

A Mississippi State Tale of a Tennessee Walking Horse Named Florida Line

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Introduction

Pleuropneumonia in horses may also be referred to as pleuritis or pleurisy and is casually referred to as transport pneumonia due to its close association with recently transported horses.⁷ However, transportation is not necessary for the development of pleuropneumonia, and any number of factors may allow for the introduction of bacteria into the lower airway by suppressing or overwhelming the immune system.¹ A diagnosis of pleuropneumonia is often based on clinical signs and diagnostic procedures which may include thoracic ultrasonography and radiography, complete blood count, serum biochemistry, thoracocentesis with accompanying cytology and culture of the collected pleural fluid, cytology and culture of tracheobronchial aspirates, and thoracic auscultation.⁴ Treatment often includes drainage of the pleural fluid, systemic anti-inflammatory and antibiotic therapy, and supportive care.¹ A thoracostomy drain tube can be placed, but a thoracotomy may be necessary if fibrin prevents adequate drainage.¹ Intrapleural fibrinolytic treatments have been proposed as an alternative to surgical intervention.³

History and Presentation

Florida Line is a 3-year-old Tennessee Walking horse gelding who frequently trained and traveled to compete in shows. He presented to MSU CVM's Equine Service on November 1, 2018 for progressing pleuropneumonia of one week's duration. Florida Line initially presented to his RDVM on October 29, 2018 for mucopurulent nasal discharge, intermittent coughing, lethargy, and anorexia. Upon presentation to his RDVM, Florida Line was determined to be tachycardic and moderately febrile. He was administered Excede (ceftiofur crystalline free acid) and flunixin meglumine but failed to improve. Intravenous fluids and gentamicin were also administered with no change noted. Thoracic ultrasound was performed on November 1, revealing bilateral pulmonary consolidation, worsening pleural effusion, and fibrin on the pleura

and pericardium. Florida Line was administered gentamicin, flunixin meglumine, ceftiofur sodium, and omeprazole before being referred to MSU.

Upon presentation to MSU, Florida Line was quiet but alert and responsive. He had an ideal body condition of 5/9 and weighed 972 lbs (441 kg). Florida Line had a temperature of 98.8°F and a moderately elevated heart rate of 72 beats per minute. No arrhythmias or murmurs were appreciated. Florida Line had a respiratory rate of 30 breaths per minute and exhibited an increased expiratory effort. Both crackles and wheezes could be appreciated bilaterally. His mucous membranes were pink and moist with a normal capillary refill time of less than 2 seconds.

Pathophysiology

Pleuropneumonia is a condition classified by the presence of bacteria within the lungs and surrounding pleural space.⁷ Clinical signs associated with bacterial pleuropneumonia in horses include fever, lethargy, weight loss, anorexia, nasal discharge, dyspnea, coughing, respiratory distress, exercise intolerance, sternal edema, flared nostrils, and pleurodynia.⁴ The condition is allowed to develop and progress as a result of overwhelmed or suppressed pulmonary defenses.^{4, 5} In horses, contributing factors may include an aspiration event, excessive training, stress or overexertion, anesthesia, surgery, comorbidity, and long-distance transport.^{4, 5} Long-distance transportation is the most common causing factor in horses. It is standard practice for the horse's head to be tied for the ride. The horse is thus unable to lower its head while in the trailer.⁶ As a result, contaminants from the oral cavity and pharynx as well as respiratory secretions which would normally drain from the nares are forced to drain into the lower respiratory tract.⁶ Common aerobic bacterial isolates include *Streptococcus equi zooepidemicus*, additional *Streptococcus* sp., *Actinobacillus*, *Pasteurella*, *Enterobacter*, *Klebsiella pneumoniae*, and *Escherichia coli*.⁶ The most commonly isolated anaerobes include *Clostridium*,

Fusobacterium, *Bacteroides*, and *Peptostreptococcus*.^{1,6} Aerobic bacteria are more commonly isolated and are associated with a better prognosis.¹

