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Lecture title: Sudden or Unexpected Death and shock

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Summary: Sudden or unexpected Death in single animals:

1.Spontaneous internal hemorrhage: This condition could be caused by cardiac tamponade in cows, ruptured aorta or atrium, inherited aortic aneurysm, or verminous mesenteric arterial aneurysm in horses.

2.***Rupture of internal artery:***

a) Rupture of internal carotid artery aneurysm, this condition may occur secondary to mycosis of the guttural pouch of the horse.

b) Most reported cases of sudden death in the horse are the result of cardiovascular accidents.

c) Fracture of the pelvis can result in fatal hemorrhage within the gluteal muscles of the horse

d) Rupture of the middle uterine artery at parturition in cattle may occur with uterine prolapse.

3. Peracute endogenous toxemia: can arise from rupture of the stomach of horses, abomasum of cows, and the colon in mares at foaling.

4. ***Peracute exogenous toxemia*** in a single animal could be as a result of snakebite.

5. Transportation stress: can result in sudden death in stress-susceptible animals

6. Trauma may cause death by either internal hemorrhage or damage to the CNS, especially the brain or atlantooccipital joint sufficient to damage the medulla oblongata.

7. Gastrointestinal conditions:

a) Gastric rupture in the horse may occur following overeating highly fermentable feed, administration of excessive quantities of fluids by nasogastric tube, gastric impaction, or when gastric motility is markedly reduced in acute grass sickness or gastric distension with fluid.

b) Peracute enteritis in the horse can cause rapid unexpected death

8. Iatrogenic deaths may be caused by:

a) overdose with intravenous solutions of calcium salts in an excited cow

b) too-rapid fluid infusion in an animal with pulmonary edema

c) intravenous injection of procaine penicillin suspension

d) intravenous injections of ivermectin in horses

Sudden or unexpected death in a group of animals:

1. ***Lightning strike or Electrocution:*** This usually affects a number of animals that are found together in a pile or group. Rarely, electrical current only electrifies a contact object intermittently and deaths will be intermittent. In most cases the history and an examination of the environment reveals the cause.

2. Nutritional Deficiency and Poisoning:

a) At pasture, sudden death may come from the sudden exposure of the cattle to plants that cause bloat, hypomagnesemia, cyanide or nitrite poisoning, fluoroacetate poisoning, microcystins (produced by algae in a stagnant lake or pond), or acute interstitial pneumonia.

b) Acute myocardiopathy in young animals on diets deficient in vitamin E or selenium is in this group, as is inherited myocardiopathy in Herefords.

c) Gross nutritional deficiency of copper in cattle causes “falling disease,” which is a manifestation of acute myocardiopathy.

3. Access to Potent Poisons:

a) May occur in housed animals or in those fed prepared feeds.

b) A select number of herbicides, insecticides, rodenticides, and metals.

c) There are few poisons that cause sudden death without premonitory signs. Cyanide is one, but is an unlikely poison in these circumstances. Monensin, mixed in a feed for cattle that is then fed to horses, or fed in excess to cattle, does cause death by heart failure .

4. Diseases associated with Infectious Agents:

a) These diseases cause septicemia or toxemia,and include anthrax, blackleg, hemorrhagic septicemia, and (especially in sheep, but occasionally in cattle) peracute pasteurellosis.

b) In horses, colitis is probably the only disease that will cause sudden death.

c) In sheep and young cattle, enterotoxemia associated with Clostridium perfringens should be included and this may be involved in rumen overload in feedlot cattle on heavy grain feed.

d) Circumstances, feeding practices, climate, and season of the year usually give some clue as to the cause of death.

5. Neonatal and Young Animals:

In very young, including neonatal, animals, congenital defects that are incompatible with life-prematurity, septicemia because of poor immune status or toxemia associated with particular pathogens, especially E. coli, and hypothyroidism-are important causes of sudden death.

6. Anaphylaxis:

a) after injection of biological materials, including vaccines and sera, is usually an obvious diagnosis, but its occurrence in animals at pasture can cause obscure deaths.

b) In these circumstances it usually affects one animal and clinical illness is often observed.

c) A similar occurrence is sudden death in a high proportion of piglets injected with an iron preparation when their selenium–vitamin E status is low.

shock

- is a critical condition brought on by the sudden drop in blood flow through the body. Shock may result from trauma, heatstroke, blood loss or an allergic reaction. It also may result from severe infection, poisoning, severe burns or other causes.
- Or is defined as *inadequate cellular energy production or decreased cellular oxygen utilization related to decreased blood flow that leads to cell death and organ failure.*

Shock There are four main ways that circuit failure occurs:

1. Hypovolemic shock
2. Hemorrhagic sock
3. Obstructive Shock
4. Maldistributive shock

Etiology:

The circulatory system consists of a pump (the heart) and a circuit (the vasculature) Circulatory shock can result from abnormal functioning of the pump or circuit, or both.

- **Hypovolemic shock** occurs when there is a reduction in circulating blood volume caused by loss of blood, plasma, or free water.
- **Hemorrhagic shock** occurs when there is a reduction in circulating blood volume caused by the rapid loss of blood.
- **Maldistributive shock** occurs when there is a reduction in circulating blood volume caused by increased capillary permeability, pooling of blood in capacitance vessels (such as the veins in the splanchnic circulation), or pooling of plasma in a large third space such as the thoracic or abdominal cavities.
- **Obstructive shock** occurs when there is an acute reduction in venous return caused by a mechanical obstruction, such as pericardial tamponade or pulmonary artery thrombosis. Obstructive shock is extremely rare in large animals.

