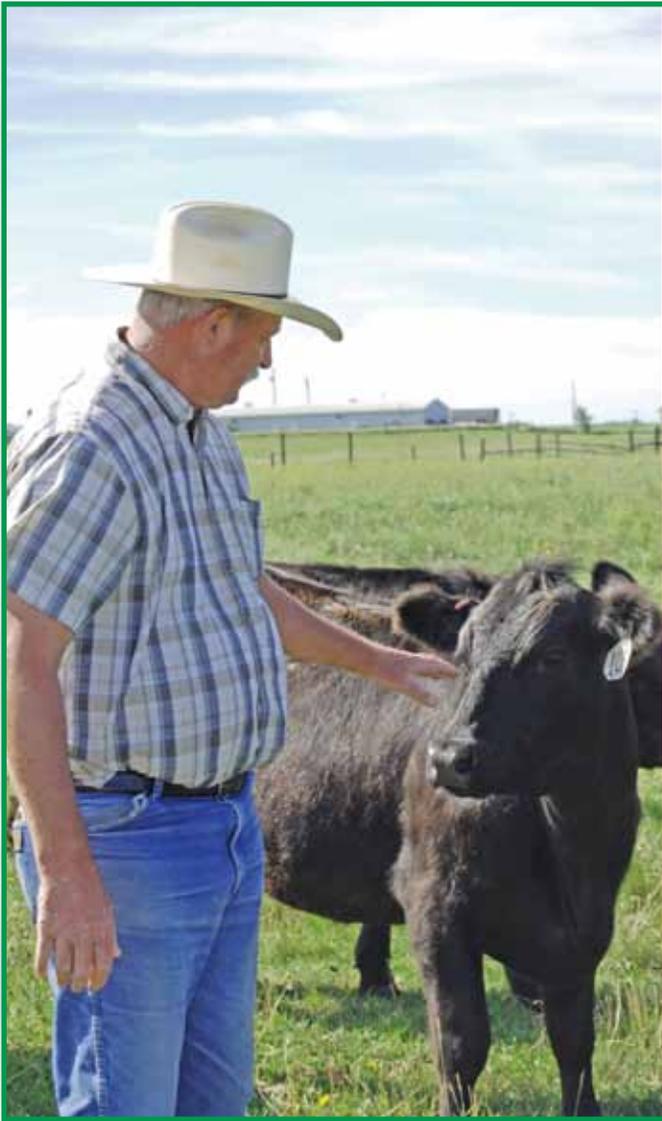


PRACTICAL EUTHANASIA OF CATTLE



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OVERVIEW

Livestock caretakers have an obligation to ensure the welfare of animals under their care. Euthanasia of an animal that is suffering from irreversible disease or injury is a primary responsibility caretakers assume. As per the "AVMA Guidelines for the Euthanasia of Animals (2013)" euthanasia is defined as: "A method of killing that minimizes pain, distress, and anxiety experienced by the animal prior to loss of consciousness, and causes rapid loss of consciousness followed by cardiac or respiratory arrest and death". The contents of this pamphlet are intended to aid caretakers, animal owners, livestock market operators, animal transporters, and veterinarians in choosing effective euthanasia methods.

The "AVMA Guidelines for the Euthanasia of Animals (2013)" recognizes and accepts three primary methods (two have conditions) of euthanasia for cattle:

- Intravenous (IV) administration of a lethal dose of a barbiturate or barbituric acid derivative to induce a transition from consciousness to unconsciousness and then death.
- Gunshot using an appropriate firearm and ammunition to cause physical disruption of brain activity by direct destruction of brain tissue.
- Penetrating captive bolt to induce unconsciousness in combination with an adjunctive step such as exsanguination, administration of IV potassium chloride, or pithing (increasing destruction of brain and spinal cord tissue) to ensure death.

When properly applied, the above euthanasia methods can cause rapid loss of consciousness and death with no detectable distress to the animal.

Cover photos: Top left, Adams Ranch by Bud Adams; top right, Donson breeding heifers by Leo Timms, DVM; bottom, Renee Dewell.

CONSIDERATIONS FOR SELECTION OF METHOD OF EUTHANASIA

When euthanasia is the most reasonable option for a compromised animal, the following elements should be considered to aid in the selection of the appropriate method:

1. HUMAN SAFETY: The first consideration in the choice of euthanasia method is human safety. For example, the use of a firearm carries greater safety risks when compared to other methods.

2. ANIMAL WELFARE: All methods of euthanasia should produce a rapid death with no detectable pain and distress. Select a euthanasia technique that considers human safety as well as animal welfare and is appropriate for the specific situation.