Initial lesions are typical of aspiration pneumonia with the ventral right cranial lung lobe most affected.⁶ As the infection spreads to additional lung tissue and visceral pleura, inflammation stimulates the production of tumor necrosis factor alpha (TNF α) and additional plasminogen activator inhibitor-1 (PAI-1) is released.² Once the availability of PAI-1 surpasses that of tissue plasminogen activator (TPA), fibrin accumulates.² Fibrinopurulent exudate and scar tissue, known as loculations, may be present.⁶ Fibrin may adhere to the lung tissue and abscesses may form within the thoracic cavity.⁶ Additional thoracic complications include pneumothorax as a result of bronchopleural fistulae or iatrogenic causes and constrictive or effusive pericarditis.⁶ Albumin loss into the pleural fluid combined with blocked lymphatics and stall rest may lead to gravity-dependent edema.^{1,6} Laminitis, antibiotic-induced diarrhea, and thrombophlebitis due to IV catheterization are also potential complications during treatment.¹ Laminitis is often the sequela of endotoxemia that occurs when gram negative bacterial lipopolysaccharide (LPS) accumulates in the bloodstream and triggers an inflammatory cascade.⁸ Additional complications may result including disseminated intravascular coagulation (DIC).⁸ The prognosis for pleuropneumonia in horses is variable with some reports showing a 30-66% survival rate for aerobic infections and less than half of this survival rate for anaerobic infections.² Early diagnosis and treatment increase the survival rate with many athletic horses returning to performance.⁷ However, the deposition of fibrin complicates treatment and negatively impacts prognosis by walling off pockets of fluid that are unable to drain appropriately.³ Fibrinous adhesions may require surgical removal via thoracotomy if drainage is insufficient, and a rib resection may be necessary in some cases to achieve desired results.¹ Any

necrotic pulmonary tissue should also be removed.¹ Surviving horses that experience these additional complications may not return to previous performance.¹

Diagnostic Approach/Considerations

At presentation, a thoracic ultrasound was performed on Florida Line and revealed that the left lung was completely surrounded by fluid and was consolidated with a 2 cm layer of fibrin on the surface. Approximately half of the right lung was consolidated and surrounded with fluid. Fibrin was located on the pleural surface of the right lung as well as the pericardial sac.

Following initial ultrasound, thoracocentesis was performed with approximately 6 liters of fluid drained from the right hemithorax with a lactate of 3.8 mmol/L (reference <2 mmol/L), a total protein of 4.0 g/dL (ref. <2.5 g/dL), and a glucose of 109 mg/dL (ref. 60-122 mg/dL). Approximately 10 liters of fluid were drained from the left hemithorax with a lactate of 12.4 mmol/L, a total protein of 4.5 g/dL, and a glucose that was too low to read. These values indicated that a septic process was occurring in the left side. During this process, Florida Line exhibited signs of respiratory distress and was administered oxygen.

Pleural fluid from both the left and right sides was submitted for cytology as well as aerobic culture/sensitivity and anaerobic culture. Cytology of the pleural fluid from the left was described as a turbid, yellow fluid with mostly nondegenerate neutrophils. Cytology of the fluid from the right was described as hemorrhagic with mostly nondegenerate neutrophils. Severe inflammation was indicated by the high neutrophilic presence, and sepsis was likely despite the absence of observed bacteria.

Culture of fluid from the left hemithorax exhibited no aerobic or anaerobic growth within 48 hours. *Staphylococcus warneri* was isolated from the fluid collected from the right hemithorax. Antibiotic susceptibilities included amikacin, chloramphenicol, doxycycline, gentamicin, rifampin, and trimethoprim/sulfa. Continuation of broad-spectrum antibiotics was

advised due to the difficulty of culturing certain bacteria as well as the possibility of false negatives as a result of previous antimicrobial therapies.

