STUDIES ON EPIDURAL ANAESTHESIA IN GOATS

By

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THESIS

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DECLARATION

I hereby declare that this thesis entitled "STUDIES ON EPIDURAL ANAESTHESIA IN GOATS" is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship, or other similar title, of any other University or Society.

Mannuthy,
27-7-1981.

K.RAJANKUTTY

CERTIFICATE

Certified that this thesis, entitled "STUDIES ON EPIDURAL ANAESTHESIA IN GOATS" is a record of research work done independently by Sri.K. Rajankutty under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship, or associateship to him.

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INTRODUCTION

INTRODUCTION

Anaesthesia is an essential prerequisite in surgery, since it abolishes perception of pain in patients and hence the efficiency of surgery is improved. In veterinary patients anaesthesia can be accomplished by the administration of local anaesthetics at the site or along the course of the peripheral nerves and spinal cord or by the administration of general anaesthetics.

Epidural anaesthesia has been recommended for desensitizing the hind-quarters and the abdomen in animals. The advantages of epidural anaesthesia are the relative simplicity of administration, satisfactory muscular relaxation, rapid recovery and minimal effect on cardiovascular and respiratory systems. Epidural anaesthesia is often practised in goats, but it has not gained popularity as in large animals like cattle and horses.

Linzell (1964) and Nelson et al. (1979) had reported their findings on epidural anaesthesia in goats. These workers had not tried increasing doses of the local anaesthetic during their study. Hence, the present study was under taken with the object of finding out the effects of epidural administration of varying doses of lidocaine hydrochloride, two per cent solution with and without the addition of hyaluronidase.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Corning in 1885 was the first to introduce epidural anaesthesia in animals. Later, Sicard and Cathelin (1901) experimented on this technique in dogs. The technique of epidural anaesthesia was described by Pape and Pitzschki (1925) in horses, by Benesch (1926) in cattle and by Frank (1927) in cats (cited by Lumb and Jones, 1973).

Singh (1951) reported satisfactory anaesthesia in a she goat for caesarian section, following administration of 10 ml of two per cent solution of procaine hydrochloride with adrenaline at the lumbosacral epidural space.

According to St. Clair and Hardenbrook (1956) epidural injection of weak solutions of local anaesthetic would delay the onset and reduce the duration of anaesthesia.

Brook (1958) had observed persistent paralysis of the hind-limbs, usually bilateral and rarely unilateral, following epidural anaesthesia in sheep.

Hall (1958) reported that when a large volume of fluid was injected rapidly into the epidural space, arching of the back and opisthotonos were observed in cattle, which disappeared after a short period. This was attributed to rapid increase in the pressure within the epidural space.

For obstetrical manipulations, Oakley (1958) resorted to lumbosacral epidural anaesthesia in 26 sheep, of which four died within 24 hours, three showed transient unilateral hind-leg lameness and the remaining 19 were normal. The cause of the death was attributed to the escape of cerebrospinal fluid through the needle as a result of accidental dural puncture.

Tufvesson (1963) reported that in late pregnancy the quantity of drug required was less because the chance for the solution to spread was more.

In an experimental study, Linzell (1964) injected 8-10 ml. 1.5 per cent solution of lignocaine with adrenaline into the lumbosacral epidural space in goats, after inserting the needle to a depth of 3-4 cm. The injections were given after restraining the animals in standing position. Sensory paralysis was complete within 10-12 minutes and persisted for 2-2.5 hours, but motor paralysis was seldom complete. Anaesthesia was observed as forward as the first lumbar vertebral space in adult goats. Of the 75 animals where chloropromazine was administered as a premedicant, mild convulsions were noticed in 17 animals, after 1-2 minutes of the injection.

Westhues and Fritsch (1964) had reported considerable reduction in blood pressure in ruminants during anterior epidural anaesthesia.

For docking the tail of lambs, Bradley (1966) preferred epidural injection of local anaesthetics at the sacrococcygeal and first intercoccygeal space and considered the standing position to be the best for epidural injection.

Hopcroft (1967) conducted experiments on lumbosacral epidural anaesthesia in sheep using 8-12 ml, two per cent solution of Xylocaine. The onset of anaesthesia was reported to be within 2-10 minutes with an average of 4.6 minutes. The area of anaesthesia in a sheep weighing 35 kg extended up to the last rib anteriorly involving the entire abdomen, hind-quarters and hind-limbs. When epidural anaesthesia was administered without chlorpromazine premedication, some animals exhibited convulsive seizures. Accidental injection of a large volume (16 ml) of the solution produced death in one animal.

Klide and Soma (1968) reviewing the reports on epidural anaesthesia in dogs and cats stated that the size, age and obesity of the patient; quantity and strength of the drug; the speed of injection and the direction of the needle bevel were the factors which influenced the ultimate level of epidural blockade.

Koehler (1969) studied the postmorten changes in the spinal cord in cattle, where paralysis was noticed following epidural administration of heavy dose of procaine hydrochloride solution. No gross lesion of the spinal cord was observed, except occasional small intradural haemorrhages. Microscopical examination revealed serious circulatory disturbances in spinal cord and its branches resulting in liquifactive changes of myelin sheaths and pyknosis of ganglionic cells.

Musser and O'Neil (1969) reported that lidocaine did not cause vasoconstriction or vasodilation. The anaesthesia produced was more prompt, intense and involved a wide area than with procaine solution. The reactions resulting from systemic absorption were due to stimulation or depression of the cerebral cortex and medulla. The excitatory symptoms were slow in onset and manifested as dizziness, tremors and convulsions while those of depression were respiratory arrest, cardiovascular collapse and cardiac arrest.

Ritchie and Cohen (cited by Goodman and Gilman, 1970) reported that sleepiness was noticed in the experimental animals, as a result of systemic absorption of lidocaine when a large dose was administered.

Hall (1971) reported the toxic manifestations when local anaesthetic solution was injected into the venous plexuses within the epidural space. Epidural administration of large quantity of local anaesthetic sometimes produced fall in blood pressure due to paralysis of the splanchanic nerves. The spread of the anaesthetic solution within the epidural space depended u on the adipose tissue present, in the vertebral canal.

In pregnancy, the dose required for epidural anaesthesia was very low, according to Marx et al. (cited by Hall, 1971) because of the increase in vascularity of meninges and changes in the cerebrospinal fluid.

Soma (1971) reported that the ultimate level of epidural block was influenced by the position of the animal and the direction of the needle beval. One sided block sometimes occurred when the drug was injected keeping the animal to a side. When the animal was tilted to the head down position during injection, the drug was found to infiltrate more towards the head. In cranial, caudal or unilateral blocks, the direction of the needle was found to influence the flow of the anaesthetic.

For surgical procedures of the genital region in horses, Brankov et al. (1972) preferred lidocaine hydrochloride solution because of the muscular relaxation, when administered epidurally.

Lumb and Jones (1973) reported that addition of hyaluronidase to local anaesthetic solutions promoted its diffusion and absorption when locally infiltrated, but in epidural and spinal anaesthesia, the efficiency of local anaesthetic solution was not increased.

Bromage (1975) had mentioned three principal sites of action of local anaesthetic in epidural blockade in animals, viz., the spinal nerve roots, the spinal nerves in the paravertebral space and the spinal cord.

Nelson et al. (1979) carried out studies on epidural anaesthesia in 16 goats. Two per cent solution of lignocaine was administered at the lumbosacral site, at a dose of 1 ml/4.55 kg body-weight. Paralysis of the hind-quarters persisted for 198.5 ± 36.6 minutes. Xylazine was administered intramuscular at a dose of 0.11 mg/kg body-weight, when posterior paralysis was complete. The extent of analgesia was determined by needle pricks. Muscle relaxation was satisfactory for manipulation of the viscera during surgical operation.

ANATOMICAL CONSIDERATION

The spinal cord is the caudal part of central nervous system, contained in the verteoral canal. The cranial end of the spinal cord is continous with the medulla o longata of the brain at the level of the foramen magnum of the skull. In goats, the spinal cord terminates at the level of the second sacral vertebra.

The spinal cord is divided into cervical, thoracic, lumbar and caudal or coccygeal part. These parts correspond to the areas of the spinal cord to which the cervical, thoracic, lumbar, sacral and coccygeal nerves are connected. In level with the last three cervical and first two thoracic vertebrae, the spinal segment is larger in diameter and forms the cervical enlargement (intumescentia cervicalis). Similarly in level with the last three lumbar and first two or three sacral vertebrae lumbar enlargement (intumescentia lumbalis) is noticed.

The caudal extremity of the spinal cord tapers to a point caudal to the lumbar segments and is referred to as the conus medullaris. From the conus a slender nonnervous filament of piamater, the filum terminale, extends caudally in the sacral dural sac. The filum terminale becomes incorporated in the filum of the spinal duramater, at the caudal end of the dural sac. The caudal portion of the spinal cord and the roots of the spinal nerves are attached to it, which resembles the tail of a horse and hence referred to as the cauda equina.

The spinal cord is enclosed within the spinal meninges. They are duramater, arachnoid and piamater. The duramater is tough and fibrous. The spinal duramater is separated from the periosteum of the vertebra by the epidural space. The epidural space contains spinal branches, internal vertebral venous plexuses and branches from the vertebral, ascending cervical, deep cervical, intercostal, lumbar and iliolumbar arteries. The space between the nerves, arteries and veins are filled with adipose tissue. The spinal duramater is a long cylindrical tube surrounding the spinal cord. Lateral tubular extensions cover the roots of the spinal nerve and accompany them to the intervertebral foramina. As the dorsal and ventral roots join to form the spinal nerve, the duramater forms a single sheath which is continuous with the epineurium of the spinal nerve. The duramater tubes are firmly attached to the periosteum around the intervertebral foramen. Cranially the spinal duramater is continuous with the cranial duramater. Caudally in the sacral area, the spinal duramater tapers in the shape of a cone and forms the filum of the spinal duramater. The spinal duramator extends caudally to the body o' the fourth caudal vertebra.

