Chapter 1
General Surgical Considerations

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Determining Surgical Candidacy

A formula for determining if a patient is a surgical candidate does not exist, but the following should be considered:

- Patient factors
  - Does the diagnosis warrant surgery?
  - Do nonsurgical options exist?
  - Is the patient healthy enough for surgery? What are the risks of surgery to the patient? Risks of not performing surgery? (Note these risks may be different depending on the surgical procedure, approach, anesthesia employed, etc.).
- Owner factors
  - Do expected outcomes meet the client's expectations?
  - Available finances versus cost of the procedure.
- External factors
  - Facilities and equipment available.
  - Knowledge and surgical expertise available.
  - Is the animal insured? – Contact the insurance company before procedure.

Preoperative Procedures

Medical History (Anamnesis)

- Assessment of all patients should begin with a detailed history.
- Begin with broad, open-ended questions that allow the client to elaborate on their observations. Focus on objective observations related to the case; avoid tunnel vision associated with owner interpretations of the findings.
- Important historical information includes clinical signs, chronicity, onset, information regarding nutrition, the patient's environment, age, parity, stage of lactation (if applicable), and previous disease.
- Ascertain if treatment has been attempted. What was the response to treatment?
- A medical history template can aid clinicians in gathering an accurate history (Figure 1-1).

Noordsy's Food Animal Surgery, Sixth Edition. Edited by Joseph W. Lozier and Andrew J. Niehaus.

Companion website: www.wiley.com/go/loziersurgery

FARM ANIMAL HISTORY

Animal ID
Client/Owner
DOB mm/dd/yyyy Exam Date mm/dd/yyyy
Clinician

Species Breed Age Weight lbs / kg actual / estimated

Presenting Complaint

Duration Onset

Born on Farm? Y/N Acquired? Y/N Date Acquired mm/dd/yyyy

PREVIOUS ILLNESS

Date	mm/dd/yyyy	Illness		Tx		Outcome	
Date	mm/dd/yyyy	Illness		Tx		Outcome	
Date	mm/dd/yyyy	Illness		Tx		Outcome	

Last Parturition mm/dd/yyyy

Housing/Pasture Environment

VACCINATION/ DEWORMING

Date	mm/dd/yyyy	Product	
Date	mm/dd/yyyy	Product	
Date	mm/dd/yyyy	Product	
Date	mm/dd/yyyy	Product	
Date	mm/dd/yyyy	Product	

DIET/ NUTRITION

Concentrate Y/N Forage Y/N Pasture Y/N Minerals Y/N Supplements Y/N Other Y/N

Milk Production lbs/day Avg. 305 day lbs/day Rolling herd avg. lbs/day

Travel History

HERD HISTORY

Animals in Herd # Animals in Group # Animals Sick # Animals Susceptible # Deaths

New Additions Arrival Date mm/dd/yyyy

Other Diseases in Herd (Respiratory, GI, Urinary, Skin, Weight Loss, etc.)

Other Notes:

FIGURE 1-1. An example template that can be used to guide history taking on a farm animal.

Physical Examination (PE)

- Arguably the most important diagnostic tool. Most conditions are diagnosed with a PE.
- Develop a systematic approach – avoids tunnel vision once problems are identified and keeps the clinician from forgetting elements of PE. PE should be thorough but efficient; efficiency will increase with experience.
- Start PE with an observational assessment of the animal.
- A templated datasheet can be helpful to record information as well as guide the clinician and avoid omissions (Figure 1-2).
- In cattle, end PE with an examination of the head as this is most likely to make the patient nervous.

Clinical Diagnostics

- Prioritize tests that are likely to impact therapy.
- Consider tests that can be performed patient side and yield quick and accurate results. Examples include urine dipstick and fecal occult blood.
- Diagnostic imaging may not be an option in field situations; however, portable, digital, radiographic equipment is becoming common. Portable units usually are limited to imaging of extremities; portable machines lack the power to image the proximal limbs of cattle or the chest/abdomen of large patients. Portable ultrasound units are common in large animal reproductive work; however, their utility may be extended to other nonreproductive applications.

