Equine Thoracic Trauma

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I. Introduction

Thoracic trauma in the horse is an infrequent occurrence but has the potential to be life threatening, acutely or chronically. Collision with an object has been identified as the most common cause penetrating thoracic trauma in horses (Laverty et al). Horses that sustain trauma to the thoracic region can suffer from fractured ribs, pneumothorax, hemothorax, pleuropneumonia, or impairment of vital organs such as heart, lungs, and vasculature. Triage and stabilization of equine patients suffering from thoracic trauma is vital for a positive outcome. Extensive treatment plans should be implemented depending on the extent of the trauma sustained to the thorax and potentially abdomen.

History and Presentation

Horses with a penetrating thoracic wound can present with a variable history ranging from a detailed account of a collision to an unknown happenstance. Patients will show a range of clinical signs that can be related to the degree of trauma sustained. It is also possible that a horse that has sustained penetrating thoracic trauma may not exhibit any respiratory symptoms. Tachypnea (a respiratory rate greater than 24 breaths per minute), tachycardia (a heart rate greater than 44 beats per minute), pale to injected mucous membranes, and labored breathing are signs indicative of respiratory distress. Clinical signs can also include colic or neurological deficits if the trauma extends beyond the thoracic cavity (Radcliffe et al). A retrospective analysis of thoracic trauma revealed a 20% occurrence of abdominal involvement along with thoracic trauma in the equine patient (Laverty et al).

Physical Exam and Wound Triage

Ambulatory Emergency Stabilization

Horses with penetrating thoracic wounds may first present to an ambulatory veterinarian on the farm. If possible, the wound should be cleaned with sterile technique and bandaged prior to trailering to the hospital. Appropriate dressing for penetrating wounds creates a seal over the wound and prevents additional foreign debris or air from entering the wound. For instance, plastic wrap can be used to seal a penetrating wound to the chest. The plastic wrap should be sterile, incorporate the entire wound, and act as a barrier from the environment. Other types of closures could be used such as sutures or sterile packing of the wound (Radcliff et al).

Horses that sustain a thoracic injury of any magnitude should be administered a tetanus prophylaxis vaccination if there is not a history of recent administration (Hassel). Broad-spectrum antibiotics plus anti-inflammatories and pain medication should also be administered on the farm prior to hospital presentation (Auer and Stick).

Hospital Emergency Triage

When presented with a patient that has sustained a penetrating foreign body to the thorax, there are a few steps that should be taken to triage the patient. First, the patient must be assessed for a patent airway allowing for proper oxygenation and ventilation, and adequate circulation (Radcliffe et al). Increase respiratory rate, lack of air movement, stridor, lack of lungs sounds, and nasal discharge are all evidence of a non-patent airway. Passing a nasotracheal tube or performing a tracheostomy will be necessary if the airway is not patent. Oxygen should be available to administer to the patient via flow by, nasal insufflation, or passing oxygen tubing into the trachea (Coumbe).

A thorough physical exam follows to determine the extent of the penetrating injury and, whether there are any life-threatening sequelae such as tension pneumothorax, hemothorax, shock, or abdominal involvement (Radcliffe et al). Pneumothorax or hemothorax can be

diagnosed promptly with lung auscultation and ultrasonography. Absent lung sounds in a particular lung field, specifically in the dorsal aspect, are evidence of pneumothorax. If lung sounds can be auscultated but are muffled in the ventral lungs fields, hemothorax may be the cause of the distress (Radcliffe et al).

Emergency placement of a chest tube may be indicated if pneumothorax or hemothorax is suspected coupled with respiratory distress to allow the lung to reinflate (Hassel). To place a chest tube, clip and clean around the dorsal aspect of the twelfth to thirteenth rib space. In the event of pneumothorax, the chest tube is inserted cranial to the desired rib space to avoid the vasculature supplying the ribs. Gentle vacuum is applied to reinflate the lung. A one-way valve should be placed on the end of the chest tube or teat cannula to prevent influx of air into the chest, which would worsen the pneumothorax. For a hemothorax, a chest tube should be placed ventrally in the area of the hemorrhage (Radcliff et al).