3. RESTRAINT: When performing euthanasia procedures, appropriate methods of restraint should be used. Some methods, such as captive bolt, require excellent restraint of the animal. Quality and availability of cattle chutes, halters, gates or other forms of restraint make certain forms of euthanasia more practical than others.

4. PRACTICALITY: An appropriate euthanasia technique must also be practical to use. For example, not all individuals responsible for carrying out euthanasia procedures have access to pharmaceuticals or firearms.

5. SKILL: Certain techniques require skill and training to accomplish correctly. Individuals responsible for conducting euthanasia should be trained in proper euthanasia protocol and should have access to appropriate, well-maintained equipment and/or medications.

6. COST: Euthanasia options vary in cost. Certain techniques, such as the use of firearms or captive bolt, require a larger initial investment, which may be defrayed over time if used often.

7. AESTHETICS: Certain euthanasia techniques, such as use of a barbiturate overdose, may appear more humane to the general public when compared to other techniques. Some methods, such as a penetrating captive bolt, may cause significant involuntary movements by the animal that may be misinterpreted as a voluntary painful response to those inexperienced in bovine euthanasia. When selecting a euthanasia method, potential negative reactions by the animal or observer should be considered.

8. DIAGNOSTICS: The selected euthanasia method should not compromise diagnostic sample collection.

9. CARCASS DISPOSAL: Carcass disposal is a critical consideration when selecting a euthanasia technique. Carcasses must be handled and disposed of in accordance with state and federal regulations. Options may include rendering, burial, composting, incineration and potentially landfills. Cattle euthanized using a barbiturate overdose may not be accepted at rendering facilities since the drug persists in residual material following the rendering process. In some regions, regulations require animals euthanized with barbiturates to either be incinerated or buried. Appropriate disposal of the carcass prevents scavenging and potential toxicity issues among wildlife. Gunshot or captive bolt is often a viable option that may facilitate ease of disposal.

DECISION MAKING

Actions involving compromised cattle include treatment, slaughter or euthanasia. The following criteria should be considered when making a decision:

1. Pain and distress of animal
2. Likelihood of recovery
3. Ability to get to feed and water
4. Drug withdrawal time
5. Economic considerations
6. Condemnation potential
7. Diagnostic information

INDICATIONS FOR EUTHANASIA

The following conditions or situations may lead to an animal being compromised to such an extent that euthanasia is indicated:

- Fracture, trauma or disease of the limbs, hips or spine resulting in immobility or inability to stand
- Loss of production and quality of life (advanced age, severe mastitis, etc.)
- Disease conditions for which no effective treatment is known (i.e. Johne's disease, lymphoma)
- Diseases that involve a significant threat to human health (i.e. rabies)
- Advanced ocular neoplastic conditions ("cancer eye")
- Disease conditions that produce a level of pain and distress that cannot be managed adequately
- Emaciation and/or debilitation from disease, age or injury that resulting in an animal being too compromised to be transported or marketed
- Disease conditions for which treatment is cost prohibitive
- Extended drug withdrawal time for clearance of tissue residue
- Poor prognosis or prolonged expected recovery



Bud Adams, Adams Ranch

MECHANISMS OF EUTHANASIA

The agents of primary or adjunct euthanasia cause death by one of the three following mechanisms:

1. Direct depression of the central nervous system or organs necessary for life function (barbiturate overdose, intravenous administration of saturated potassium chloride or magnesium sulfate).
2. Hypoxia associated with agents or procedures that displace or block the uptake of oxygen (such as that caused by exsanguination).
3. Physical disruption of brain activity (such as that caused by gunshot, penetrating captive bolt, or pithing).

TABLE 1: APPROVED METHODS FOR PRACTICAL EUTHANASIA

Method	Risk to Human Safety	Skill Required	Potential Public Perception Issues	Adjunctive Method Required
Gunshot	High	Moderate*	Moderate: Some blood and motion	No
Penetrating Captive Bolt	Moderate	Moderate*	Moderate: Some blood and motion	Yes
Barbiturate Overdose	Low	Moderate*	Perceived well	No