Examination Template

A physical exam template may be useful to guide clinicians in performing a PE. Many templates exist and often should be modified by the clinician to suit their individual needs. Figure 1-2 is an example of a physical exam template that may be used.

Surgical Facilities

- In a farm setting, a properly selected surgical location will improve the surgical outcome.
- The ideal surgical facility should take into account:
  - Accessibility of the patient, surgical personnel, and equipment
  - Adequate and safe patient restraint (see Chapter 2)
  - Footing for the standing patient and adequate drainage
  - Adequate lighting to safely and efficiently perform the procedure
    - If utilizing sunlight, consider time of day and estimated procedure length as the lighting may change.
  - Access to clean, hot, and cold running water
  - Protection from environmental conditions:
    - Rain
    - Temperature extremes
    - Wind
    - Dust
    - Flying insects

Restriction of Food and Water in Elective Surgery

- Ruminants placed in lateral or dorsal recumbency should have restricted intake:
  - Roughage for 48 hours.
  - Concentrate for 24 hours.
  - Water for 12 hours.
  - Note that over-fasting ruminants may result in rumen contents that are more watery than normal and are more easily regurgitated.
- Neonates or animals fed exclusively a milk diet require no food or water restriction.

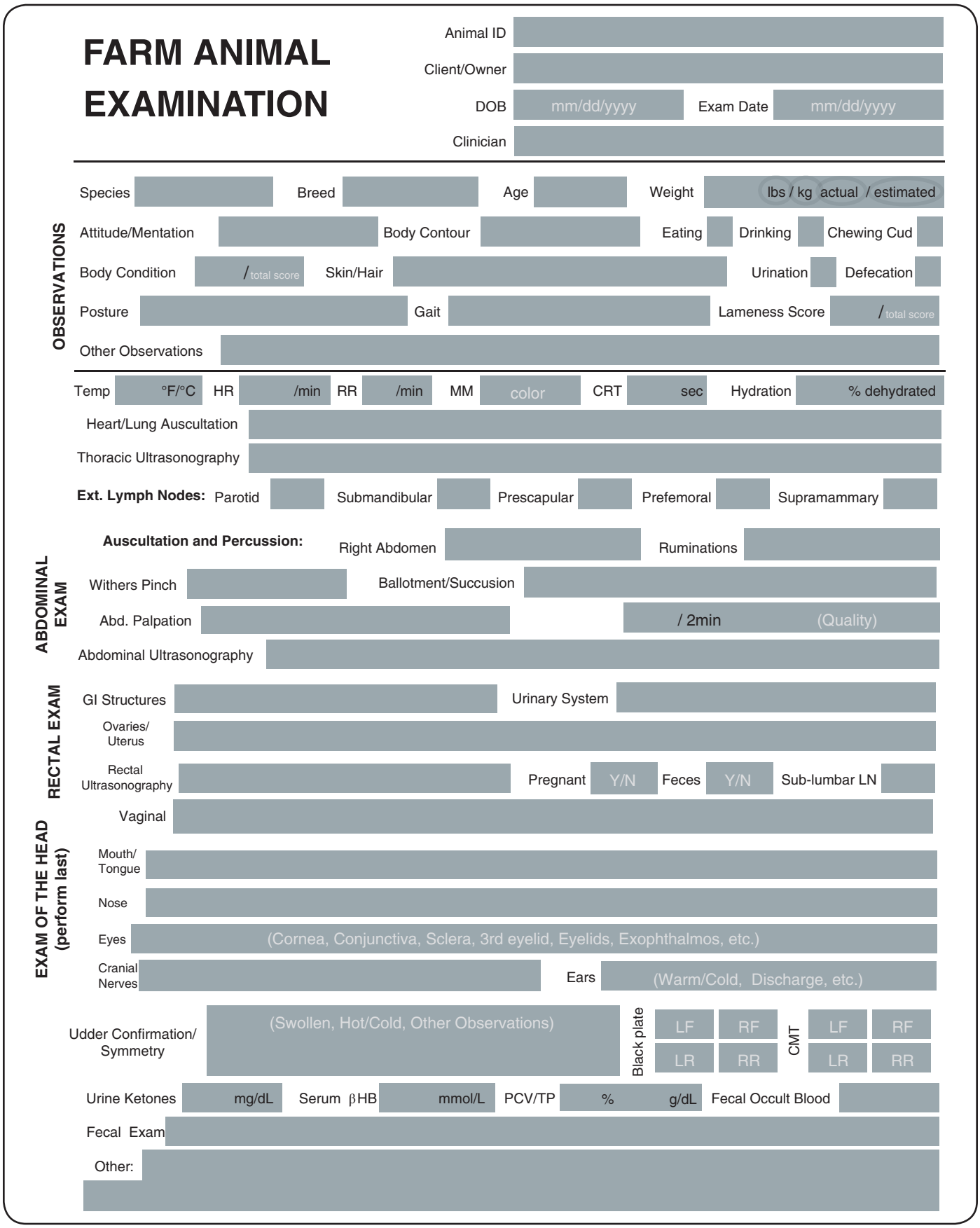

FIGURE 1-2. An example template that can be used to guide a complete physical exam on a farm animal.

- Monogastric patients should have restricted intake:
  - Feed for 24 hours.
  - Water for 12 hours.

Preoperative Medications

- Antibiotics
  - Preoperative antibiotics are indicated for patients with likely surgical contamination (e.g., umbilical abscess and open wounds).
- Sedatives and tranquilizers
  - Keep animals calm before anesthesia; doing so will reduce aesthetic complications and produce a smoother recovery.