Pain management is essential in triaging patients for thoracic trauma (Auer and Stick). Nociception contributes to the disease process and hastens fatal outcomes if not addressed properly. The consequences of pain include: decreased ventilation, hypoxia, decreased cardiac output, lactic acidosis, and ultimately, death. In the event of fractured ribs, pain control is vital. Intercostal nerve blocks have been reported to be an effective method of pain control not only in horses, but also in rib fractures in humans (Laverty et al).

Emergency treatment should continue with intravenous fluid administration to correct any possibility of shock and stabilize the patient. Clinical signs of hemorrhagic shock include tachycardia or a murmur upon cardiac auscultation. The choice of fluid depends on the severity of the fluid loss in the patient. If rapid volume expansion is vital, hypertonic solutions can be administered directly followed by isotonic solutions. In the event of active hemorrhaging and

obvious patient decompensation, fresh whole blood administration should be considered. (Radcliff et al).

Wound debridement and exploration should be performed once the horse is stabilized. A sterile clip and scrub of the wound should be performed prior to exploration. Using sterile gloves and instruments, palpation is the next step to determine the extent of the wound. (Radcliffe et al). During wound exploration, unsuspected foreign bodies may be found in the thoracic cavity (Pollock). Other diagnostic approaches apart from palpation, such as thoracoscopy, may be necessary in visualizing the wound and foreign material present.

Rib fractures can be identified during this step along with assessing the deeper structures of the thoracic cavity for potential injury (Radcliffe et al; Hassel). In addition to thorough thoracic examination, the abdominal cavity should also be critically evaluated with physical examination, ultrasonography, and radiography (Radcliffe et al). Penetrating foreign bodies into the thoracic cavity, especially those extending beyond the 6^{th} rib, could extend into the abdomen creating a rent in the diaphragm, further leading to a diaphragmatic hernia (Auer and Stick; Groover and Wooldrige).

Diagnostic Approach

Radiography

Diagnostic imaging should be pursued along with the physical exam. Radiography is an imaging modality that can be used to diagnose conditions such as pneumothorax or mediastinum, hemothorax, rib fractures and occasionally, the presence of foreign material. Radiographic evidence of a pneumomediastinum includes silhouetting of the esophagus, great vessels, and trachea. Pneumothorax can be diagnosed with radiography when the caudal-dorsal portions of

the lungs are outlined. Radiography should also be used to image the abdominal contents in the event of a diaphragmatic hernia or other involvement (Radcliffe et al).

Ultrasonography

Additionally, ultrasonography is a diagnostic tool that can be used in a trauma work up. Air in the thoracic cavity will yield lack of congruency as the ultrasound probe is applied to the thoracic wall (Epstein). Ultrasonography of a hemothorax will reveal pleural fluid that is hyperechoic in nature. Other types of fluid that could accumulate in the thoracic cavity would yield a hypoechogenicity on ultrasonography (Groover and Wooldridge). Rib fractures are also diagnosed with ultrasonography (Radcliffe et al). It is important to remember that subcutaneous emphysema, common sequelae of thoracic trauma, can hinder the ultrasound image (Epstein). Ultrasound should be the mainstay of diagnosing pleuropneumonia in the equine patient as fluid accumulation and abscess formation may occur (Sprayberry).

Thoracocentesis

Thoracocentesis via ultrasonography is an important diagnostic step especially in the case of hemothorax and pneumothorax. Fluid analysis yielding evidence of a chronic hemothorax includes erythrophagocytosis, hemosiderin, degenerative neutrophils, and thrombocytopenia. Further evaluation can continue with a complete blood count. Hemothorax indices would reflect anemia, thrombocytosis and hypoproteinemia associate with ongoing blood is lost into the thoracic cavity.(Groover and Wooldridge). Thoracocentessis of a pneumothorax is diagnostic in itself as air is pulled from the thoracic cavity (Racliffe et al).