A serum biochemistry performed on presentation showed a decreased magnesium of 1.1 mg/dl (ref. 1.6-2.5), increased globulin of 4.4 g/dl (ref. 2.5-4.0), and decreased albumin of 2.6 g/dl (ref. 2.8-3.9). These values were found to be consistent with an inflammatory response with albumin loss via pleural effusion. A complete blood count showed a moderate leukocytosis (15.2 K/ μ l; ref. 5.0-11.9) consisting of a mature neutrophilia (12920/ μ l; ref. 2500-6000) and a mild anemia (RBC 5.3 M/ μ l; ref. 6.0-12.0) indicating immunologic response to an ongoing disease process. Serial CBCs, serum biochemistries, and thoracic ultrasounds were performed to monitor the progression of his pleuropneumonia.

Treatment and Management

At presentation, Florida Line was relatively stable and medical management of his condition with intravenous broad-spectrum antimicrobials was elected. Additional therapies were considered but ultimately decided against. A thoracotomy could have potentially introduced additional bacteria into the thorax. Intrapleural fibrinolytic treatment was considered but decided against due to lack of availability and cost. A long-term jugular catheter was placed in the right side of the neck on November 1st that was frequently monitored and flushed with heparinized saline every 4 hours. Injection ports were changed every 24 hours. Antimicrobial therapy was started immediately and included gentamicin sulfate at 6.6 mg/kg IV every 24 hours, metronidazole at 25 mg/kg orally every 6 hours, and ceftiofur sodium at 4.4 mg/kg IV every 12 hours. Pain and inflammation were managed with flunixin meglumine at a rate of 1.1 mg/kg IV every 12 hours. Dimethyl Sulfoxide (DMSO), a free radical scavenger, was administered at a rate of 1 pint/5 L LRS intravenously every 24 hours for the first 3 days to reduce inflammation. Aspirin was administered at 25 mg/kg orally every 24 hours to reduce the formation of fibrin,

thrombi, and inflammation. Heparin (40 IU/kg) was administered into the pectoral region subcutaneously every 8 hours in an attempt to reduce fibrin formation and prevent laminitis. Ice boots were applied every 2 hours to all four limbs to prevent laminitis, and his legs were rewrapped daily. Florida Line was administered 2 scoops (12 g) of a pre-/probiotic, Platinum Balance, orally every 12 hours to support gastrointestinal health during antibiotic therapy and 30 cc salt orally every 8 hours to encourage drinking. Although most horses with pleuropneumonia exhibit anorexia, Florida Line continued to eat Bermuda grass hay. He did not show interest in water despite being offered several flavors.

A second serum biochemistry and CBC were performed on November 3. The CBC showed a slightly improved leukocytosis (WBC 14.4 K/ μ l) with a mild anemia (RBC 5.43 M/ μ l) still present. The serum biochemistry showed that albumin was relatively unchanged at 2.5 g/dl, and globulin continued to increase to 5.4 g/dl. Magnesium was still mildly decreased at 1.4 mg/dl. Over the next few days, Florida Line's water intake failed to improve and he was offered a feed mash and hydra hay in lieu of Bermuda grass hay. His inadequate water intake was evidenced by small, hard fecal piles. On November 5, he was placed on LRS fluids at a rate of 1.5 L/hour intravenously to replace fluid deficits and meet maintenance requirements. His appetite diminished, and he appeared depressed and exhibited signs of pain such as flaring his nostrils and staring at the wall. As a result, he was administered lidocaine intravenously as a constant rate infusion of 65 ml/hr (~3 mg/kg/hr) to manage pain. On November 6, metronidazole administration was changed from every 6 hours to every 8 hours to combat side effects including depression, anorexia, and adipsia. On November 7, edema of the pectoral tissue was noted and was possibly the result of inflammation due to the subcutaneous heparin injections. It may have also been gravity-dependent edema caused by the low albumin and thus oncotic pressure due to

his ongoing pleuropneumonia. As a result, the heparin injections were discontinued. On November 8, Florida Line's jugular catheter was partially exposed and bent. The catheter was promptly removed and replaced with a new jugular catheter in the left side of the neck. The previous site did not appear inflamed. His LRS fluid rate was reduced to 1 L/hr in an effort to increase thirst.

