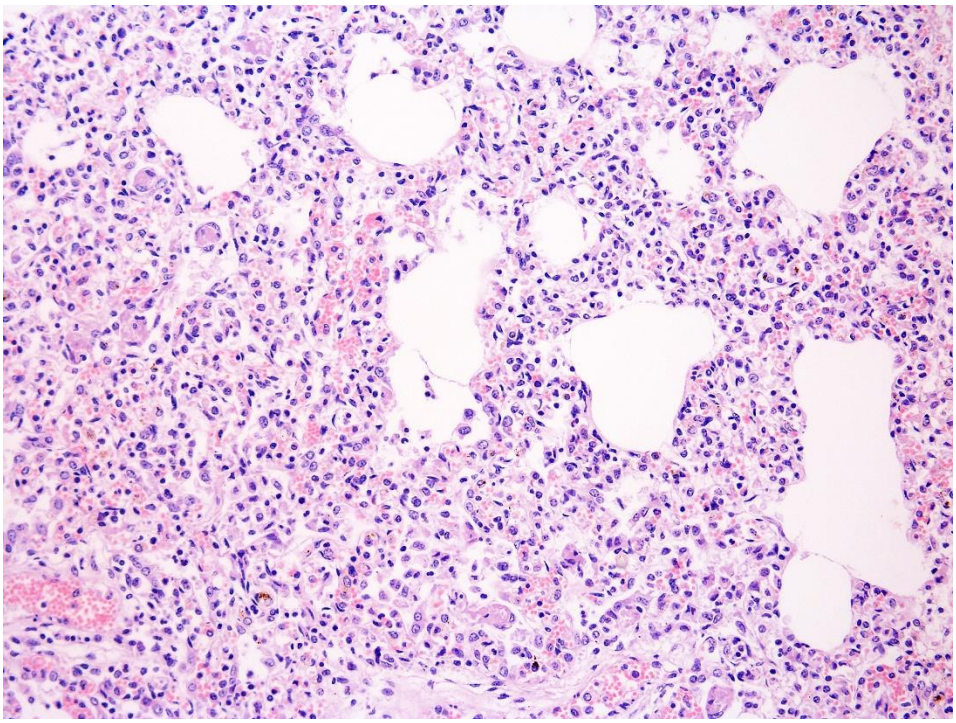


Figure 4: Lung: the alveolar septa are markedly expanded by inflammatory cells



(H&E, 40x).

Figure 5: Alveolar septa are markedly expanded by macrophages, lymphocytes and neutrophils; moderate type II pneumocyte hyperplasia and mild and multifocal fibrin deposition (H&E, 200x)