  - Ruminants frequently do not require sedation prior to surgical procedures.
  - See Chapter 5 for details of drugs used and dosages.
  - Over-sedated livestock may lie down.
  - Commonly used drugs (often used in combination)
    - Acepromazine maleate
    - Xylazine
    - Ketamine
    - Butorphanol tartrate
  - Effect depends on dose and route of administration.
- Analgesics
  - Butorphanol tartrate
    - May be used alone or in combination with sedatives and tranquilizers.
    - Not approved by the United States Food and Drug Administration (FDA) for food animals.
    - May cause excitement and a rough recovery from general anesthesia.
  - Flunixin meglumine
    - A nonsteroidal anti-inflammatory drug (NSAID) that has a label for food animals (unless justification exists) should be the first NSAID used.[1]
    - Dose = 1 mg/kg (IV or transdermal only in cattle; IM in pigs).
    - Does not have FDA approval for all food animal species.
    - Pharmacodynamic properties.
      - Analgesic
      - Antipyretic
      - Anti-endotoxic
    - May be ulcerogenic at high doses or with prolonged use.
  - Meloxicam
    - No label for food-producing species in the United States (all use is considered ELDU); Animal Medicinal Drug Use Clarification Act (AMDUCA) regulates extra-label use of FDA-approved drugs.[1]
    - Labeled for use in Canada and the European Union[2]
      - 1.0 mg/kg PO for analgesia following castration in calves.
      - 0.5 mg/kg SC for analgesia following dis-budding and abdominal surgery.
  - Other NSAIDs
    - Aspirin is not recommended due to low efficacy, short duration, and ulcerogenic properties.
    - Phenylbutazone (bute) not recommended in ruminants.
      - All use is considered extra label.
      - Erratic pharmacokinetic properties with variable elimination across species leads to long withdrawal times.
      - Prohibited from use in dairy cattle 20 months of age and older.

