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CLINICAL PRACTICE GUIDELINES FOR MILITARY WORKING DOGS

Military Working Dogs (MWDs) are critical assets for military police, special operations units, and others operating in today's combat environment. Expectations are that injured working dogs will receive the highest level of resuscitative care as far forward as possible, often in the absence of military veterinary personnel. As chapters are updated, they will be pulled out of this document and published as individual clinical practice guidelines. These guidelines are not a substitute for clinical judgments. (CPG ID: 16)

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CHAPTER 1

Scope of Healthcare Provider Responsibilities

The Scope of Healthcare Provider Responsibilities chapter is updated and is published as a separate guide on the JTS CPG website (<https://jts.health.mil/index.cfm/CPGs/cpgs>) or the Deployed Medicine website (deployedmedicine.com)

Normal Clinical Parameters for MWDs

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CHAPTER 3

Emergency Airway Management

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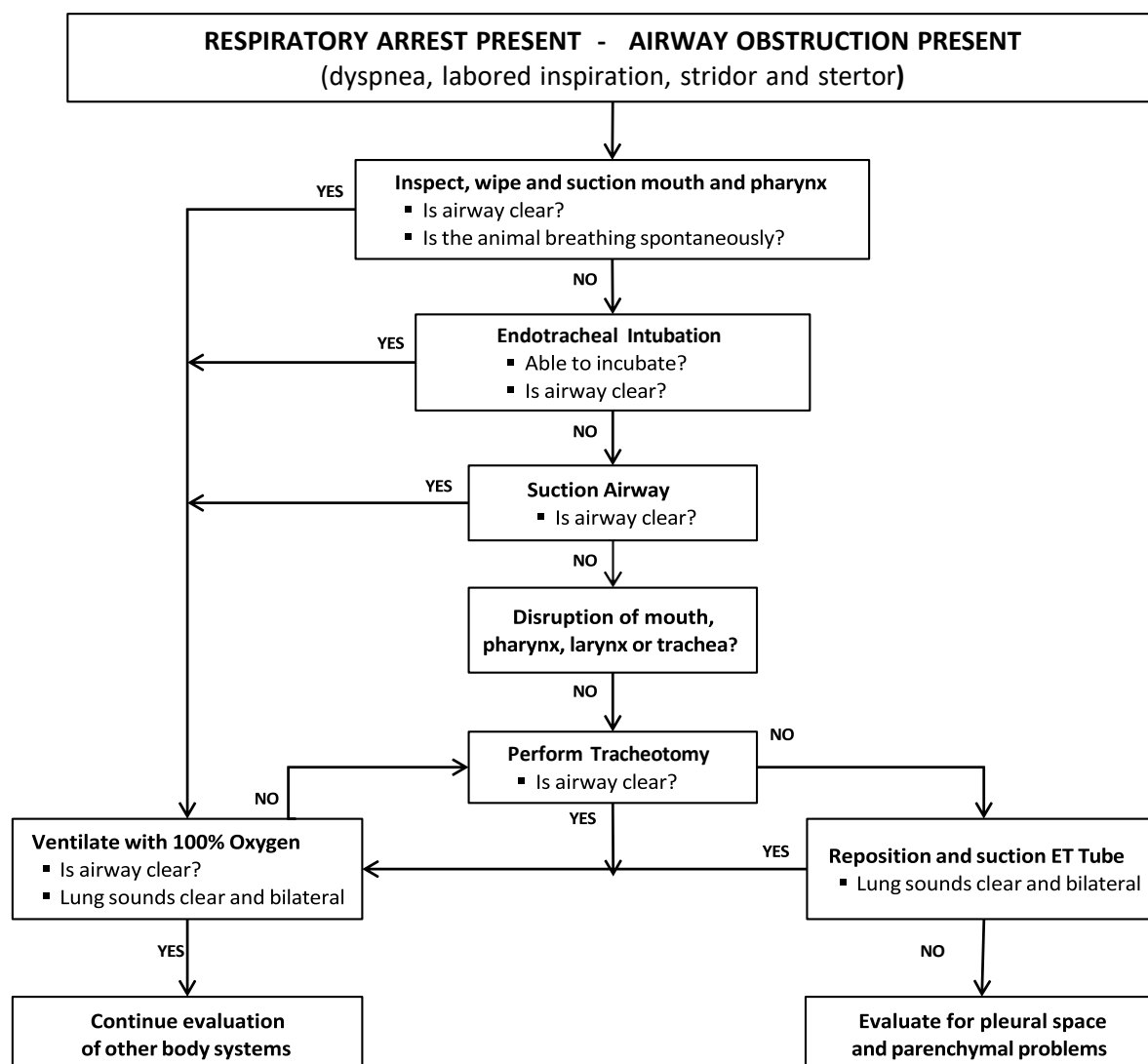
Penetrating Chest Wounds & Respiratory Distress

Respiratory distress develops in deployed MWDs most commonly due to trauma. MWDs in respiratory distress are fighting to get oxygen: they are anxious, usually have obvious problems breathing, usually have their head and neck extended, elbows and upper legs held out from the chest, don't want to lie down, and fight restraint and handling. Cyanosis, if present, is a late finding.

MWDs in respiratory distress typically have 1 of 3 characteristic breathing patterns that help localize the problem. A clinical algorithm for differentiating the most likely cause of a patient's distress based on the pattern of breathing is provided (See Figure 26).

Provide supplemental oxygen for any dog in respiratory distress (See Chapter 3).

Figure 26. Clinical Algorithm for Differentiating Cause of Distress Based on Breathing Pattern.¹



Thoracic Radiography and Thoracic Focused Assessment with Sonography in Trauma (TFAST)

Thoracic radiography and TFAST exams are useful adjunct procedures, especially in the diagnosis and treatment of pneumothorax, hemothorax, pleural effusion, pulmonary contusions, or pulmonary edema. Radiography is also appropriate for documentation of correct thoracostomy tube placement.

Perform thoracic radiography on every traumatized MWD, if available, even if there is no clinical evidence of thoracic trauma. A significant number of trauma patients without outward evidence of chest trauma have hidden trauma that may manifest later, complicate management, or worsen with treatment of other conditions.

TFAST should be performed on every MWD that presents with a history of trauma, if the HCP has significant experience in its use; TFAST requires a high degree of experience to optimize diagnostic reliability. As with human casualties, TFAST is sensitive and specific for the diagnosis of pneumothorax and pulmonary parenchymal fluid, and for rapidly evaluating for pericardial and pleural effusions.⁴ Figure 27 shows the imaging locations for TFAST in the dog. Figure 28 describes a clinical management algorithm for the use of TFAST in dogs.

Figure 27. Imaging Locations for TFAST.⁴

Figure 27 shows the ultrasound probe locations for TFAST in the dog.

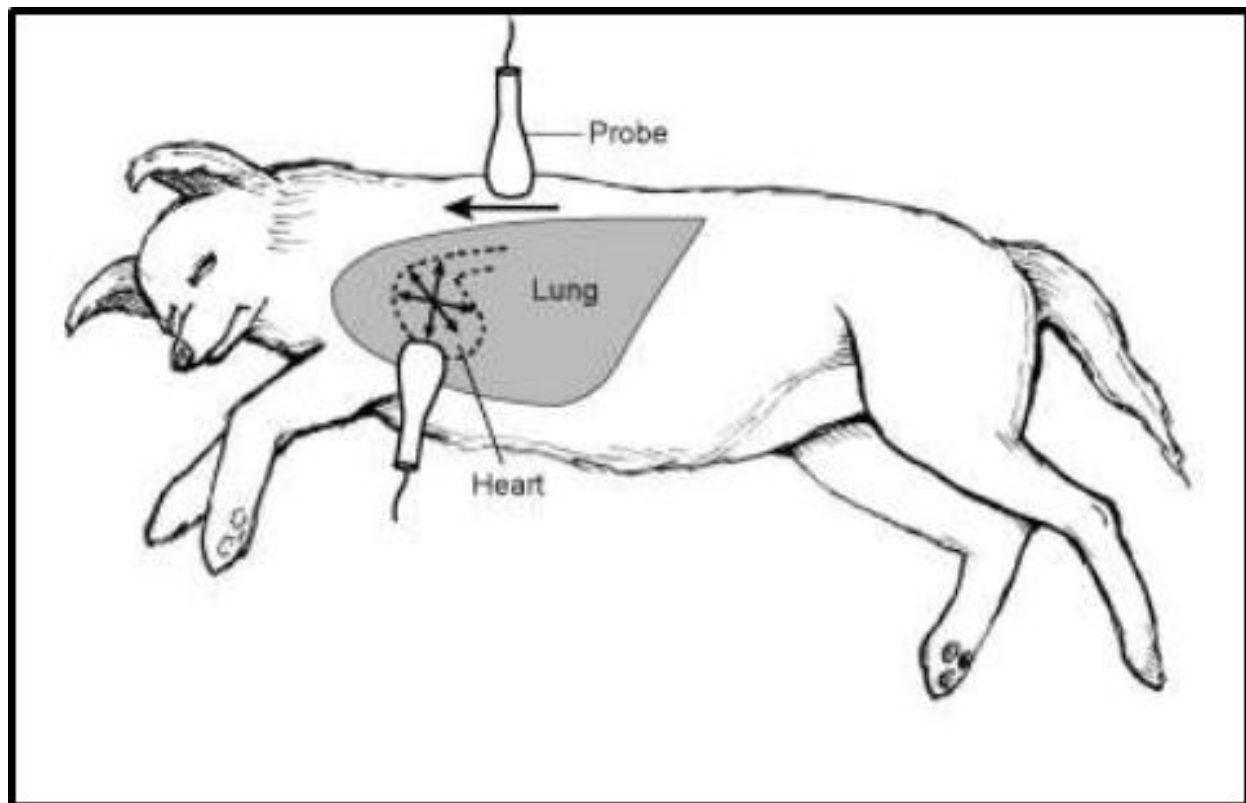
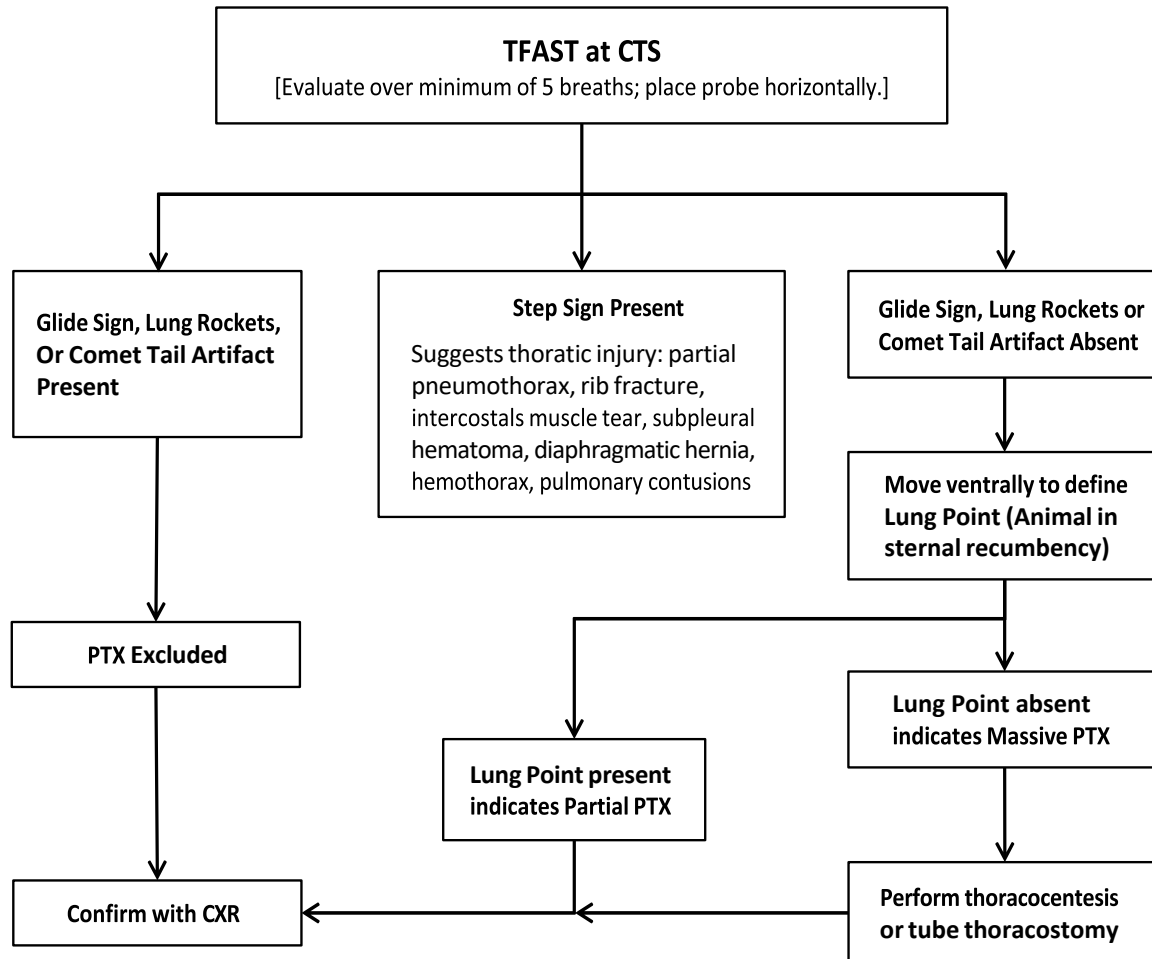