On November 9, a complete blood count and a serum biochemistry were performed. The CBC continued to show a mild anemia (RBC 4.67 M/ μ l) as the result of his ongoing disease process. The white blood cell count was within the normal reference range with a mildly elevated mature neutrophil count (7573/ μ l). The serum biochemistry showed that albumin continued to decrease (2.4 g/dl), and globulin continued to increase (7.2 g/dl) as a result of continuing inflammation and pleural effusion. Electrolytes were improved as evidenced by a normal magnesium value of 1.7 mg/dl. Thoracic ultrasound showed no change in fibrin. The left lung showed mild improvement, but it was still surrounded by several centimeters of fluid. A mild amount of fluid remained in the right hemithorax, and the right lung exhibited moderate improvement. Neither side contained enough fluid to warrant a thoracocentesis. Florida Line's water consumption continued to increase, and the LRS was discontinued. Lidocaine administration was reduced to 60 ml/hr (~2.7 mg/kg/hr) before being discontinued. Ice boots were also discontinued. Unfortunately, scrotal edema was noted in addition to the already present pectoral edema. On November 11, Florida Line was bright with a good appetite for both Omelene feed and Timothy grass. His water intake was still inadequate, and his salt intake was increased to 45 cc orally every 8 hours to promote thirst. His jugular catheter was removed due to kinking, and a new catheter was not placed. Because of the little improvement shown between ultrasounds, the gentamicin sulfate and ceftiofur sodium were discontinued, and chloramphenicol

was added as an oral broad-spectrum antibiotic treatment at 50 mg/kg every 6 hours. On November 12, short hand-walks were added to his daily regimen to reduce scrotal and pectoral edema. By November 13, his water intake was adequate. Thoracic ultrasound was again performed on November 19 to monitor the progression of his pleuropneumonia. The left lung still contained lesions and an irregular surface but was significantly improved. Several fluid-filled fibrin pockets were present within the pleural space. The right hemithorax contained a mild volume of fluid. Irregularities were still present on the cranioventral lung tip, and the surface contained a mild amount of fibrin. Florida Line's ventral edema was resolved by November 21.

Case Outcome

After 24 days of hospitalization and intense medical management, Florida Line was deemed healthy enough to be discharged to his owner on November 24, 2018. At the time of discharge, he had a temperature of 99.7°F, pulse of 50 beats/minute, and respiratory rate of 40 breaths/minute. No harsh lung sounds were detected. Mucous membranes were pink and moist with a capillary refill time of less than 2 seconds. Feed and water consumption were adequate, and urination and defecation remained normal. He remained in good body condition and had gained 18 pounds during his stay. Florida Line was also doing well during walks.

Following discharge, Florida Line continued antimicrobial therapy by taking chloramphenicol compounded liquid (500 mg/ml) at 46 mls orally every 6 hours for 6 weeks. Aspirin was administered at 23 grams (1/4 oz) orally every 48 hours for 6 weeks for anti-fibrin therapy. Pain was managed with flunixin meglumine paste at 1,000 lb dose orally once a day for 6 days and then as needed. Firocoxib was administered 24 hours after the last flunixin meglumine dose at an initial dose of two 57 mg tablets orally every 24 hours for 2 days and then one tablet orally every 24 hours for 2 weeks. Florida Line was able to continue his usual feeding routine with the addition of 2 scoops (12 g) of Platinum Balance twice daily to maintain normal

gastrointestinal flora during antimicrobial therapy. Stall rest was advised with the exception of brief daily hand walks. The owner was advised to return in 6 weeks for a recheck examination and thoracic ultrasound to assess Florida Line's progress and determine if any additional medical or surgical therapy was warranted, but he did not return. During a follow-up phone call in July of 2019, the owner stated that Florida Line continues to do well and is still training for shows.

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