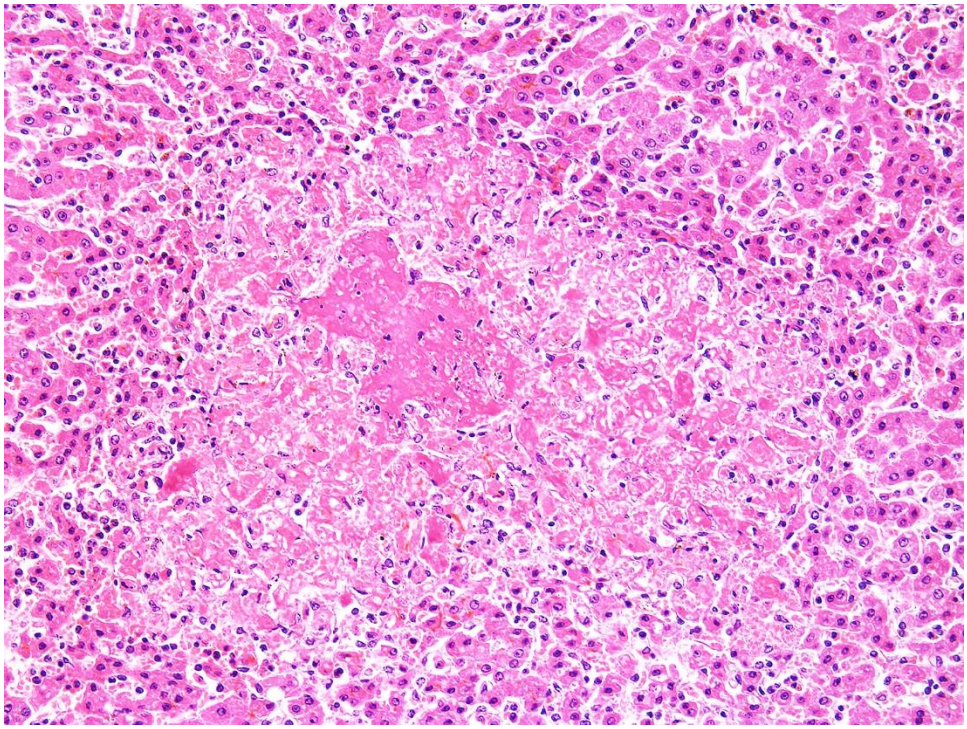


Figure 6: Liver presenting a focally extensive area of necrosis with fibrin deposition and mild inflammatory infiltrate of neutrophils (paratyphoid nodule) (H&E, 200x)

Follow up questions:

- *Morphologic diagnosis:* Lung: Pneumonia, interstitial, lymphohistiocytic, and neutrophilic, multifocal to coalescing, severe, with type II pneumocyte hyperplasia, and interlobular edema. Liver: necrotic neutrophilic hepatitis, multifocal, moderate, with cholestasis, multifocal, moderate and mild thrombosis.
- *Etiological diagnosis: Bacterial pneumonia and hepatitis.*
- *Etiology: Salmonella enterica* subsp. *enterica* serovar Dublin

Ancillary tests:

Salmonella spp. was isolated from fresh samples of lung and liver, and the serotype identified was *Salmonella* Dublin. RT-PCR for Influenza D and bovine respiratory complex agents (bovine herpesvirus - BoHV/ bovine parainfluenza type 3 - PI-3/ bovine respiratory syncytial virus - BRSV) were negative.

Discussion:

Pathological and microbiological findings supported the diagnosis of *Salmonella*-associated septicemia in this case. In cattle, salmonellosis is predominantly caused by *Salmonella enterica* subsp. *enterica* serovar Typhimurium and *S. enterica* subsp. *enterica* serovar Dublin.[1,8,9] *Salmonella* Typhimurium may cause septicemia and is commonly detected in outbreaks of enteric disease in calves. In contrast, *S*. Dublin, a host adapted serovar in cattle, is predominantly associated with septicemia across all age groups in cattle.[9] Salmonellosis in cattle is often characterized by watery or mucoid diarrhea containing fibrin and blood, septicemia,

respiratory disease, weight loss, and abortions.[1,7] Lesions include enterocolitis, pneumonia, paratyphoid nodules in the liver, necrotic foci in the kidney, and splenomegaly.[2]

The fecal-oral route represents the main route of transmission, and disease development is associated with bacterial efficiency in invading the intestinal mucosa, colonizing lymphoid tissues, and evading host immune response. Affected animals or asymptomatic carriers may spread the disease in the herd.[7] Young calves (< 6 months of age) are more vulnerable to the disease and may be infected a few hours after calving; nonetheless, adult cattle may also develop the clinical disease.[5,7] Potential predisposing factors for the development of clinical salmonellosis include concomitant diseases, stressors and immunosuppression, which may favor the development of clinical disease or may propitiate cattle to become asymptomatic carriers.[7] Besides, infection in cattle may be favored by age and physiological stage.[7]

Salmonella Dublin infection in adult cattle can result in the development of asymptomatic carriers or sporadic cases of abortion in pregnant cows. However, in naive herds, clinical disease is observed in young calves with acute systemic infection, including signs of respiratory distress, labored breathing, depression, occasional diarrhea, and sudden death.[5] This serovar has been implicated in cases of septicemia with lung involvement and absence of enteric lesions, in Brazil.[3,4,6] Likewise, a study conducted in the United States of America reported similar lung lesions in young cattle.[8]

In cases of *Salmonella*-associated pneumonia, the most representative changes include interstitial pneumonia, and therefore, the main differential diagnosis should include other important causes of bronchointerstitial pneumonia in calves, such as BoHV, PI-3 and BRSV, which were ruled by molecular assays in this case. These agents can also be responsible for inducing immunosuppression and consequently leading to susceptibility for secondary bacterial infections.[9]

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*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 (https://davisthompsonfoundation.org/diagnostic-exercise/).

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