Anesthesia in Cattle

N. Kent Ames, *D.V.M., M.S.*
Thomas W. Reibold, *D.V.M.*
Dept. of Large Animal Surgery and Medicine
Michigan State University
East Lansing, Michigan 48824

Due to the nature of cattle, most surgical procedures can be accomplished with physical restraint and local anesthesia. This is an excellent method for most surgical procedures, but what about the procedures where more complete anesthesia is desired or required? How often is a surgical procedure not performed or performed inadequately because it would require the use of general anesthesia?

Local and Regional Anesthesia

First, let us look at the use of local and regional anesthesia. Local anesthetic agents prevent the conduction of nerve impulses along the nerves and thus, the patient perceives no pain. The agents themselves are weak acids, and do not work well in an acid medium such as an abscess. Small and non-myelinated nerves are more sensitive to the effects of the anesthetic agent than the large and myelinated nerves. The length of action of these agents is commonly increased by the use of epinephrine, which decreases the blood flow in the area and delays absorption. Likewise, hyaluronidase facilitates the spread of agent by breaking down tissue barriers.

Some of the common agents used in bovine practice are procaine[1], lidocaine[2] and mepivacaine[3]. Procaine can be combined with epinephrine and used for specific nerve blocks, local infiltration and epidural anesthesia. Lidocaine, which is 50% more effective than procaine at the 2% concentration, is also commonly used for local and regional anesthesia. Lidocaine is compatible with epinephrine and is commonly used for epidural anesthesia in the cow. Mepivacaine has a more rapid onset and prolonged effect when compared to lidocaine, and is used in a similar manner (4).

Some of the common regional nerve blocks used in cattle are: the Peterson block and retrobulbar eye block, the caudal epidural, proximal or distal paravertebral lumbar nerve block, and the intravenous infusion technique in the foot (1,2,3). Local infiltration of an area, as well as the ring block and the inverted "L", are commonly used for anesthesia in cattle (1,4).

Regional nerve blocks in calves may be more difficult due to slightly different anatomy and conformation in the growing animal. Procaine toxicity can also be a problem if the amount of procaine exceeds 2.7 mg/kg (6.0 mg/lb.) in calves (5).

General Anesthesia

The concepts of general anesthesia in cattle are very similar to anesthesia in other animals, except for a few species variations. Prior to anesthetizing any animal, a few precautions are necessary. A routine physical exam should be performed to determine the state of health of the animal. Particular attention should be paid to the cardiopulmonary system. Basic clinical pathology tests should be performed to obtain baseline data for the animal. These tests would include a complete blood count, serum electrolytes, minerals, blood urea nitrogen, and serum glutamic oxaloacetic transaminase. Animals with metabolic disturbances are poorer anesthetic risks than healthy animals.

All animals should be held off feed before general anesthesia. Adult cattle should be kept off roughage 48 hours; grain and concentrate, 24 hours; and water, 12 hours. This decreases the problem of tympany and regurgitation by decreasing the amount of ingesta within the rumen. Even with these precautions, about 25% of anesthetized cattle will regurgitate. Regurgitation does not seem to be as serious a problem in young calves. They should be held off feed for 12-24 hours and off water overnight.

Because cattle generally recover from anesthesia very smoothly, tranquilizers are usually not necessary. However, they may be used prior to anesthesia, much the same as they are in other species. Unfortunately, few if any tranquilizers are approved for use in food animals, and the practitioner must take full responsibility when using these agents.

Promazine[4], acetylpromazine[5], and xylazine[6] are three commonly used tranquilizers in cattle. Promazine and acetylpromazine are phenothiazine derivatives and are contraindicated in animals in shock, due to their alpha blockade and hypotensive actions. They are both commonly used in large

[1]Procaine, W.A. Butler Co., 5079 Canterbury St., Brighton, Mich. 48116.
[2]Lidocaine, W.A. Butler Co., 5079 Canterbury St., Brighton, Mich. 48116.
[3]Carbocaine, Invenox Pharmaceuticals, Div. of the Mogul Corp., Chargrin Falls, Ohio 44022.
[4]Promazine, Ft. Dodge Labs, Fort Dodge, Iowa 50501.
[5]Acepromazine, Ayerst Labs, Vet. Med. Div., 685 Third Ave., N.Y., N.Y. 10017.
[6]Rompun, Haver-Lochart Labs, Kansas City, Mo. 64100.

animals and can be given intramuscularly or intravenously at approximately the same dose used in horses. Their analgesic properties are less than that of xylazine, which is a very potent sedative in cattle.