Preparing the Surgical Site

- General Considerations
  - Prepare surgical site with wide margins (at least 6 inches adjacent to the intended surgical incision).
  - Be neat: A client's interpretation of surgery is often based on the appearance (i.e., the neatness) of the surgical site and skin sutures.
- Supplies needed
  - Cotton rope clothesline (10 foot length)
  - Soft brush or curry comb
  - Surgical clipper blade (#10 or #40)
  - Stiff scrub brush
  - Dish soap
  - Chlorhexidine or iodine-based surgical scrub
  - 70% isopropyl alcohol
  - Disposable or reusable cloth sterile surgical drapes

- With a soft brush and comb, remove all loose debris from the animal.
- Remove excess hair with a #10 or #40 head clipper. Dirty animals may require "pre-clipping" with a larger clipper.
- For cattle undergoing standing procedures, secure the tail to the side with a tail tie to prevent contamination of the surgical site by the tail (see Chapter 2).
- Rough scrub with liberal amounts of soap or surgical scrub and water. Dish detergent works well to remove debris and natural oils from the skin. Commercially available antiseptic scrubs also contain detergents that are effective.
- Following a rough scrub, a minimum of two scrub and rinse cycles with an antiseptic scrub solution is recommended. Most commonly chlorhexidine or iodine-based scrub is used for this step. Both disinfectants have been shown to be effective as a presurgical prep.
- Complete a final scrub with alternating scrub and alcohol solutions. Start at the proposed surgical site and work in circles of increasing diameter to the edge of the clipped area.

Draping

- Because many surgical procedures in cattle involve local or regional anesthesia and standing restraint, complete draping may be difficult or impossible. Thus, regional draping (covering the field of surgery) is recommended.
- Use moisture-resistant drapes: Abdominal fluid spillage followed by capillary contamination of cloth drapes is a common break in sterile technique.

Postoperative Care

Nutrition

- Animals require good postoperative nutrition for optimal recovery and return to normal function.
- Palatable grass or alfalfa hay is a good first choice for cattle, sheep, and goats.
- Enticing a patient to resume normal eating behaviors postoperatively is often a frustrating task. The following are recommendations to stimulate appetite and gastrointestinal (GI) function:
  - Changing the character of food by moistening it with water or molasses may help.
  - Transfaunation with rumen fluid from a healthy cow via a stomach tube can promote appetite and GI function (see Transfaunation).
  - Feeding a variety of feedstuffs in a smorgasbord fashion may be beneficial.
  - Make certain the feed is fresh and is changed on a regular basis.
  - Small, frequent portions are generally better than large portions.

- Patients will eat more if they feel good. **Treat all concurrent disorders (including ketosis, dehydration, and infection), provide analgesia, control fever, and house in a clean, dry environment preferably in sight of herd mates.**

- Force feeding via stomach tube can provide some nutrition but will be unable to provide fibrous ingesta that is required for normal rumen function. A slurry of alfalfa meal or pellets in water with electrolytes added increases the fill of the GI tract and stimulates animals to resume eating.
  - Use 0.5 to 1 kg (1 to 2 lb) of alfalfa meal in 12 to 15 l (3 to 4 gallons) of water pumped into the rumen.
  - Keep stirring the slurry or it may clog the stomach pump.
  - Do not add dextrose, rumen bacteria will utilize added dextrose.
- Electrolytes may need to be provided as a supplement.
  - Sodium, potassium, and chloride are the most commonly supplemented electrolytes.
  - 30 g of KCl + 50 g of NaCl in 20 l (5 gallons) of water will often be consumed voluntarily by cows with low serum chloride levels commonly seen in left displaced abomasum (LDA), right displaced abomasum (RDA), and right abomasal volvulus (RAV).
  - Consider placing a small salt block in the manger for the patient to lick.
  - Cows commonly refuse feed with too much salt.
- Water
  - Maintain a clean, fresh water supply.
  - Consider providing water orally via a stomach tube and pump; 20 to 40 l (5 to 10 gallons) is generally sufficient for adult dairy animals.
  - Hypertonic saline (7%), 1 l IV, will stimulate cows to drink.
- Transfaunation
  - Postoperative appetite of ruminants may be improved by inoculating the rumen with fresh rumen fluid obtained from the rumen of a healthy cow.
    - Rumen flora is collected from a herd mate, an animal from a slaughter facility, or a cow fitted with a rumen cannula.
    - Fresh undiluted rumen liquid, 2 to 12 l (0.5 to 3 gallons), pumped into the patient will repopulate the rumen with normal bacteria and protozoa.
    - Maintain the temperature of the rumen fauna as the bacteria and protozoa are heat/cold sensitive.
  - Note: using rumen content from a cow in a different herd may breach biosecurity protocols.

