Introduction: This presentation will be comprised of two sessions. The first is a session on Veterinary Disaster Triage and the second on Treatment Priorities in Trauma. Notes for each session are found below.

Veterinary Disaster Triage: Making the Tough Decisions

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Throughout history disasters have exacted a heavy toll of death and suffering. In the past 20 years over 20 million humans have died worldwide and property damage easily exceeds $50 billion. To date, the United States has yet to experience a truly massive disaster with thousands of deaths of humans. On the other hand, many disasters in this county have easily affected millions of poultry, swine, and fish. When urban populations are affected by a disaster, many of the victims are animal owners. In the past, the first priority of disaster relief is protecting and saving human life. With the widespread emphasis on the human-animal bond and now the Pets Evacuation and Transportation Standards Act (PETS Act), disaster agencies are being called upon to deal with animal-related issues. Many factors point towards an increasing probability of mass casualty incidents. Amongst these factors are the increasing population in flood plains, seismic zones, ocean or lakeside housing developments, the transport of hazardous materials, the risks of chemical or nuclear facility mishaps, terrorism, and catastrophic fires and explosions.

Nature of Disasters

There is no standard definition of "disaster". Traditionally, the term disaster is used to describe large-scale incidents that overwhelm the resources of the affected community. Because disaster medicine is multidisciplinary and depends upon the integration of multiple levels of responders, the use of more concise definitions is essential. More frequently in the USA, the term "emergency" should be used to describe incidents that can be handled with existing community resources. It is certainly possible for an emergency to quickly overwhelm the resources, especially in small rural community. This is less likely in larger metropolitan areas provided there is an organizational structure to the veterinary professionals responding to the incident. Thus, it seems it is more a functional impact on a specific area that is the key to determining whether a disaster exists.

Casualty Triage and Management

Little is written regarding pets caught in disasters. Most frequently it is volunteers and rescuers who find dogs and cats following a large scale disaster.[1] In a unique study following the fire in Oakland, CA, that occurred in 1991, several observations associated with dogs and cats caught in a large scale disaster are reported.[2] In this study, cats are apparently less likely to be evacuated than dogs. This is likely due to the solitary nature of the cat and the more family-oriented behavior of dogs. Pets are also abandoned during a disaster. This is likely due to the lifestyle change of the family, loss of property or family members, and motivational priorities associated with the disaster. Nevertheless, reports from individuals searching for their lost pet experience a trauma similar to other victims. Experience in the Oakland fire shows the importance of a disaster "hotline" dedicated to lost or found animals. This hotline should be locally based and staffed, and have an organized, computerized, database ready when called upon to react.[2] Consistency in the database should be of paramount importance. The longer an owner waits to search for their pet, the lower the chance of being reunited.[2] Interestingly, animals wearing a collar with the owner's name and address have a 10-fold increased likelihood of being reunited.[2] Few pets are reunited with their owners four weeks after a disaster.[2]

Triage During the Emergency Phase

In a disaster triage must be conducted with the purpose of doing the greatest good for the largest number of patients.[5] Rapid examination followed by classification of patients according to the urgency of their treatment needs is critical. Triage calls for an organized approach to multiple patients and ensures that the most critical animals are identified and normalized first. To that end, triage is based upon two key points: 1) the medical needs of the patient and 2) the available medical resources (facilities, equipment, personnel, and time). Triage in local disasters requires knowledge of available facilities and capacities immediately adjacent to the disaster as well as knowing this same information for facilities located just outside of the disaster area. Without doubt, conventional triage is only the first step in a dynamic decision-making process.

Field Triage: Field triage is done to assure priority of the most severely injured. This involves categorizing patients at the disaster site and divides the animals into two categories: 1) "Acute" (RED) and 2) "Non-Acute" (Green). When faced with large numbers of veterinary patients in a disaster, the initial assessment involves an organized, systematic assessment of several important organ systems. Specifically the triage officer assesses **R**espiration, **P**ulse rate, **P**ulse character, and **N**eurological status (Figure 1). This assessment uses the acronym **RPPN**. Respiratory distress, abnormal pulse rates, weak pulse character, and abnormal neurological status all require more immediate assessment and possible emergency treatment. Additionally, abnormalities in these parameters may direct the veterinarian to other decisions that may include euthanasia. These decisions are based upon the patient's physiological status, available resources, and personnel. Importantly, field triage only identifies the patients and for the most part, does *not* routinely administer immediate care.

In human medicine, few articles address triage in disasters. In veterinary medicine, disaster medicine has concentrated on the many other facets of disaster preparedness and has also avoided a discussion of triage. Traditionally, in human medicine, triage systems have sorted victims into categories to determine their priority for treatment and transport. Varieties of colors, numbers, and symbols have been used to delineate triage categories based on degree of injury or illness (Table 1).

Table 1: Categories and identification in triage.

Group	Color	Type of Injuries
Priority 1 / Immediate	**Red**	Critical; may survive if simple lifesaving measures are applied.
Priority 2 / Delayed	**Yellow**	Likely to survive if simple care is given within hours.
Priority 3 / Nonurgent	**Green**	Minor injuries; care may be delayed while other patients receive treatment.
All Groups	**Blue***	Patients have been decontaminated
None (Dead or Dying)	**Black**	Dead or severely injured and not expected to survive.

* Blue is not a universally approved triage category but is listed as one means to identify patients that have been decontaminated following the disaster. This gives caretakers more confidence they will not be exposed nor will their facility become contaminated.

Triage is a *learned skill*. Placing patients in appropriate categories requires knowledge of injury assessment, anatomical and physiological determinants, and clear awareness of the system, resources, equipment, and personnel available.

SAVE Triage: In veterinary medicine we are often faced with catastrophic casualty management (e.g. poultry, swine, and fish) with large numbers of victims, severely limited medical resources, and poorly trained local rescue personnel. With these catastrophic casualties the animals remain at the scene for a protracted period of time and must be frequently reassessed. Triage is decentralized and often occurs at multiple sites in the disaster zone. In order to address these considerations, the **S**econdary **A**ssessment of **V**ictim **E**ndpoint (SAVE) system of triage is designed to identify animals most likely to benefit from the care available under austere conditions. Most likely the SAVE system will be used for large mass casualty events that may occur in feedlots, poultry houses, or swine rearing facilities.