The spinal arachnoid is a thin, almost transparent tube which surrounds the spinal cord and, like the duramater, has tubular extension which cover the roots of the spinal nerves. The cavity between the duramator and archnoid is the subdural cavity, which contains a very small amount of fluid. The arachnoid is connected to the piamater by connective tissue trabaculae which passes across the subarchnoid cavity. The cavity is filled with cerebrospinal fluid.

The spinal piamater is a highly vascularised layer which is firmly attached to the spinal cord nd spinal nerve roots (Chandna, 1976; and Dellmann and McClure, 1975)

Distribution of the Sensory and Motor Fibres of the Spinal Nerves (Gall, 1971)

Spinal region	No. of nerve	Structures supplied	
		Sensory	Motor
Coccygeal	All	Greater part of tail	Coccygeal muscles
Sacral	5 and 4	Group, base of tail, anus, vulva, perineum and adjacent parts	Anus, terminal part of rectum, vagina, penis, bladder, urethra
Sacral	3, 2 and 1	Dorsal branches-sensory to region of croup	
Lumbar	6, 5 and 4	Ventral branches-enter into the formation of the lumbo-sacral plexus	
Lumbo-sacral plexus	Post. gluteal nerve (1 and 2 S.)	Lateral and posterior parts of hip and thigh	Extensors of hip (in part)
	Great sciatic nerve (5 and 6 L., 1S.)	Middle of tibial region to foot	Flexors of the stifle (in part); flexors and extensors of hook and digit
	Ant. gluteal nerve (5 and 6 L., 1S.)	Lateral aspect of thigh	Flexors and abductors of hip
	Obturator nerve (4 and 5 L)	Medial aspect of thigh	Adductors of hip
	Femoral nerve (4 and 5 L.)	Anterior and medial aspects of limb as low as hook	Flexors of hip (in part), extensors of stifle

(Contd.)

Spinal region	No. of nerve	Structures supplied	
		Sensory	Motor
Lumbar	3	Loins and croup, anterior aspect of stifle, scrotum, prepuce and inguinal region, mammary gland	Sublumbar group (in part) post. parts of abdominal muscles .
	2	Loins, flank, anterior, and lateral aspect of thigh, scrotum, prepuce, mammary gland.	Sublumbar group (in part), post. parts of abdominal muscles.
	1	Loins, post. abdominal region, lateral aspects of thigh.	Post. parts of abdominal muscles.
Thoracic	Last two	Abdominal wall and flank	Abdominal muscles
	Mid-thoracic region to last pair	Anterior and ventral parts of abdominal wall	Intercostal muscles, anterior parts of abdominal muscles.

MATERIALS AND METHODS

MATERIALS AND METHODS

The experimental study was conducted on 36 apparently healthy, Alpine-Malabari crossbred bucks, aged from six to fifteen months and weighing from seven to twenty-two kilograms.

These animals were divided into two groups, viz., Group I and II, each group consisting of 18 animals. Group I and II were further subdivided into three Subgroups viz., (a), (b) and (c), each Subgroup consisting of six animals. These animals were numbered serially from 1 to 6 viz.,

I a(1), a(2), a(3), a(4), a(5) and a(6);
I b(1), b(2), b(3), b(4), b(5) and b(6);
I c(1), c(2), c(3), c(4), c(5) and c(6).

II a(1), a(2), a(3), a(4), a(5) and a(6);
II b(1), b(2), b(3), b(4), b(5) and b(6);
II c(1), c(2), c(3), c(4), c(5) and c(6).

The site of injection was the lumbosacral epidural space in all these animals.

Lidocaine hydrochloride (Xylocaine - Astra), two per cent solution was administered at the rate of

(i) 4 mg/kg body-weight in group I (a);

(ii) 8 mg/kg body-weight in group I (b) and

(iii) 16 mg/kg body-weight in group I (c).

Lidocaine hydrochloride, two per cent solution, along with hyaluronidase (Hyalase- Rallis India Ltd.) (at the rate of 150 I.U. per 100 ml of lidocaine hydrochloride solution) was administered at the rate of

(i) 4 mg/kg body-weight in group II (a);

(ii) 8 mg/kg body-weight in group II (b) and

(iii) 16 mg/kg body-weight in group II (c).

Preparation of the Animal

The animals were fasted for 12 hours. The hairs at the lumbosacral region, in between the iliac crests were clipped. The skin at the site was painted with Tincture of Iodine.

Technique

The animal was controlled in standing position. The two iliac crests were palpated by the thumb and the middle finger. With the index finger, the lumbosacral space was palpated as a depression posterior to the line joining the two iliac crests, on the dorsal midline. Two per cent solution of lidocaine hydrochloride, 0.5 ml was injected subcutaneously at the site to produce an insensitive skin weal. A large-bore (18-gauge) hypodermic needle was inserted through the skin and the needle was withdrawn to leave a clearly defined skin puncture. A Brooks' epidural needle with stilette was introduced through the skin puncture. The needle was directed, perpendicular to the dorsal midline, through the lumbosacral space so as to reach the epidural space. The stilette was withdrawn and the syringe, containing the calculated dose of the local anaesthetic, was attached to the needle. The anaesthetic solution was injected slowly. In the animals which became recumbent during the course of injection, the injection was completed in the position assumed by them. Absence of resistance during the injection was taken as the indication for the delivery of the anaesthetic solution into the epidural space. After completing the injection, the syringe was detached. The stilette was reintroduced and the needle with stilette was withdrawn.

The following observations were made following the injection

i) The depth (in cm) to which the epidural needle had to be inserted to reach the epidural space

ii) Onset and duration of

a) flaccidity of tail

b) relaxation of anal sphincter

c) relaxation of abdominal muscles

d) sternal and/or lateral recumbency

e) relaxation of the muscles of hind-limbs

iii) The extent of analgesia, assessed by response to pin pricks on the skin

iv) Additional observations, if any, during induction and recovery

v) Postanaesthetic observations, if any, up to a period of two weeks.

The association between the body-weight and depth to which the epidural needle had to be inserted so as to reach the epidural space was studied by estimating the correlation of coefficient. The effects of different doses of lidocaine hydrochloride solution with and without the addition of hyaluronidase were assessed by comparing concerned subgroup means by Student's 't' test (Snedecor and Cochran, 1967).

RESULTS

RESULTS

The observations in general with respect to each group of animals are tabulated and presented in Tables 1 to 8.

Group I (a)

The data are tabulated and presented in Tables 1 and 3.

The average body-weight of the animals in this group was 11.25 ± 1.03 kg. Lidocaine hydrochloride at the rate of 4 mg/kg body-weight was administered as a two per cent solution into the lumbosacral epidural space. The epidural needle was inserted to a depth of 2.71 ± 0.08 cm.

The animals did not show any sign of discomfort during the injection. The tail became flaccid in 3.50 ± 0.43 minutes. The anal sphincter became relaxed in 4.00 ± 0.63 minutes. Incoordination of the hind-limbs commenced gradually along with the onset of flaccidity of the tail and was apparent with the dragging of the hindlimbs. In this group all the animals excepting animal No. 5 assumed 'dog sitting posture' ie., by keeping both the fore-limbs straight and the hind-limbs flexed or extended at the hocks.

Relaxation of the abdominal muscles was observed by 8.83 ± 1.45 minutes. The animals assumed sternal recumbency by 11.33 ± 1.87 minutes and relaxation of the hind-limbs was complete by 11.83 ± 1.35 minutes.

The maximum extent of analgesia was noticed up to the level of the second lumbar vertebra, while the minimum was only up to the level of the fifth lumbar vertebra.

The tone of muscles of abdomen reappeared in 21.17 ± 7.51 minutes and of the muscles of hind-limbs in 21.50 ± 7.60 minutes. The relaxed anal sphincter became apparently normal in 43.00 ± 8.18 minutes. Flaccidity of the tail disappeared in 44.17 ± 8.63 minutes. The position of recumbency persisted for 47.67 ± 11.73 minutes.

The '*dog sitting posture*' assumed by the animals at the time of induction, was not noticed in any of the animals during the recovery phase. However, flexion of hocks causing lameness of the hind-limb was noticed in three animals (Nos. 2, 5 and 6) during the recovery phase.

Progression with incoordination of hind-limbs was possible in 59.00 ± 28.21 minutes and this incoordination persisted for 11.00 ± 2.14 minutes. Slight lameness of the hind-limbs, dullness and anorexia for a day or two were observed in four animals (Nos. 1, 2, 3 and 6) though not of any serious consequence.

Group I (b)

The data are tabulated and presented in Tables 1 and 4.

The average body-weight of the animals in this group was 10.75 ± 0.97 kg. Lidocaine hydrochloride at the rate of 8 mg/kg body-weight was administered as a two per cent solution into the lumbosacral epidural space. The epidural needle was inserted to a depth of 2.58 ± 0.06 cm.

The animals did not show any sign of discomfort during the injection. Flaccidity of the tail and relaxation of the anal sphincter were observed simultaneously at 1.67 ± 0.33 minutes after the injection. Incoordination of the hind-limbs commenced gradually along with the onset of flaccidity of the tail and was apparent with the dragging of the hind-limbs. In this group, one of the animals (No. 3) assumed 'dog sitting posture' during induction. Relaxation of the abdominal muscles was observed by 4.67 ± 0.42 minutes. The animals assumed sternal recumbency by 4.83 ± 0.70 minutes. The muscles of the hind-limbs were relaxed by 5.83 ± 0.54 minutes. All the animals excepting Nos. 1 and 2 assumed lateral recumbency following sternal recumbency. Lateral recumbency was observed by 14.25 ± 3.88 minutes.