Wound Care

- The speed of wound healing is rarely increased, but factors that slow wound healing can be controlled.
- Wound dressings and skin antiseptics, especially powder preparations, can act as foreign materials and thereby delay healing.
- Principles of wound healing include:
  - Controlling contamination and infection
  - Controlling inflammation
  - Avoiding desiccation
  - Avoiding disruption of normal cellular function
  - Minimizing tension and movement of the wound

Wound Lavage

- Goals
  - Decreases gross contamination.
  - Prevents desiccation of the wound bed and creates a more favorable environment for wound healing.

- Warm water increases blood flow to area to promote healing.
- Cold water causes vasoconstriction to decrease bleeding and inflammation.

■ Prior to lavage, consider the location, health, and contamination of the wound. Most traumatic wounds are highly contaminated. Try not to introduce additional contamination to the wound. Consider the source of the lavage fluid and try to minimize washing surface contaminants into the wound.
- Sterile isotonic solutions with or without antiseptics are recommended (but not required) for wound lavage.
- Low-pressure, tap-water lavage from a garden hose can be cost-effective and very beneficial to decrease inflammation as well as surface contamination. Prolonged contact with hypotonic fluids may cause tissue edema.

■ Solutions warmed to or slightly warmer than body temperatures will be more comfortable for the patient.

■ Use large volume plus low pressure (≤15 psi).

Bandages

■ Supplies needed
- Antiseptic ointment
- Nonadherent dressing
- Cotton bandage material
- Gauze 4 × 4 sponges
- Saline
- Stockinette
- Combine cotton bandage
- Adhesive tape
- Elastic bandage (Ace)
- Elastic adhesive (Elastikon®) bandage
- Nonadhesive (Vetwrap™) bandage
- Esmarch's bandage
- Roll gauze

■ Bandages may be useful to protect wounds from additional contamination, help to reduce tissue edema, and promote a warm, moist wound environment. However, bandages can harbor bacteria and act as a foreign body. Bandages should be monitored and changed frequently.

■ Bandage layers:
- Contact layer (primary layer) – contacts the wound. Promotes local tissue health. Needs to be selected based on the current phase of wound healing.
- Secondary (intermediate layer) – absorbent layer that provides for absorption of exudate from the wound and padding for physical protection.
- Tertiary layer – provides compression of bandage and holds the bandage together (Figure 1-3).

■ Bandage materials
- Contact Layer
  - Gauze
  - Soft, nonirritating, and very absorbent
  - Permits rapid evaporation
  - May adhere to the wound unless coated with some type of ointment (e.g., triple antibiotic ointment or povidone-iodine)
  - Can be used in wet-to-dry applications to promote wound debridement
  - Nonadherent wound dressing
  - Poorly absorbent
  - Nonadherent properties will not disrupt epithelium that has formed across wound
  - Used as contact layer after debridement is complete