Triage under the SAVE system is immediate and dynamic, rather than delayed and static. The methodology divides animals into three categories: 1) those that will die regardless of how much care they receive; 2) those who survive whether or not they receive care; and 3) those that will benefit significantly from the austere interventions. Only those animals expected to improve receive more than basic care and comfort measures. In this way, resources can be focused appropriately. The decision to place an animal in a particular group is based largely upon the experience of the triage team. This is because there is little to no information available regarding statistical probability of survival in veterinary patients. These are tough decisions but they must be made and adhered to. After the disaster resolves, the team can retrospectively examine decisions in hopes of improving performance at the next disaster.

Triage Scenarios: Preexisting Illness and Multiple Injuries. When a disaster affects a veterinary hospital and requires triage decisions, it must be remembered that an injury or illness to this hospitalized animal will confound the seriousness of the previous illness/injury. These multiple injuries should be considered synergistic and the prognosis is worse for an individual patient than the simple sum of the likelihood of survival for each injury. With preexisting illness, multiple injuries, and advancing age, there is a worsening prognosis and these factors should thereby be taken into consideration when making triage decisions.

Newly Acquired Illnesses During Triage. Just because there is a disaster does not mean illness takes a few days off. There will be animals requiring renewal of prescriptions, having an exacerbation of an ongoing chronic illness (e.g., acute on chronic renal failure), and even developing new illnesses (e.g. diarrhea, salmonellosis). These animals will require treatment and should be seen by their regular veterinarian if possible or a veterinary colleague temporarily. For sure, these animals triage category will be influenced by this newly acquired illness (especially in austere conditions).

Special Triage Resources. Occasionally an animal owner is recruited to assist with treatment of disaster victims. The poultry or swine producer, the owner/manager of a dog kennel or cattery, the animal attendants from the zoo, all know their species and are used to handling these animals. Moving these people to a treatment area and seeking their assistance can enhance outcomes. Undoubtedly, the addition of skilled hands to a disaster treatment team not only improves outcome but also increases effectiveness. Again, the guiding principle in disaster triage is to maximize the benefit to the majority of affected animals.

Advanced Triage

Veterinary Systems Triage and Rapid Treatment (V-START): In veterinary disaster medicine, triage describes a medical decision-making process used to identify the most seriously affected body system in a sick or injured animal and then targets treatment to that body system. The goal of these aggressive medical efforts is to recognize and then successfully treat life-threatening emergencies.[4]

To quickly and efficiently triage and initiate life-saving treatment on emergency patients, it is imperative to develop a "team approach". All veterinary clinical personnel should have a working knowledge of basic life-saving procedures and equipment. Staff meetings should utilize a portion of their time for review and updates on trauma priorities, basic cardiopulmonary resuscitation (CPR), emergency procedures, and individual duties and responsibilities. "Dry-runs" or practice drills can improve the team's speed and efficiency.[6, 7]

Initial Evaluation**.** Upon arrival of the disaster patient(s), an initial evaluation is done. Staff must stay calm, work quickly, and minimize patient stress, especially with cats.

A systematic, standardized approach to every emergency is essential (Table 2).

Table 2. Veterinary Systems Triage and Rapid Treatment (V-START)

1.	Arterial bleeding
2.	Respiratory system
3.	Cardiovascular system
4.	Hemorrhage Control and Transfusion
5.	Neurologic system
6.	Musculoskeletal system
7.	Abdominal injuries

Such an approach minimizes oversight during assessment of organ systems and anatomical areas. By having a standardized emergency response protocol, life-threatening problems can be identified, and immediate therapy initiated (Figure 2).

Adequate assessment and appraisal of the disaster patient consists of several components. Although these components often discussed separately, in actual practice there is often no chronological separation of the entire appraisal and management scheme. Several goals are accomplished simultaneously as diagnosis, treatment, and monitoring coincide.

Key Issues in the Triage of Disaster Patients

- Disasters frequently result in animals with trauma affecting multiple organ systems being affected.
- Field triage generally involves the assessment of respiration, pulse rate, pulse character, and neurological status (RPPN).
- An organized, systematic approach should be undertaken for ***each patient.*** This approach begins with an assessment of the respiratory, cardiovascular, and neurologic system and concludes with musculoskeletal management and the diagnosis of abdominal injuries.
- An aggressive diagnostic and therapeutic approach is taken toward each of the involved systems.
- Over treatment of some complications can be just as hazardous as under treatment. This is especially true of respiratory trauma and/or intra-abdominal hemorrhage.
- Constant monitoring and reassessment of the patient's status is mandatory.
- Each patient deserves frequent "hands on" special attention and lots of "tender loving care".

References (Available on Request)