Xylazine is not approved for use in cattle at the present time in this country and has been the subject of several malpractice suits. Its action is dose related. The most serious potential complications are bloat and regurgitation, with aspiration pneumonia. Holding the animal off feed and water will decrease the likelihood of these complications. Since cattle are so sensitive to this drug, the dosage is extremely important. Only 1/10-1/20 of the calculated equine dose is required in cattle. A tuberculin syringe and/or a diluted product, such as in the small animal preparation, should be used to assure proper dosage.

Atropine[7] may be administered at 0.13 mg/kg (0.06 mg/lb.) to decrease salivation. However, this is open to controversy, and some people contend that atropine only decreases the volume by increasing the viscosity of the saliva and should not be given.

Prior to anesthesia, the patient's mouth should be washed out to remove food particles that may be aspirated or pushed into the trachea by the endotracheal tube.

There are a number of intravenous anesthetics that can be used in cattle. Chloral hydrate given slowly as a 7% solution at 20-30 ml/45.5 kg (20-30 ml/100 lb.), or to effect, can be an effective agent. It can also be used in combination with magnesium sulfate and pentobarbital (Equithesin[8]). The long recovery period and lack of control of the depth of anesthesia are the major disadvantages (4).

Pentobarbital can be given at 26 mg/kg (12.0 mg/lb.) total dose. Half of the calculated dose should be given quickly and the remainder to effect. The dose can be decreased if tranquilizers or sedatives have been given to the patient. Again, the most serious disadvantages are the long recovery period and the lack of control of the depth of the anesthesia (4).

The ultra-short thiobarbiturates, sodium thiamylal and sodium thiopental (Surital[9] and Pentothal[10]) can be given at 6.6 mg/kg (3.0 mg/lb.) rapidly intravenously as a 2.5-5% solution (2.5% for calves). Anesthesia is maintained with small additional increments. The total dose should be kept as low as possible (11.0 mg/kg [5 mg/lb.] maximum) to shorten the recovery time (4).

Glyceryl guaiacolate (Glycodex[11]) given rapidly intravenously is a good muscle relaxant in cattle. This product has very little analgesic actions by itself, but can be combined with 2.0 gm of a thiobarbiturate per liter to give it analgesic properties. The dose of glyceryl guaiacolate is 2.2 ml/kg (1.0 ml/lb.) of a 5% solution. This dose may be lessened and given to effect with the thiobarbiturate. Glyceryl guaiacolate is not approved for use in food animals (4).

All cattle under general anesthesia should be intubated to prevent regurgitation and aspiration. If an endotracheal tube is not available, position the animal's head such that any fluid would run out the animal's mouth. Other supportive care would include intravenous fluids in the form of lactated Ringers or saline, depending upon the acid-base balance of the cow. Equipment should be available to assist ventilation and to supply oxygen if it is needed. It may be advantageous to administer oxygen to cattle via a nasal tube if intravenous anesthesia is being used. Cattle require the same type of padding that horses do to prevent nerve and muscle injury (4).

Inhalation anesthesia is the preferred method for general anesthesia in cattle, because the depth of anesthesia can be controlled and the recovery time is rapid. Halothane[12] is the agent of choice. Methoxyflurane[13] requires a longer induction and recovery. Nitrous oxide is not commonly used, other than for induction. It tends to accumulate in the rumen, causing tympany (4).

Induction can be accomplished with an intravenous agent or by masking the animal down. Mask induction can be easily performed in calves with halothane and oxygen. Nitrous oxide can be added to the gas mixture as 50% of the total flow to hasten induction by utilizing the second gas effect. Adult cattle are usually restrained on a surgical table and intravenous anesthesia agents given for induction. Some of the more commonly used combinations are the thiobarbiturates given rapidly as a bolus at 6.6-8.5 mg/kg (3.0-4.0 mg/lb.) or a 5% glyceryl guaiacolate - 0.2% thiobarbiturate solution given rapidly to effect through a large bore needle (12 ga. in adults, 14-16 ga. in calves). The calculated dose is 2.2 ml/kg (1.0 ml/lb.).