Figure 28. Clinical Management Algorithm for TFAST Use in Military Working Dogs.⁴



*Note: CTS refers to probe imaging location at the conventional Chest Tube Site (8th-11th intercostal space).
PTX refers to pneumothorax. CXR = thoracic radiography.*

Thoracic Injury

Up to 50% of traumatized dogs have some form of thoracic injury.⁵⁻¹² Pneumothorax (PTX) and pulmonary contusions are very common. Dogs with thoracic injury typically have restrictive and parenchymal breathing patterns (See [Figure 26](#)).

Rib Cage Trauma

This includes flail chest, rib fractures, intercostal muscle rupture, and penetrating wounds. Signs mimic pleural space injury (restrictive breathing pattern). Usually the defect is obvious, especially if paradoxical chest wall motion is noted.

- Adequate management usually involves careful handling, laying the patient with affected side down, minimizing restrictive chest bandaging, and providing analgesia. External splinting or surgical management is usually not necessary unless injury is severe or extensive, or the chest wall is compromised and prolonged interference with gas exchange and ventilation is evident.
- Pain can substantially interfere with gas exchange and ventilation. Alleviate pain once the patient is stabilized to improve oxygenation and ventilation. Systemic or local analgesia are acceptable options (See [Chapter 16](#)). Local nerve/rib blocks and intrapleural analgesia administration work well and are readily accomplished.

Pleural Space Trauma

This includes PTX (open, closed, tension), hemothorax (HTX), and diaphragmatic hernia. A restrictive breathing pattern is the classic presentation—shallow, rapid respiration with muffled lung and/or heart sounds. Auscult the chest for decreased lung sounds over most of the thorax, which suggests either fluid (blood) or air in the pleural space, pulmonary contusions, or diaphragmatic hernia.

- Open PTX requires immediate action. Rapidly clip hair from around the wound, and apply any occlusive seal over the wound. Apply a chest bandage to secure the material. Delay wound closure until the MWD is stable. Open PTX always requires chest decompression after closure of the wound.
- The presence of decreased lung sounds in a trauma patient with signs of respiratory distress, or rapid clinical deterioration in a MWD with respiratory distress is sufficient justification for needle thoracocentesis.
- Thoracocentesis is readily and rapidly accomplished, and safe when performed properly – “When in doubt, tap it!” Figure 29 on the next page shows the location for needle thoracocentesis in dogs.¹³ See [Table 8](#) for thoracocentesis technique in MWDs.
- The mediastinum in dogs is thin and typically ruptures; therefore, ***always tap both sides of the chest***, even if a positive tap is achieved on one side of the chest, as air will form pockets and will migrate.
- Repeated thoracocenteses may be required to stabilize the patient. A negative chest tap doesn’t always mean there’s not an abnormal accumulation of air or fluid in the pleural space – it may mean you just couldn’t find it! “When in doubt, tap it again!”
- In dogs, the intercostal artery, vein, and nerve run on the caudal aspect of each rib; thus, the best approach is by inserting the needle or catheter in the center of the intercostal space or at the cranial aspect of a rib.

Figure 29. Location for Needle Thoracocentesis.

Figure 29 shows anatomic location for needle thoracocentesis in dogs, with the dog in lateral or sternal recumbency, and the needle inserted generally on the mid-lateral thorax between the 6th to 8th intercostal space. Count forward from the last rib (#13; red dotted line) to find the insertion site.

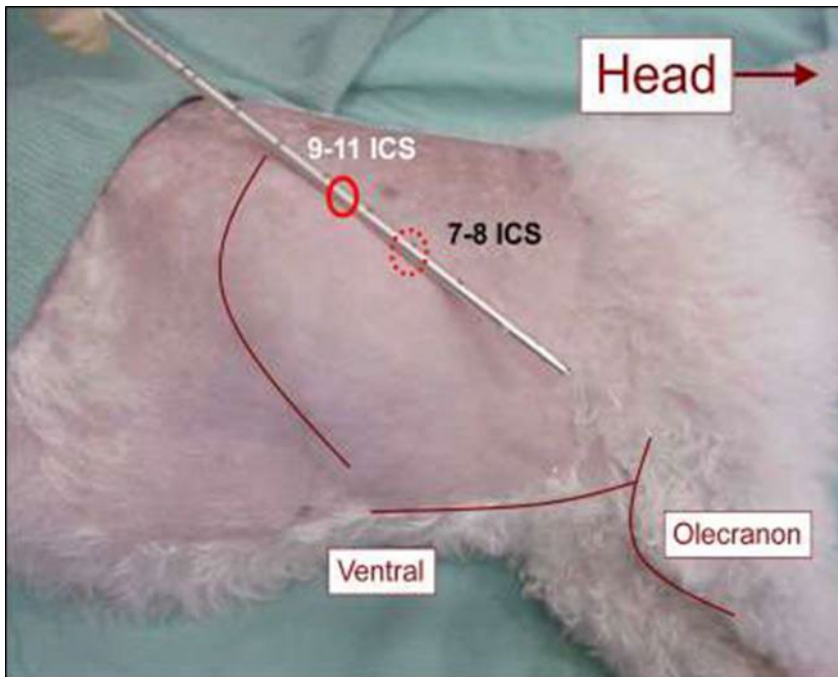


Immediate placement of a thoracostomy tube is indicated if negative pressure cannot be achieved with needle thoracocentesis, if large amounts of blood are aspirated, or if repeated thoracocenteses are required to maintain negative pleural pressure.

- A general rule of thumb for thoracostomy tube sizes is the chest tube should be the largest size that comfortably fits in the intercostal space. For most MWDs, use fenestrated tubes that are 24-36 Fr. Figure 30 shows the correct anatomic orientation for chest tubes placed in dogs. Table 9 describes techniques for chest tube placement in MWDs.
- Tube thoracostomy is a painful procedure. In emergent or critically ill patients, local analgesia may not be necessary. Consider local anesthesia, intercostal nerve blocks, and intrapleural analgesia in all other patients (See [Chapter 16](#)).
- Remove chest tubes when air or fluid accumulation is less than 2-4 mL/kg body weight per day.
- The chest tube will ideally lie in the pleural space, generally oriented cranioventrally to maximize removal of air and fluid. It is best to pre-measure the tube visually before placement to ensure proper depth of insertion. Be certain the last fenestration of the tube will be within the chest cavity.
 - Patients with chest tubes in place MUST be monitored continuously!
 - Some form of removal of air or fluid must be used. This can be continuous suction or intermittent aspiration by personnel.

Figure 30. Anatomic Orientation for Chest Tube Placement.

Figure 30 shows correct placement of a chest tube on the lateral aspect of the chest in a dog, with the tube penetrating the skin at the 9th to 11th intercostal space (ICS), tunneling cranioventrally to penetrate the chest wall at the 7th to 8th ICS, directed toward the olecranon of the elbow. Photo courtesy of Dr. Tim Hackett.



Resuscitative Thoracotomy

- Emergent thoracotomy may be indicated, keeping in mind caveats discussed previously.
- Thoracotomy in dogs is generally best done through a LEFT lateral thoracic wall approach, generally at the 4th to 5th or 5th to 6th intercostal space to afford optimal visualization. A median approach is not recommended in MWDs, given difficulties in post-operative management.
- Euthanasia should be considered for a MWD for which a resuscitative thoracotomy is deemed necessary but cannot be performed or has proven unsuccessful (See [Chapter 21](#)).

Parenchymal Trauma

Pulmonary contusions and intrabronchial hemorrhage are common. A restrictive breathing pattern may be noted in patients with mild and moderate parenchymal injury. Patients with severe parenchymal injury often have a parenchymal pattern, seen as respiratory distress with labored inspiration and expiration, with or without hemoptysis.

- Auscult the chest for decreased lung sounds, which suggest either fluid (blood) or air in the pleural space, or pulmonary contusions. A patchy distribution of altered lung sounds may be noted, which helps differentiate parenchymal injury from pleural space trauma.

- A negative thoracentesis suggests the presence of pulmonary contusions in patients with these clinical signs. Note that radiographic signs (mixed interstitial-alveolar pattern) may lag 12-24 hours, and the stress of the process is usually not warranted.
- Hemoptysis, especially of arterialized (bright red) blood suggests significant large pulmonary vessel trauma that typically carries a very guarded prognosis.
- Most MWDs with pulmonary contusions do not require mechanical ventilation. Management of pulmonary contusions involves minimizing stress, providing oxygen supplementation, cautious intravenous fluid administration to prevent progression of contusions and/or development of pulmonary edema, and possible addition of colloids to the fluid therapy plan to decrease the amount of lung water that may accumulate during shock resuscitation. Diuretics and steroids are not indicated in treatment of pulmonary contusions, and may increase patient morbidity and mortality.
- Severe, life-threatening major pulmonary vessel hemorrhage may require resuscitative thoracotomy. Refer to the discussion of **Resuscitative Thoracotomy** in this chapter for guidance and technique.

