

# Epidural Analgesia in the Dog

Lynn E. Halley, BS\*  
Dean H. Riedesel DVM, PhD\*\*

Epidural analgesia is the injection of an anesthetic agent outside the dura mater producing a reversible motor and sensory paralysis of the spinal nerves. This is in contrast to spinal analgesia, in which the local anesthetic is injected into the subarachnoid space. Spinal analgesia is more commonly performed in man than in animals for the following reasons: 1) in man, the subarachnoid space extends into the sacral canal, past the termination of the spinal cord at L1 or L2 and is readily available for subarachnoid injection; in the dog, however, the subarachnoid space extends only one segment distal to the termination of the spinal cord at L6-7 and thus is less acceptable for low lumbar puncture;<sup>1</sup> and 2) the relative ease and safety of application of epidural analgesia decreases the usefulness of subarachnoid analgesia.<sup>1</sup>

Epidural analgesia has experienced cyclic popularity since it was first reported in the dog and man in 1901.<sup>1</sup> Because of the usefulness of this technique, a review of the anatomy of the lumbar area, the technique of epidural injection, the mechanism of action and pharmacology of the local anesthetic and the indications and possible complications of epidural analgesia is needed.

## ANATOMY

The spinal cord is encased in three protective meninges: the pia mater, the arachnoid membrane and the dura mater. The innermost meninx is the pia mater. It is separated from the arachnoid membrane by the subarachnoid space which is filled with cerebrospinal fluid. The arachnoid membrane is separated from the dura mater by the subdural space, a potential space which contains a

film of serous fluid. The most superficial and protective meninx is the dura mater. It is separated from the periosteum of the spinal canal by the epidural space which is filled with fat.<sup>2</sup>

The spinal cord tapers in the lumbar area to form the conus medullaris. In most dogs, the spinal cord terminates at the cranial border of L7; in small dogs, it often extends to the lumbosacral vertebral junction. The dura mater extends one additional vertebral segment caudally. The cord caudal to the conus medullaris consists of caudally directed sacral and caudal spinal roots comprising the cauda equina. Most of the cauda equina lies caudal to the dural sac in the dog.<sup>2</sup>

In the dog, the epidural space is easily entered at the lumbosacral vertebral junction. The intervertebral space here is large, accessible and has prominent external landmarks.<sup>3</sup> In addition, the danger of puncturing the subarachnoid space and striking the spinal cord is minimal in this area.<sup>4</sup>

## TECHNIQUE

The major external landmarks for injection in the epidural space are the dorsal spinous processes of L6, L7 and S1 and the right and left dorsal iliac crests.<sup>3</sup> The patient can be positioned sternally with the rear legs pulled cranially or in a flexed lateral position.<sup>3</sup> These positions open the intervertebral space maximally. Dogs seem to resent sternal positioning least, however the primary factor in determining the position depends on the comfort and condition of the animal.<sup>5</sup>

The area between L6 and S1 and the iliac crests is clipped and surgically prepared with surgical soap and alcohol scrubs. Aseptic technique is used. The thumb and middle finger of one hand are placed on the iliac crests and the index finger is used to palpate the dor-

\*Ms. Halley is a fourth-year student in the College of Veterinary Medicine, Iowa State University.

\*\*Dr. Riedesel is an associate professor in Veterinary Clinical Sciences at Iowa State University.

sal spinous processes of L6, L7 and S1. The dorsal processes of L6 and L7 are prominent and pointed, in contrast to the median sacral crest which is lower, longer and has several ridges.<sup>5</sup> The index finger is now used to locate the intervertebral space on the midline. The spinal needle is inserted exactly on the midline, perpendicular to the skin in the L7-S1 depression.<sup>3</sup> A local skin block may be used if necessary. The spinal needle is advanced until it "pops" through the ligamentum flavum and enters the epidural space.<sup>3,5</sup> Some authors advocate advancing the needle until the floor of the vertebral canal is reached and then withdrawing a short distance.<sup>6</sup> Other authors feel this is not necessary for proper placement and should never be done intentionally.<sup>5</sup> Once the needle is in the epidural space, the stylet is removed and aspiration with a syringe for blood or cerebrospinal fluid is attempted. If either are aspirated, the needle should be repositioned.<sup>4,5</sup> The most common method of determining proper position of the needle in the epidural space is lack of resistance to injection. If the needle is in the epidural space, the anesthetic agent should flow smoothly and easily.