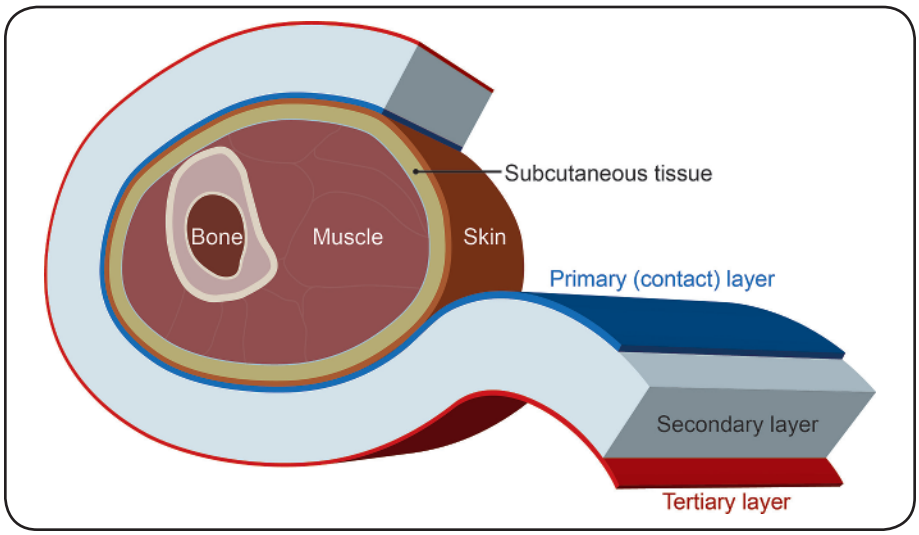

FIGURE 1-3. A bandage consists of 3 layers, the primary layer contacts the wound and should promote healing. The secondary layer comprises the bulk of the bandage and provides protection as well as absorption of exudate. The tertiary layer is the outermost layer and provide integrity for the bandage.

- Stockinette
- Tube shape that resembles long, thin sock
- Available as long roll that can be cut to the desired length
- Will stick to wounds and disrupt epithelium when removed – not recommended as contact layer for open wounds or when exudate is present. Useful as contact layer with intact skin in case of support bandage, splint, or cast.

- Secondary Layer
  - Absorbent cotton
  - Available as sterile or nonsterile cotton and in various grades
  - Should be sterile and of a high-quality grade
  - Commonly used on the outside of gauze as a protective absorbent dressing for wounds (seldom used as contact layer as it tends to stick to wound)
  - Absorbs moisture rapidly, but evaporation is very slow, which results in a wet bandage that supports bacterial growth.
- Tertiary Layer
  - Adhesive tape
  - Elastic bandage (Ace)
  - Elastic adhesive (Elastikon®)
  - Nonadhesive (Vetwrap™)

■ Nontraditional Bandages
- Elastic bandages are often used when pressure is required temporarily.
- Esmarch's bandage is a rubberized bandage.
  - It can be used as a torniquet to facilitate hemostasis during surgery when applied preoperatively to an extremity. It is designed to exsanguinate an extremity.
  - Begin bandaging at the distal end of a limb. Blood is forced up and away from the extremity.
  - Commonly used as a temporary bandage but may be used for an extended period (e.g., 72 hours on a prolapsed prepuce).
- Bandages of the feet and distal extremities can be challenging to keep from slipping. Bandage the bovine foot in a figure-eight pattern. Include padding in the interdigital space (Figure 1-4).

FIGURE 1-4. A bandage applied to a bovine foot. Using a figure-eight pattern will help retain the bandage on the foot. Padding should be placed in the interdigital space to provide protection to the interdigital tissues. Source: Ames, N. K. (2014) / John Wiley & Sons.

- Do not create excessive pressure on the blood vessels of the pastern. Bandages need to be applied tight enough to maintain placement without excessive pressure.
- Spray bandages (e.g., aluminum spray bandage) can provide light covering and protection of wound but does not offer any mechanical support.
- Bandages can be applied to the prepuce to decrease swelling and edema. These will be discussed in detail in Chapter 32.