Diaphragmatic Hernia

Auscultation of borborygma over the area of the lung field suggests the presence of a diaphragmatic hernia, but can be misleading. Standard radiography and ultrasonography procedures are diagnostic. Assume a hernia is present, and carefully manage the patient to minimize discomfort and further organ herniation until the patient is stable enough to allow definitive diagnosis of the hernia.

- ***Diaphragmatic hernia (DH) is usually not considered a surgical emergency unless the stomach is involved, or the patient's condition deteriorates or fails to respond to conservative management.*** In most cases, the patient should be stabilized for shock and other organ injury, with definitive repair of the hernia at a later time. Most patients suffering trauma severe enough to rupture the diaphragm have other pulmonary injuries that would preclude anesthesia and intermittent positive pressure ventilation (IPPV) (e.g., contusions, pneumothorax).
- Emergent repair of a DH may be indicated. Repair is performed via a cranial ventral midline laparotomy, with retraction of the liver and stomach caudally, to afford optimal visualization.
 - Some means of positive pressure ventilation is necessary intraoperatively.
 - At least 1 thoracostomy tube should be placed intraoperatively and maintained for at least 24 hours post-operatively to manage pneumothorax.
 - Generally, rents in the diaphragm due to trauma occur in the muscular portions of the diaphragm, and are readily repaired using a simple continuous suture closure.

Ventilatory Support

Ventilatory support (e.g., manual IPPV or mechanical ventilation) may be required for dogs that fail to respond to correction or stabilization of the primary respiratory problem and supplemental oxygen support.¹⁵ Ventilatory support requires a heavily sedated or anesthetized patient, even if a tracheostomy tube is in place (See [Chapter 16](#)).

- Manual intermittent positive pressure ventilation (MIPPV) is feasible if personnel can be spared for this, and is ideal for short-term (i.e., <6 hours) of ventilator support.
- There may be instances in which mechanical ventilation (MV) is necessary to afford a chance for patient survival. MV may be necessary if MIPPV fails or duration of ventilator support is expected to be >6 hours. Providers must note that MV should be considered only if the provider has the necessary advanced MV training and experience, the provider feels there is a reasonable likelihood of success, and the provider has the necessary support staff, facilities, and monitoring and intensive care facilities to manage a MWD on MV without compromising human patient care. Thus, MV should be considered only in Level 2 or higher medical facilities and by trained specialists with adequate staff.
- Generally, it is best to induce general anesthesia and initially manage the ventilated dog using Controlled Ventilation or Assist-Control ventilator mode. Key ventilator settings are shown (See Table 7).

TABLE 7: MECHANICAL VENTILATOR SETTINGS & KEY PARAMETERS ¹³

PARAMETER	NORMAL LUNGS	ABNORMAL LUNGS
F _I O ₂	100%, then reduce to <60%	100%, then reduce to <60%
Tidal Volume (V _T)	5 – 15 mL/kg	5 – 15 mL/kg
Breathing Rate (f)	8 – 20 bpm	8 – 20 bpm
Minute Ventilation (V _E)	150 – 250 mL/kg/min	150 – 250 mL/kg/min
Peak Inspiratory Psi (PIP)	10 – 20 cmH ₂ O	15 – 25 cmH ₂ O
Positive End-Expiratory Psi (PEEP)	0 – 2 cmH ₂ O	2 – 8 cmH ₂ O
Trigger Sensitivity	-2 cmH ₂ O or 2 L/min	-2 cmH ₂ O or 2 L/min
Inspiratory: Expiratory Ratio (I:E)	1:2	1:2
Inspiratory Time	~ 1 sec	~ 1 sec

TABLE 8. NEEDLE THORACOCENTESIS OF MWDS¹⁴

1. Position the animal in sternal recumbency if conscious or lateral recumbency if unconscious, sedated, or anesthetized.
2. Clip the hair from and surgically prepare a 6 inch X 6 inch square area of skin on the mid-lateral aspect of the thorax centered between the 6th to 8th ribs.
 - If pneumothorax is suspected, prepare the thoracenteses sites at the junctions of the upper 1/3rd and lower 2/3rds of the thoracic wall.
 - If pleural effusion is suspected, prepare the thoracenteses sites at the costochondral junctions.
3. In conscious MWDS and if time, infiltrate 1 mL of local anesthetic (20 mg lidocaine or 5 mg bupivacaine) in the skin to the pleura.
4. Assemble an emergency thoracocentesis set. For a tension PTX, a 1-1.5 inch, 16-18 gauge over-the-needle catheter is sufficient to relieve tension. For other types of PTX, use a 1-1.5 inch, 18 gauge over-the-needle catheter, to which sterile extension tubing and a stopcock and 60 cc syringe are attached; this allows aspiration of air and fluid without iatrogenic PTX. **Do NOT use the standard Needle Decompression Device (3.25 inch, 16 gauge), as risk of cardiac or pulmonary vessel trauma is high.**
5. Hold the needle with the thumb and index finger of one hand and brace the hand on the lateral aspect of the thorax by firmly resting the "knife" of the hand on the thorax near the proposed thoracocentesis site.
6. Hold the syringe in your dominant hand, or have an assistant manipulate the syringe and stopcock while you manipulate the needle. The syringe should be empty and the stopcock closed to room air.
7. While stabilizing the hand holding the needle, insert the needle at the proposed thoracocentesis site through the skin, intercostal muscles, and parietal pleura until ½ the length of the needle has been inserted.
8. While stabilizing the depth of the needle with your non-dominant hand, aspirate with the syringe plunger in an attempt to remove air or fluid.
9. If you are successful in removing air or fluid, close the stopcock to the patient and expel the contents from the syringe through the stopcock without removing the needle from the pleural space or breaking aseptic technique.
10. Repeat until no further air or fluid can be removed.
11. If you are not successful in removing air or fluid, insert the needle to the hub while aspirating with the syringe, or redirect the needle cranially, caudally, dorsally and ventrally, or do both in an attempt to tap a pocket of air or fluid.
12. If you are still unsuccessful in removing air or fluid, completely remove the needle from the thorax and attempt thoracocentesis in an intercostal space cranial or caudal to the initial site.

TABLE 9. TUBE THORACOSTOMY OF MILITARY WORKING DOGS¹⁵

1. Clip the hair from and surgically prepare an area of skin from the 4th to the 12th rib, and from the dorsal midline to the ventral midline.
2. Infiltrate local anesthetic (20 mg lidocaine +/- 10 mg bupivacaine) at the proposed skin incision site between the 9th and 11th intercostal space at the junction of the upper 1/3rd and the lower 2/3rds of the lateral thorax. Continue infiltration of the subcutaneous tissues cranioventrally to the intercostal space at the intended site of penetration of the thoracic wall between the 6th and 8th intercostal space. Infiltrate the intercostal muscles, down to the level of the parietal pleura.
3. Make a skin incision with a #10 scalpel blade that is the same diameter as the thoracostomy tube. Note that an incision that is too large increases the risk of iatrogenic PTX and fluid leakage.
4. Insert the thoracostomy tube using either a trocar or forceps through the skin incision and advance the tube cranioventrally toward the intercostal space where you intend to penetrate the thorax. This creates a subcutaneous tunnel and orients the tube to lie in the intended direction in the chest.

***Note:** The interval between the skin incision and the intercostals space where the tube penetrates the thorax must be at least 2 intercostal spaces in width to allow sufficient creation of a subcutaneous tunnel that is important in minimizing iatrogenic PTX and fluid leakage.*

***Note:** MWDs rarely develop pleural adhesions, so digital exploration before tube placement is not necessary.*

Trocar Technique: (RECOMMENDED technique)

- 1) Insert the tip of the tube through the skin incision and advance the tube subcutaneously cranioventrally at least 2 intercostal spaces. Be sure to hold the trocar firmly in the tube.
- 2) Firmly drive the tip of the stylet into the intercostal musculature as you raise the thoracostomy tube vertically so that the tube is almost perpendicular to the thorax.
- 3) This movement will cause the skin to bunch over the intercostal space and will expose the distal part of the tube that was in the skin tunnel.
- 4) Firmly grasp the distal-most part of the thoracostomy tube with one hand approximately 2 cm from the tip to prevent inadvertent over insertion of the trocar when advancing the tube in the next step. Note that this step is vital, as this hand acts as a “brake” to prevent lung and heart trauma as the tube is inserted.
- 5) Using either a single, sharp blow to the proximal blunt end of the stylet or firm continuous downward pressure on the proximal blunt end of the stylet, penetrate the intercostal muscles and pleura to advance the tube into the pleural space approximately 2 cm.
- 6) Once the tip of the thoracostomy tube has been inserted approximately 2 cm into the pleural space, lay the tube flat against the body wall AS YOU BEGIN TO ADVANCE THE TUBE in the pleural space cranioventrally toward the point of the elbow.
- 7) As the tube is advanced, begin to slide the stylet out of the tube.
- 8) Clamp the thoracostomy tube using the box lock of the Rochester-Carmalt or similar forceps as the stylet is removed to prevent pneumothorax.
- 9) Close the proximal (outer) opening of the thoracostomy tube using either a Heimlich valve or tubing adapter and stopcock so that air does not enter the pleural space.

TABLE 9. TUBE THORACOSTOMY OF MWDS¹⁵ (CONTINUED)

Forceps Technique: (NOT ideal; more traumatic and technically demanding)

- 1) Create a subcutaneous tunnel by bluntly advancing a 7" curved Rochester-Carmalt forceps or similar forceps (without the tube) cranioventrally from the skin incision site to the proposed intercostal space where the thoracostomy tube will penetrate the thorax.
 - 2) Forcefully drive the tip of the forceps through the intercostal muscles and parietal pleura using a firm, quick thrusting motion, to enter the chest cavity.
 - 3) While the tips of the forceps are inserted through the intercostal muscles and pleura, firmly open the jaws of the forceps to dilate the penetration site in the thoracic wall.
 - 4) Remove the forceps and grasp the distal end of the thoracostomy tube with the jaws of the forceps such that the length of the tube is lying over the handles of the forceps. Just a small part of the tip of the tube should extend beyond the tip of the forceps.
 - 5) Attach a Heimlich valve or clamp the thoracostomy tube BEFORE placing the tube to prevent pneumothorax.
 - 6) Insert the forceps holding the tube through the skin incision and advance the tube and forceps cranioventrally through the subcutaneous tunnel to and through the intercostal opening.
 - 7) Without removing the forceps, open the jaws of the forceps to release the thoracostomy tube. Advance the thoracostomy tube into the pleural space in a cranioventral direction toward the point of the elbow.
 - 8) As the thoracostomy tube is advanced into the pleural space, slowly remove the forceps completely.
 - 9) Continue to advance the thoracostomy tube until you are absolutely certain the most proximal fenestration of the tube is well within the pleural space, and is not in the subcutaneous tunnel or outside the skin.
-
5. Secure the chest tube to the skin using a horizontal mattress suture through the skin ventral to the skin tunnel, a purse string suture at the skin incision site that surrounds the tube where it enters the skin, and a "finger trap" suture around the tube anchored to the skin. Incorporate the chest tube in a bandage applied around the thorax to protect the tube.

