

How to Place an Indwelling Chest Tube for Drainage and Lavage of the Pleural Cavity in Horses Affected with Pleuropneumonia

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Placement of indwelling chest tubes in horses with pleuropneumonia is an easy and safe procedure to facilitate continuous drainage of pleural fluid. Pleural lavage via indwelling chest tubes is an effective procedure to promote drainage of thick exudate, bacteria, and necrotic material from the pleural cavity. Authors' address: Department of Large Animal Medicine and Surgery, College of Veterinary Medicine, Texas A&M University, College Station, TX 77843-4475. © 2000 AAEP.

Introduction

Bacterial pleuropneumonia (i.e., pleuritis) involves bacterial colonization of the lung, resulting in pneumonia and/or lung abscessation, followed by extension to the pleural space and accumulation of pleural effusion (parapneumonic effusion).¹ In horses, pleuropneumonia has been associated with stress, long-distance transport, and strenuous exercise, likely because of suppressive effects on pulmonary defenses.¹⁻⁶ Pulmonary aspiration has also been associated with pleuropneumonia, likely due to overwhelming of pulmonary defense mechanisms.¹

Clinical signs of pleuropneumonia are variable and include lethargy, anorexia, fever, nasal discharge, cough, exercise intolerance, dyspnea, respiratory distress, flared nostrils, weight loss, and sternal edema.⁷⁻¹¹ Acutely affected horses often exhibit pleurodynia, evident as pawing, stiff gait, abducted elbows, and reluctance to move or cough.⁷ Diagnosis is made based on thoracic auscultation and percussion, hematology, thoracic radi-

ography and ultrasonography, thoracocentesis, and cytologic examination and microbiologic culture of pleural fluid and tracheobronchial aspirates.⁷⁻¹¹

Treatment of pleuropneumonia varies depending on the severity and duration of the disease process; the causative organisms; the presence, character, and volume of pleural effusion; the extent of fibrin deposition; the microenvironment within the pleural space; and the development of sequelae.¹² Therapeutic modalities include anti-inflammatory and antimicrobial medications, pleural drainage, pleural lavage, thoracostomy, rest, supportive care, and management of sequelae.^{8,10,12,13}

An important decision in the management of horses with pleuropneumonia is determining whether pleural drainage is indicated. Parapneumonic effusions have been classified based on the need for pleural drainage. Uncomplicated effusions are those that resolve spontaneously without drainage, whereas complicated effusions generally require drainage in addition to antimicrobial ther-

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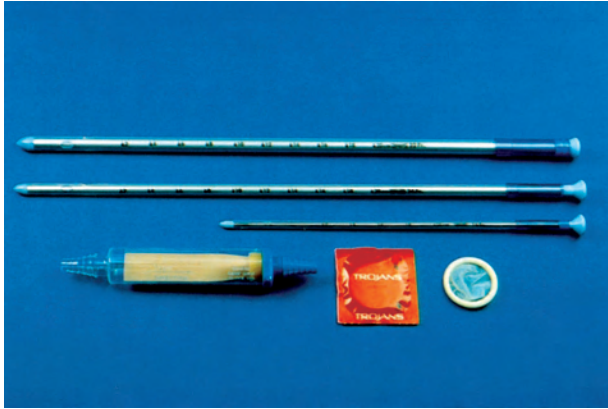


Fig. 1. Chest tubes of various size with blunt trocars for placement in horses with pleuropneumonia. The top tube is a 32 french, the middle tube is 24 french, and the bottom tube is 16 french. A Heimlich valve (left) or nonlubricated condom (right) can be used as a unidirectional valve.

apy for resolution.^{1,12} Indications for pleural drainage include a poor response to conservative therapy and/or pleural fluid with one or more of the following characteristics: sufficient volume to cause respiratory distress, empyematous character, putrid odor, cytologically-visible bacteria, positive microbiologic cultures, low concentration of glucose (< 40 mg/dl), low pH (< 7.1) and high LDH concentration (> 1,000 IU/L).^{8,12-14} When indicated, pleural drainage should be initiated as early in the disease process as possible, because when delayed, fibrin loculation can hinder adequate drainage.¹²

Pleural fluid can be drained using either intermittent thoracocentesis or indwelling chest tubes. Intermittent thoracocentesis may be considered in horses with small volumes of pleural fluid that do not have a putrid odor or contain thick cellular debris.¹² In horses that are accumulating pleural fluid rapidly or in which pleural fluid is thick and exudative, indwelling chest tubes enhance drainage and facilitate continual drainage throughout treatment.

In some affected horses, pleural lavage is helpful to remove fibrin, debris, and necrotic tissue; to dilute thick, viscous pleural fluid; and to facilitate drainage.¹² Lavage is probably most effective in subacute stages before fibrin loculated pockets of effusion develop.