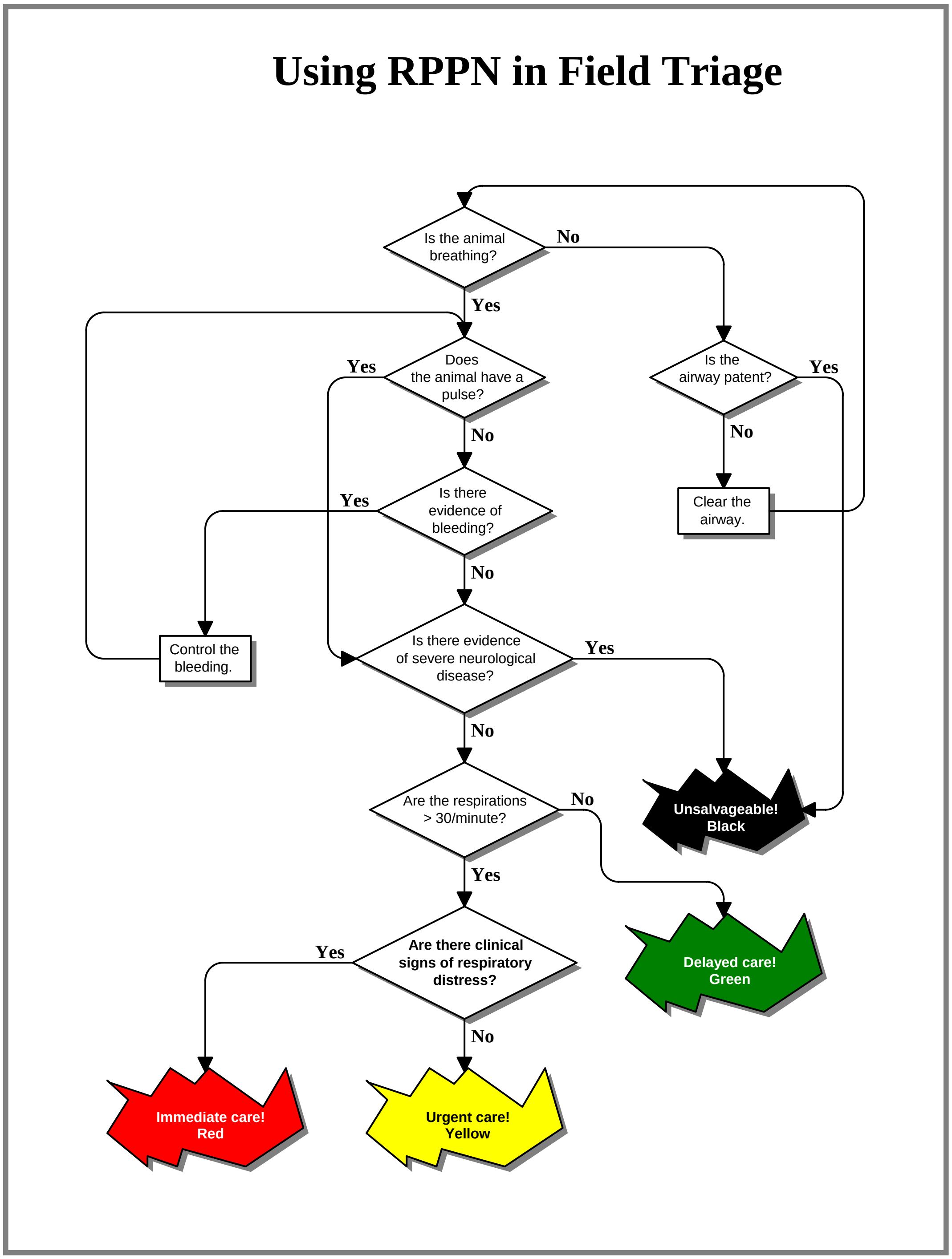
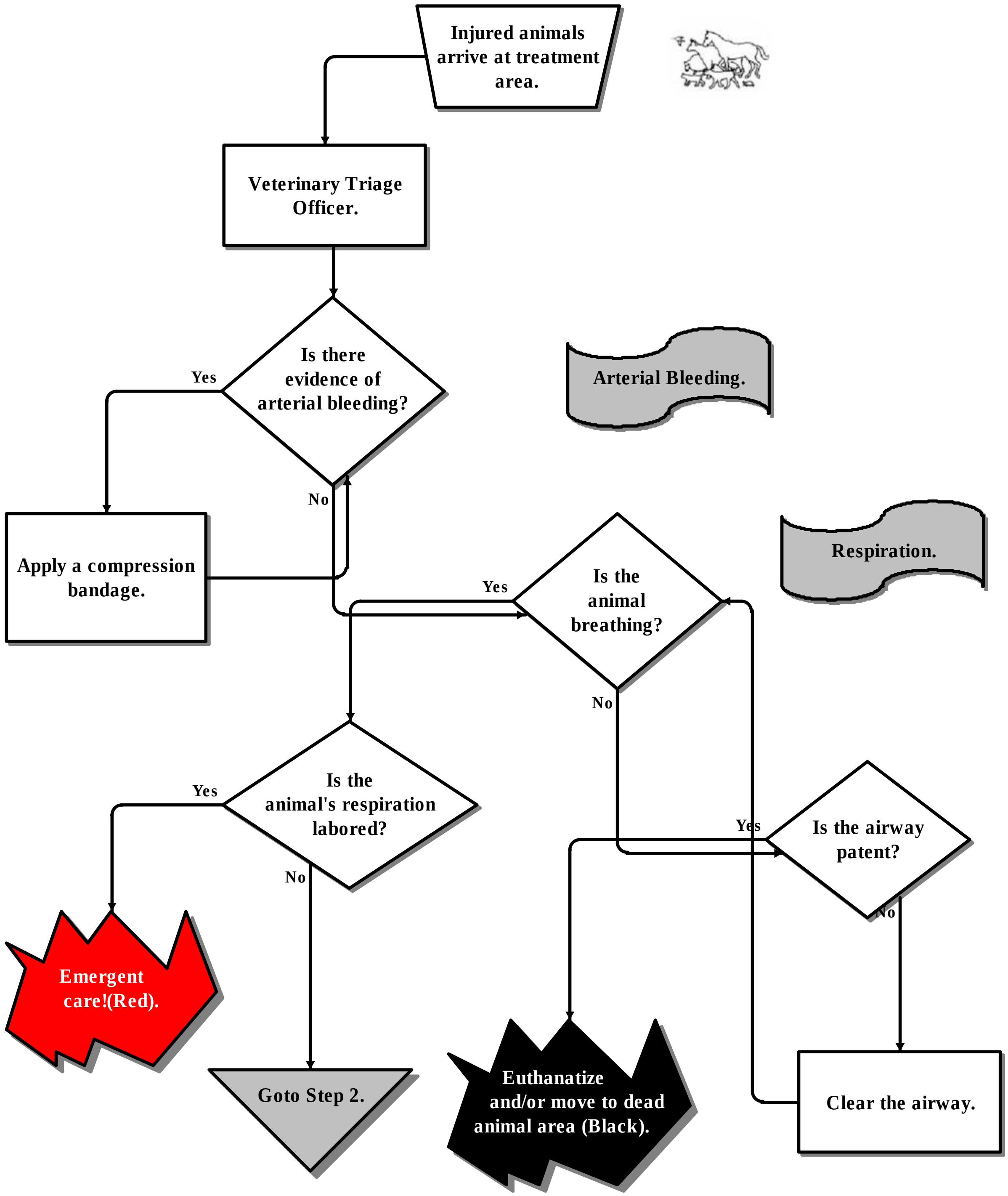