* Operator training required

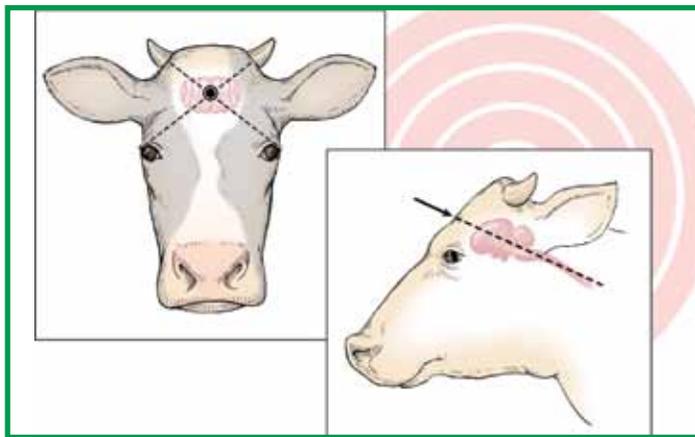


Figure 1. Optimal point of entry for bovine euthanasia with gunshot or captive bolt described as on the intersection of two lines each drawn from the lateral canthus (outer corner) of the eye to the center of the base of the opposite horn (or where horn would be).

ACCEPTED PRIMARY EUTHANASIA METHODS

1. GUNSHOT: When properly executed, gunshot induces instantaneous unconsciousness and death, is inexpensive and does not require close contact with the animal. It should be emphasized that this method should only be attempted by individuals trained in the use firearms and who understand the potential associated dangers. Firearm options include handguns (pistols), rifles or shotguns. Current recommendations suggest that the .22

caliber handgun or rifle loaded with a solid point bullet is sufficient for calves, but may not be the best choice for consistent use on adult animals.

The "AVMA Guidelines for the Euthanasia of Animals (2013)" recommends the use of solid-point bullets. Muzzle energy available from a .22 LR is in the range of 100 to 150 ft./ lb. (135 to 216.8 joules), whereas larger calibers such as the .38 Special, .357 magnum or 9 mm will push muzzle energies well above the 300 lb. (407 joules or greater) range. Rifles are capable of higher muzzle energies compared with handguns and are often a better choice in situations where a fractious animal must be shot from a distance. Finally, shotguns are very lethal at close range (less than 2 feet from point of intended entry) whether

loaded with shot-shells or slugs. The 12-, 16-, and 20-gauge shotguns are a good choice for euthanasia of adult cattle.

The 28 or .410 gauge shotgun is an excellent choice for use in calf euthanasia. If using a shotgun loaded with shot shells the operator should be very conscious of the distance

from the gun barrel to the animal as projectiles will spread out into a larger pattern that can greatly increase the risk of ricochet and operator and bystander injury. The firearm should be held within 1 to 2 feet from the intended target and the bullet should be directed perpendicular to the front of the skull to minimize the likelihood of ricochet. In cattle, the point of entry of the projectile should be at the intersection of two imaginary lines, each drawn from the outside corner of the eye to the base of the opposite horn as shown in Figure 1.

2. PENETRATING CAPTIVE BOLT: Captive bolt devices ("guns" or "stunners") are either penetrating or non-

penetrating. Only penetrating captive bolt devices are approved for euthanasia of mature bovines and, according to "AVMA Guidelines for Euthanasia of Animals (2013)", must not

be used as the sole method of euthanasia. The bolt gun must be placed firmly against the skull at the same entry point previously described for a gunshot. Since use of the captive bolt gun requires close proximity to the animal, adequate restraint and prior sedation or tranquilization may be required. It is critical to maintain and clean the





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bolt gun as described by the manufacturer. Additionally, selection of cartridge strength may vary among manufacturers and the appropriate type and strength for the size of the animal must be used. The optimal point of entry for the penetrating captive bolt is depicted in Figure 1.

3. BARBITURATE AND BARBITURIC ACID DERIVATIVES: When properly administered by the intravenous route, barbiturate overdose (60-80 mg/kg sodium pentobarbital IV) produces rapid unconsciousness and anesthesia followed by respiratory depression, hypoxia, and cardiac arrest. The barbiturate selected should be potent, long acting, and stable in solution. The carcass of barbiturate treated animals is considered unfit for human or animal consumption. Ingestion by wildlife or other animals can induce toxicities. (FDA-CVM 2003 <http://www.fda.gov/AnimalVeterinary/NewsEvents/CVMUpdates/ucm119205.htm>).

Finally, as mentioned previously, the use of pharmaceuticals limits carcass disposal options as renderers are less likely to accept animals euthanized by these methods.

DETERMINATION OF UNCONSCIOUSNESS

A state of apparent unconsciousness must be established immediately following the initial euthanasia procedure. In the field, the surrogate to unconsciousness is "lack of response" described below, as true unconsciousness can only be determined by EEG. The person performing euthanasia must be prepared to immediately apply an accepted euthanasia technique if any sign of consciousness is detected by the observer or demonstrated by the animal.

Secondary or adjunct euthanasia methods must not be performed until the animal has been determined to be unconscious.