The maximum extent of analgesia was noticed up to the level of the 11th thoracic vertebra, while the minimum was only up to the level of the first lumbar vertebra.

The tone of muscles of abdomen reappeared in 38.50 ± 6.57 minutes and of the muscles of hind-limbs in 41.17 ± 6.10 minutes. The relaxed anal sphincter became apparently normal in 61.67 ± 6.44 minutes. Flaccidity of the tail disappeared in 62.17 ± 6.25 minutes. The position of recumbency persisted for 64.67 ± 8.30 minutes.

'Dog sitting posture' was not seen in any of the animals during the period of recovery. But flexion of the hocks, causing lameness of the hind-limbs was noticed in one animal (No.6) during the recovery period.

Progression with incoordination of hind-limbs was possible in 70.83 ± 8.04 minutes and the incoordination persisted for 13.17 ± 4.08 minutes. Slight lameness of the hind-limbs, dullness and anorexia for a day or two were observed in all the animals though not of any serious consequence.

Group I (c)

The data are tabulated and presented in Tables 1 and 5.

The average body-weight of the animals in the group was 16.17 ± 1.46 kg. Lidocaine hydrochloride at the rate of 16 mg/kg body-weight was administered as a two per cent solution into the lumbosacral epidural space. The epidural needle was inserted to a depth of 2.88 ± 0.09 cm.

The animals did not show any sign of discomfort during the injection. Flaccidity of the tail and relaxation of the anal sphincter were observed simultaneously by 0.33 ± 0.21 minutes after injection. Relaxation of the abdominal muscles was observed by 0.83 ± 0.54 minutes. The animals assumed sternal recumbency by 0.50 ± 0.34 minutes. The muscles of hind-limbs were relaxed by 0.83 ± 0.54 minutes. The animals assumed lateral recumbency by 0.67 ± 0.33 minutes.

In all the animals, except in Nos. 1 and 2, flaccidity of the tail, relaxation of the anal sphincter, abdominal muscles and hind-limbs, followed by recumbency, were observed when the injection was in progress and the remaining dose had to be administered in the recumbent position.

Lacrimation, dyspnoea, bleating, stiffness of the head and neck and pedalling movements with the fore-limbs were observed in all the animals except animals Nos. 3 and 4. Such bouts persisted for about 10 minutes initially, subsided for about five minutes and reappeared with less severity and wained away by 30 minutes. During the intermission the animal was snoring. The respiration was laboured and abdominal with the mouth half open.

In all animals, except in No.3 the maximum analgesic effect was extending from 9th thoracic vertebra to the base of the ears. In animal No.3 the extent of analgesia was found to be only up to the level of the first lumbar vertebra.

The animals resumed sternal recumbency in 48.30 ± 8.98 minutes. The tone of muscles of abdomen reappeared in 61.33 ± 9.59 minutes and of the muscles of hind-limbs in 70.83 ± 9.31 minutes. Muscular tremors were seen in two animals (Nos. 1 and 5) during recovery phase. The relaxed anal sphincter became apparently normal in 73.67 ± 9.32 minutes. Flaccidity of the tail disappeared in 80.50 ± 12.10 minutes.

'Dog sitting posture' was observed during the induction and recovery phase only in one animal (No.3). It was noticed that in this animal the extent of analgesia was only up to the first lumbar vertebra.

Progression with incoordination of hind-limbs was possible in 84.50 ± 11.28 minutes and the incoordination persisted for 34.33 ± 17.97 minutes. Slight lameness of the hind-limbs, dullness and anorexia for a day or two were observed in all the animals, except in one animal (No.6).

Group II (a)

The data are tabulated and presented in Tables 2 and 6.

The average body-weight of the animals in this group was 14.67 ± 2.08 kg. Lidocaine hydrochloride at a rate of 4 mg/kg body-weight was administered as a two per cent solution, along with hyaluronidase into the lumbosacral epidural space. The epidural needle was inserted to a depth of 2.88 ± 0.09 cm.

The animals did not show any sign of discomfort during injection. The tail became flaccid by 1.33 ± 0.21 minutes. The anal sphincter became relaxed by 1.50 ± 0.22 minutes. Incoordination of the hind-limbs commenced gradually along with the onset of flaccidity of the tail and was apparent with dragging of the hind-limbs.

In this group, all the animals excepting Nos. 4 and 6 assumed 'dog sitting posture' during induction. Relaxation of the abdominal muscles was observed by 6.83 ± 1.45 minutes. The animals assumed sternal recumbency in 6.33 ± 1.43 minutes and relaxation of the muscles of hind-limbs was complete by 7.67 ± 1.40 minutes.

The maximum extent of analgesia was observed up to the level of the second lumbar vertebra, while the minimum was only up to the level of the fifth lumbar vertebra.

The tone of muscles of abdomen reappeared in 16.33 ± 4.01 minutes. The tone of muscles of hind-limbs reappeared in 25.33 ± 8.82 minutes. The relaxed anal sphincter became apparently normal in 41.67 ± 4.41 minutes. Flaccidity of the tail disappeared in 43.67 ± 6.75 minutes.

'Dog sitting posture' assumed by the animals at the time of induction, was not noticed in any of the animals during the recovery phase.

Progression with incoordination of hind-limbs was possible in 43.83 ± 5.61 minutes and the incoordination persisted for 10.83 ± 3.17 minutes. Dullness and anorexia for a day or two were observed in five animals.

Group II (b)

The data are tabulated and presented in Tables 2 and 7.

The average body-weight of the animals in this group was 11.33 ± 0.67 kg. Lidocaine hydrochloride at the rate of 8 mg/kg body-weight was administered as a two per cent solution along with hyaluronidase into the lumbosacral epidural space. The epidural needle was inserted to a depth of 2.63 ± 0.06 cm.

The animals did not show any sign of discomfort during the injection. Flaccidity of the tail and relaxation of the anal sphincter were observed simultaneously at 1.00 ± 0 minutes. Incoordination of the hind-limbs commenced gradually along with the onset of flaccidity of the tail and apparent with dragging of the hind-limbs.

Only one animal (No.6) in this group assumed 'dog sitting posture' during induction. Pedalling movements with the fore-limbs were noticed in two animals (Nos. 2 and 3). Relaxation of the abdominal muscles was observed by 2.17 ± 0.60 minutes. The animals assumed sternal recumbency by 2.67 ± 0.62 minutes. Only two animals in this group (Nos. 2 and 3) assumed the position of lateral recumbency immediately following sternal recumbency. The muscles of hind-limbs were found to be relaxed by 2.67 ± 0.80 minutes.

The maximum extent of analgesia was noticed up to the level of the 10th thoracic vertebra, while the minimum was only up to the level of the third lumbar vertebra.

The tone of muscles of abdomen reappeared in 28.50 ± 2.74 minutes. Tone of muscles of hind-limbs reappeared in 33.50 ± 7.37 minutes. The relaxed anal sphincter became apparently normal in 47.50 ± 8.03 minutes. Flaccidity of the tail disappeared in 48.17 ± 7.92 minutes.

Progression with incoordination of the hind-limbs was possible in 51.50 ± 9.27 minutes and the incoordination persisted for 10.83 ± 3.30 minutes. Slight lameness of the hind-limbs, dullness and anorexia for a day or two were observed in three animals (Nos. 1, 2 and 4). Lameness of the right hind-limb was noticed for 12 days in one animal (No.3).

Group II (c)

The data are tabulated and presented in Tables 2 and 8.

The average body-weight of the animals in this group was 15.92 ± 1.24 kg. Lidocaine hydrochloride at the rate of 16 mg/kg body-weight was administered as a two per cent solution along with hyaluronidase into the lumbosacral epidural space. The epidural needle was inserted to a depth of 2.83 ± 0.06 cm.

The animals did not show any sign of discomfort during the injection. Flaccidity of the tail and relaxation of the anal sphincter were observed simultaneously at 0.17 ± 0.17 minutes after the injection. Relaxation of the abdominal muscles was observed by 0.33 ± 0.21 minutes. The animals assumed sternal recumbency by 0.17 ± 0.17 minutes. The muscles of hind-limbs were found to be relaxed by 0.33 ± 0.21 minutes. The animals assumed lateral recumbency by 1.17 ± 0.54 minutes.

In all the animals, except in Nos. 3 and 5 flaccidity of the tail, relaxation of the anal sphincter, abdominal muscles and hind-limbs, followed by recumbency were observed when the injection was in progress and remaining dose had to be administered in the recumbent position.

During onset, in animal No.1 protrusion of tongue, locked jaw, salivation and opisthotonos were noticed. In animal No.4 muscular tremors and sleepiness were observed. In all other animals stiffness of the head and neck, dyspnoea and pedalling movements with the fore-limbs were observed.

In two animals (Nos.1 and 3) the extent of analgesia was noticed up to the level of the base of the horns. In all other animals the extent was noticed up to the level of the base of the ears.

The animals resumed sternal recumbency by 30.00 ± 6.76 minutes. Tone of muscles of abdomen reappeared in 47.50 ± 8.98 minutes and of the muscles of hind-limbs in 52.83 ± 10.88 minutes. The relaxed anal sphincter became apparently normal in 56.83 ± 10.32 minutes. Flaccidity of the tail disappeared in 60.00 ± 10.42 minutes.

'Dog sitting posture' was observed in animal No.5 during induction and in animal No.6 during recovery phase.

Progression with incoordination of the hind-limbs was possible in 58.33 ± 10.54 minutes and the incoordination persisted for 8.50 ± 1.65 minutes. Anorexia and dullness were observed in all the animals, except in No.6, for one or two days.