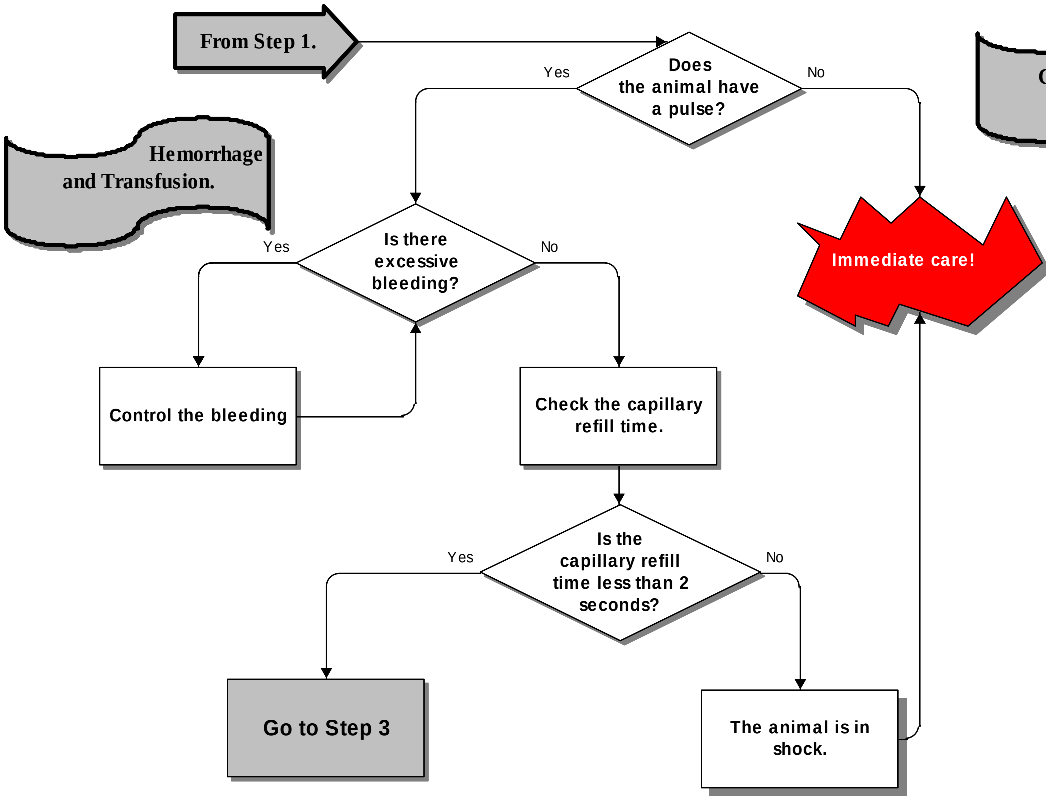