SECONDARY OR ADJUNCT EUTHANASIA METHODS

A second shot, exsanguination, pithing and rapid intravenous injection of a concentrated solution of potassium chloride or magnesium sulfate may serve as adjunct

SIGNS OF UNCONSCIOUSNESS

- Absence of corneal reflex
- Absence of vocalization
- Absence of gag reflex (no voluntary tongue movements or swallowing)
- Lack of rhythmic respiration
- No coordinated attempt to rise or right itself

methods to ensure death following use of an acceptable primary euthanasia method.

EXSANGUINATION

This method can be used to ensure death subsequent to stunning, anesthesia, or unconsciousness. It must not be used as the sole method for euthanasia. The most common exsanguination method in the bovine is to lacerate both the jugular vein and carotid artery.

A 6-inch long sharp knife is fully inserted behind the point of the jaw and directed downwards until blood is freely flowing. Brachial vasculature can be lacerated by lifting a forelimb, inserting the knife deeply at the point of the elbow and cutting skin and vasculature until the limb can be laid back against the thorax of the animal. The aorta can be transected via the rectum, by a trained individual, so that blood pools within the abdominal cavity.

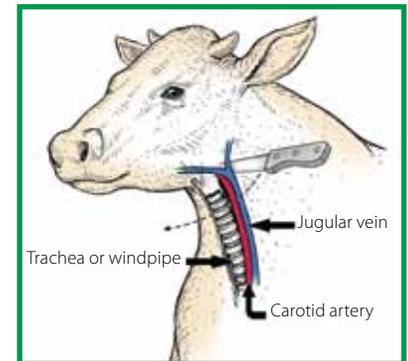


Figure 3. Exsanguination technique

J.K. Shearer

PITHING

Pithing is an adjunctive technique designed to cause death by increasing the destruction of brain and spinal cord tissue. It is performed by inserting a pithing rod or similar tool through the entry site produced in the skull by a bullet or penetrating captive bolt device. The operator



Dr. Dee Griffin

manipulates the pithing tool to destroy both brain stem and spinal cord tissue, which results in death.

POTASSIUM CHLORIDE (KCL)

Rapid IV administration of a saturated solution potassium chloride (KCl) induces cardiac arrest. Cattle must be anesthetized or unconscious prior to administration. The injection of xylazine or any other alpha-2 agonist has not been shown to induce anesthesia and must not be used alone. The use of a captive bolt is also acceptable if a state of unconsciousness is achieved. The specific dose of KCl will vary according to the size of the animal, but an injection of 250 ml of a saturated KCl solution is appropriate for most mature cows. The KCl solution should always be given to effect (i.e., until death).

MAGNESIUM SULFATE

Similar to potassium chloride (KCl), magnesium sulfate is approved for use only in anesthetized animals. Compared to the use of IV KCl, death is usually much slower.

CONFIRMATION OF DEATH

Confirmation of death following a euthanasia procedure is absolutely essential regardless of what method of euthanasia is chosen. Keep personal safety in mind when confirming death because animals can make sudden involuntary movements.

The following combination of criteria recommended by the AVMA includes: "...lack of pulse, breathing, corneal