References for Penetrating Chest Wounds & Respiratory Distress

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CHAPTER 5

Cardiopulmonary Resuscitation (CPR)

The CPR for MWDs chapter is updated and is published as a separate guide on the JTS CPG website (<https://jts.health.mil/index.cfm/CPGs/cpgs>) or the Deployed Medicine website (deployedmedicine.com)

CHAPTER 6

Shock Management

Shock in deployed MWDs will most likely be due to hemorrhage from trauma or hypovolemia due to heat injury or gastrointestinal losses. Control bleeding (if present) and then stabilize the patient using targeted fluid therapy. Figure 33 provides a clinical management algorithm for shock management in MWDs.

Immediate Hemorrhage Control

Treatment by handlers and combat medics may have been performed, with varying degrees of success.^{1,2} Expect dogs to arrive with pressure dressings, hemostatic gauze packed into wounds, and improvised tourniquets. Expect untreated or inadequately treated extremity hemorrhage, and suspect “hidden” intracavitary hemorrhage in the chest and abdomen.

- Assess for unrecognized hemorrhage and control all sources of external bleeding. Use direct pressure initially, or rapidly clamp and ligate major vessels if traumatized. Dogs have excellent collateral circulation, and paired major vessels can be ligated without concern for tissue ischemia or edema, to include the femoral arteries and veins, external jugular veins, external carotid arteries, and brachial arteries and veins.^{3,4}
- Tourniquets are unreliable on the limbs of dogs due to the anatomic shape of the leg. Conventional human tourniquets do not remain in place or effectively control hemorrhage. Some success is reported in use of improvised tourniquets, such as surgical rubber tubing or constrictive gauze bandage. If delay in definitive care of major extremity trauma is expected, use hemostatic agents, direct pressure, and compressive bandaging to assist with hemorrhage control.
- Use thoracic FAST (TFAST) and abdominal FAST (AFAST) to rapidly scan for intracavitary fluid (See [Chapter 4](#) and [Chapter 7](#)).^{5,6} Assume intracavitary fluid is due to bleeding until proven otherwise.

Clinical Signs of Shock in MWDs^{7,8}

Dogs in shock are amazing in how stable they appear on initial presentation, due to compensatory mechanisms.

- MWDs in early (compensatory) shock may have tachycardia, tachypnea, alert mentation, rapid arterial pulses with a normal or increased pulse pressure, decreased capillary refill time (< 2 seconds), and normal or bright red mucous membranes. While this MWD seems normal, it is already in compensatory shock. Immediate treatment at this point may stop the progression of shock.
- As the early decompensatory phase of shock begins, tachycardia persists, pulse pressure and quality begins to drop or may be normal, capillary refill time becomes prolonged, mucous membranes appear pale or blanched, peripheral body temperature drops, and mental depression develops. Aggressive treatment must be provided to halt ongoing shock.
- As late decompensatory shock develops, the heart rate drops despite a decreased cardiac output, capillary refill time is very prolonged or absent, pulses are poor or absent, both peripheral and core temperature is very low, and marked mental depression (stupor) is present. Irreversible cellular injury may be present to such a severe degree that despite aggressive measures at this point, many patients will die.

Standard Shock Therapy

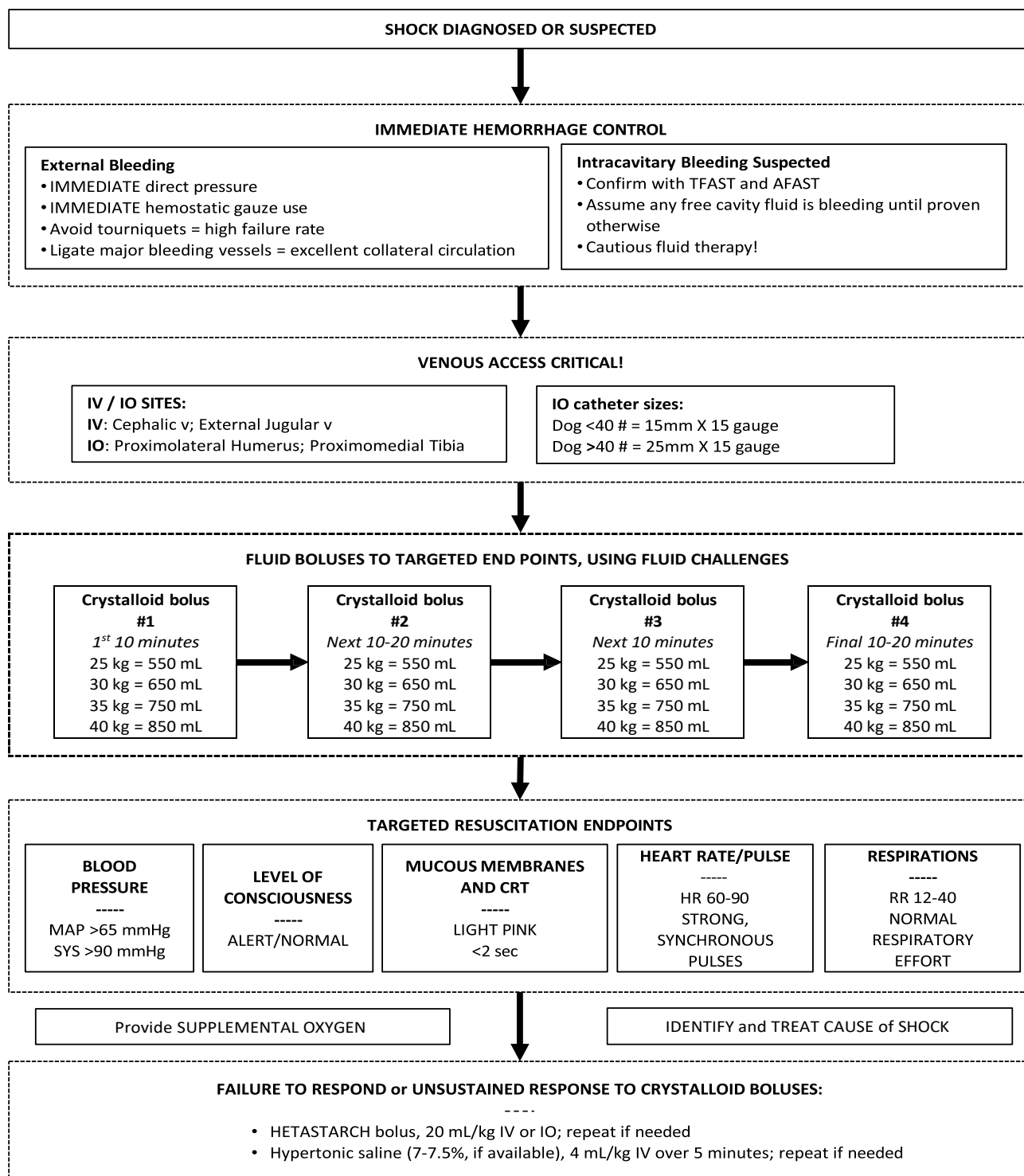
Provide immediate fluid therapy targeted to specific endpoints, provide supplemental oxygen, and identify and treat the cause for the shock. Tranexamic acid (TXA) or ϵ -aminocaproic acid (EACA) may be helpful in dogs with catastrophic hemorrhage.

1. Place multiple large-bore IV or IO catheters or perform venous cut-down.
 - Do not delay in placing catheters. *The IO route is rapid, reliable and safe — USE IT!* Place peripheral or central lines when feasible. If one percutaneous attempt is not successful in a shock patient, immediately choose an alternate percutaneous site and also begin an immediate venous cutdown or perform IO catheterization. The cephalic veins and external jugular veins are ideal for peripheral catheterization.
 - The proximal cranial medial tibia and the proximal lateral humerus are ideal for IO catheter placement, using the same technique as for people (See Figures 34-37). Most MWDs weigh >40#, so use adult (25mm X 15 gauge) IO catheters. Use pediatric (15mm X 15 gauge) IO catheters in dogs weighing less than 40#.
2. Give crystalloid fluids as the first-line treatment.⁹⁻¹⁴
 - Normosol-R® or Plasmalyte-A® are optimal for dogs; however, saline or LRS are acceptable in emergent cases.
 - Crystalloid fluid challenges, as needed based on response to therapy, are better than large volume fluid administration.¹¹⁻¹³ Be prepared to administer up to 90 mL/kg of crystalloids in the first hour (1 blood volume for the dog). Aggressive, but careful, fluid delivery, with frequent reassessment of the patient's status, is critical. Most MWDs can be resuscitated with much less than this calculated maximum volume.
 - For quick reference, ADD a ZERO to the dog's body weight (***in pounds***) to approximate a safe but effective bolus volume. For example, a 45# dog would need about a 450 mL bolus, and a 75# dog would need about 750 mL as a bolus.
3. Use synthetic colloids and hypertonic saline (HTS) in dogs with refractory shock. Very limited data in dogs suggest increased risks,¹⁵⁻¹⁸ but dogs do not seem as sensitive to the adverse effects of these fluids as are people. Two recent studies in dogs showed no adverse side effects, specifically acute kidney injury, with tetrastarch use.^{19,20} The benefits outweigh the risks, so be aggressive with synthetic colloid and HTS.¹⁵⁻¹⁷
 - Give hydroxyethyl starch (HES) as an IV or IO bolus of 10-20 mL/kg total over 5-10 minutes if clinical signs of shock do not abate after the first 30 minutes or the first 2 bolus crystalloid challenges), or response to crystalloid challenges is not sustained.^{11-13,15,20,21} Repeat this bolus if no response to therapy.
 - Use HTS IV boluses, if 7.0 - 7.5% HTS is available, for MWDs that fail to respond to 2 or 3 boluses of crystalloids and/or 1 or 2 boluses of HES. Give 4 mL/kg over 5 minutes.^{11-13,20} Do not administer HTS by the IO route.