Figure 1: Using RPPN in field triage.

Veterinary Systems Triage and Rapid Treatment (V-START)
Step 1: Check for Arterial Bleeding and Breathing



Step 2: Check Circulation and Control Hemorrhage



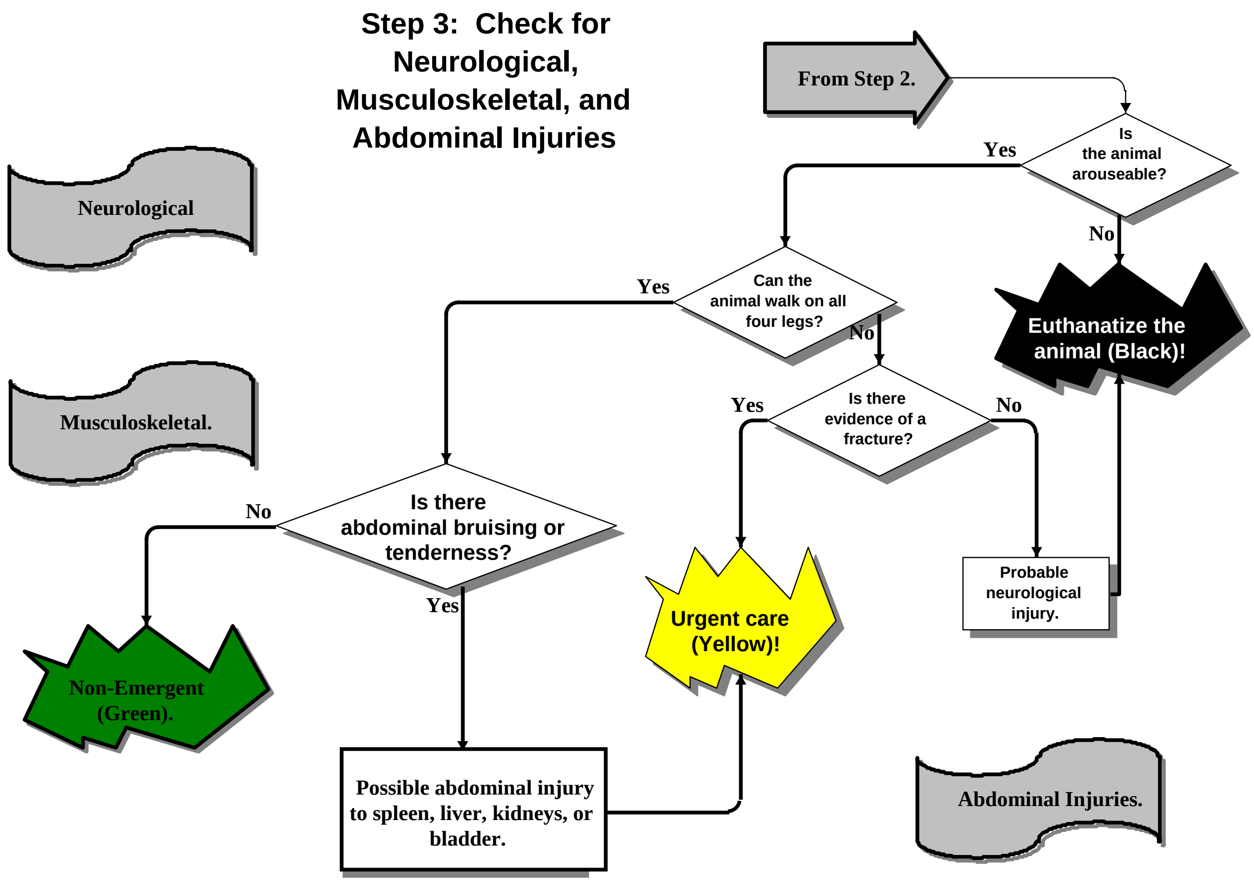


Figure 2. Veterinary Systems Triage and Rapid Transport (V-START) for animals in a disaster.

Treatment Priorities in the Injured Four-Legged Patient

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With every disaster there are injured veterinary patients. These injuries must be quickly recognized and prompt treatments applied in order to save the animal's life. In this discussion, trauma priorities in dogs and cats will be discussed and suggestions offered for the prompt treatment of life-threatening injuries. Although not implicitly discussed, it is VERY important to recall the importance of pain management in all trauma victims.

Definitions

The word "emergency" is defined as a sudden, generally unexpected occurrence, or set of circumstances, demanding urgent action.

The term "trauma" is defined as "bodily injury caused by violence" or any insult to the body. There are many causes of trauma to the companion animal, especially in disaster sites. Encounters with motor vehicles, interactions with other animals, falls from heights, injuries sustained from weapons, and crushing forces are just a few. We must also consider that injuries can occur from thermal insult (hot or cold), electrical shock, chemicals, blast injuries, and changes in environmental force. Many times the cause of the trauma is unknown. Some injuries have diffuse systemic effects, while others may involve only one or two organ systems. The final outcome of any traumatic insult will depend on the number and severity of the injuries. The purpose of this paper is to offer guidelines to a systematic, systemic, thorough, physiologically sound approach to the traumatized patient.

SYSTEM PRIORITIES IN TRAUMA MANAGEMENT (V-START)

Initial Assessment:

When the trauma patient arrives, one should make the initial evaluation as to the severity of the trauma. Stay calm, work quickly, protect yourself, and do not stress the patient. Use an organized approach each time, for every emergency. This approach will minimize oversight during assessment of any organ system or anatomical area. Depending upon the severity of the trauma, the initial physical examination may be cursory but should be organized. This cursory assessment is often used during triage and may only result in a quick evaluation of four parameters: 1) respiration, 2) pulse rate, 3) pulse character, and 4) neurological abnormalities. Once the animal has been initially triaged it is moved to an area where more definitive care can be administered. At this point the assessment becomes more detailed and specifically examines the following systems:

1. Arterial Bleeding
2. Respiratory
3. Cardiovascular
4. Hemorrhage Control and Transfusion
5. Neurological
6. Musculoskeletal
7. Abdominal Injuries

These systems will be discussed separately, but in actual practice there is often little chronological separation of the entire appraisal and management scheme. Several goals are accomplished simultaneously as diagnosis and treatment coincide.

ARTERIAL BLEEDING

Arterial hemorrhage is characterized by bright red spurting blood from a wound, as opposed to venous hemorrhage which is more of an "oozing" from a wound. Initial arterial bleeding is controlled with sponges placed over the wound with direct applied digital pressure over the sponges. It can also be controlled with a pressure bandage, which consists of a quick tight wrap over the wound with roll gauze and tape. If the artery is exposed, the tear can be controlled with hemostats and ligated later. Usually trauma patients that have severe arterial hemorrhage do not arrive at the veterinary hospital alive.

Once arterial hemorrhage is controlled, continue the cursory physical exam, or "primary survey," to identify any life threatening injuries. Whenever a problem is identified, immediate therapy is initiated.

RESPIRATORY FUNCTION

These injuries require immediate recognition and treatment. The goal of emergency treatment of respiratory distress is to ensure adequate ventilation which is dependent on unobstructed major airways, an intact respiratory tree, and the efficient exchange of gases (ventilation/perfusion).

Respiratory complications are common in trauma patients. A good rule to remember is *SUSPECT THORACIC INJURY WITH ANY TRAUMA*. Cats that present with thoracic trauma, especially the cat that presents orthopneic (bowed forelimbs), head extended, and with an "open-mouthed" panting breathing pattern are treated very conservatively. The cat is placed into an oxygen cage and left to rest with NO stress. If the patient does not stabilize in 10 to 15 minutes, often the chest is tapped (thoracocentesis) with the cat still in his cage--the least amount of handling and stress, the better. Therapy can be more aggressive with dogs. Usually they will tolerate oxygen therapy via mask.

Respiratory distress following trauma can be caused by any of the following:

1. pneumothorax - open or closed
2. pulmonary contusions
3. airway obstruction
4. flail chest
5. tension pneumothorax
6. hemothorax
7. diaphragmatic hernia

An increased respiratory rate can also be due to many other causes: shock with a possible metabolic acidosis, pain, fright, and anxiety.

- In the presence of pneumothorax, there is no longer negative pressure in the pleural space. Pneumothorax can be life threatening. This is an example where a diagnostic procedure is also therapeutic. If a pneumothorax is suspected, thoracocentesis is indicated. Air can be withdrawn from the chest with a 20 gauge needle, IV extension set, three-way stopcock and a 60 ml syringe. This allows a substantial amount of air to be removed from the chest with minimal manipulation or stress to the animal. Always tap both sides of the chest. It is recommended to have this "chest tap" apparatus set up and ready at all times so it is immediately available in emergencies. If the thorax continues to fill with air despite further thoracocentesis, the veterinarian will need to place a chest tube into the thorax.