Postoperative Medication

- Antibiotics
  - If possible, antibiotics should be used according to their label. Any deviation from the label use (indication, dose, and route) is considered Extra-Label Drug Use (ELDU). In the United States, the Animal Medicinal Drug Use Clarification Act (AMDUCA) clarifies how drugs can be used in an extra-label manner.[1]
  - Use appropriate drug, dose, duration, route, and withdrawal time. In cases of ELDU, the Food Animal Residue Avoidance Databank (FARAD) can be used to help establish a withholding period (www.farad.org).
  - Antibiotics should not be used as a substitute for poor sterile technique.
  - Local/regional antibiotic therapy
    - Can be useful to increase the concentration of antibiotic at the intended site.
    - Almost always ELUD.
    - Includes intraperitoneal (IP), intraarticular (IA), regional limb perfusions (RLP), local wound lavage, etc.
    - Choose an antibiotic with minimal inflammatory response and safe for the local environment. For example, only antibiotics that are safe for IV use should be used for RLP.
    - For IP antibiotics used during abdominal surgery, dilute the drug with 500 to 1000 ml of sterile isotonic solution and pour directly into the abdominal cavity.
- Fluids
  - 20 to 40 liters (5 to 10 gallons) of sterile isotonic fluids administered IV during a period of 24 hours is effective for eliminating dehydration and beginning convalescence in adult cattle.
  - If sterile fluids are not available, distilled water or clean filtered tap water with added electrolytes can be effective. The risk of complications increases with the use of nonsterile fluids.
  - If possible, electrolyte profiles can be used to determine deficits. If unavailable, the clinician may need to make an educated guess of abnormalities.
    - Neonates with diarrhea (scours) often have a metabolic acidosis from $NaHCO_3$ loss. The acidosis leads to secondary hyperkalemia.
    - **Animals with proximal GI obstruction (e.g., cow with RAV) will have metabolic alkalosis due to sequestration of HCl in the abomasum and reflux into the rumen (internal vomiting). Metabolic alkalosis leads to hypokalemia.**
  - The amount of $NaHCO_3$ required to replace a deficit is determined by the following equations for all livestock species:

$$0.3\frac{ml}{kg} \times \text{Adult body weight}\,(kg) \times \text{Base deficit}\left(\frac{mEq}{ml}\right) = NaHCO_3\ \text{Deficiency}\,(mEq)$$

$$0.5\frac{ml}{kg} \times \text{Neonatal body weight}\,(kg) \times \text{Base deficit}\left(\frac{mEq}{ml}\right) = NaHCO_3\ \text{Deficiency}\,(mEq)$$

- Hypertonic saline 7%.
  - Very useful for restoring circulating blood volume in cases of shock.
  - **1 l contains 70 g of NaCl (≈1200 mEq of sodium and 1200 mEq)**
  - **Hypertonic saline will stimulate the patient to drink water;** do not give hypertonic saline without access to water.

■ Drugs to increase GI motility
- No proven GI motility agents in ruminants
- Neostigmine
  - Has a questionable effect on ruminants.
  - Stimulation of smooth muscle may not be well organized, with GI spasms rather than organized propulsive movement being the result.
- Bethanechol
  - Preliminary studies indicate that bethanechol may increase contractility of the small intestine.
  - Indications exist that a synergistic response occurs when given in combination with metoclopramide.
- Metoclopramide
  - Has been used (at 0.1 mg/kg) to treat abomasal emptying defects in sheep.
  - Its greatest effect appears to be in forestomachs and abomasum.
  - Has been used in selected cases of vagal indigestion.
- Erythromycin
  - An antibiotic with GI stimulation as a side effect (1.0 mg/kg in 1 l of saline infused for 60 minutes every 6 hours has been used to treat postoperative ileus in horses).
  - Pain is a possible negative side effect.
  - Lidocaine IV constant rate infusion (CRI).
    - ★ Is thought to promote motility by decreasing abdominal pain associated with surgery.
    - ★ Dose = 0.05 mg/kg/min IV CRI.
    - ★ Evidence for efficacy is mostly anecdotal and has been adopted from use in horses.
    - ★ May be combined with morphine and ketamine (MLK). The addition of opioids may be controversial since they are known for inducing ileus.

References

1. Animal Medicinal Drug Use Clarification Act. (https://www.fda.gov/animal-veterinary/guidance-regulations/animal-medicinal-drug-use-clarification-act-1994-amduca), 1994.
2. Melendez DM, Marti S, Pajor EA, et al. Pharmacokinetics of oral and subcutaneous meloxicam: effect on indicators of pain and inflammation after knife castration in weaned beef calves. *PLoS One* 14: e0217518, 2019.