The purpose of this paper is to describe the techniques for placement of indwelling chest tubes and for pleural lavage. Our experience has been that practitioners are often reluctant to perform pleural drainage and lavage, likely due to unfamiliarity with the procedure.

Materials and Methods

The materials we use for placement of an indwelling chest tube include 20 ml of local anesthetic, fenestrated chest tubes of various size (16–32

french)^a with a blunt trocar (Fig. 1), a no. 15 scalpel blade, no. 1 nonabsorbable suture material, and a nonlubricated condom (Fig. 1) or a Heimlich valve^b (Fig. 1).^{8,12,13}

For placement of chest tubes, manual restraint of the horse is usually adequate; however, in uncooperative patients, mild sedation may be required. The size of the chest tube to be used is determined by the character of the pleural fluid. Thick, tenacious pleural exudate necessitates a large bore (32 french) tube (Fig. 1); whereas less tenacious pleural fluid may allow for a smaller bore tube (16 or 24 french; Fig. 1).^{12,13} The location for insertion of the chest tube is determined based on ultrasonographic assessment of the thorax (Fig. 2). It is preferable to strategically place the tube at the most ventral extent of the pleural fluid, yet avoid contact of the tube with the heart or diaphragm. Frequently, this location will be just above the costochondral junction of the seventh or eighth intercostal space.¹⁰⁻¹³

The site should be clipped and surgically prepared. Five to 20 ml of local anesthetic is deposited from the parietal pleura (3–6 cm deep) to the subcutaneous tissue at the selected site.¹⁰ A stab incision is made through the skin and subcutaneous tissue with a no. 15 scalpel at the center of the intercostal space. The chest tube with its blunt trocar is inserted through the incision and then forced bluntly through the intercostal muscle (Fig. 3). We do not recommend subcutaneous tunneling of the tube, as kinking of the tube and/or excessive tissue trauma often occurs.^{8,12,13} A sudden release of resistance is usually appreciated once the end of the tube enters the pleural cavity. One should use caution to avoid punching the tube into the under-



Fig. 2. The appropriate site for placement of an indwelling chest tube is determined by sonographic imaging of the thorax. This image was obtained through the left ninth intercostal space. Dorsal is to the left and ventral is to the right. The chest wall is at the top. Atelectic lung is represented by the echogenic structure on the left. Diaphragm and liver are imaged on the lower right aspect of the image. Pleural fluid is the hypoechoic material between the body wall, lung, and diaphragm.



Fig. 3. Placement of the chest tube through the right seventh intercostal space. A moderate amount of force is needed to punch the tube through the intercostal muscle into the pleural cavity.

lying lung. The tube is then gently advanced enough to assure that all the fenestrations (on the side of the tube) are inside the pleural cavity. At this point, the trocar is slowly removed, taking care to avoid allowing air to enter the pleural cavity.¹² We use hemostats to quickly clamp the tube if air suddenly rushes in the tube. As the trocar is removed, pleural fluid will usually start to drain immediately. If drainage does not commence, fibrin or lung may be overlying the fenestrations of the tube, the tube may incompletely pass through the parietal pleura, or the tube has been placed at an improper site.⁷

A Heimlich valve is then attached to the end of the chest tube to facilitate unidirectional drainage (Fig. 4).^{12,13} Some clinicians prefer to use a nonlubricated condom with the end snipped off. The unidirectional valve must be attached securely to the chest tube with white bandage tape. The chest tube is then secured to the body wall with a purse-string suture and a Chinese lock-stitch suture to prevent it from inadvertently sliding out (Fig. 5).^{12,13} When necessary, the thorax can be lightly bandaged with the drainage portal of the tube turned slightly caudal, so as to prevent drainage fluid from scalding the forelimb.

We most frequently use continual drainage as opposed to intermittent drainage; alternatively, the chest tube can be occluded with a syringe and periodically attached to unidirectional valves for intermittent drainage.¹³ We prefer to allow pleural fluid to drain by gravity flow (Fig. 4), because suction often results in obstruction of the tube or drainage portals with fibrin or peripheral lung.⁸

Indwelling chest tubes may be required unilaterally or bilaterally, depending on the patency of the mediastinal fenestrations. We prefer to first place a chest tube in the hemithorax that appears to contain the most fluid; after allowing all the fluid to drain, the opposite hemithorax is then reevaluated



Fig. 4. An indwelling chest tube placed at the right seventh intercostal space with a Heimlich valve attached as a unidirectional valve. Pleural fluid is allowed to drain via gravity flow.