It is important to have the bevel of the needle directed toward the site of action, as this will direct the flow of the anesthetic agent in the epidural space. Unless a perineal block is desired, the bevel is usually directed craniad.<sup>5</sup>

Some discomfort may be noted by the dog to the injection. If this occurs, the injection should be stopped for a minute or two, then continued. No further discomfort is usually seen.<sup>3</sup> If more analgesia is desired on the right or left side, the dog is placed with that side down for five minutes to enhance regional absorption.<sup>3</sup>

The effectiveness of analgesia can be tested in approximately five minutes by examination of tail tone, anal tone and rear leg flexor reflex. Complete analgesia should be seen within 15 minutes.<sup>3</sup>

### RESTRAINT

Unless the animal is quite depressed or lethargic, a premedication should be used to reduce apprehension and struggling.<sup>4,5</sup> This serves to balance or complete the anesthetic effect.<sup>7</sup> Hypotensive agents such as phenothiazine tranquilizers should be used cautiously, as decreased blood pressure can be

a complication of epidural analgesia.<sup>5</sup> Narcotics are preferred in the dog because they can be reversed if the animal becomes severely depressed.<sup>5</sup>

### LOCAL ANESTHETIC AND DOSE

Many local anesthetics have been used for epidural analgesia (See Table 1). Selection of a local anesthetic depends, in part, on the duration of analgesia desired. Bupivacaine<sup>a</sup> is commonly used when a long surgical procedure is anticipated. Bupivacaine is highly lipid-soluble and thus undergoes less distribution into the circulation than less lipid-soluble agents such as Lidocaine.<sup>b</sup> Lidocaine is a commonly used local anesthetic for shorter procedures. Other factors affecting the duration of analgesia produced include the concentration of the anesthetic, the cranial extent of the blockade, and the rate of systemic absorption from the epidural space.<sup>3,5,7</sup>

TABLE 1<sup>1</sup>  
LOCAL ANESTHETIC DRUGS

Generic Name	Duration (hours)
2-Chloroprocaine	¾-1 ½
Lidocaine	1-2 ½
Mepivacaine	1-2 ½
Prilocaine	1-3
Bupivacaine	2-5 ½
Etidocaine	2-6

The cranial extent of the blockade depends on several factors. The most important of these is the volume of drug injected. For the "average" dog, 1 ml/4.5 kg (10 lb) will produce a blockade to L1; 1 ml/3.4 kg (7.5 lb) will produce a blockade to T5; for perineal surgery, 1 ml/4.5 kg (10 lb), with the bevel of the needle directed caudad, is adequate.<sup>5</sup> If the higher cranial blockade is undesirable, a continuous technique may be used. This entails the placement of a spinal catheter in the epidural space through the spinal needle. The catheter is taped or sutured to the back of the animal and positioned to be easily accessible after the animal is draped. Lidocaine is commonly used with the continuous technique; a dose of one-half the initial dose (with epinephrine) is added every hour.<sup>5</sup>

The duration of the blockade can be prolonged by the addition of epinephrine to the

<sup>a</sup>Bupivacaine HC1, Abbott Hospital Products, North Chicago IL 60064

<sup>b</sup>Lidocaine HC1, Abbott Hospital Products, North Chicago, IL 60064

local anesthetic. This decreases the rate of systemic absorption. In addition to increasing duration, it also decreases the chance of attaining toxic blood levels of the local anesthetic.<sup>5</sup> The epinephrine should be added to the local anesthetic immediately before use. A small amount of epinephrine (1:1000) is drawn into the syringe and then expelled. The epinephrine left in the dead space of the syringe will approximate a 1:200,000 dilution when the syringe is filled with the local anesthetic.<sup>5</sup> The local anesthetic used should be packaged in single-dose vials, without epinephrine or preservatives.<sup>5</sup>

