Providing the best quality care and service for the patient, the client, and the referring veterinarian.
Penetrating injury

- One that occurs when an object pierces the skin and enters deeper tissues of the body, creating an open wound.
Perforating injury

- When an object enters the body and passes all the way through.
- Entry and exit wounds.
Blunt Trauma

- Impact to the body tissues resulting in injury, but the skin may not be disrupted.
Factors that guide decision-making

- Systemic condition
- Severity of the wound and degree of tissue damage
- Time since injury
- Degree of contamination
- Blood supply or lack of it
- Ability to close or treat the wound depending on location and anticipated complications (contracture or tension)
Systemic condition

- Resuscitation & stabilization
- Blood pressure, O2 saturation/supplementation, CBC/Chemistry, UA, blood gas, systemic pain control
- Restore volume
  - crystalloids: 40-60 ml/kg/hr cats
  - 60-90 ml/kg/hr dogs
- colloids: 5-10 ml/kg bolus
  - 20 ml/kg/day
- whole blood, packed rbc’s
Severity of wound and degree of tissue damage

- superficial vs. deep
- muscles
- tendons
- bone
- neurovascular
- organ damage
- multiple body cavities
Surgical Wound Classification

- **Clean (Class I):**
  - Non-traumatic: blunt trauma are in this category if they meet all other criteria.
  - No inflammation or infection
  - GI, Resp or GU tract not entered
  - Primary closure +/- drains

- **Clean-contaminated (Class II):**
  - GI or Resp tract entered under controlled conditions without unusual contamination

- **Contaminated (Class III):**
  - Gross spillage from the GI tract
  - Open traumatic wounds < 4 hours old
  - Entrance into GU or biliary tract with infected urine or bile
  - Major break in technique

- **Dirty and Infected (Class IV):**
  - Acute bacterial inflammation encountered, without pus
  - Transsection of "clean" tissue to access pus reoperative perforation of respiratory, gastrointestinal, biliary or genitourinary tract
  - Traumatic wound with retained devitalized tissue, foreign bodies, fecal contamination, and/or >4 hours old; or from a dirty source
Assessing degree and depth of tissue injury
Stab wounds to the abdomen: failure of blunt probing to predict peritoneal penetration

- Stab wounds were created using a #11 blade in the abdomens of 10 anesthetized dogs.
- Wounds were probed using cotton swab and based on this exam were predicted if they were deep (through parietal peritoneum) or superficial.
- 59/100 penetrated deep layer, examiners incorrectly called 24/59 superficial.
- Deep perforation harder to predict with this method.
Methods

• Visualization
• Direct probing:
  • sedation preferred
  • don’t be afraid to make the wound bigger
• Radiographs
• Ultrasound
• Surgical Exploration
• CT
• Laparoscopy

- Poor success with contrast fistulograms
- DPL : under-utilized?
Full body assessment

4 y/o F/S pitbull
- gunshot to face
- entry wounds right ear and right mandible
Mandibular fracture
Time lapse since injury

**Primary closure:**
for clean wounds/lacerations within 6-10 hours of injury

**Delayed primary closure:**
delay for approximately 3-4 days
- patient unstable
- wound is dirty
- questionable viability

**Healing by secondary intention**
heal through contraction without surgical intervention
Degree of contamination

Lavage
- Copious irrigation delivered under low to intermediate pressure to cleanse the wound and decrease bacterial count
- 18 ga needle attached to a 35 ml syringe can generate 7-8 psi
- High pressures (>13psi) may drive bacteria deeper into tissues
- Amount of fluid is probably more important than the pressure applied

- Infection rates were no different for wounds cleaned with tap water as compared to isotonic saline.
  *(Fernandez R, 2008)*

- Chlorhexidine, povidone-iodine and hydrogen peroxide can be toxic to tissues

- “The solution for pollution is dilution”
Antibiotics?

Blunt vs. penetrating injuries

Topical vs. systemic antibiotics

Broad-spectrum antibiotics appropriate in chronic and infected wounds

Is prophylactic usage of antibiotics in acute wound management justifiable?

- Study was a follow-up to previous study by same authors which looked at 61 patients (human) with 215 dog bite wounds.
- All treated with copious saline lavage, wound debridement, more lavage, antibiotics, and wound closure.
- A wound infection rate of .53% and patient infection rate of 1.8% seen

- New study used same protocol, excluding antibiotics
- 49 patients with 145 bite wounds: wound infection rate of 1.4% and patient infection rate of 4%
Antibiotics should not be a substitute for good wound care

- Patients with compromised immune system or concurrent metabolic disease may need greater coverage
- Broad-spectrum antibiotics are a good initial choice
- Continued use should be based on culture results
Wound Coverage

- Cleans
- Protects
- Stabilizes
  - soft bulky bandage
  - splint or cast
- Decreases bleeding
Pain management

- **Local**
  - Bupivacaine: (0.5%) 4-6 hours duration <2mg/kg dogs, <1mg/kg cats
  - Lidocaine (2%) 2 hours duration <6mg/kg dogs, <3mg/kg cats
- Sodium bicarbonate: can mix with Lidocaine in a 9:1 ratio of lido:bicarb by volume
  - Increase pH and stings less
- **Systemic**
- **IV sedation vs. general anesthesia**
Debridement

- Remove devitalized, infected or compromised tissue
- Devitalized tissue promotes further inflammation and bacterial growth
- May need to be done daily or more than once
- Be aggressive but salvage all healthy tissue
Types of debridement

- Surgical: most effective
- Enzymatic: trypsin /chymotrypsin
  - for poor anesthesia candidate or areas where surgery is too difficult
- Mechanical: adherent bandages used to remove debris from the surface
Blood supply or lack of it

- Wounds must have sufficient blood supply to ensure normal physiology of healing
- Crushing and blunt trauma damages vascular tissues
- Edema and vasospasm can lead to tissue death: waiting 48-72 hours may allow better idea of what will stay viable
Crushing dermal wounds

- Avoid subcutaneous sutures
- Avoid tension
- Loose skin sutures to cover the defect and decrease wound contracture
- Recheck
- Client communication: inform of potential failure of repair
Traumatic body wall hernias

Organ or soft-tissue herniation through:
- Paracostal
- Inguinal/femoral
- Prepubic
- Muscle separation
Decision to operate is based on multiple factors

History
Physical Exam
- Can be unreliable due to delay in development of clinical signs
  - Clinical signs of hemorrhage may not be apparent immediately after trauma
Radiographic and Ultrasonographic studies
- Free air and free fluid
  - Disruption of the body wall
Laboratory analyses
- Serial PCV analyses
- Chemistry panel
- Fluid cytology of effusion
Is surgery urgent?

Small defects can be more worrisome than large defects.

Incarceration or strangulation of internal organs more likely with small defects.
Surgical repair

- Midline approach: explore the entire abdomen
- Use non-absorbable sutures
- Take healthy bites of healthy tissue
- Avoid mesh: infection
Traumatic hernias

75% of cases have additional significant injuries

*Majority of these are orthopedic
Traumatic abdominal wall hernia

Rare: classified as either high-energy or low-energy

“Handlebar” hernias

CT is preferred modality for diagnosis
Ability to close or treat the wound depending on location and anticipated complications
Consider long-term effects when planning repair

Try to close wounds over:
- Joints
- Pressure points:
  - Olecranon
  - Calcaneous
- High-tension or high-mobility areas
Wounds that cannot be closed may need flaps or grafts once a vascular bed is established.