  The thoracostomy tube, or chest tube, allows rapid continuous evacuation of air or fluid from the pleural space. The decision to place a drainage tube is too often delayed. Before placing the tube, a sterile preparation of the thorax is provided. In dogs, a local anesthetic is employed and in cats ketamine hydrochloride (2.2 mg/kg, intravenously) is used to provide analgesia. Insertion is best accomplished with a stylet enclosed in the tube in order to avoid unnecessary dissection of subcutaneous tissues, which might lead to infection or accumulation of subcutaneous air. The thoracostomy tube can be either intermittently drained and quantitated with a syringe, or preferably through use of continuous thoracic drainage.

Other respiratory injuries commonly seen are as follows:

- ***Tension pneumothorax*** is characterized not only by abnormal gas exchange but also by a progressive increase in pleural pressure sufficient to impair circulation. This occurs as gas enters the pleural space during spontaneous negative pressure inspiration and remains there during expiration because tissue or fluid occludes the pulmonary parenchyma. The accumulating gas not only collapses the lungs but also interferes with venous return to the right atrium.

- A ***hemothorax*** similarly can be relieved. Thoracic radiographs may be indicated but often the animal is just not stable enough to withstand the stress of radiographs. A chest tap will be therapeutic as well as diagnostic and less stressful to the patient. Air, fluid, or both, can be aspirated via chest tap.

- ***Pulmonary contusions*** occur when there is hemorrhage into the lung. Blood and edematous fluid accumulate, causing atelectasis and hypoxemia to result. Pulmonary contusions are often seen in animals with pneumothorax and hemothorax. Treatments of pulmonary contusions include supportive therapy with oxygen and cautious tempered fluid therapy volumes. The use of corticosteroids is still a subject of controversy in the treatment of pulmonary contusions. If used, use cautiously and after fluid therapy has begun.

- ***Diaphragmatic hernia*** occurs when there is a tear in the diaphragm that then allows organs from the abdomen to enter the thoracic cavity. Often diaphragmatic hernias occur in conjunction with other chest injuries, such as pneumothorax and pulmonary contusions. Diaphragmatic hernias ultimately will require surgical repair, but the animal should be stabilized first. If the chest has been tapped and the patient is still dyspneic, it sometimes is helpful to suspend the animal in a head-up vertical position and literally "shake" the abdominal organs back down into the abdominal cavity and offer the patient some temporary respiratory relief. This, however, does not always work but it is worth a try.

- ***Fractured ribs*** - The most common complications of rib fractures are pain and limited diaphragmatic and chest wall motion that result in atelectasis of the underlying lung and hypoxemia through ventilation-perfusion mismatching. Treatment is directed to local anesthetics being infused at the fracture sites.

- ***Flail chest*** occurs when three or more ribs, or the junction of ribs and the sternum are each fractured at two points. This injury is suggested by paradoxical inward movement of the flail segment during inspiration when the rest of the thoracic cage expands. Clinicians have recognized that hypoxemia associated with flail chest results from a combination of many conditions, including atelectasis due to pain and splinting and contusion of the lung underlying the flail segment. Therapy is aimed at relieving pain through analgesics and local blocks, correcting hypoxemia, and supporting the patient while the lung contusions are healing.

CARDIOVASCULAR FUNCTION

Pump - Evaluate the heart and its ability to pump. Included in the cardiovascular evaluation is the appraisal of circulating blood volume. Is this patient in shock? Check the femoral pulse, get a pulse rate and very importantly, note the pulse pressure. It will get better or worse as your fluid therapy continues so keep a close monitor on pulse pressure. ***Pulses do not lie.*** The pulses reflect the pump function. Check for pulse deficits. Simultaneously auscultate the heart while feeling the femoral pulse. They should be equal. Low pulse pressure is due to low cardiac stroke volume. Threadiness is also due to low stroke volume, which is likely due to hypotension, which is due to hypovolemia and shock. If an electrocardiogram is available, get a baseline lead II tracing. If it is noted that there are cardiac arrhythmias, they are probably due to myocardial contusions, associated with the trauma. In most cases the onset of arrhythmias is delayed for 12 to 48 hours. Most likely the catecholamines released with the traumatic episode and the stress of hospitalization leads to an overdrive suppression of ectopic foci. The sinoatrial (SA) node of the heart keeps doing its job until the catecholamine levels fall, then the ectopic foci exceeds the SA node's rate and this leads to dysrhythmias, usually premature ventricular contractions, and ventricular tachycardia. If ventricular tachycardia is noted on admission, and the patient is in shock and not stable, often a bolus of intravenous fluids is administered to see if the ventricular tachycardia will convert before trying antiarrhythmic drugs.

If the heart rate is less than 70 beats per minute, bradycardia is present. This could be due to an increase in intracranial pressure. If the patient is in shock, be very careful with fluid administration. Give fluids slowly and monitor heart rate, pulse pressure, respiration, and mental status closely.

Volume - Shock is defined as a "low-flow state with poor tissue perfusion and abnormal cellular metabolism". It occurs when there is a decrease in the intravascular fluid volume (hypovolemia), decreased venous return to the heart, and decreased myocardial contractility. A patient in a state of hypovolemic shock will present with an elevated heart rate (tachycardia) and weak, thready pulses. Respiratory rate will be increased, the body temperature (core) usually will be hypothermic to normothermic. The mucous membranes usually are pale and blanched or gray and cool; the extremities are cool to cold and oliguria (decreased urine production) is present. The capillary refill time is slower than normal. The etiology of shock in traumatized patients is usually hypovolemia. Since prompt therapy is vital to a successful outcome, the responder who can recognize shock may be instrumental in saving a patient's life. In trauma victims, it is wise to ***assume that the victim is in shock until proven otherwise***. Hypovolemic shock should respond rapidly to intravenously administered fluid/blood unless severe bleeding continues.