Blood Gas Analysis

Blood gas analysis aids the practitioner in the triage process also; PCO_2 and PO_2 are indicative of the patient's ventilatory and oxygenating capabilities (Auer and Stick). A PCO_2

range of 36-46 mmHg and a PO_2 of 94 mmHg are considered normal for the horse (Muir and Hubbell). Trauma to the thoracic cavity such as lung contusions or flail chest may yield higher PCO_2 and lower PO_2 values. Hypercarbia will require ventilator assistance and hypoxemia can be treated with supplemental oxygen administration (Hassel; Laverty et al). Another diagnostic tool is pulse oximetry, which measures proper oxygenation in the blood (Hassel). Pulse oximetry values should remain above 90% in the equine patient (Muir and Hubbell).

Thoracoscopy

Thoracoscopy enables visualization of structures within the thoracic cavity, especially in the instance of a penetrating thoracic wound. At a minimum, the horse can be sedated and the procedure performed while the horse is standing. (Ruess and Giguère). Abnormalities that can be visualized using thoracoscopy in a horse that has sustained a deep penetrating wound include but are not limited to: hemorrhage from the great vessels, cardiac contusions, diaphragmatic hernia, lung lacerations, and the presence of foreign material (Pollock).

Pathophysiology and Sequelae to Thoracic Injury

Rib Fractures and Flail Chest

Rib fractures can often be the result of penetrating thoracic trauma. The main stay of diagnosing fractured ribs and sequelae is ultrasonography. Flail chest is the result of unattached segments of ribs. The presence of flail chest creates problematic ventilation due to the reversed motion during normal respiration cycles. Stabilization of the fractured rib segments is necessary to return the patient to adequate ventilation (Radcliffe et al; Laverty et al). Surgical correction may be required in severe cases of flail chest (Radcliffe et. al).

Pneumothorax and Pneumomediastinum

Penetrating thoracic wounds allow air to enter the thoracic cavity and accumulate in the mediastinum or the pleural space creating a pneumomediastinum or pneumothorax. Horses are known to frequently have an incomplete mediastinum, which allows air to move from one hemi-thorax to the other and remain in the mediastinum itself. In the event of thoracic trauma, this accumulation of air can become fatal. Specifically, tension pneumothorax is life threatening when air is allowed into the thoracic cavity but the inlet is occluded preventing escape of air on expiration. Patients that are not treated for pneumothorax upon emergency presentation should be monitored with ongoing diagnostic imaging such as radiography and ultrasonography (Hassel).

Hemothorax

An additional sequelae to thoracic trauma is accumulation of blood in the thoracic cavity known as hemothorax. Hemothorax is generally due to internal lacerations of vasculature or lung tissue in thoracic trauma patients (Laverty et al). Clinical signs associated with hemothorax correlate with the onset of the accumulation of blood in the thorax. Most horses that sustain severe and penetrating thoracic trauma into the heart or great vessels will suffer from acute hemothorax, exsanguination, and death rapidly before a veterinarian can attend the patient. A chronic accumulation of blood in the thoracic cavity will be evident by the following clinical signs: tachypnea, tachycardia, pale mucous membranes, pleurodynia, and muffled lung sounds ventrally upon lung auscultation. It is suggested to completely remove the blood from the thoracic cavity, as blood is the ideal medium for bacterial growth, further complicating the case outcome (Laverty et al).

Pleuropneumonia

Pleuritis or pleuropneumonia is another sequelae to penetrating thoracic wounds. When an infection is created in the pleura and the lung tissue, the outcome becomes grave. Four out of seven horses that sustained thoracic trauma developed pleuropneumonia and were ultimately euthanized (Laverty et al). In cases of penetrating thoracic trauma, colonization of anaerobic bacteria causing a direct septic pleuropneumonia yields a worse prognosis compared to other etiologies (Sprayberry; Rush and Davis). Clinical signs of pleuropneumonia can include tachycardia, tachypnea, injected mucous membranes, anorexia, pyrexia, and pleurodynia. Upon auscultation of the thoracic cavity, lung sounds will not be heard ventrally due to the presence of pleural effusion. Along with pleural effusion, edema along the ventrum of the horse may be evident (Sprayberry).