Fig. 5. The indwelling chest tube is secured to the chest wall with a purse string suture followed by a Chinese lock-stitch pattern to prevent the tube from inadvertently sliding out.

with ultrasound to determine whether bilateral chest tubes are needed.⁷ In many horses with bilateral effusion, both hemithoraces will drain from one side, indicating that the mediastinum remains fenestrated.⁷ In some horses with loculated pockets of pleural fluid, multiple drains may be necessary to effectively drain the pleural fluid (Fig. 6).¹² Ultrasonography is used to determine the presence of loculations and to dictate the appropriate site for placement of multiple tubes.

Pleural Lavage

We generally perform pleural lavage using the indwelling chest tube as an ingress and egress portal.

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Fig. 6. This horse affected with pleuropneumonia required two indwelling chest tubes in the right hemithorax. The first tube is in the ventral right seventh intercostal space. The second tube is more dorsally located in the right eleventh intercostal space. Loculation of fluid by fibrin had resulted in two non-communicating pockets of pleural fluid.

Alternatively, a separate tube can be inserted dorsally for infusion and a ventrally-positioned indwelling tube used for drainage. Five to 10 liters of sterile, warm isotonic solution such as lactated Ringer's solution or saline are infused into each affected hemithorax by gravity flow (Fig. 7).¹² After infusion, the chest tube is reconnected to a unidirectional valve and the lavage fluid is allowed to drain.⁴ Pleural lavage may be performed several times daily, depending on the nature of the pleural fluid.

Results

Indwelling Chest Tubes

We have treated over 100 horses with pleuropneumonia using this indwelling chest tube technique, and believe this to be an effective, low-maintenance method of pleural drainage. We generally leave the tubes in place as long as they are functional or until the pleural fluid ceases to accumulate. Although complications (local cellulitis, subcutaneous infection, and pneumothorax) from indwelling chest tubes do occasionally develop, most are easily managed if recognized and treated promptly.^{8,12} We have left indwelling chest tubes in horses for as long as a month, with only minor irritation. Generally the tubes do not complicate the disease process or induce further pleural fluid accumulation.^{12,13}

The chest tube and the unidirectional valve should be monitored at least twice daily for breakage, leaking, obstruction, or detachment.¹² Fibrin clots may periodically occlude the tube or valve, and must be manually removed.^{8,12} Occasionally, fibrin obstruction may require replacement of the tube. Also, the tube will occasionally become kinked, necessitating replacement.

Pleural Lavage

We use pleural lavage in most horses with pleuropneumonia and believe it to be helpful for resolving the septic process within the pleural cavity. In some horses, lavage of the entire hemithorax is not possible due to loculation; however, pleural lavage may help break down fibrous adhesions and establish communication between individual loculae.¹² Large loculae can be mapped out using ultrasonography and individually lavaged through small chest tubes. Care must be exercised that infused fluid is communicating with the drainage tube or it may not be retrievable.^{12,13}

In most horses, we have not observed adverse effects from pleural lavage; however, in patients with bronchopleural communications, infusion of lavage fluid will result in coughing and drainage of lavage fluid from the nares.¹² This finding confirms the presence of bronchopleural communication, which is usually not otherwise known by the clinician. In such cases, lavage should be discontinued or performed with caution to prevent spread of septic, pleural debris up the airways and into normal areas of the lung.^{12,13}

Discussion

This technique of placing indwelling chest tubes is easy, feasible, and allows the practitioner to provide continuous pleural drainage. Complete and continual drainage is beneficial for resolution of the pleural infection, and likely results in a better prognosis for survival and return to normal athletic function.^{12,13} This technique of indwelling chest tubes facilitates continual drainage, which is less time consuming for the veterinarian than intermittent drainage via thoracocentesis.

Pleural lavage is also an easy, feasible procedure that can be performed with minimal equipment. This procedure dilutes out thick pleural exudate and enhances drainage via the indwelling tube.¹² La-



Fig. 7. Pleural lavage in a horse. Lactated Ringer's solution is being infused into the right hemithorax of this horse via an indwelling chest tube. After infusion, a Heimlich valve will be attached to allow drainage of the lavage fluid.

vage may facilitate removal of bacteria, inflammatory mediators, and small pieces of fibrin and necrotic debris that otherwise would not be removed.¹² Lavage also allows detection of bronchopleural communications, which otherwise would not be recognized. There currently are no studies of the effect of pleural lavage on case outcome; however, our clinical impression is that this procedure improves the prognosis and may often decrease the duration of treatment.

References and Notes

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^a Trocar catheter, Deknatel Inc, 600 Airport Rd, Fall River, MA 02720.

^b Heimlich Valve, Becton Dickinson Co, Lincoln Park, NJ 07035.