Standard Shock Therapy (continued)

4. Human serum albumin (HSA) use. Do not give HSA or other synthetic colloids (e.g., dextrans) to MWDs, because severe allergic reactions are possible (HSA) and coagulopathies are common (dextrans). Some data suggest benefit in a very limited subset of patients with severe hypoalbuminemia,^{22,23} but risks far outweigh potential benefit in dogs with shock.
5. Blood product use. Canine blood products are not available for immediate HCP use.² Dogs cannot be transfused with human blood products. HCPs will have to manage hemorrhagic shock with crystalloid and colloid therapy.
6. Tranexamic acid (TXA) and ε-aminocaproic acid (EACA) use. There is limited, but promising, data to guide use of TXA²⁴⁻²⁷ and EACA²⁸ in dogs with hemorrhage. Dogs appear to be hyperfibrinolytic compared to humans, suggesting higher doses of TXA may be needed in dogs. Consider TXA or EACA if the dog is anticipated to need significant blood transfusion, such as severe hemorrhagic shock, limb amputation, penetrating torso trauma with severe non-compressible bleeding, because canine blood products are not available. Administer these drugs as soon as possible after trauma, but NO LATER THAN 3 HOURS post injury.
 - TXA: 10 mg/kg in 100 mL NS or LRS, IV over 15 min.
 - EACA: 150 mg/kg in 100 mL NS or LRS, IV over 15 min.
 - If bleeding continues, a CRI of additional TXA at 10 mg/kg/hour for 3 hours can be administered.
7. Targeted shock resuscitation end points that are practical for HCPs include systolic and mean arterial pressures, level of consciousness and mentation, mucous membrane color and capillary refill time, HR, RR, and pulse quality.
 - Target a MAP >65 mmHg or a Sys >90 mmHg. Note that neonatal or pediatric blood pressure cuffs must be used (See [Chapter 2](#)).
 - Target normal level of consciousness (LOC) and an alert mentation.
 - Target light pink-to-salmon pink MM and a CRT <2 seconds.
 - Target a HR that is 60-90 beats per minute at rest with a strong, synchronous pulse quality.
 - Target a respiratory rate at rest of 12-40 breaths per minute with normal effort.
 - Once shock has abated, continue IV crystalloid fluids at 3-5 mL/kg/hour for 12-24 hours to maintain adequate intravascular volume.
8. Provide supplemental oxygen therapy. Oxygen supplementation is critical. Every shock patient should receive supplemental oxygen therapy until stable (See Chapter 3).
9. Identify and treat the cause of shock. The cause of shock must be corrected, if possible.
 - Patients with massive intra-abdominal or intrathoracic bleeding need surgery to find the site of bleeding and surgically correct the loss of blood, with the caveats in mind as discussed previously.
 - [Chapter 4](#) addresses emergent resuscitative thoracotomy. [Chapter 7](#) addresses emergent abdominal laparotomy.
 - Euthanasia should be considered to prevent undue suffering for a MWD for which emergent surgery is deemed necessary but cannot be performed or has proven unsuccessful (See [Chapter 21](#)).

Figure 33. Clinical Management Algorithm for Shock Resuscitation in MWDs.



Figures 34-37. Intra-osseous Catheter Placement (Tibia) in a MWD.

Note: Sterile draping is removed to provide better visualization; perform catheterization using sterile technique.

Figure 34 shows the general landmark for IO catheterization on the upper medial aspect of the hind leg of the dog.



Figure 35 shows the intended insertion site (red oval) on the proximal medial tibial crest, just distal to the knee joint. The area should be clipped of hair and prepared for aseptic catheter placement.



Figure 36 shows insertion of a pediatric IO catheter in the proximomedial tibia using the EZ-IO® device.



Figure 37 shows full insertion of the IO catheter, after removal of the stylet.



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Abdominal Trauma

The Abdominal Trauma chapter is updated and combined with the Gastrointestinal Emergencies chapter under (K9) Acute Abdomen, and is published as a separate guide on the JTS CPG website (<https://jts.health.mil/index.cfm/CPGs/cpgs>) or the Deployed Medicine website (deployedmedicine.com)

CHAPTER 8

Gastrointestinal Emergencies

The Gastrointestinal Emergencies chapter is updated and combined with the Abdominal Trauma chapter under (K9) Acute Abdomen, and is published as a separate guide on the JTS CPG website (<https://jts.health.mil/index.cfm/CPGs/cpgs>) or the Deployed Medicine website (deployedmedicine.com)

Heat Injury

The Heat Injury chapter is updated and is published as a separate guide on the JTS CPG website (<https://jts.health.mil/index.cfm/CPGs/cpgs>) or the Deployed Medicine website (deployedmedicine.com)

CHAPTER 10

Hypothermia and Cold Injuries

Hypothermia and Cold Injuries is updated and is published as a separate guide on the JTS CPG website (<https://jts.health.mil/index.cfm/CPGs/cpgs>) or the Deployed Medicine website (deployedmedicine.com)

CHAPTER 11

Snake and Insect Envenomation

The Snake and Insect Envenomation chapter is updated and is published as a separate guide on the JTS CPG website (<https://jts.health.mil/index.cfm/CPGs/cpgs>) or the Deployed Medicine website (deployedmedicine.com)

CHAPTER 12

Blast, Burn and Crush Injuries

The Blast, Burn and Crush Injuries chapter is updated and is published as a separate guide on the JTS CPG website (<https://jts.health.mil/index.cfm/CPGs/cpgs>) or the Deployed Medicine website (deployedmedicine.com)

Long Bone Fractures

The Long Bone Fractures chapter is updated and renamed (K9) Orthopedics, and is published as a separate guide on the JTS CPG website (<https://jts.health.mil/index.cfm/CPGs/cpgs>) or the Deployed Medicine website (deployedmedicine.com)

Wound Management

The Wound Management chapter is updated and is published as a separate guide on the JTS CPG website (<https://jts.health.mil/index.cfm/CPGs/cpgs>) or the Deployed Medicine website (deployedmedicine.com)

CHAPTER 15

Ocular Injuries

The Ocular Injuries chapter is updated and is published as a separate guide on the JTS CPG website (<https://jts.health.mil/index.cfm/CPGs/cpgs>) or the Deployed Medicine website (deployedmedicine.com)

Analgesia and Anesthesia

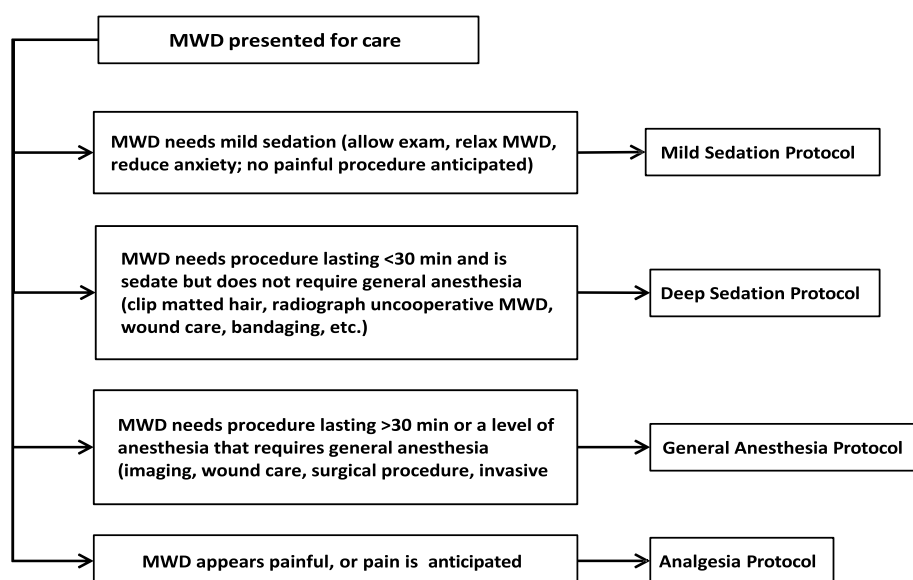
This chapter provides succinct, quick reference protocols for analgesia and anesthesia of emergently ill or injured MWDs, using simple combinations of drugs readily available to most HCPs.¹ A decision-making algorithm is provided below (Figure 45) to determine which analgesia or anesthesia protocol is recommended, based on specific need. Before any use of analgesia or anesthesia, a full physical exam must be performed.

MWDs can be fractious and difficult to manage, and often require heavy sedation for relatively simple procedures. Tailored protocols are provided, based on the level of sedation or anesthesia required – mild or deep sedation, or general anesthesia.¹

Prehospital Analgesia

MWD handlers or combat medics may have given morphine, fentanyl, or ketamine before arrival, so inquire about drug use before transport, which may affect assessment of the patient's mentation and analgesia.

Figure 45. Decision-making Algorithm for Analgesia or Anesthesia.



Protocol Guidance

All drug combinations use the intramuscular (IM) route for ease and safety. If used within 5 minutes, all drugs can be combined in the same syringe to simplify administration. ***Wait at least 20 minutes after administration before attempting any procedure, to allow maximal drug effect.*** Ideally, an IV catheter should be placed once feasible (See [Chapter 2](#)).

Drug Dosing in Dogs

Dosages for many analgesics in dogs are significantly higher than for people. Trust the doses provided in this chapter, and dose as directed to prevent inadequate analgesia or sedation and ‘wind up’ pain.

Gastrointestinal Side Effects of Opioids

Protocols include opioids, which in dogs typically causes emesis, often within 5 minutes of administration. Use caution and have the handler prepared to remove the muzzle to minimize aspiration risk.

Mild Sedation Protocol

- Use to relax MWDs for examination, handling, or short minor procedures that will not cause pain. Use to reduce anxiety.
- **Protocol:** MIDAZOLAM 0.3 mg/kg IM and HYDROMORPHONE 0.2 mg/kg IM.
- **Expectations:** The MWD will be calm, but reactive and noise sensitive.

Deep Sedation Protocol

- Use for procedures that can be completed in <30 minutes and do not require general anesthesia, such as clipping of hair, wound cleansing, minor wound debridement, splinting of lower limb fractures, bandage application or removal, ear cleaning, or radiography. First-line protocol for fractious MWDs.
- **Protocol:** MIDAZOLAM 0.3 mg/kg IM and KETAMINE 5 mg/kg IM and HYDROMORPHONE 0.1 mg/kg IM.
- If deeper sedation or light anesthesia is necessary, or to allow general anesthesia induction, use PROPOFOL in 1 mg/kg boluses IV as needed.
- **Expectations:** The MWD will not be able to walk, cannot be intubated, can be aroused with stimulation, and maintains laryngeal and palpebral reflexes.

General Anesthesia Protocol

- Use to facilitate imaging, allow management of fractures, perform surgical procedures, and perform invasive diagnostic procedures.
- Preoxygenate for 5 minutes using oxygen mask.

- Premedicate using the Deep Sedation Protocol, and place an IV catheter.
- Induce using PROPOFOL 1 mg/kg IV boluses to effect.
- Intubate with an appropriate endotracheal tube. Most MWDs require a 9-11 mm ID endotracheal tube. Use a cuffed tube.
- Maintain anesthesia using ISOFLURANE 0.5-1.5% titrated to effect in 100% oxygen or SEVOFLURANE 2.0-2.5% titrated to effect in 100% oxygen or PROPOFOL CRI 100-300 mcg/kg/min.
- Manage pain with HYDROMORPHONE 0.1 mg/kg IV boluses, not to exceed 0.2 mg/kg per hour.
- Monitor appropriately, give IV fluids, and keep the MWD warm (See **Ancillary Support** in this chapter, and Table 20 on the next page).