Treatment

Supportive Care

Horses that sustain thoracic trauma should receive supportive care as the basis of treatment. Antibiotic therapy should be implemented in combination using a beta lactam plus an aminoglycoside or fluoroquinolone and metronidazole to achieve broad-spectrum coverage. Additionally, anti-inflammatory agents should be administered for inflammation and pain control (Groover and Wooldridge). At a minimum, patients should receive fluid maintenance requirements during the hospital stay. Ongoing testing and ultrasonography should also be implemented during the horse's hospitalization stay to track any changes and response to therapy (Sprayberry).

Conservative Treatment

Conservative treatment can be elected if the horse does not have extensive trauma or is not experiencing respiratory distress (Laverty et al). Conservative treatment of pneumothorax

should include resolving the primary cause and then the body will resorb the excess air (Epstein). Continuous monitoring via ultrasonography is highly recommended as the reoccurrence of pneumothorax after resolution has been reported (Laverty et al).

Horses suffering from hemothorax are treated initially by controlling the hemorrhage, correcting any fluid imbalances, and then providing adequate oxygenation. In penetrating wounds, controlling the origin of the hemorrhage should be achieved if possible. Suggested medications used to control internal bleeding: aminocaproic acid, tranexamic acid, and formalin (Wong et al). Restoring the blood volume is essential to achieve proper tissue perfusion and cardiac output. Fluid choice is dependent on the urgency of fluid resuscitation. Hypertonic saline, colloids, or isotonic fluids can be used in the event of acute blood loss. If the patient has lost a significant amount of blood volume, which results in anemia on the complete blood count, the practitioner should consider using blood products to restore volume expansion to the patient. (Groover and Wooldridge).

Additional treatment will necessitate the removal of the blood from the pleural cavity in the event of hemothorax. Medical management can become the treatment of choice in horses that have been diagnosed with hemothorax but only if the patient is stable. It has been proven that the body can correct the fluid accumulation itself but a drain should be placed in the intercostal space directly correlated with the fluid accumulation if the patient exhibits clinical signs (Groover and Wooldridge).

Thoracoscopy

Therapeutically, thoracoscopy coupled with ultrasonography can be used to place a thoracic drain in the event of draining abscesses and removing foreign material (Pollock). Invasive techniques can be performed with an endoscope in the thorax such as lung lobectomy,

diaphragmatic hernia repair, and other necessary interventions. Thoracoscopy can leave the patient with pain associated from the procedure and also pneumothorax from entering the chest Complicated cases may not allow thoracoscopic surgical techniques, but allow visualization and surgical planning for thoracotomy (Vachon and Fischer).

Surgical Treatment

Thoracotomy

Patients who sustain severe thoracic trauma may require surgical intervention to debride and resect damaged tissues. A standing approach is generally performed due to risk to the equine patient with diseased lung tissue coupled with general anesthesia. A thoracotomy in horses can include rib resection to allow for better visualization of the thoracic cavity. Rib resection also creates opportunities for drainage, proper incision closure, and post-operative treatments such as flushing. An incision is made over the rib to be resected, about 30 cm, followed by dissection through the musculature and fascia and to the rib itself. Prior to removing the rib, it is important to separate the periosteum from the bone with a periosteal elevator. Rib resection is performed using obstetrical wire and then the rib is removed at the level of the cartilage junction. Once the rib is removed, scissors are used to incise the pleura covering the lung tissue. The surgeon is encouraged to thoroughly examine the tissues after entering the thoracic cavity to remove any necrotic tissue or debris. In the event an abscess is encountered, it is recommended to insert a catheter through a second incision apart the thoracotomy to drain and flush the abscess. Once the surgery is complete, the incision can be left to heal by second intention or closed. A thoracic tube should be placed for postoperative removal of fluid or air from the surgical procedure. Potential complications can include cardiac arrhythmias and pneumothorax (Auer and Stick). Other risks include cellulitis and abscessation, which have been reported post-thoracotomy procedure

(Hilton et al). In the event of abscessation in the thorax, a thoracotomy procedure is favored over other approaches to establish proper drainage (Auer and Stick).