An intravenous catheter is placed and at that time a blood sample is drawn for a minimum data base. We draw a packed cell volume and a total protein and often run blood glucose, especially if the patient is a neonate or pediatric case just to get a baseline value on glucose. A complete blood count and chemistry profile is also drawn. If there is a lot of action around the animal's head with oxygen administration, etc, then a lateral saphenous catheter is placed. If the patient will tolerate lateral recumbency, a jugular catheter is placed. A jugular catheter is the catheter placement of choice because it is a central line and large amounts of fluids can be administered very quickly. It stays cleaner than peripheral catheters and central venous pressures can be monitored frequently. This is very important, especially in patients with pulmonary contusions or heart problems. If venous access is very difficult, especially in neonates, a large bore needle with a stylet can be inserted into the trochanteric fossa of the femur or into the bone marrow of the humerus and large fluid volumes can be infused at rapid rates right into the intraosseous space. These catheters usually are left in place only until an intravenous line can be successfully placed.

The initial intravenous solution should be a balanced electrolyte fluid, such as Normosol-R™ or Ringer's lactate. The rate fluid should be administered in shock should be individualized. In the presence of severe pulmonary contusions, caution is advised and close monitoring is necessary to avoid over hydration. In most instances, one should be prepared to administer a blood volume in one hour (dogs = 90 ml/kg/hr; cats = 44 ml/kg/hr). Our technique is to administer one-fourth of the volume in the first 15 minutes, assess for evidence of shock (rapid heart rate, hyperpnea, weak pulse, cool extremities, slow capillary refill time), and to then give another one-fourth aliquot over the next 15 minutes if shock is still present. At 30 minutes the patient is again assessed and a packed cell volume and total solids is evaluated. If the packed cell volume is above 20 percent, the total solids have not fallen below 50% of starting value, and the patient is still showing clinical signs of shock, another one-fourth aliquot is given during the next 15 minutes. At 45 minutes, the patient is reassessed and the last one-fourth given during the last 15 minutes if the patient is still in shock. At 60 minutes, the process starts over with a packed cell volume, total solids, and patient assessment. At that time it may be necessary to consider a transfusion of whole blood or plasma.

HEMORRHAGE CONTROL AND TRANSFUSIONS

It generally requires at least 3 liters of crystalloid solution to replace one liter of whole blood lost. If continued hemorrhage or hemodilution is present, then whole blood or a blood substitute should be given. Ideally, the amount of blood given should closely match the amount lost. In order to predict how much blood may be needed, one may use the following formula: 2.2 ml/kg whole blood raises the PCV by 1% (or 1 ml/lb of body weight will raise PCV by 1%).

Although transfusions have previously been recommended if the PCV is below 20%, higher hemoglobin levels will improve oxygen-carrying capacity while causing little reduction in cardiac output.

Whole blood and plasma should always be administered with a blood administration set that has an in-line filter. Start whole blood or plasma transfusion slowly for about the first 20 minutes of infusion. If the patient has already received a full 90 ml/kg shock dose of crystalloids, it would be advisable to check the central venous pressure value. Normal central venous pressure is 0 to 5 cm of H_2O. Fluids should be slowed if central venous pressure is 6 to 9 cm H_2O. If the central venous pressure is 10 or greater, fluids should be discontinued. If the patient has been diagnosed with pulmonary contusions, monitor the central venous pressure frequently, auscultate the chest frequently and monitor for other signs of over hydration. These signs would include chemosis, clear serous nasal discharge, restlessness, increased respiratory rate. Observe the patient for signs of a blood transfusion reaction. Fever, nausea (do not feed animals during transfusions), urticaria, diarrhea, and hemoglobinuria are all clinical signs of transfusion reaction.

NEUROLOGIC ABNORMALITIES

A rapid neurologic examination is the final step in the primary survey.

1. Determine the state of consciousness.
2. Assess the patient's response to pain or other noxious stimuli.
3. Observe pupillary light reflex.
4. Observe for depressed or diminished respiration in the face of patent airway. This is often indicative of grave prognosis.

5. Observe motor activity (Figure 1).
6. Monitor body temperature. Hyperthermia associated with head injury is indicative of poor prognosis.
7. Check motor reflexes.
8. Examine external ear canals for presence of blood or cerebrospinal fluid. Examine the tympanic membrane for middle ear hemorrhage.
9. Lateralized neurologic signs may be indicative of intracranial hemorrhage. Such findings may include asymmetric dilation of pupils and alteration of deep reflexes and motor responses.
10. With spinal trauma the animal may present in one of the abnormal postures: (Figure 1)
    With suspected spinal injuries, do not manipulate the patient for diagnostic purposes. Attempt to stabilize the spine and obtain radiographs as soon as possible. (Place the animal in lateral recumbency on a board, tape animal down, ensuring that respiration is not compromised.)
11. Additionally, one should quickly assess and note peripheral nerve injuries that may be present with certain fractures and massive soft tissue injury (i.e. fractured humerus = radial nerve; fractured acetabulum = sciatic nerve).

The treatment for head injuries includes oxygen administration to prevent hypoxia, which can increase cerebral edema. Fluid therapy may also exacerbate the cerebral edema, cause seizures and even lead to arrest. Hyperosmotic agents are generally administered and will be effective in controlling cerebral edema when used early. Mannitol is generally the preferred agent and is administered at an intravenous dosage of 0.5 to 1 gm/kg. There are two precautions in the use of mannitol: 1) Do not give mannitol to a hypovolemic patient, and 2) mannitol should be used with caution in the presence of cerebral hemorrhage.

Glucocorticoids are still controversial for the treatment of brain trauma. To be effective, they must be given early after trauma and in high dosages. Barbiturate therapy is advocated for severe brain injury. Furosemide has also been employed to reduce intracranial cerebrospinal fluid pressure.