✍ **Common causes of circuit failure in large animals are as follows.**

Hypovolemic Shock Fluid loss and dehydration, such as in neonatal calf diarrhea and burn injury, especially when fluid loss is severe and rapid. Fluid loss into the gastrointestinal tract caused by acute intestinal obstruction.

Hemorrhagic Shock Acute hemorrhage with loss of 35% or more of total blood volume, equivalent to an acute blood loss of 2.8% of BW (assuming blood volume is 8% of BW) will lead to clinical signs of severe hemorrhagic shock.

Cattle, Sheep, and Goats:

- Spontaneous pulmonary hemorrhage associated with caudal vena caval syndrome
- Abomasal ulcer, sometimes originating from a bovine viral leukosis lesion (cattle)
- Enzootic hematuria with bleeding from a bladder lesion (cattle)
- Pyelonephritis with bleeding from a renal lesion (cattle)
- Intraabdominal hemorrhage as a result of arterial aneurysm, possibly associated with copper deficiency (cattle)
- Laceration of arteries in the wall of the vagina as a result of dystocia
- Ruptured middle uterine artery during uterine prolapse or torsion of uterus

- Cardiac tamponade caused by rupture of the coronary artery or ventricular chamber, rupture of the aorta Rupture of liver associated with dystocia in lambs, and in older lambs possibly associated with vitamin E deficiency .

Horses:

- Ethmoidal hematoma
- Exercise-induced pulmonary hemorrhage
- Rupture of the middle uterine, uteroovarian (especially right side), or iliac artery associated with parturition, more commonly in aged mares
- Nasal bleeding from hemorrhage into the guttural pouch, from carotid or maxillary arteries with guttural pouch mycosis or associated with rupture of the longus capitis muscle following trauma
- Rupture of mesenteric arteries secondary to strongyle larval migration
- Splenic hematoma or rupture following blunt trauma
- Rupture of liver with hyperlipemia
- Hemangioma, hemangiosarcoma, squamous cell carcinoma of the stomach, and other Neoplasia
- Persistent bleeding from the vulva in association with ulcerated varicose veins on the dorsal wall of the vagina
- Congenital venous aneurysm (rare)

- **Pathogenesis of shock**

A. Hypovolemic Shock

- Decreased venous return, cardiac output falls.
- The carotid and aortic baroreceptors stimulate the sympathetic nerves and adrenal medulla to release catecholamines.
- Resulting in vasoconstriction in vessels with α-adrenergic receptors.
- Vasoconstriction leads to decreased renal perfusion inducing sodium and water retention.
- Renal ischemia and nephrosis develops.
- Water shifts from the interstitial space to the vascular space.
- Decreased perfusion of organ systems, with resultant damage from hypoxia and tissue acidosis.

B. Hemorrghic shock:

- Loss of blood volume (hypovolemic shock).
- Loss of plasma protein (decreased plasma oncotic pressure).
- Loss of erythrocytes (decreased oxygen-carrying capacity and buffering capacity).
- Rapid loss of blood volume results in hypovolemic shock and the loss of erythrocytes in anemic anoxia.

C. Maldistributive Shock:

- The integrity of the intestine is compromised by factors such as ischemia, trauma, or inflammation.
- Sufficient endotoxin can be absorbed.
- Overwhelm the clearance mechanisms of the liver.

- Endotoxin leak to the peritoneal cavity gaining access to the systemic circulation.
- Endotoxin activates macrophages and neutrophils provoking the release of a multitude of inflammatory mediator.
- Which lead to endothelial damage, leaky vessels, hypotension and vasculitis, and eventually decreased intravascular volume.
- Damage to other organ systems and further complications from the development of coagulopathies, including DIC.

D. Obstructive Shock:

- In severe pericardial tamponade, the rapid increase in pericardial fluid volume impedes diastolic filling of the heart, resulting in decreased cardiac output .

Clinical Finding:

1. Depression, weakness, and listlessness
2. Fall in temperature to below normal.
3. The skin is cold and skin turgor decreased.
4. The mucosae are pale gray to white and dry, and capillary refill time is extended beyond 3 to 4 seconds.
5. Increase in heart rate to 120 to 140 beats/min in horses and cattle
6. Abnormalities of the pulse including small and weak pressure amplitudes (manifested as a "thready" pulse)
7. Anorexia is usual but thirst may be evident and there is anuria or oliguria.
8. Nervous signs include depression, listlessness and obtusion, and coma in the terminal stages.

Clinical Pathology:

1. The hematocrit and plasma protein concentrations usually fall to their lowest levels 12 to 24 hours following hemorrhage
2. Abdominocentesis, thoracocentesis, and ultrasound are used to identify sites of internal bleeding.
3. Thrombocyte and clotting factor examinations are indicated in cases in which unexplained spontaneous hemorrhages occur.

Treatment:

1. Identification of cause
2. Rapid administration of intravenous fluids
3. Blood transfusion
4. Ancillary Treatment

a) **Corticosteroids**

b) Cyclooxygenase Inhibitors: **flunixin meglumine (0.25 mg/kg BW and IM ketoprofen (0.5–2.2mg/kg BW) .**

c) **Antibiotic Therapy**

d) **Immunotherapy**

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References:

Constable PD, Hinchcliff KW, Done SH, et al. (2017). Veterinary Medicine: A Textbook of the Diseases of Cattle, Horses, Sheep, Pigs, and Goats. 11th ed. Elsevier, St. Louis, Missouri, USA.