Effective Analgesia Protocols for MWDs

Assessment of pain in dogs is difficult. Dogs are generally very stoic and often hide or fail to show outward signs of pain. HCPs should err on side of providing analgesia – if performed properly, it is safe and effective, and analgesia is critically important for safe handling and alleviation of pain.

- Note that all protocols have analgesia incorporated into them. Additional analgesia can be provided by the IV, IM, or PO route, as necessary.
- ***Scheduled administration of analgesics in the post-procedure period is preferred*** to as needed administration in dogs, because pain can be difficult to assess and to avert the ‘roller coaster’ effect of unmanaged pain.
- For intermittent IV or IM supplementary analgesia, use one of the following drugs:
 - HYDROMORPHONE 0.1-0.2 mg/kg q2-4h.
 - MORPHINE 0.2-0.5 mg/kg q4-6h
- For CRI supplementary analgesia, use one of the following drugs:
 - FENTANYL 2-10 mcg/kg/h.
 - MORPHINE 0.1-0.25 mg/kg/h.
 - HYDROMORPHONE 0.02-0.05 mg/kg/h.
- For PO supplementary analgesia, use TRAMADOL 5-10 mg/kg PO q8-12h for up to 5 days.

Caution: Do NOT use acetaminophen or ibuprofen in MWDs, as these drugs can cause liver toxicity. AVOID use of NSAIDs such as naproxen, meloxicam, and aspirin in emergently ill or injured MWDs.

Opioid Reversal

At appropriate doses, dogs appear less susceptible to opioid-induced respiratory depression and excessive sedation. However, opioid side effects can be reversed in the dog using NALOXONE 0.01-0.02 mg/kg slow IV to effect if needed. Note that this will reverse analgesia as well as sedation!

Ancillary Support

- Any MWD that is deeply sedated or under general anesthesia should be given IV crystalloid fluid therapy at 10 mL/kg/h to offset anesthesia-induced hypotension. Additional fluid volumes may be necessary based on the underlying problem (e.g., shock should be given IV fluids to targeted endpoints, as per [Chapter 6, Figure 33](#)).
- Active warming should be provided for any MWD that is deeply sedated or under general anesthesia. Use forced-air warmers, warm water circulating blankets, heat-retaining covers, and warming tables to target a body temperature of 100-101° F. Monitor temperature post-procedure until sustained >100° F.
- Basic and advanced monitoring of the MWD at a level considered appropriate for a human patient for the respective level of analgesia or anesthesia must be provided. Table 20 lists key monitoring parameters and goals for anesthetized MWDs, and common anesthesia machine settings.

TABLE 20. KEY MONITORING PARAMETERS & ANESTHESIA MACHINE SETTINGS		
Parameter	Normal Values	Notes
Heart rate	60-100 bpm	See Chapter 2 for placement of ECG electrodes
Heart rhythm	Normal sinus	
Blood pressure	MAP >60 mmHg	Non-invasive technique
Pulse oximetry	97 ± 2%	See Chapter 2 for placement
Capnography	EtCO ₂ : 35 – 45 mmHg	Up to 60 mmHg is permissible in a normotensive, spontaneously ventilating patient
Temperature	99 - 102.5 ° F	Continuous recording probes can be inserted into the esophagus or rectum
Fresh gas flow	1 – 2 L/min	
F _I O ₂	0.3 – 1.0 %	
Inhalant agent	Isoflurane: 0.5 – 1.5% Sevoflurane: 1.0 – 3.0 %	
Ventilation modes	Spontaneous (preferred) Volume controlled: TV=10-20 mL/kg Pressure controlled: PIP=1-25 cmH ₂ O BPM = 6-12 PEEP: 0 – 5 cmH ₂ O	

Analgesia and Anesthesia Reference

US Army Public Health Command, Veterinary Medical Standardization Board, Anesthesia and Pain Management Standards, 10 October 2013.

Traumatic Brain Injury and Acute Spinal Cord Injury

Traumatic brain injury (TBI) and acute spinal cord injury (ASCI) are uncommon in MWDs. These injuries are often catastrophic, with poor long-term outcome. Caring for affected MWDs is daunting and can tax resources. However, some CNS injuries are recoverable, so efforts to evaluate MWDs with TBI and ASCI should be made to determine the severity of injury and potential for successful outcome. Anticipate these injuries in MWDs exposed to building collapses, blast, and ballistics injuries.

Acute Spinal Cord Injury

Assume ASCI is present in every MWD trauma patient until proven it is not present. Maintain a high index of suspicion! 40-50% of MWDs with ASCI have concurrent injury elsewhere that may be more life-threatening.¹ Focus on initial resuscitation and stabilization, but constantly consider potential neurological injuries. Excessive movement can cause a partial injury to become a permanent injury. Limit movement during the initial exam and treatment period to that which is absolutely necessary until a detailed neurological exam is performed.

Clinical Signs Suggesting ASCI

Clinical findings of bruising over any part of the spine; spinal instability, misalignment, crepitus or pain along the spine; presence of head injury or altered mentation or level of consciousness; or major trauma to other body systems are early tips that ASCI may be present.

Specific neurological signs that strongly suggest ASCI include loss of conscious proprioception, loss of superficial and deep pain, and loss of function (paresis or paralysis).

Lesion Localization

It is ideal to localize the segment of the cord affected. Determine if upper motor neuron (UMN) or lower motor neuron (LMN) signs are present.

- **UMN signs** are characterized by increased motor tone causing normal or exaggerated limb reflexes, normal to increased muscle tone, and decreased proprioception and decreased superficial and deep pain sensation in areas caudal to the lesion.
- **LMN signs** are characterized by flaccid or weak motor tone causing depressed limb reflexes and decreased muscle tone in areas caudal to the lesion.

With both UMN and LMN involvement, paresis or paralysis are possible.

- C1-C5 – UMN signs to all 4 limbs, possibly abnormal respiration (shallow or absent).
- C6-T2 – UMN signs to the hind limbs and LMN signs to the forelimbs.
- T3-L3 – UMN signs to the hind limbs with normal forelimbs.
- L4-S2 – LMN signs to the hind limbs with normal forelimbs.

Diagnostic Imaging

Radiographs, CT, or MRI are often necessary for definitive diagnosis in patients with fractures or dislocations to determine the site of injury. If these imaging modalities are available and the MWD can be managed without worsening possible injury, attempt imaging (See [Chapter 20](#)). Heavy sedation or anesthesia will be necessary (See [Chapter 16](#)).

General Management Considerations for Patients with ASCI

Goals are to reduce neurological deficit and prevent further loss of neurological function (See [Figure 46](#)).

- Follow guidance in this CPG for management of shock, hypotension, hypovolemia, hemorrhage control, and respiratory dysfunction. Be prepared to intubate patients that are not breathing or have depressed ventilation. Careful intubation using manual in-line stabilization (MILS) is essential to minimize further injury.
- If signs suggest ASCI are present and the MWD is NOT ambulatory, immobilize the MWD using a backboard (plywood sheet, plastic board, EMS backboard, etc.) to which the animal is taped, and sedate with or without analgesia as often as necessary to prevent unwanted patient movement due to anxiety and pain.
- If signs suggest ASCI is present and the MWD IS ambulatory or adequate immobilization is not possible (due to lack of sedative/analgesia or support devices or patient temperament), confine the MWD to a small area or kennel and prevent excessive movement until evacuated.
- Do NOT use nonsteroidal anti-inflammatory drugs (NSAIDs).
- Do NOT give corticosteroids to MWDs with ASCI, UNLESS the animal has no deep or superficial pain, is paralyzed, or the neurological condition deteriorates. If corticosteroids are given, use ONLY a SINGLE dose of methylprednisolone sodium succinate, IV, 30 mg/kg over 15 minutes.

Conservative Management of ASCI

Indications for conservative (non-surgical) treatment include patients that are ambulatory or paraparetic, and patients that have strong voluntary movement and peripheral pain sensation.

- Maintain enforced confinement, analgesia, and sedation as needed to minimize movement.
- Evacuate URGENTLY if feasible.

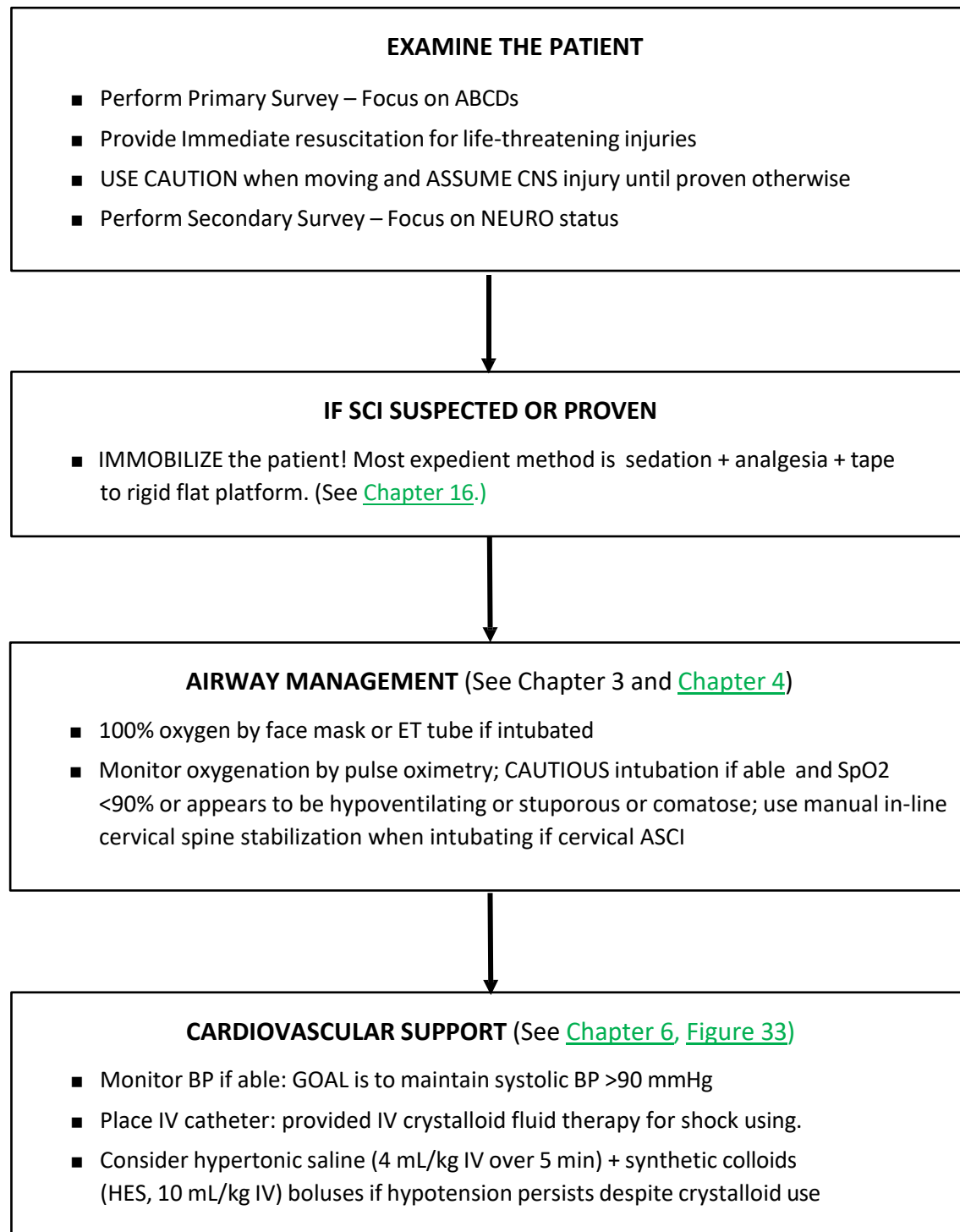
Surgical Management of ASCI

Early definitive surgical correction is indicated in non-ambulatory patients, patients with palpably unstable or displaced injuries, patients that deteriorate with conservative therapy, patients with peripheral pain sensation but no voluntary movements, and patients requiring decompressive surgery to correct displaced or fractured

spinal segments or bone fragments. Surgical management is likely not be feasible in a deployed setting.