Proper technique is critical. A complete absence of analgesia is most commonly due to a misplaced injection. Incomplete blockades can be the result of an inadequate volume of anesthetic agent, improper bevel direction or receding analgesic level during a prolonged procedure.<sup>5</sup>

**MECHANISM OF ACTION,  
PHARMACOLOGY AND  
PHYSIOLOGICAL EFFECTS**

Local anesthetics block the nerve fibers in proportion to their diameter, the smaller-diameter fibers being affected first and more rapidly. This produces a zone of differential blockade; sensory fibers are affected first, then sympathetic fibers and last, motor fibers.<sup>5</sup>

The anesthetic agent spreads longitudinally in the epidural space. Anesthetic uptake occurs by vascular absorption, leakage through the intervertebral foramen, dural cuff penetration, epidural fat uptake and diffusion through the spinal cord dura into the subarachnoid space.<sup>2</sup> The most important of these is thought to be dural cuff penetration allowing the local anesthetic to ascend and descend along the nerve axon.<sup>8,9</sup>

Local anesthetics block both the generation and conduction of nerve impulses.<sup>9</sup> The membrane of the axon is thought to be stabilized by blocking the flux of sodium and potassium, thus preventing the passage of the nerve impulse.<sup>1,8</sup>

Complications, although uncommon, do occur and it is wise to be prepared for them. Hypotension can occur from the direct cardiovascular effects of the local anesthetic, with or without epinephrine, in addition to the decrease in sympathetic tone that occurs when the anesthetic agent extends into the thoracic area, producing vasodilatation caudal to the

level of the blockade. Rapid fluid replacement will usually correct this.<sup>5</sup> If this is ineffective, a combined alpha and beta stimulator such as ephedrine<sup>c</sup> can be used to produce peripheral vasoconstriction and cardiac stimulation. Because of this possibility of hypotension, epidural analgesia should be used cautiously, if at all, in the hypovolemic or shock patient.<sup>3,5</sup>

Respiratory depression can result from a very high cranial blockade (C5 to C7) producing paralysis of the intercostal muscles and phrenic nerves. It can also result from ischemia of the respiratory center due to profound hypotension. If blood pressure is maintained, however, respiratory function is usually uninfluenced even in very high epidural blockade.<sup>3,5</sup>

Rarely, persistent blockade of the nerve supply to the bladder can occur. Also, persistent paralysis can occur, most commonly due to infection, degenerative lesions or hemorrhage.<sup>4</sup>

**DISCUSSION**

Epidural analgesia can be used for any surgery performed caudal to the diaphragm, in addition to minor procedures such as cast application, soft tissue debridement and abdominal palpation<sup>3,5</sup> (See Table 2). It has been used extensively for cesarean section in man and in dogs.<sup>5,7</sup> Because of the excellent post-operative analgesia produced, it is useful in

**TABLE 2<sup>3</sup>**  
**INDICATIONS FOR EPIDURAL**  
**ANESTHESIA**

Rectal/anal/perianal surgery
Femoral head and neck excision
Pelvic limb amputation
Exploratory laparotomy
Coxofemoral joint surgery
Fractured femur
Lymph node biopsy
Pelvic trauma
Soft tissue debridement
Ovariohysterectomy
Joint tap
Stifle surgery
Tail amputation
Castration
Cast application
Lymphangiogram
Scrotal ablation
Mammary gland surgery

<sup>c</sup>Ephedrine Sulfate, Vitarine Co., Inc. Springfield Gardens, N.Y. 11413.

very painful procedures such as rectal, perineal or orthopedic surgery.<sup>5</sup> Following pelvic limb amputation, dogs show minimal post-operative pain.<sup>3</sup> It also has minimal effect on the body as a whole, giving it some advantages over general anesthesia in the aged, toxic or debilitated patient. Some pre-existing problems that might warrant epidural analgesia include hepatic, renal and pulmonary disease.<sup>5</sup> Additionally, epidural analgesia provides excellent muscle relaxation, is minimally expensive and is technically easy to perform.<sup>3,5</sup>