The correlation coefficient between the body-weight and the depth to which the epidural needle had to be inserted to reach the epidural space and results of comparison of means of different subgroups for the time of onset and duration of flaccidity of tail, relaxation of anal sphincter, muscles of abdomen and hind-limbs and period of recumbency,following epidural anaesthesia using different doses of lidocaine hydrochloride two per cent solution with and without the addition of hyaluronidase, are given in Tables 9 to 12.

DISCUSSION

DISCUSSION

In the present study two per cent lidocaine hydrochloride solution alone was administered epidurally in Group I, while hyaluronidase at the rate of 150 I.U. per 100 ml of two per cent lidocaine hydrochloride solution was added in Group II.

Body-weight and its Relationship to the Depth of Insertion of the Epidural Needle

The average body-weight of these animals was 13.34 ± 0.63 kg. The epidural needle had to be inserted to a depth of 2.76 ± 0.03 cm, so as to reach the epidural space. Significant positive correlation (r : 0.80) was found between the body-weight of the animals and the depth to which the needle had to be inserted (Table 9).

Onset of Anaesthesia

Flaccidity of Tail.

The time of onset of flaccidity of the tail, when lidocaine hydrochloride alone was used, was 3.5 ± 0.43, 1.67 ± 0.33 and 0.33 ± 0.21 minutes respectively in Subgroups I(a), I (b) and I (c) whereas this was 1.33 ± 0.21, 1.00 ± 0, and 0.17 ± 0.17 minutes respectively in

Subgroups II (a), II (b) and II (c). In Group I, the time was reduced by 52 per cent when the dose was doubled and by 90 per cent when the dose was quadrupled and the differences were statistically significant ($P < 0.01$). In Group II, the corresponding reduction was found to be 25 per cent and 87 per cent respectively, but the latter only being statistically significant ($P < 0.01$). Compared to Group I, the time of onset of flaccidity of tail was found reduced by 62 per cent, 40 per cent and 48 per cent for the doses of 4 mg, 8 mg and 16 mg/kg body-weight respectively in Group II. But only the first being statistically significant ($P < 0.01$).

Proportionate reduction in the time of onset of flaccidity of tail was observed when the dose of lidocaine hydrochloride per kilogram body-weight was increased, may be because of the consequent increase in the volume of the solution injected. In the same dose level further reduction in these timings was noticed when hyaluronidase was added.

Relaxation of the Anal sphincter.

The time required for relaxation of the anal sphincter, when lidocaine hydrochloride solution alone was used, was 4.00 ± 0.63, 1.67 ± 0.33 and 0.33 ± 0.21 minutes in

Subgroups I (a), I(b) and I (c) respectively, whereas this was 1.50 ± 0.22, 1.00 ± 0 and 0.17 ± 0.17 minutes respectively in Subgroups II(a), II(b) and II(c). In Group I, the time of onset of the relaxation of anal sphincter was reduced by 58 per cent when the dose was doubled and by 92 per cent when the dose was quadrupled and the differences were statistically significant ($P < 0.01$). In Group II, the corresponding reduction was found to be 33 per cent and 89 per cent respectively and the differences were statistically significant ($P < 0.05$ and $P < 0.01$). Compared to Group I, this time was reduced by 62 per cent, 40 per cent and 48 per cent for the doses of 4 mg, 8 mg and 16 mg/kg body-weight respectively in Group II, where hyaluronidase had been added, but only the first being statistically significant ($P < 0.01$).

Proportionate reduction in the time of onset of relaxation of anal sphincter was observed when the dose of lidocaine hydrochloride per kilogram body-weight was increased, may be because of the consequent increase in the volume of the solution injected. In the same dose level further reduction in these timings was noticed when hyaluronidase was added.

It is interesting to note that the time of onset of flaccidity of the tail and relaxation of the anal sphincter were simultaneous. Statistical analysis of the data did not indicate any significant difference between them.

<u>Relaxation of Abdominal Muscles.</u>

The time of onset of relaxation of the abdominal muscles, when lidocaine hydrochloride alone was used, was found to be 8.83 ± 1.45, 4.67 ± 0.42 and 0.83 ± 0.54 minutes respectively in Subgroups I(a), I(b) and I(c) while this was 6.83 ± 1.45, 2.17 ± 0.60 and 0.33 ± 0.21 minutes respectively in Subgroups II (a), II (b) and II (c). In Group I, time was reduced by 47 per cent when the dose was doubled and by 91 per cent when the dose was quadrupled and the differences were statistically significant ($P < 0.05$ and $P < 0.01$). In Group II, the corresponding reduction was found to be 68 per cent and 95 per cent respectively and the differences were statistically significant ($P < 0.05$ and $P < 0.01$). Compared to Group I, this time was reduced by 23 per cent, 54 per cent and 60 per cent for the doses of 4 mg, 8 mg and 16 mg/kg body-weight respectively in Group II, but the differences were not statistically significant.

Proportionate reduction in the time of onset of relaxatio of abdominal muscles was observed when the dose of lidocaine hydrochloride per kilogram body-weight was increased, may be because of the consequent increase in the volume of the solution injected. In the same dose level further reduction in these timings was noticed when haluronidase was added.

Sternal Recumbency.

The time taken to assume sternal recumbency, when lidocaine hydrochloride alone was used, was 11.33 ± 1.87, 4.83 ± 0.70 and 0.50 ± 0.34 minutes respectively in Subgroups I (a), I (b) and I (c) while this time was 6.33 ± 1.43, 2.67 ± 0.62 and 0.17 ± 0.17 respectively in Subgroups II (a), II (b) and II (c). In Group I, the time was reduced by 58 per cent when the dose was doubled and by 92 per cent when the dose was quadrupled and the differences were statistically significant ($P < 0.01$). In Group II, the corresponding reduction was found to be 58 per cent and 97 per cent respectively and the differences were statistically significant ($P < 0.05$ and $P < 0.01$). Compared to Group I, the time taken to assume sternal recumbency was found reduced by 44 per cent, 45 per cent and 66 per cent for the doses of 4 mg, 8 mg and 16 mg/kg body-weight respectively in Group II, but only the difference between the Subgroups I (b) and II (b) was statistically significant ($P < 0.05$).

Proportionate reduction in the time to assume sternal recumbency was observed when the dose of lidocaine hydrochloride per kilogram body-weight was increased, may be because of the consequent increase in the volume of the solution injected. In the same dose level further reduction in these timings was noticed when hyaluronidase was added.

Relaxation of Muscles of Hind-limbs.

The time of onset of relaxation of the muscles of hind-limbs, when lidocaine hydrochloride solution alone was used, was 11.83 ± 1.35, 5.83 ± 0.54 and 0.83 ± 0.54 minutes respectively in Subgroups I (a), I (b) and I (c) while this time was 7.67 ± 1.40, 2.67 ± 0.80 and 0.33 ± 0.21 minutes respectively in Subgroups II (a), II (b) and II (c). In Group I, this time was reduced by 51 per cent when the dose was doubled and by 93 per cent when the dose was quadrupled and the differences were statistically significant ($P < 0.01$). In Group II, the corresponding reduction was found to be by 65 per cent and 96 per cent and the differences were statistically significant ($P < 0.05$ and $P < 0.01$). Compared to Group I, this was reduced by 35 per cent, 54 per cent and 60 per cent for the doses of 4 mg, 8 mg and 16 mg/kg body-weight respectively in Group II, where hyaluronidase was added, but the difference was found to be statistically significant only between the Subgroups I (b) and II (b) ($P < 0.01$).

Proportionate reduction in the time of onset of relaxation of muscles of hind-limbs was observed when the dose of lidocaine hydrochloride per kilogram body-weight was increased, may be because of the consequent increase in the volume of the solution injected. In the same dose level further reduction in these timings was noticed when hyaluronidase was added.

Linzell (loc. cit) had reported that sensory paralysis was complete within 10-12 minutes. In the present study, complete sensory paralysis of the hind-limbs was observed in an average time of 11.83 ± 1.35 minutes at the dose of 4 mg/kg body-weight.

The time taken for assuming sternal recumbency and for complete relaxation of the muscles of hind-limbs in all the six subgroups were compared and it was found that the differences were not statistically significant.

Lateral recumbency following sternal recumbency was not observed in any of the animals of Subgroups I (a) and II (a). Four animals in Subgroups I (b) and two in Subgroup II (b) assumed the position of lateral recumbency following sternal recumbency. In Subgroups I (c) and II (c), all the animals assumed the position of lateral recumbency following sternal recumbency. This could be attributed to the increase in the quantity of the local anaesthetic solution, administered epidurally.

Hopcroft (loc. cit) had reported the onset of anaesthesia within 2-10 minutes. In the present study, at the dose of 4 mg/kg body-weight flaccidity of the tail was observed within 2-5 minutes and relaxation of the muscles of hind-limbs within 6-15 minutes.

Duration of Anaesthesia

Relaxation of Abdominal Muscles.

The duration of relaxation of the abdominal muscles was found to be 21.17 ± 7.51, 38.50 ± 6.57 and 61.33 ± 9.59 minutes in Subgroups I (a), I (b) and I (c) respectively, while it was 16.33 ± 4.01, 28.50 ± 2.74 and 47.50 ± 8.98 minutes in Subgroups II (a), II (b) and II (c) respectively. In Group I, this duration was increased by 82 per cent when the dose was doubled and by 190 per cent when the dose was quadrupled. Only the latter was statistically significant ($P < 0.01$). In Group II, the corresponding increase was 75 per cent and 191 per cent respectively and the differences were statistically significant ($P < 0.05$ and $P < 0.01$). Compared to Group I, the duration was reduced by 24 per cent, 26 per cent and 23 per cent for the doses of 4 mg, 8 mg and 16 mg/kg body-weight respectively in Group II, where hyaluronidase had been added. But the differences were not statistically significant.