- Definitive surgical repair of ASCI in MWDs should only be performed by qualified veterinary personnel.
- Evacuate as soon as feasible, or consider euthanasia ([Chapter 21](#)) if severe ASCI is present based on physical exam, diagnostic imaging results, lack of deep or superficial pain, or paralysis is present at any time.

Figure 46. Clinical Management Algorithm for Acute Spinal Cord Injury in MWDs.



Traumatic Brain Injury

There is limited data on TBI in animals. Anticipate TBI in MWDs after trauma in 25-40% of cases.²⁻⁶ TBI carries an extremely high mortality; assume a prehospital mortality of >40% in severe TBI cases. Management of MWDs is largely based on recommendations for treating people. Care by HCPs should be directed at efforts to mitigate secondary injury from hypotension, hyperthermia, hyper- and hypoglycemia, hypoxia, hyper- and hypocapnia, acid-base imbalances, electrolyte imbalances, SIRS, MODS, and ARDS. Thus, HCP care should be directed at maintenance of blood pressure, normoxemia, normal ventilation, and normal body temperature.

Clinical Signs Suggesting TBI

Brain injury should be suspected in any trauma patient with altered mentation (coma, stupor, depression, lethargy, inappropriate behavior or responses) or with physical evidence of head trauma (e.g., lacerations, abrasions, bruising, swelling, pain, bleeding from the nose or ears).

- Pay special attention to the patient's level of consciousness (LOC), overall pain response, pupillary light responses, cardiac and respiratory changes, motor activity and reflexes, and body temperature.
- The external ear canals and nasal openings should be examined for evidence of blood or CSF.
- The presence of lateralizing neurologic signs in a patient with brain injury suggests underlying intracranial hemorrhage; whereas patients with diffuse CNS deficits more probably have significant intracranial edema as a cause or contributor to their neurologic dysfunction.²⁻⁵ These findings will affect treatment options.
- MWD posture on presentation may allow injury localization and estimation of prognosis. While these classic postures are not always noted, their presence can be used by first responders to identify severe TBI with poor-to-grave prognoses.
 - Patients with injury to the T2-L2 thoracic spine often display the Schiff-Sherrington syndrome (Figure 47, inset A), typically with normal mentation, forelimbs in extensor rigidity, and hind limbs that are flaccid. The prognosis for these patients is usually grave due to severe spinal cord trauma.
 - Patients with decerebellate rigidity (Figure 47, inset B) typically are obtunded or depressed, have

Figure 47. Characteristic Neurologic Postures on Presentation.

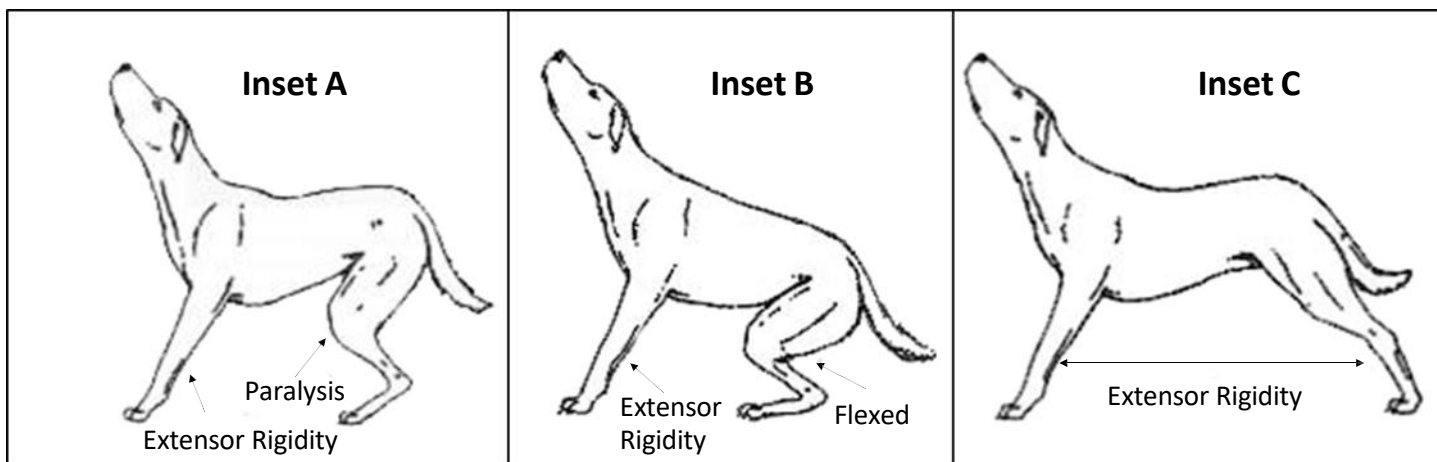


TABLE 21. MODIFIED VETERINARY GLASGOW COMA SCALE⁷	
Level of Consciousness	Score
Occasional periods of alertness and responsive to environment	6
Depression or delirium, capable of responding but response may be inappropriate	5
Stupor – semi comatose, responsive to visual stimuli	4
Stupor – semi comatose, responsive to auditory stimuli	3
Stupor – semi comatose, responsive only to repeated noxious stimuli	2
Comatose – unresponsive to repeated noxious stimuli	1
Motor Activity	
Normal gait, normal spinal reflexes	6
Hemiparesis, tetraparesis, or decerebrate activity	5
Recumbent, intermittent extensor rigidity	4
Recumbent, constant extensor rigidity	3
Recumbent, constant extensor rigidity with opisthotonus	2
Recumbent, hypotonia of muscles, depressed or absent spinal reflexes	1
Brainstem Reflexes	
Normal PLRs and oculocephalic reflexes	6
Slow PLRs, normal to reduced oculocephalic reflexes	5
Bilateral unresponsive miosis, normal to reduced oculocephalic reflexes	4
Pinpoint pupils, reduced to absent oculocephalic reflexes	3
Unilateral unresponsive mydriasis, reduced to absent oculocephalic reflexes	2
Bilateral unresponsive mydriasis, reduced to absent oculocephalic reflexes	1

opisthotonus, have fore limbs in extensor rigidity, and hind limbs in active flexion. These patients have a guarded prognosis due to severe injury to the cerebellum.

- Patients with decerebrate rigidity (Figure 47, inset C) typically are obtunded, have opisthotonus, and the fore limbs and hind limbs are in extensor rigidity. The prognosis for these patients is grave due to severe injury to the cerebrum.

Assessing Severity of TBI in MWDs

A modified veterinary Glasgow Coma Scale (Table 21 above) is validated for use in dogs.⁷ Data is limited, however, correlating long-term outcome (i.e. prognostication) with initial or serial assessment of GCS in dogs.

- As with people, the lower the total GCS, the worse the TBI and the lower the expected survival with neurological function intact.
- Limited use in veterinary trauma patients has allowed development of suggested prognoses based on the MVGCS (See Table 23). HCPs should use this guidance when assessing severity of TBI and resource allocation.

TABLE 22. SUGGESTED PROGNOSES BASED ON MODIFIED VETERINARY GLASGOW COMA SCALE ⁷	
MVGCS Score	Suggested Prognosis
3-8	Grave
9-14	Guarded
15-18	Good

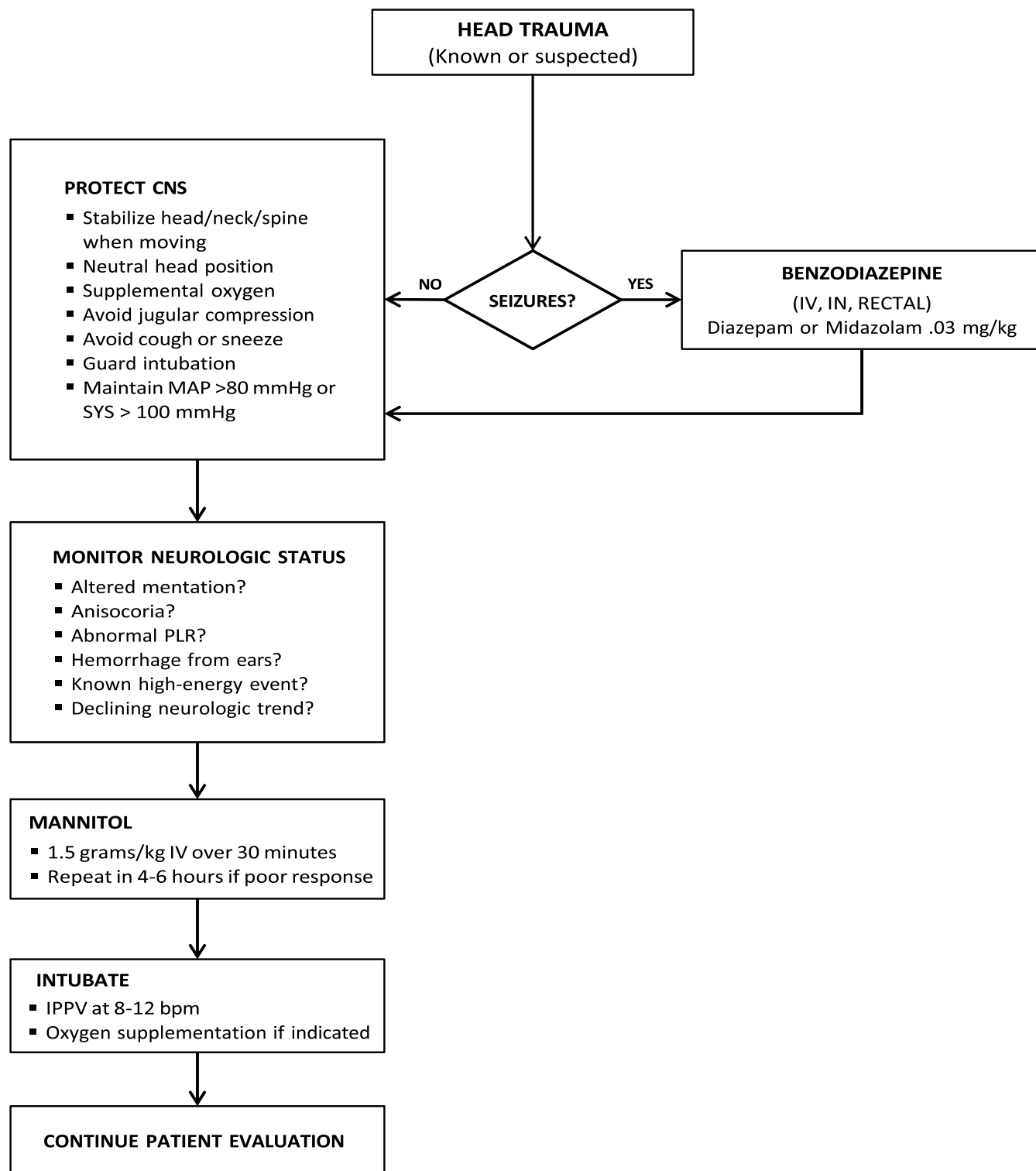
General Management Considerations for MWDs with TBI

It is critical to ensure adequate resuscitation and management of cardiovascular and respiratory problems, as hypotension, poor tissue perfusion, and hypoxia lead to progressive brain injury due to the adverse effects of secondary neurological injury due to ischemia, cerebral edema, reperfusion injury, and so forth. (See Figure 48 on the next page.)