Musculoskeletal Injuries

Although fractures alone rarely are life threatening, they do deserve attention relatively early in the management of the traumatized animal. Fractures should be splinted or otherwise stabilized to decrease secondary problems such as peripheral nerve injury and the possibility of a closed fracture becoming an open fracture and to relieve pain. Temporary stabilization should be maintained until definitive fracture repair can be undertaken. Suspected spinal fractures deserve special attention and extreme caution during patient handling. Fight wounds, gunshot wounds, and wounds with massive contusions should not be closed. Early closure of these wounds generally results in disruption and prolonged convalescence. Definitive fracture treatment is undertaken after the animal is stabilized and the anesthetic risk lessened. This may require 1 to 10 days.

Luxations of joints require use of principles described for fractures. Most joint luxations are closed and are easily managed. Following resolution of shock, the luxation is reduced and ligamentous damage investigated to ascertain the necessity for open repair.

Abdominal Injuries

With blunt abdominal trauma, the physical examination is the most informative portion of the diagnostic evaluation and should be as complete as time and the patient's condition permit. Increasing abdominal size can be an important clue for intra-abdominal injury. Abdominal rigidity and tenderness are important clinical signs of peritoneal irritation by blood or intestinal contents (see attached algorithm).

A four-quadrant abdominocentesis is our preferred means for confirming blunt abdominal injury. From the fluid obtained, a packed cell volume, total solids, cytology, and a blood urea nitrogen sample are submitted. If the packed cell volume of centesis fluid exceeds the peripheral packed cell volume, very likely there is either a splenic, hepatic or renal parenchymal laceration. In the dog or cat, the current approach is to manage these patients as conservatively as possible. In fact, it is very unusual to require surgery for a splenic or hepatic laceration. A recent study in dogs has shown the benefit of abdominal compression in conjunction with intensive fluid therapy for survival of abdominal hemorrhage. Caution should be employed in applying an excessively tight bandage when thoracic injuries are also present. Additionally, it is probably a good idea to submit some of the intra-abdominal blood for analysis of total bilirubin. With major biliary tree or common bile duct injury, the clinical signs of icterus are often delayed 4 to 6 weeks. If the abdominal fluid bilirubin is approximately 3 to 20 times greater than peripheral bilirubin, then surgical exploratory will be required to close the lacerated organ. This surgery is not considered an emergency procedure.

With urologic injury, the packed cell volume of the abdominal fluid will be lower than the peripheral packed cell volume due to hemodilution with urine. Previously, creatinine was recommended for confirmation of free urine in the abdominal cavity. Recently it has been found that blood urea nitrogen levels and urea nitrogen levels in abdominal fluid are also elevated in acute urologic trauma. This allows the veterinarian to confirm urologic trauma more readily.

Emergency management of intraperitoneal rupture of the bladder, urethra, and/or ureters involves drainage of the abdominal fluid via an indwelling Foley catheter until the patient is sufficiently stable to undergo anesthesia and surgical repair. Prior to surgery, contrast studies of kidneys, ureter and bladder should be performed to assess the severity of injury using an excretory urogram. Additionally, if there is evidence of lower urinary tract injury, positive contrast ureterography and cystography are advocated.

Should plant debris or significant numbers of mixed bacteria be found with centesis of the abdominal fluid, a ruptured hollow organ (stomach, small, or large intestine) is likely and exploratory surgery is indicated.

CONCLUSIONS

The following summary recommendations for trauma patient are highlighted:

1. Trauma frequently affects multiple organ systems.
2. An organized, systematic approach should be undertaken for ***each patient.*** This approach begins with an assessment of the respiratory, cardiovascular, and neurologic system and concludes with fracture/luxation management and diagnosis of abdominal injuries.
3. An aggressive diagnostic and therapeutic approach is taken toward each of the involved systems.
4. Overtreatment of some complications can be just as hazardous as under treatment. This is especially true of respiratory trauma and/or intra-abdominal hemorrhage.
5. Constant monitoring and reassessment of the patient's status are mandatory.
6. Each patient deserves some "hands on" special attention and lots of "tender loving care" from the veterinarian and the technician.

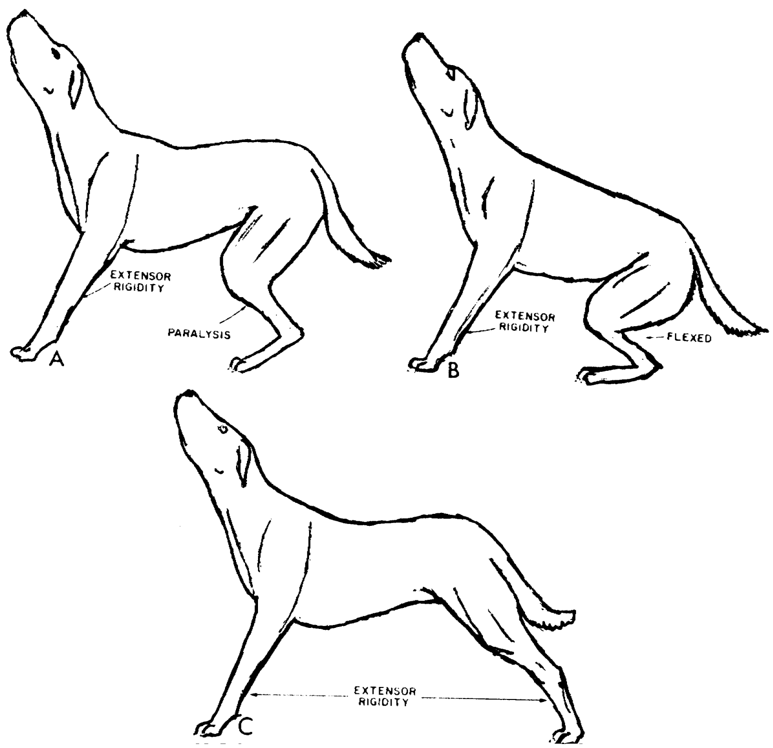

Figure 1. Abnormal motor postures. **A,** Schiff-Sherrington syndrome. This posture is due to a severe spinal cord injury between T_2 and L_4 cord segments. The prognosis is poor. **B**, decerebellate rigidity. This posture is due to severe injury to the cerebellum. The prognosis is fair. **C**, decerebrate rigidity. This posture is due to severe brain stem injury. The prognosis is grave.