Proportionate increase in the duration of relaxation of abdominal muscles was observed when the dose of lidocaine hydrochloride per kilogram body-weight was increased, may be because of the consequent increase in the volume of the solution injected. In the same dose levels, there was comparative reduction in this duration when hyaluronidase was added to lidocaine hydrochloride solution.

In no instances the penis was seen protruded out of the prepucial orifice.

Relaxation of Muscles of Hind-limbs.

The duration of relaxation of muscles of hind-limbs was 21.50 ± 7.60, 41.17 ± 6.10 and 70.83 ± 9.31 minutes in

Subgroups I (a), I (b) and I (c) respectively, while it was 25.33 ± 8.82, 33.50 ± 7.37 and 52.80 ± 10.88 minutes in Subgroups II (a), II (b) and II (c) respectively. In Group I, this duration was increased by 91 per cent when the dose was doubled and by 229 per cent when the dose was quadrupled. Only the latter was statistically significant ($P < 0.01$). In Group II, the corresponding increase was by 32 per cent and 108 per cent respectively, but the difference were not statistically significant. Compared to Group I, the duration was increased by 18 per cent at the dose of 4 mg/kg body-weight and the duration was reduced by 17 per cent and 25 per cent for the doses of 8 mg and 16 mg/kg body-weight respectively in Group II, where hyaluronidase had been added. But the differences were not statistically significant.

Proportionate increase in the duration of relaxation of muscles/hind-limbs was observed when the dose of lidocaine hydrochloride per kilogram body-weight was increased, may be because of the consequent increase in the volume of the solution injected. In the minimum dose level addition of hyaluronidase to lidocaine hydrochloride solution increased the duration of relaxation of muscles of hind-limbs whereas in higher doses comparative reduction in this duration was observed.

Relaxation of Anal sphincter.

Relaxation of the anal sphincter persisted for 43.00 ± 8.18, 61.67 ± 6.44 and 73.67 ± 9.32 minutes in Subgroups I (a), I (b) and I (c) respectively, while it was 41.67 ± 4.41, 47.50 ± 8.03 and 56.83 ± 10.32 minutes in Subgroups II (a), II (b) and II (c) respectively. In Group I, the duration of relaxation of the anal sphincter was found to be increased by 43 per cent when the dose was doubled and 71 per cent when the dose was quadrupled, but only the latter was statistically significant ($P < 0.05$). In Group II, the corresponding increase was by 14 per cent and 36 per cent respectively, but the differences were not statistically significant. Compared to Group I, the duration was reduced by 3 per cent, 23 per cent and 23 per cent for the doses of 4 mg, 8 mg and 16 mg/kg body-weight respectively in Group II, where hyaluronidase had been added. The differences were not statistically significant.

Proportionate increase in the duration of relaxation of anal sphincter was observed when the dose of lidocaine hydrochloride per kilogram body-weight was increased, may be because of the consequent increase in the volume of the solution injected. In the same dose levels, there was comparative reduction in this duration when hyaluronidase was added to lidocaine hydrochloride solution.

During the onset of anaesthesia, no significant difference was seen in the time of onset of flaccidity of tail and relaxation of anal sphincter. It could be seen from the data that the duration of flaccidity of tail and relaxation of anal sphincter was more or less the same in both the Groups, irrespective of the fact whether hyaluronidase had been added or not.

Flaccidity of Tail.

Flaccidity of tail persisted for 44.17 ± 8.63, 62.17 ± 6.25 and 80.50 ± 12.10 minutes in Subgroups I (a), I (b) and I (c) respectively, while it persisted for 43.67 ± 6.75, 48.17 ± 7.92 and 60.00 ± 10.42 minutes in Subgroups II (a), II (b) and II (c) respectively. In Group I, this duration was found to be increased by 39 per cent when the dose was doubled and by 80 per cent when the dose was quadrupled. Only the latter was statistically significant ($P < 0.05$). In Group II, the corresponding increase was by 10 per cent and 37 per cent respectively, but the differences were not statistically significant. Compared to Group I, the duration was reduced by 2 per cent, 23 per cent and 25 per cent for the doses of 4 mg, 8 mg and 16 mg/kg body-weight respectively in Group II, where hyaluronidase had been added, but the differences were not statistically significant.

Proportionate increase in the duration of flaccidity of tail was observed when the dose of lidocaine hydrochloride per kilogram body-weight was increased, may be because of the consequent increase in the volume of the solution injected. In the same dose levels, there was comparative reduction in this duration when hyaluronidase was added to lidocaine hydrochloride solution.

Flaccidity of tail and relaxation of anal sphincter disappeared simultaneously during the recovery phase.

Recumbency.

The period of recumbency was 47.67 ± 11.73, 64.67 ± 8.30 and 83.00 ± 12.42 minutes respectively in Subgroups I (a), I (b) and I (c), while it was 37.50 ± 5.43, 48.83 ± 9.24 and 58.00 ± 10.52 minutes respectively in Subgroups II (a), II (b) and II (c). In Group I, this period was found to be increased by 36 per cent when the dose was doubled and by 74 per cent when the dose was quadrupled, but the differences were not statistically significant. In Group II, the corresponding increase was by 30 per cent and 55 per cent respectively, but the differences were not statistically significant. Compared to Group I, this period was reduced by 21 per cent, 24 per cent and 30 per cent for the doses of 4 mg, 8 mg and 16 mg/kg body-weight respectively in Group II, but the differences were not statistically significant.

Proportionate increase in the period of recumbency was observed when the dose of lidocaine hydrochloride per kilogram body-weight was increased, may be because of the consequent increase in the volume of the solution injected. In the same dose levels, there was comparative reduction in this period when hyaluronidase was added to lidocaine hydrochloride solution.

The animal stood up only after the return of muscular tone of the tail and the anal sphincter.

<u>Incoordination of Hind-limbs.</u>

When the animal got up incoordination of hind-limbs was noticed for 11.21 ± 2.14, 13.17 ± 4.08 and 34.33 ± 17.97 minutes respectively in Subgroups I (a), I (b) and I (c), while it was 10.83 ± 3.17, 10.83 ± 3.30 and 8.50 ± 1.65 minut in Subgroups II (a), II (b) and II (c) respectively.

The duration of incoordination of hind-limbs was found to be prolonged when higher doses of lidocaine hydrochloride solution was used, but it was generally short wherein higher doses of lidocaine hydrochloride solution was used along with hyaluronidase.

Extent of Analgesia

In Subgroups I (a) and II (a) the maximum extent of analgesia was up to the second lumbar vertebra, while the minimum was up to the fifth lumbar vertebra. In Subgroup I (b), the maximum extent of analgesia was up to the 11th thoracic vertebra, while the minimum was up to the first lumbar vertebra. In Subgroup II (b), it was up to the ninth thoracic vertebra and third lumbar vertebra respectively. In Subgroup I (c), the maximum extent was up to the base of the ears while the minimum was up to the first lumbar vertebra (that too only in one animal). In Subgroup II (c), the maximum extent was up to the base of the horns, whereas the minimum extent was up to the base of the ears.

When hyaluronidase was added, the extent of analgesia was increased considerably at the doses of 8 mg, and 16 mg/kg body-weight, while there was no variation in the maximum and minimum extent of analgesia at a dose of 4 mg/kg body-weight. At a dose of 16 mg/kg body-weight though the analgesia extended up to the base of the horns and ears, the fore-limbs were not anaesthetised excepting on its lateral aspects, that too only up to the elbow or knee joints.

Linzell (loc. cit) had observed the extent of analgesia up to the level of the first lumbar vertebral space in a goat and Hopcroft (loc.cit) had observed up to the level of the last rib in sheep. In the present study, the extent of analgesia was from the fifth lumbar vertebra to the base of the horns, depending upon the doses administered. When the dose was increased the extent of analgesia also was found to be on the increase.

Lamb and Jones (loc. cit) had reported that addition of hyaluronidase to local anaesthetic solution did not improve the efficiency in epidural and spinal anaesthesia. However, in the present study, when hyaluronidase was added at the rate of 150 I.U. per 100 ml of lidocaine hydrochloride two per cent solution it was found that onset of anaesthesia was quick, duration short and the extent increased.

Additional Observations During
Induction and Recovery

'Dog sitting posture'.

Of the 36 animals anaesthetised 13 animals (36 %) assumed 'dog sitting posture' during the period of induction. Out of these 13 animals, nine were from the Subgroups I (a) and II (a) ie. 70 per cent. In others, only one animal from each Subgroup assumed this posture. During the recovery period only two animals belonging to the maximum dosage groups assumed this posture.

Pedalling movement.

Pedalling movements with the fore-limbs were observed during the period of anaesthesia in nine animals (25 per cent). Of the 12 animals in Subgroups I (c) and II (c), wherein the anaesthetic dose was the maximum, eight animals (66 per cent) showed pedalling movements with the fore-limbs.

The tendency to keep the head and neck stiff while in lateral recumbency was seen during the period of anaesthesia in four out of six animals of the Subgroup I (c), ie. at the dose of 16 mg/kg body-weight. It is interesting to note that the same effect was not seen in animals of Subgroup II (c), where the dose of anaesthetic was the same but hyaluronidase had been added.

Bleating and dyspnoea were observed in four (66 per cent) out of six animals of the Subgroups I (c) and II (c). Lacrimation was also observed in these animals of the Subgroup I (c).

One animal of the Subgroup II (c) showed protrusion of the tongue, locking of the jaw, salivation and opisthotonos posture during anaesthesia.