Disadvantages to epidural analgesia include transient hypotension, apnea from a cranial (C5 to C7) blockade, restraint in some patients and inadequate blockade due to poor placement.<sup>3,5</sup> In addition, epidural analgesia should be avoided in the following situations: 1) shock, hypovolemia or circulatory collapse, 2) local lumbosacral infections, 3) vertebral column deformities, 4) ataxia or paresis of nervous origin, 5) septicemia and 6) whenever there is damage to the spinal cord or meninges.<sup>4,5</sup>

As with any anesthetic protocol, epidural analgesia should be tailored to the patient and the surgical procedure. Selection of the patient is important to the success of this technique.

Because epidural analgesia is often utilized in patients where minimal anesthetic effects are desired, it is preferable for the patient to be tranquilized as little as possible. A docile dog is thus the best candidate for this technique. Use of aseptic technique, experience with the procedure, knowledge of pharmacology of the anesthetic agent and efficient monitoring will decrease the possibility of complications and make epidural analgesia a useful adjunct to many practices.

## REFERENCES

1. Soma LR: *Textbook of Veterinary Anesthesia*. Baltimore, Williams and Wilkins, 1971.
2. Miller ME, Christensen GC, Evans HE: *Anatomy of the Dog*. Philadelphia, WB Saunders, 1979.
3. Bradley RL, Withrow SJ, Heath RB, Perkins D, Kirkwood M, Megler R: Epidural Analgesia in the Dog. *Veterinary Surgery* Oct-Dec, 1980.
4. Archibald PR: *Canine Surgery*. Santa Barbara, CA American Veterinary Publications, Inc., 1971.
5. Klide M, Soma LR: Epidural Analgesia in the Dog and Cat. *JAVMA* 153:165, 1968.
6. Bone JK, Peck JG: Epidural Anesthesia in Dogs. *JAVMA* 128:236-238, 1956.
7. American Society of Anesthesiologists: *Annual Refresher Course Lectures*. New Orleans, 1981.
8. Bromage PR: *Epidural Analgesia*. Philadelphia, WB Saunders, 1978.
9. Gilman AG, Goodman LS, Gilman A: *The Pharmacological Basis of Therapeutics*. New York, Macmillan Publishing Co., Inc., 1980.

## BOOK REVIEW

*Atlas en couleur d'anatomie des bovins. Splanchnologie. By Claude Pavaux (Color Atlas of Bovine Anatomy. Splanchnology). Maloine s.a., Paris 1982. Price Frs. 194.00 (approximately \$28.00).*

On 131 pages the viscera of the head, neck, thorax, abdominal and pelvic cavities are illustrated in 197 color photographs and labeled in accompanying legends. An additional 7 pages and 15 photographs are devoted to the lateral abdominal wall, 4 pages and 8 photographs and legends to the mammary glands followed by 6 pages of index and 7 pages of literature references. This is an attractive, handy (5¼"x7¾") text printed on glossy paper for convenient use in the gross anatomy laboratory. The photographs have been selected from a large color slide collection taken during the past 20 years from specimens dissected by the veterinary medical students in the gross anatomy laboratory of the School of

Veterinary Medicine in Toulouse/France. They have been carefully chosen to represent mainly areas of interest and importance to the practicing veterinarian. Most figures are of excellent quality, their didactic value is beyond question (see for example the section on uterus and gravidity), and any student of gross anatomy will find them most instructive. However, since text and legends are in French, the nonfrancophonic student will have to rely on making an educated guess when trying to find the name of a particular structure or refer to the latin nomenclature at the end of the booklet: a rather cumbersome, tedious and certainly frustrating way of identification. Still more difficulties can be expected with the text. Since an English translation is currently being prepared, I recommend that those who are willing to pay the rather high price for a treatise of parts of the bovine anatomy wait until the English edition is on the market.

H. DIETER DELLMANN