Intubation is one of the more difficult procedures when using general anesthesia in cattle. It can be accomplished in one of three ways. One, it can be done blindly with the cow's head in extreme extension by gently passing the endotracheal tube during inspiration. The second method is placing the hand in the mouth, depressing the epiglottis, locating the larynx, and inserting the endotracheal tube. The last method is commonly used in small calves. It involves the use of a long bladed laryngoscope (205-250 mm) to visualize the larynx and allow passage of the endotracheal tube. In all cases, a mouth or dental speculum should be used to avoid trauma to the tube, the hand or the laryngoscope. After intubation, the animal is connected to the machine with the O_2 flow

[7]Atofate, W.A. Butler Co., 5079 Canterbury St., Brighton, Mich. 48116.
[8]Equithesin, Jensen-Salsbery Labs, 520 W. 21st St., Kansas City, Mo. 64141.
[9]Surital, Parke-Davis, P.O. Box 476, 3300 E. Jefferson, Detroit, Mich. 48207.
[10]Pentothal, Upjohn Co., 301 Henrietta St., Kalamazoo, Mich. 49006.
[11]Glycodex, Ganes Chem. Works, 535 Fifth Ave., N.Y., N.Y. 10017.
[12]Fluothane, Ayerst Labs, Vet. Med. Div., 685 Third Ave., N.Y., N.Y. 10017.
[13]Metofane, Pitman-Moore Inc., P.O. Box 344, Washington Crossing, N.J. 08560.

rate at 8.0-17.6 ml/kg/min. (4.0-8.0 ml/lb./min.), with 4.0-5.0% halothane to complete induction.

Monitoring of anesthesia should concentrate on many of the same parameters that are used in horses. Because most anesthetic agents depress cardiac output and blood pressure, the patient should be monitored closely with parameters that give an indication of its cardiovascular system. These would include the heart rate, pulse strength, color, and capillary refill time (4). In anesthetized cattle, the normal respiratory rate is rather rapid at 20-40/min., and the heart rate is usually between 80-120 with pulse strong and the capillary refill time is 1-2 seconds. The pulse can be monitored by palpating the facial artery as it crosses the ventral border of the mandible or the common volar metacarpal arteries dorsal to the dewclaws.

The ocular reflexes are not reliable in assessing the depth of anesthesia in cattle. However, the movement of the globe can be used to monitor anesthesia. When the patient is in surgical anesthesia, the iris and pupil are centered between the lids. When the plane of anesthesia is too light or too deep, the globe will rotate ventrally (4).

Adult cattle can usually be maintained on 2.0-3.0% halothane with calves somewhat lower, at 1.0-1.5%. The animals should be manually ventilated every 5-10 minutes to activate the pulmonary surfactant and help prevent atelectasis and decrease CO_2 retention (4).

The recovery of cattle is usually smooth. The anesthesia plane should be decreased near the end of the procedure and the endotracheal tube left in place until the laryngeal reflex has returned. If regurgitation has occurred, position the head to let the fluids run out of the mouth. Try to have the animal maintain sternal recumbency as soon as possible to prevent complications from bloat. An attendant should be close by, although assistance is seldom necessary.

References

1. J.L. Noordsy. Personal Communication, Dept. of Surgery and Medicine, Kansas State Univ., Manhattan, Ks. - 2. W.J. Gibbons, E.J. Catcott, J.F. Smithcors, Editors. Bovine medicine and Surgery, First Ed. 1970. Published by Am. Vet. Pub., Inc., Wheaton, Ill. - 3. F.W. Oehme, J.E. Prier, Editors. Textbook of large animal surgery. The Williams and Wilkins Co., Baltimore, 1974. - 4. T.W. Riebold, D.O. Goble, D.R. Geiser. Principles and techniques of large animal anesthesia. Michigan State Univ. Press, East Lansing, Mich., 1978. - 5. S. Hartsfield. Personal Communication, College of Vet. Med., Texas A&M Univ., College Station, Texas.