Hall (loc. cit) had reported arching of the back and opisthotonos posture in cattle when large volume of fluid was injected epidurally. In the present study, opisthotonos posture was noticed only in one animal in which 16.8 ml of the local anaesthetic solution was injected ie. at the dose of 16 mg/kg body weight.

Recovery phase was uneventful in all the experimental animals.

Postanaesthetic Observations

Nine (25 per cent) out of 36 animals were apparently normal following recovery from anaesthesia. Oakley (loc. cit had reported transient unilateral hind-leg lameness in three out of twenty-six sheep, following epidural anaesthesia. In the present study, lameness of one or both the hind-limbs was observed in nine animals (25 per cent) for a day or two. In one animal the lameness of the right hind-limb persisted for 12 days.

Nineteen animals, (53 per cent) were found to be dull for a day or two. Ritchie and Cohen (loc. cit) had observed sleepiness in experimental animals following systemic absorption of lidocaine.

In 15 animals (41 per cent) anorexia was observed for a day or two.

Oakley (loc. cit) had reported four deaths out of 26 sheep. Hopcroft (loc. cit) had reported death in one animal following the administration of 16 ml of the anaesthetic solution in a sheep, but in the present study no death was observed even after giving 17.6 ml of the anaesthetic solution in a goat weighing 22 kg.

SUMMARY

SUMMARY

Thirty-six bucks aged six to fifteen months and weighing seven to twenty-two kilograms were used for studying the effect of epidural administration of varying doses of lidocaine hydrochloride, two per cent solution with and without the addition of hyaluronidase. Lidocaine hydrochloride solution, at the rate of 4 mg, 8 mg and 16 mg/kg body-weight was administered in six animals each of Group I and lidocaine hydrochloride solution with hyaluronidase (150 I.U./100 ml of lidocaine hydrochloride two per cent solution) in six animals each of Group II.

The drug was administered at the lumbosacral epidural space with the animals controlled in standing position.

It was found that when the body-weight was more the depth to which the epidural needle had to penetrate so as to reach the epidural space was more.

Proportionate reduction was noticed in the time of onset of flaccidity of the tail, relaxation of the anal sphincter, muscles of the abdomen and the hind-limbs and for assuming recumbency, when the dose of lidocaine hydrochloride per kilogram body-weight was increased. So also increasing doses of lidocaine hydrochloride solution along with hyaluronidase brought about proportionate

reduction in the timings with respect to these observations. But with the same dose level these timings were less, in comparison to the timings without the addition of hyaluronidase.

It was interesting to note that the time of onset of flaccidity of tail and relaxation of anal sphincter was found to take place simultaneously. So also, there was no difference in the time taken for assuming sternal recumbency and for the complete relaxation of the muscles of hind-limbs.

Duration of flaccidity of tail and relaxation of anal sphincter, muscles of abdomen and hindlimbs was found to increase with the administration of increasing doses of lidocaine hydrochloride. Period of recumbency was also found to increase with increasing doses of lidocaine hydrochloride. In the same dose levels, there was comparative reduction in this duration when hyaluronidase was added to lidocaine solution.

Flaccidity of the tail and relaxation of the anal sphincter disappeared simultaneously during the recovery phase. The animal stood up only after the return of muscular tone of the tail and the anal sphincter.

Extent of analgesia was found to increase with increasing doses of lidocaine hydrochloride, with or without the addition of hyaluronidase. The extent was still further increased when hyaluronidase was added.

'Dog sitting posture' was noticed during the onset of anaesthesia in 36 per cent of the animals.

Untoward reactions like lacrimation, salivation, dyspnoea, protrusion of tongue, locked jaw, stiffness of the head and neck, opisthotonos and pedalling movements with the fore-limbs were noticed during onset of anaesthesia, when lidocaine at the rate of 16 mg/kg body-weight was used.

Transient unilateral or bilateral hind-leg lameness, dullness and anorexia were noticed in some of the animals as a post-anaesthetic complication.

Recovery was uneventful at all the dose levels.

Epidural injection of lidocaine hydrochloride, two per cent solution at the rate of 4 mg/kg body-weight is recommended for surgical operations of the hind-quarters and inguinal region, while 2 mg/kg body-weight is recommended for operations on the flank region. Hyaluronidase may be added for getting quicker onset and greater extent of analgesia.

TABLES

Table 3. Extent of analgesia and postanaesthetic observations in goats following epidural anaesthesia using two per cent solution of lidocaine hydrochloride at the rate of 4 mg/kg body-weight

Animal number	Extent of analgesia	Post anaesthetic observations
1	Up to the level of the second lumbar vertebra	Anorexia and dullness for one day. Limping on the right hind-limb for two days
2	Up to the level of the third lumbar vertebra	Anorexia for two days. Limping on both the hind-limbs for three days
3	Up to the level of the fifth lumbar vertebra	Limping on both the hind-limbs for one day.
4	Up to the level of the fifth lumbar vertebra	Nil
5	Up to the level of the third lumbar vertebra	Nil
6	Up to the level of the second lumbar vertebra	Dullness for one day

Table 4. Extent of analgesia and post-anaesthetic observations in goats following epidural anaesthesia using two per cent solution of lidocaine hydrochloride at the rate of 8 mg/kg body-weight.

Animal number	Extent of analgesia	Post-anaesthetic observations
1.	Up to the level of the first lumbar vertebra	Limping on both the hind-limbs and anorexia for two days
2.	Up to the level of first lumbar vertebra	Dullness and limping on both the hind-limbs for one day
3	Up to the level of the first lumbar vertebra	Dullness and limping on both the hind-limbs for one day and anorexia for two days
4	Up to the level of the first lumbar vertebra	Dullness for one day
5	Up to the level of the 11th thoracic vertebra	Dullness for one day
6	Up to the level of the 13th thoracic vertebra	Dullness and anorexia for one day

Table 5. Extent of analgesia and post-anaesthetic observations in goats following epidural anaesthesia using two per cent solution of lidocaine hydrochloride at the rate of 16 mg/kg body-weight

Animal number	Extent of analgesia	Post-anaesthetic observations
1.	Up to the level of the ears, but sensation was present on the fore-limbs excepting on its lateral aspects that to only up to the knee joints.	Anorexia for one day and dullness for two days.
2	Up to the level of the ears, but sensation was present on the fore-limbs excepting on its lateral aspects that to only up to the elbow joints.	Anorexia and dullness for two days.
3	Up to the level of the first lumbar vertebra	Anorexia and dullness for one day.
4	Up to the level of the seventh thor cic ve tebra	Anorexia and dullness for one day.
5	Up to the level of the ears, but sensation was present on the fore-limbs excepting on its lateral aspects that too only up to the elbow joints.	Dullness for one day.
6	Up to the level of the ninth thoracic vertebra.	Nil

Table 6. Extent of analgesia and post-anaesthetic observations in goats following epidural anaesthesia using two per cent solution of lidocaine hydrochloride at the rate of 4 mg/kg body-weight with hyaluronidase

Animal number	Extent of analgesia	Post-anaesthetic observations
1	Up to the level of the second lumbar vertebra	Nil
2	Up to the level of the fifth lumbar vertebra	Anorexia and dullness for one day
3	Up to the level of the second lumbar vertebra	Dullness for one day
4	Up to the level of the fourth lumbar vertebra	Dullness for one day
5	Up to the level of the fourth lumbar vertebra	Anorexia for two days
6	Up to the level of the fourth lumbar vertebra	Dullness for one day

Table 7. Extent of analgesia and post-anaesthetic observations in goats following epidural anaesthesia using two per cent solution of lidocaine hydrochloride at the rate of 8 mg/kg body-weight with hyaluronidase

Animal number	Extent of analgesia	Post-anaesthetic observations
1	Up to the level of the 10th thoracic vertebra	Dullness and anorexia for two days. Limping on the right hind-limb for three days
2	Up to the level of the third lumbar vertebra	Anorexia for one day
3	Up to thelevel of the 10th thoracic vertebra	Limping on the right hind-limb for 12 days
4	Up to the level of the 11th thoracic vertebra	Dullness for one day
5	Up to the level of the third lumbar vertebra	Nil
6	Up to the level of the 12th thoracic vertebra	Nil

Table 8. Extent of analgesia and post-anaesthetic observations in goats following epidural anaesthesia using two per cent solution of lidocaine hydrochloride at the rate of 16 mg/kg body-weight with hyaluronidase

Animal number	Extent of analgesia	Post-anaesthetic observations
1	Up to the level of the base of the horns, but sensation was present on the fore-limbs excepting on its lateral aspects that too only up to the elbow joints	Limping on the right hind-limb for three days
2	Up to the level of the ears, but sensation was present on the fore-limbs excepting on its lateral aspects that too only up to the knee joints	Dullness with arched back for four days. Anorexia for two days
3	Up to the level of the base of the horns, but sensation was present on the fore-limbs excepting on its lateral aspects that too only up to the knee joints	Nil
4	Up to the level of the base of the ears, but sensation was present on the fore-limbs excepting on its lateral aspects that too only up to the elbow joints	Dullness for one day. Anorexia for two days
5	Up to the level of the base of the ears, but sensation was present on the forelimbs excepting on its lateral aspects that too only up to the knee joints	Nil
6	Up to the level of the base of the ears, but sensation was present on the fore-limbs excepting on its lateral aspects that too only up to the knee joints	Nil

Table 9. Mean and standard error of the body weight (in kg) of the animals and the depth to which (in cm) the epidural needle had to be inserted to reach the epidural space and their correlation coefficient

No. of animals	Average body-weight of the animals	Average depth to which the epidural needle inserted	'r' value
36	13.34 ± 0.63	2.76 ± 0.03	0.80 **