- Follow guidance in this CPG for management of shock, hypotension, hypovolemia, hemorrhage control, and respiratory dysfunction.
- Be prepared to intubate patients that are not breathing or have depressed ventilation; careful intubation using manual in-line stabilization (MILS) is essential to minimize further injury.
- Focus care on preventing hypoxemia, maintaining cerebral perfusion pressure and systemic arterial pressure in the normal ranges, and preventing secondary ischemic cerebral injury.
 - Provide 100% oxygen by facemask. Monitor respiratory rate and effort. Be prepared to intubate and provide supplemental oxygen by ET tube. Maintain arterial carbon dioxide content in the normal range using assisted manual ventilation. Avoid hyperventilation!
 - Maintain normotension (MAP 70-80 mmHg or systolic BP >90 mmHg). Start IV crystalloid fluid therapy to correct shock and provide ongoing volume support (See [Chapter 6, Figure 33](#)). Measure blood pressure if possible; otherwise, guide fluid therapy based on presence or absence of distal pulses. Consider hypertonic saline (4 mL/kg IV over 5 min) or hyperoncotic fluid (HES, 10 mL/kg IV) boluses if hypotension persists despite crystalloid use.
 - Nurse with head elevated 30° with neutral neck position, avoid external jugular vein compression and catheters, avoid procedures that stimulate coughing or sneezing.
 - If evacuation will be prolonged and the patient is recumbent, rotate lateral recumbency and lubricate the eyes with ophthalmic ointment every 4 hours and maintain in a well-padded area.
 - If the MWD is conscious, restrict activity and movement (e.g., portable kennel), which may require sedation and analgesia (See [Chapter 16](#)).

(Continued on page 70)

Figure 48. Management Algorithm for TBI for MWDs.



- Give mannitol, 1.5 grams/kg, IV, over 30 min for MWDs with a MVGCS score of ≤ 8 . Repeat this dose once more 4-6 hours after the first dose.
Note that dogs are less likely to suffer subdural or intracranial hemorrhage; thus, mannitol should be used early in any MWD with moderate-to-severe TBI (MVGCS ≤ 8).
- ***Do NOT use corticosteroids to treat MWDs with TBI.***

Prognosis

HCPs must be realistic when treating MWDs with ASCI and TBI. While efforts and resources should be extended for MWDs with mild-to-moderate ASCI and TBI, HCPs should consider the likelihood of return to function. Consider euthanasia (See [Chapter 21](#)) for MWDs with catastrophic neurological injuries, or dogs with paralysis and that fail to respond to therapy or deteriorate despite care.

TBI and ASCI References

1. Park EH, White GA, Tieber LM. Mechanisms of injury and emergency care of acute spinal cord injury in dogs and cats. J Vet Emerg Crit Care 2012;22:160-178.
2. Dewey CW. Brain trauma. In: The Veterinary ICU Book. Teton NewMedia, Jackson, WY, 2003;910-920.
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4. Fletcher DJ and, Syring RS. Traumatic brain injury. In: Small Animal Critical Care Medicine, Silverstein DC and Hopper K, eds. Saunders/Elsevier, St Louis, MO, 2015;723-727.
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6. Sharma D, Holowaychuk MK. Retrospective evaluation of prognostic indicators in dogs with head trauma: 72 cases (January-March 2011). J Vet Emerg Crit Care 2015;25:631-639.
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CHAPTER 18

Canine Post Traumatic Stress Disorder (C-PTSD)

The Canine Post Traumatic Stress Disorder (C-PTSD) chapter is updated and is published as a separate guide on the JTS CPG website (<https://jts.health.mil/index.cfm/CPGs/cpgs>) or the Deployed Medicine website (deployedmedicine.com)

CHAPTER 19

Training and Toxicoses in MWDs

MWDs are exposed to small quantities of select drugs and explosives, contained in specially-constructed containers called training aids. Training aid ingestion and toxicity are events unique to MWDs and working dogs employed by law enforcement agencies.

- Training aids that are of concern when ingested include nitrate-based explosives (TNT, water gel, dynamite, RDX, detonation cords, and C-4), smokeless powder, sodium and potassium chlorates, and drugs (marijuana, heroin, cocaine, and amphetamines).¹
- Potential toxicity is a concern and it is plausible that HCPs will be presented with an MWD that has ingested a training aid and is or may become toxic.

Clinical Signs of Intoxication (by Agent)

MWD handlers will have critical knowledge of the agent to which an MWD was exposed, for training aid ingestion. Common agents used and associated clinical signs follow.

- **Nitrate/nitroglycerin-based explosives.** Ingestion may result in hypersalivation, severe CNS abnormalities (ataxia, incoordination, seizures, tremors), gastrointestinal irritation (nausea, vomiting), and methemoglobinemia (cyanosis, weakness, syncope, respiratory distress).
- **Smokeless powder explosive.** Ingestion may result in hypotension, CNS depression (ataxia, depressed mentation, incoordination), and methemoglobinemia (cyanosis, weakness, syncope, respiratory distress).
- **Potassium and sodium chlorate explosives.** Ingestion may result in methemoglobinemia (cyanosis, weakness, syncope, and respiratory distress), CNS abnormalities (ataxia, incoordination, and depressed mentation), gastrointestinal irritation (nausea, vomiting, abdominal cramping and pain, hemorrhagic diarrhea with melena or hematochezia), hematuria, hemoglobinuria, and renal and liver failure.
- **Marijuana/hashish.** Ingestion may result in altered mentation (disorientation), hallucinations (in the dog, typically manifested as vocalizing, useless scratching, hyperexcitability), nausea and vomiting, and respiratory distress.
- **Heroin.** Ingestion may result in bradycardia, respiratory distress, miosis, coma, and sudden death.
- **Cocaine and amphetamines.** Ingestion may result in restlessness, tachycardia, hyperexcitability, vocalization, excessive or unprovoked aggression, seizures, and mydriasis.

Treatment of Training Aid Toxicity¹

If ingestion occurred ≤ 4 hours before presentation and the MWD is conscious and has normal CNS responses, induce vomiting.

- Apomorphine is the drug of choice to induce vomiting in the dog. MWD handlers are issued apomorphine in tablet form, which is generally available in 6 mg tablets. If available, place ¼ to ½ tablet into either conjunctival sac. Vomiting typically occurs in 5-10 minutes. Once vomiting has occurred, rinse residual apomorphine from the conjunctival sac.
- Apomorphine may be available in the HCP drug inventory as an injectable agent (10 mg/mL). If the injectable form is available, give 0.03-0.04 mg/kg IV. Emesis is typically evident within 5 minutes in most MWDs.
- An alternative is to give hydrogen peroxide orally if apomorphine is not successful or available. Give 1 mL per kilogram body weight of hydrogen peroxide 3% orally. Note that hydrogen peroxide is less successful than apomorphine.
- Do NOT use Syrup of Ipecac or salt, or try to induce vomiting manually. These methods are ineffective in the dog and risk intense gastrointestinal irritation in the dog, and bite wounds to the HCP.

If ingestion occurred >4 hours before presentation, or if the dog has abnormal mentation or is unconscious or seizing, do not induce vomiting. In these cases, balance the benefit of gastric decontamination by orogastric lavage against the very real risk of aspiration pneumonia. If gastric lavage is elected, induce general anesthesia (See [Chapter 16](#)) and ensure a cuffed endotracheal tube is used. Lavage the stomach using repeated instillations of water at a dose of 10-20 mL/kg. Maintain the cuffed endotracheal tube until the MWD has regained a swallowing reflex.

The next critical step in management of any training aid toxicity is to administer activated charcoal.

- The dose for activated charcoal is 1.5 grams/kg PO. Most MWDs will ingest activated charcoal if the charcoal is mixed with canned food. If the MWD will not ingest the charcoal voluntarily, either have the handler syringe the slurry slowly orally or (if the MWD is anesthetized) give the slurry by orogastric tube. MWD handlers are issued Toxiban® with sorbitol and may have initiated therapy prior to presentation.
- Activated charcoal WITH sorbitol as a cathartic is preferred as the initial dose.
- Repeat activated charcoal once in 4-6 hours. This dose should not include sorbitol.

If seizures are present or develop, treat the MWD with a benzodiazepine.

- Give midazolam (0.3 mg/kg IV or IN) or give diazepam (0.3 mg/kg IV, IN, or per rectum).
- Repeat in 10-15 minutes if seizures persist or recur.

If methemoglobinemia is suspected or confirmed and deemed causing significant respiratory distress, treat with methylene blue (if available).

- The dose for methylene blue 1% in the dog is 1-2 mg/kg IV slow bolus.
- This dose can be repeated once or twice if respiratory distress persists.
- Methylene blue can cause severe Heinz body anemia in the dog, so monitor an HCT q6-8h if this drug is used.

Toxicoses in MWDs Reference

Bright PA. Military working dog training aids: toxicity and treatment. Air Force Occupational and Environmental Health Laboratory (AFSC), Human Systems Division, Brooks Air Force Base, TX, 1989;1-32.

CHAPTER 20

Diagnostic Imaging

The Diagnostic Imaging chapter is updated and is published as a separate guide on the JTS CPG website (<https://jts.health.mil/index.cfm/CPGs/cpgs>) or the Deployed Medicine website (deployedmedicine.com)

Euthanasia

The Euthanasia Chapter is updated and is published as a separate guide on the JTS CPG website (<https://jts.health.mil/index.cfm/CPGs/cpgs>) or the Deployed Medicine website (deployedmedicine.com)

CHAPTER 22

Documentation—Medical Records

The Documentation—Medical Records chapter is updated and is published as a separate guide on the JTS CPG website (<https://jts.health.mil/index.cfm/CPGs/cpgs>) or the Deployed Medicine website (deployedmedicine.com)