Prognosis.

Prognosis of patients who sustain thoracic trauma depends the individual case. Trauma that is isolated to the thoracic cavity can be managed, but the prognosis becomes poor if the trauma extends beyond the thoracic cavity (Laverty et al). Sequelae to penetrating thoracic wounds can contribute to a poor prognosis, such as bacterial pleuropneumonia, pneumothorax, or hemothorax (Auer and Stick).

Conclusion

The most commonly reported cause of thoracic trauma is collision with another object. Triage and stabilization should be implemented immediately upon patient presentation. Treatment options for thoracic trauma range from medical treatment to surgical debridement and drainage. The prognosis tends to be guarded to good in thoracic trauma patients as long as the trauma is isolated to the thoracic cavity.

References

Auer, JÃ¶rg A., and John A. Stick. *Equine Surgery (Fourth Edition)*. Vol. Fourth. St. Louis: W.B. Saunders, 2012. Print.

Coumbe, Karen. "Chapter 7: Basic First Aid." *Equine Veterinary Nursing*. Chichester, West Sussex: Wiley-Blackwell for the British Equine Veterinary Association, 2012. 158. Print.

Epstein, K.L. “Pneumothorax and Pneumomediastinum: Causes, Diagnosis, and Treatment.” *Equine Veterinary Education* 21.12 (2009):627-628. Web. 21 June 2017.

Groover, E. S., and A. A. Wooldridge. "Equine Haemothorax." *Equine Veterinary Education* 25.10 (2013): 536-41. Web. 21 June 2017.

Hassel, Diana M. "Thoracic Trauma in Horses." *Veterinary Clinics of North America: Equine Practice* 23.1 (2007): 67-80. Web. 13 June 2017.

Hilton, Hugo, Monica Aleman, John Madigan, and Jorge Nieto. "Standing Lateral Thoracotomy in Horses: Indications, Complications, and Outcomes." *Veterinary Surgery* 39.7 (2010): 847-55. Web. 21 June 2017.

Laverty, Sheila, J.-P. Lavoie, J. R. Pascoe, and N. Ducharme. "Penetrating Wounds of the Thorax in 15 Horses." *Equine Veterinary Journal* 28.3 (1996): 220-24. Web. 21 June 2017.

Muir, William W., and John A. E. Hubbell. *Equine Anesthesia: Monitoring and Emergency Therapy*. 2nd ed. St. Louis, MO: Saunders/Elsevier, 2009. Print.

Pollock, P. J. "Penetrating Injuries to the Thorax: A Clinical Challenge." *Equine Veterinary Education* 20.8 (2008): 418-21. Web. 21 June 2017.

Sprayberry, Kim A., and T. D. Byars. "Equine Pleuropneumonia." *Equine Veterinary Education* 11.6 (1999): 290-93. Web. 7 June 2017.

Radcliffe, Rolfe. M., N. G. Ducharme, T. J. Divers, and R.D. Gleed. “Treating Thoracic Injuries”. *Compendium Equine Continuing Education for Veterinarians.* June 2009. Print.

Reuss, Sarah M., and Steeve GiguÃ¨re. "Update on Bacterial Pneumonia and Pleuropneumonia in the Adult Horse." *Veterinary Clinics of North America: Equine Practice* 31.1 (2015): 105-20. Web. 21 June 2017.

Rush, B. R., and E. G. Davis. "Pleuropneumonia: When Additional Diagnostics Are Indicated." *Equine Veterinary Education* 23.6 (2011): 302-05. Web. 21 June 2017.

Vachon, Anne M., and A. T. Fischer. "Thoracoscopy in the Horse: Diagnostic and Therapeutic Indications in 28 Cases." *Equine Veterinary Journal* 30.6 (1998): 467-75. Web. 21 June 2017.