** Significant at 1 per cent level.

Table 10. Mean and standard error of the time of onset of flaccidity of tail, relaxation of anal sphincter, relaxation of the abdominal muscles, recumbency and relaxation of muscles of hind-limbs following epidural anaesthesia in goats and comparison of means under different Subgroups, each of size six

	Subgroups	Flaccidity of tail	Relaxation of anal sphincter	Relaxation of abdominal muscles	Recumbency	Relaxation of the muscles of hind-limbs
Means	I (a)	3.50 ± 0.43	4.00 ± 0.63	8.83 ± 1.45	11.33 ± 1.67	11.83 ± 1.35
	I (b)	1.67 ± 0.33	1.67 ± 0.33	4.67 ± 0.42	4.83 ± 0.70	5.83 ± 0.54
	I (c)	0.33 ± 0.21	0.33 ± 0.21	0.83 ± 0.54	0.50 ± 0.34	0.83 ± 0.54
	II (a)	1.33 ± 0.21	1.50 ± 0.22	6.83 ± 1.45	6.33 ± 1.43	7.67 ± 1.40
	II (b)	1.00 ± 0	1.00 ± 0	2.17 ± 0.60	2.67 ± 0.62	2.67 ± 0.80
	II (c)	0.17 ± 0.17	0.17 ± 0.17	0.33 ± 0.21	0.17 ± 0.17	0.33 ± 0.21
't' values	I(a) Vs I(b)	3.395**	3.277**	2.762*	3.250**	4.118**
	I(a) Vs I(c)	5.714**	7.710**	5.168**	5.691**	7.550**
	II(a) Vs II(b)	1.571	2.242*	2.976*	2.352*	3.090*
	II(a) Vs II(c)	4.345**	4.345**	4.446**	4.281**	5.165**
	I(a) Vs II(a)	3.761**	3.748**	0.978	2.140	2.134
	I(b) Vs II(b)	2.012	2.012	1.222	2.315*	3.264**
	I(c) Vs II(c)	0.590	0.590	1.065	0.815	0.859

* Significant at 5% level

** Significant at 1% level

Table 11. Mean and standard error of the duration of the relaxation of abdominal muscles, relaxation of the muscles of hind-limbs, relaxation of anal sphincter, flaccidity of tail and recumbency following epidural anaesthesia in goats and comparison of means under different Subgroups, each of size six

	Subgroups	Relaxation of abdominal muscles	Relaxation of muscles of hind-limbs	Relaxation of anal sphincter	Flaccidity of tail	Recumbency
Means	I (a)	21.17 ± 7.51	21.50 ± 7.60	43.00 ± 8.18	44.17 ± 8.63	47.67 ± 11.73
	I (b)	38.50 ± 6.57	41.17 ± 6.10	61.67 ± 6.44	62.17 ± 6.25	64.67 ± 8.30
	I (c)	61.33 ± 9.59	70.83 ± 9.31	73.67 ± 9.32	80.50 ± 12.10	83.00 ± 12.42
	II(a)	16.33 ± 4.01	25.33 ± 8.82	41.67 ± 4.41	43.67 ± 6.75	37.50 ± 5.43
	II(b)	28.50 ± 2.74	33.50 ± 7.37	47.50 ± 8.03	48.17 ± 7.92	48.83 ± 9.24
	II(c)	47.50 ± 8.98	52.83 ± 10.88	56.83 ± 10.32	60.00 ± 10.42	58.00 ± 10.52
't' values	I(a) Vs I(b)	1.737	2.016	1.801	1.641	1.184
	I(a) Vs I(c)	6.777**	4.107**	2.467*	2.409*	2.078
	II(a) Vs II(b)	2.505*	0.711	0.636	0.432	1.058
	II(a) Vs II(c)	3.187**	1.972	1.351	1.316	1.733
	I(a) Vs. II(a)	0.569	0.530	0.143	0.046	0.787
	I(b) Vs. II(b)	0.899	0.615	1.167	1.153	1.183
	I(c) Vs II(c)	1.054	1.257	1.216	1.290	1.544

* Significant at 5% level

** Significant at 1% level

Table 12. Comparison of means of time of onset of flaccidity of tail and relaxation of anal sphincter, time taken for assuming sternal recumbency and time of onset of relaxation of muscles of hind-limbs and duration of relaxation of anal sphincter and flaccidity of tail within subgroups, each of size six

	I(a)	I(b)	I(c)	II(a)	II(b)	II(c)
Time of onset of flaccidity of tail	3.50 ± 0.43	1.67 ± 0.33	0.33 ± 0.21	1.33 ± 0.21	1.00 ± 0	0.17 ± 0.17
Time of onset of relaxation of anal sphincter	4.00 ± 0.63	1.67 ± 0.33	0.33 ± 0.21	1.50 ± 0.22	1.00 ± 0	0.17 ± 0.17
't' value	0.659	0	0	0.556	0	0
Time taken for assuming sternal recumbency	11.33 ± 1.87	4.83 ± 0.70	0.50 ± 0.34	6.33 ± 1.43	2.67 ± 0.62	0.17 ± 0.17
Time of onset of relaxation of muscles of hind-limbs	11.83 ± 1.35	5.83 ± 0.54	0.83 ± 0.54	7.67 ± 1.40	2.67 ± 0.80	0.30 ± 0.21
't' value	0.217	1.131	0.517	1.499	0	0.599
Duration of relaxation of anal sphincter	43.00 ± 8.18	61.67 ± 6.44	73.67 ± 9.32	41.67± 4.41	47.50 ± 8.03	56.83 ± 10.32
Duration of flaccidity of tail	47.17 ± 8.63	62.17 ± 6.25	80.50 ± 12.10	43.67 ± 6.75	48.17 ± 7.92	60.60 ± 10.42
't' value	0.198	0.080	0.567	0.298	0.085	0.306

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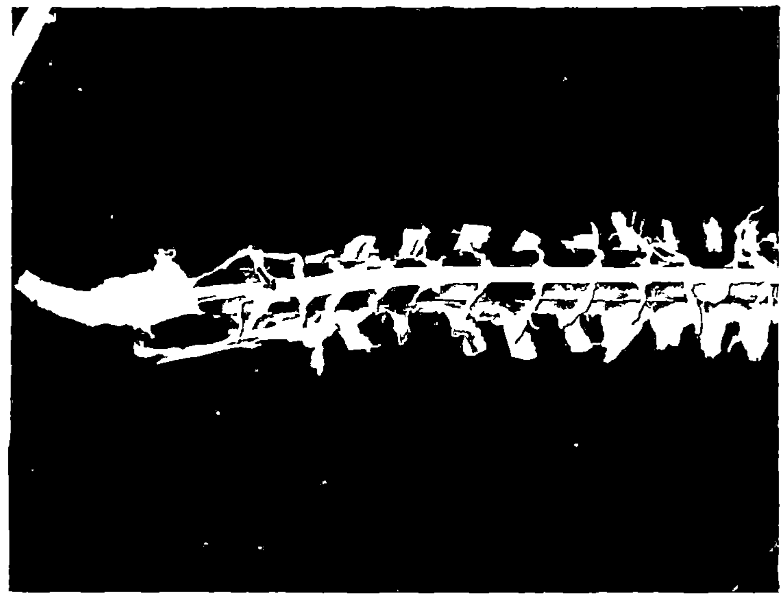
ILLUSTRATIONS



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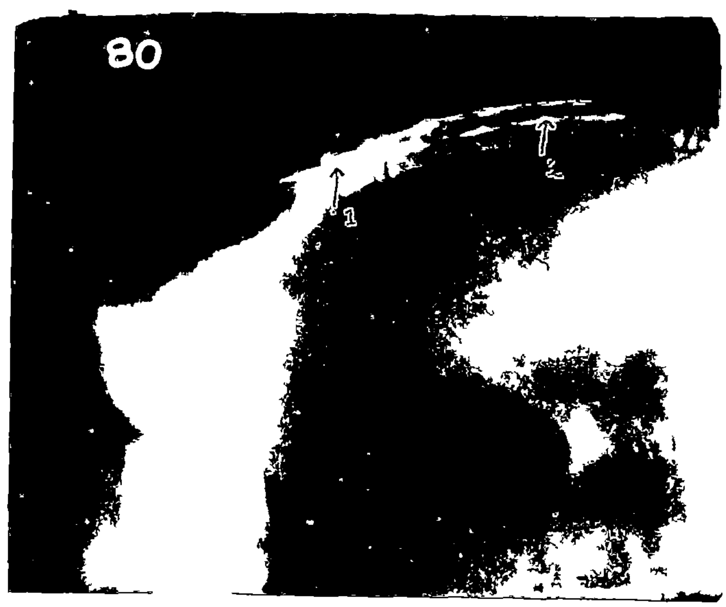

