CORD ANESTHESIA IN RABBITS

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THE LABORATORY RABBIT is a most useful experimental animal, but ease of anesthesia is not among its virtues [1]. Relatively insensitive to minor pain and manipulation, it retains a most annoying degree of cutaneous sensibility with conventional intravenous and intraperitoneal agents. When subjected to experimental burns under barbiturate anesthesia, the animal may be pulseless and apneic and yet contort and distort its cutaneous surface when a superficial burning device is applied. This problem recently led to an examination of anesthesia methods for the lagomorph and resulted in development of the technique to be described.

Perhaps because barbiturates are hypnotics rather than anesthetics and produce considerable respiratory depression before unconsciousness occurs [2], rabbits seem to retain their cutaneous sensitivity even when more vital functions are suppressed. Other agents, such as the inhalants, some of which are flammable, may require considerable manipulation during performance of an experiment. With a burning device, use of a flammable agent is hazardous, and the careful maintenance of anesthesia by another person adds to the expense and ease of animal manipulation.

After review of the literature and discussions with veterinarians failed to suggest a more satisfactory agent, spinal anesthesia was considered. Although it seems likely this method has been used in rabbits, no literature was found which described or discussed such a technique. Subsequently, a method effective in our hands was developed and used throughout a study involving burns of rabbit skin. Since it appears the technique may have wider application, it is presented for consideration.

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MATERIALS AND METHODS

ANATOMY. The rabbit is generally known to be a vertebrate, a mammal with excellent reproductive abilities. It is a lagomorph, that is, a member of the mammalian order *Lagomorpha,* resembling a rodent, but having two pairs of upper incisors. Its vertebral arrangement is similar to that in humans through the thoracic level, but differs below, there being 7 lumbar, 4 sacral, and 14 to 16 caudal vertebrae. Also similar to man, but more caudally, the spinal cord ends in a *cauda equina* in the lower lumbar area.

Coverings of the cord are familiar: an inner pia mater, a filmy arachnoid membrane, and the overlying tough dura mater. The cord in the spinal canal is surrounded by the vertebral bodies with their processes and their protective and supportive muscles and ligaments; of which the supraspinous ligament overlies the spinous processes and between which processes runs the interspinous ligament.

Spinous processes are directed cephalad in the lumbar area, lying between the inferior articulatory processes of the next superior-adjacent vertebra, and with these processes forms a pathway through which a needle may be passed to lie within the canal.

ANESTHETIC AGENTS. While it would seem that nearly any local anesthetic would be effective, for simplicity a readily available and familiar agent, lidocaine hydrochloride, 1%, and lidocaine hydrochloride, 1%, with epinephrine 1:100000 was used, mixed with an equal volume of a 50% solution of dextrose in water to produce a hyperbaric solution. Tetracaine was not used, but would seem likely to give longer anesthesia, if desirable.

TECHNIQUE. For purposes of the experiment which followed anesthesia, the flank skin was clipped and depilated with a commercial depilatory (Surgex) 24 hours prior to anesthesia. This depilation did not involve the hair over the vertebrae. The day of the experiment, the rabbit was placed in a commercial rabbit holder of the "squeeze box" variety and compressed to arch the vertebral column. Arching separates the vertebral spines and tends to displace the cord toward the ventral surface of the canal where it is less likely to be stimulated by the advancing needle. The desirable vertebrae of the lumbar area are placed in a favorable position by the compression, and are located between the wires of the holder by manipulation.

At this point, the twelfth rib is located by palpation and its vertebra and vertebral spine determined. From this, the second lumbar spine is located; and the 21-gauge, 1½-inch spinal needle, bevel directed caudally, is introduced through the supraspinous ligament perpendicularly, anterior to this spine. Once through the supraspinous ligament, a level easily determined by the decreased resistance to pressure, the needle is directed forward and down toward the first lumbar spine, angling only slightly toward either side. The needle passes immediately lateral to the spinous process and medial to the adjacent inferior articulatory process until the firm resistance of the dura is encountered.

The needle is slowly passed through the dura, *bevel downward*, and the hub is examined for spinal fluid. If none appears, the needle is advanced 1 to 2 mm. and again examined. Depending on previous experience, if no fluid appears, the needle may be advanced further, or the anesthetic agent may then be introduced regardless. If the needle is still extradural, ordinarily a satisfactory, though shorter duration, anesthesia of the extradural type will result (Figs. 1 and 2).