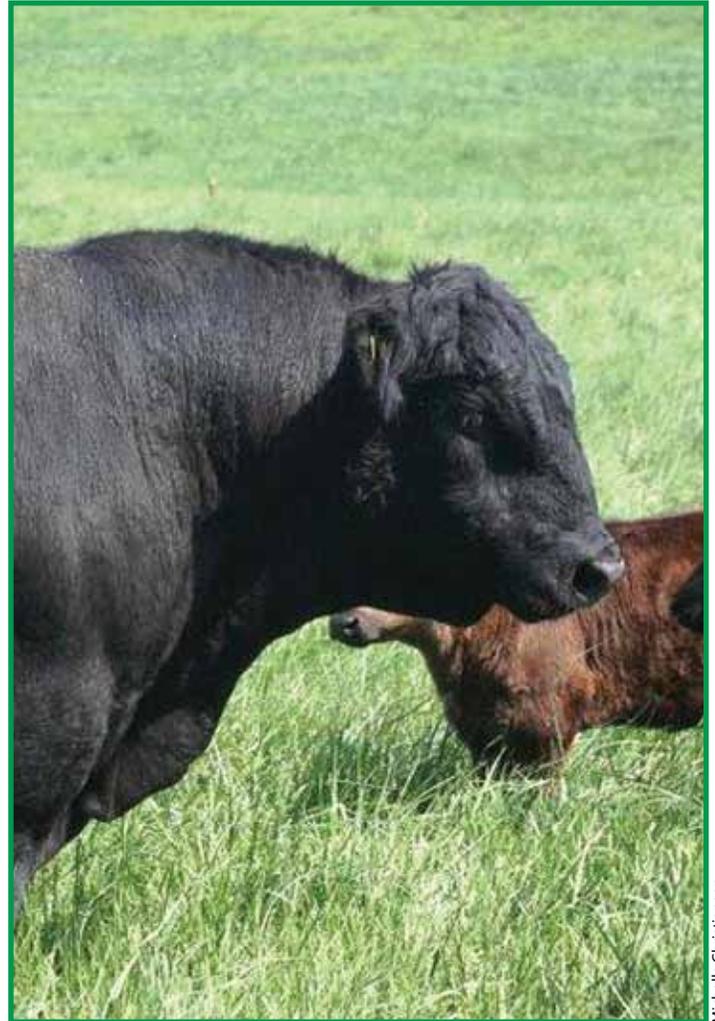
Renee Dewell

reflex and response to firm toe pinch, inability to hear respiratory sounds and heartbeat by use of a stethoscope, graying of the mucous membranes and rigor mortis. None of these signs alone, except rigor mortis, confirms death."

The presence of a heartbeat can be best evaluated with a stethoscope placed under the left elbow. Observation for movement of the chest indicates respiration. However, respiration rates may be very erratic in unconscious animals; therefore, one must be cautious in the interpretation of respiration for confirmation of death. Lack of heartbeat and respiration for three to five minutes should be used to confirm death. The corneal reflex may be tested by touching the surface of the eye. Normal or conscious animals will blink when the eye's surface is touched. Lack of a corneal reflex alone is not sufficient for confirmation of death. Continued monitoring of animals for a period of 20 to 30 minutes after euthanasia has been performed is also good advice to livestock owners and managers.

CONSIDERATION FOR EUTHANASIA OF CALVES AND BULLS

Calves and bulls require special consideration in selecting the proper method of euthanasia. Ethical considerations do not change for the calf because it is small or more easily handled. Blunt trauma by physical blow to the head is not acceptable for euthanasia of calves because the skull is too hard to consistently achieve immediate and lethal destruction of brain tissue. This method is also difficult to apply



Michelle Christianson

consistently because of restraint and complications in positioning the calf for effective use of blunt trauma methods. In addition to the methods outlined in Table 1 for mature bovines, the use of a purpose-built non-penetrating captive bolt stunner is an acceptable (with conditions) method of euthanasia for calves.

Euthanasia of bulls presents unique challenges because of their size, temperament, and thickness of their skull. Operator safety is of primary concern in euthanasia of bulls, and for certain techniques such as barbiturate overdose or captive bolt, proper restraint is critical. Bulls may be euthanized with specialized heavy-duty captive bolt guns or firearms capable of muzzle energies of 1000 ft. / lb., or by barbiturate overdose.

CONCLUSION

UNACCEPTABLE METHODS OF EUTHANASIA

Based on ethical and humane considerations, the “AVMA Guidelines for the Euthanasia of Animals (2013)” considers the following methods unacceptable techniques:

- Manually applied blunt trauma to the head of calves or mature cattle
- Injection of unapproved chemical agents or substances (e.g. disinfectants, non-anesthetic pharmaceutical agents)
- Sedation with alpha-2 agonist such as xylazine followed by potassium chloride, magnesium sulfate, or any other euthanasia method that requires the animal to be unconscious prior to its use
- Air injection into the vein
- Electrocutation with a 120-volt electrical cord
- Drowning
- Exsanguination of conscious animals

Personnel at sites that routinely handle cattle should be prepared with the knowledge, necessary skills, and well-maintained equipment to conduct euthanasia. Penetrating captive bolt and gunshot are the only two acceptable methods typically available to non-veterinarians for emergency euthanasia of cattle. Animal transporters should also be properly trained in euthanasia techniques and should have contact information for appropriate personnel in case of an emergency. An action plan for routine and emergency euthanasia should be developed and followed wherever animals are handled. Persons who perform this task must be technically proficient, mentally capable and possess a basic understanding of the anatomical landmarks and equipment used for humane euthanasia of animals. If there is any degree of question or discomfort with a proposed euthanasia procedure, a veterinarian should be consulted.

Livestock markets and sale yards should have written euthanasia protocols to follow and trained personnel should be available for emergency euthanasia during all shifts. When practical, select a location where the carcass can be easily reached by removal equipment.

Dead animals should be disposed of promptly and in accordance with all federal, state, and local regulations.



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