Before injection of the anesthetic, an assistant raises the holder and rabbit vertical, head up, and 1 cc. of the hyperbaric solution is slowly injected and the needle withdrawn. After 3 minutes, the rabbit is lowered and examined. By this time, the anesthetic agent is fixed and little or no increase in anesthetic level will occur. The animal may then be lifted from the holder by grasping the neck skin, which will make obvious the level and quality of anesthesia.

COMPLICATIONS. The most dramatic complication is needle irritation of the cord. This event will produce violent paraspinous muscle contracture, despite the holder, usually dislodging the needle. Although there was concern about possible transverse myelitis in these rabbits, no gross or microscopic changes were seen on postmortem examination, and surviving animals had no apparent functional deficit.

Less dramatic, but more lethal, was phrenic paralysis from an unfortunately high anesthesia. This was a frequent early complication but did not occur in the last 25 animals.

No irritation of cord or meninges was seen post-spinal injection, grossly or microscopically.

RESULTS

Successful spinal or epidural anesthesia was achieved in all 95 rabbits. No records were kept of the precise time duration anesthesia remained effective, because of the demands of the concurrent burning experiment; but when complete spinal anesthesia was achieved, successful levels were at T-1 to T-4 and lasted for 45 to 60 minutes. Corresponding levels and durations for epidural anesthesia were T-6 to

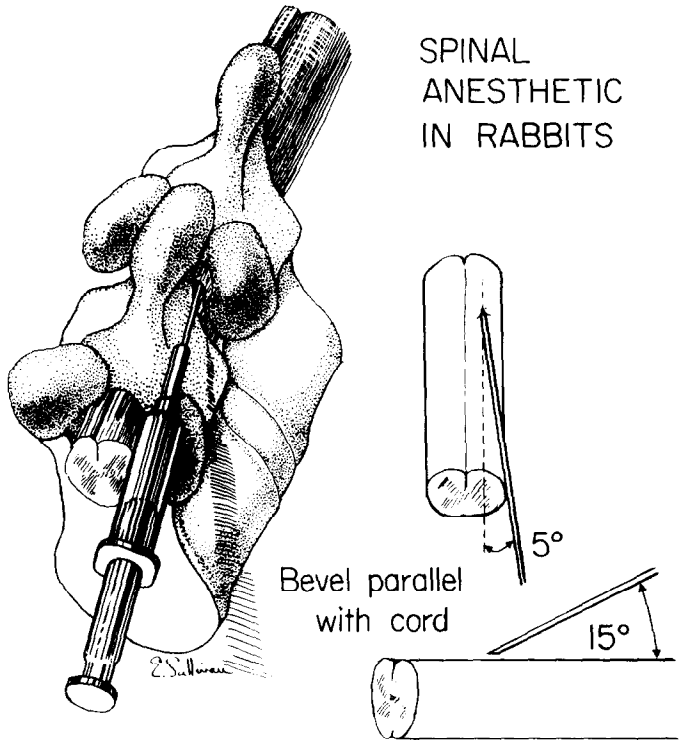

Fig. 1. This illustration indicates the correct placement of needle and its bevel in relation to the vertebral processes and canal.

Fig. 2. The angulation of the needle when properly in place may be seen from this photograph, as well as the lumbar flexion produced by the rabbit holder.

T-8 and 20 to 30 minutes. Epinephrine in a 1:100000 concentration prolonged anesthesia approximately 50% of the base time cited.

Of the last 95 animals, 10 died with phrenic paralysis, but none was among the last 25, indicating in our judgment that practice, positioning of the rabbit holder, and slow injection give improved results (Table 1).

Table 1. Mortality of Cord Anesthesia in Rabbits[a]

		Died	
	No.	No.	%
Group I	11	2	18.2
Group II	84	8	9.5
Total	95	10	10.5

[a]Mortality figures in the experimental series of successful spinal anesthesia. Surgical anesthesia was accomplished in every animal in which it was attempted.

Among the first 11 animals, 3 were reanesthetized after an initial failure of anesthesia, and 2 died from the effects of high spinal anesthesia. Of the subsequent 84 animals, 8 died from phrenic paralysis and no record was kept of repeat spinal anesthesia.

SUMMARY

A method is presented for spinal cord anesthesia in rabbits.

Advantages of the technique are high quality complete anesthesia in a selected area and, in many cases, reduced personnel and material requirements.

Of 95 animals anesthetized, 11 died from respiratory paralysis, none in the last 25.

REFERENCES

1. Gardner, Alvin F. The development of general anesthesia in the albino rabbit for surgical procedures. *Lab. Anim. Care* 14:214, 1964.
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