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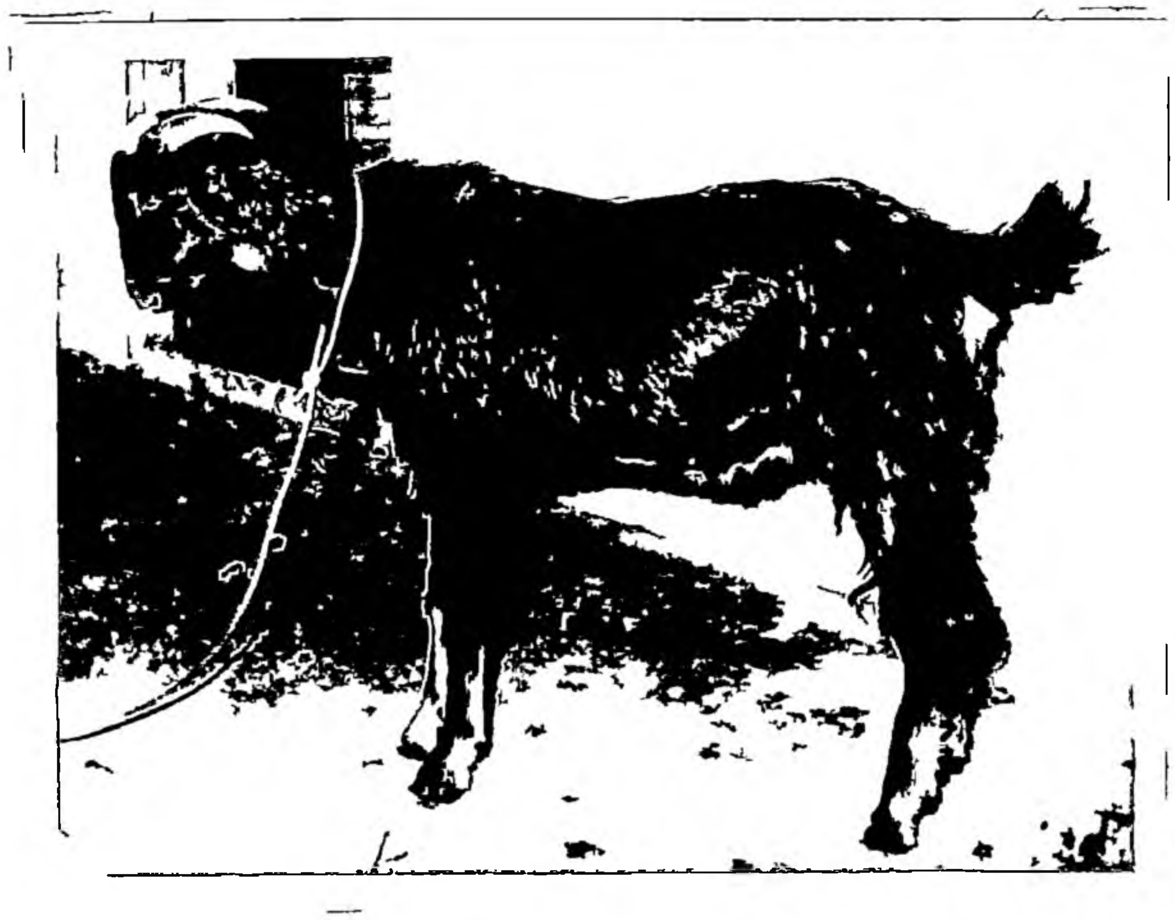
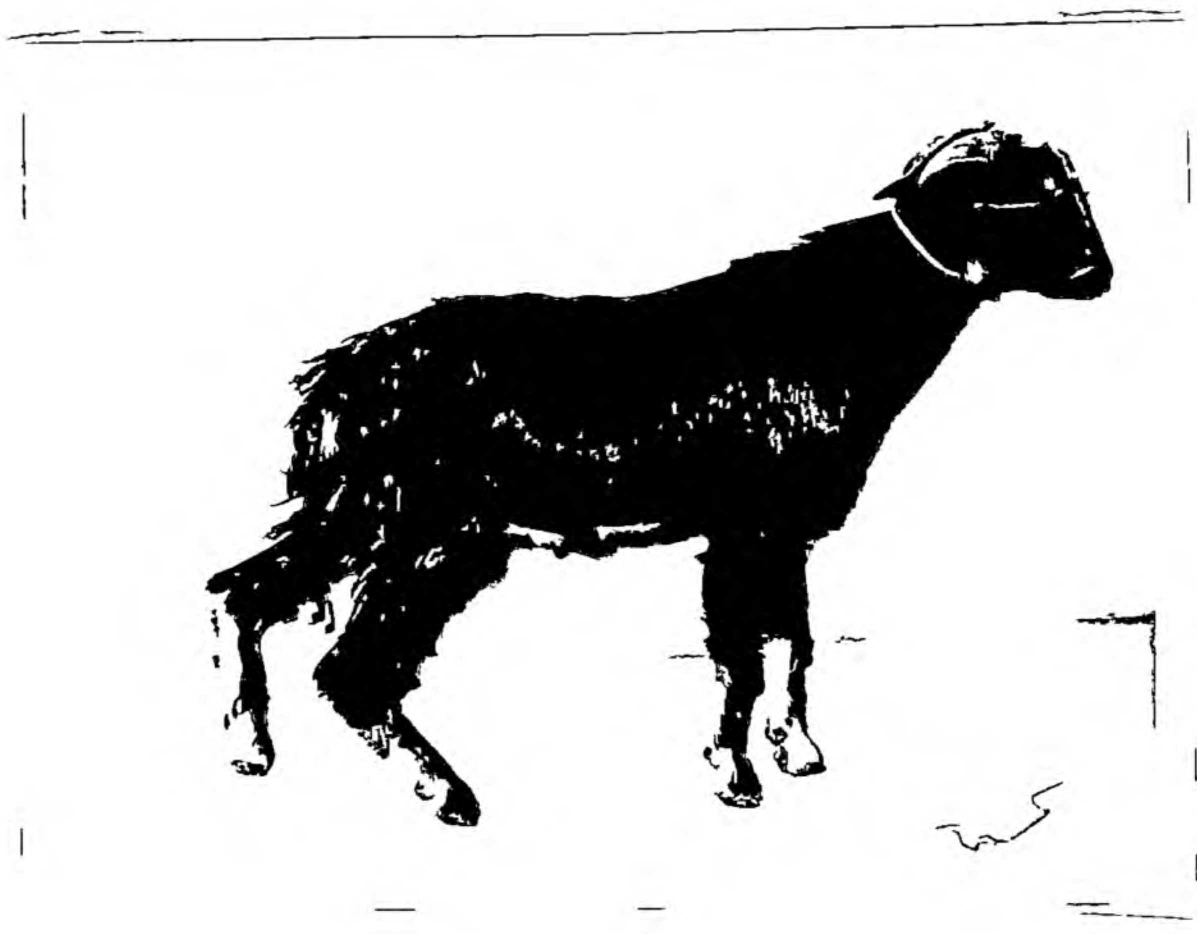


Fig. 3.

Fig. 4.



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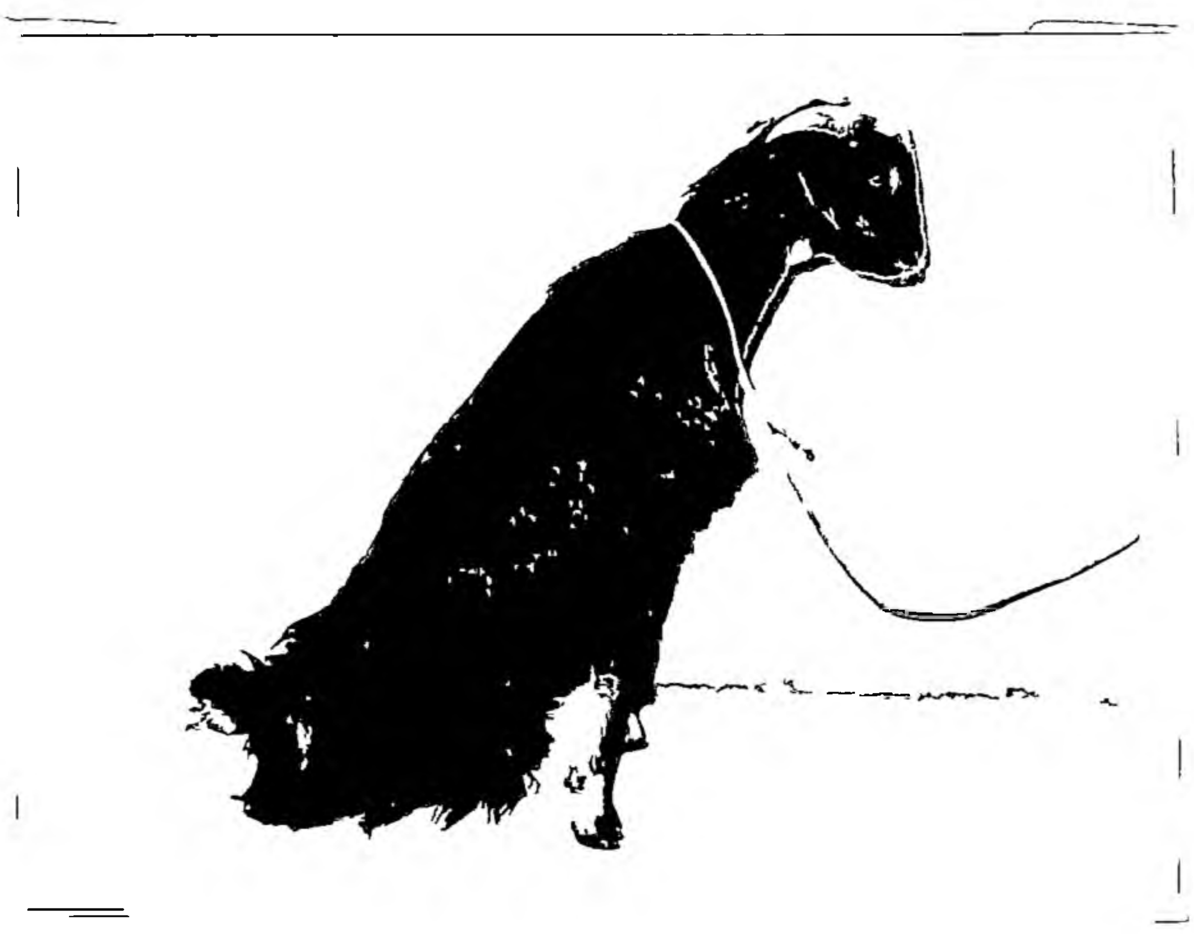
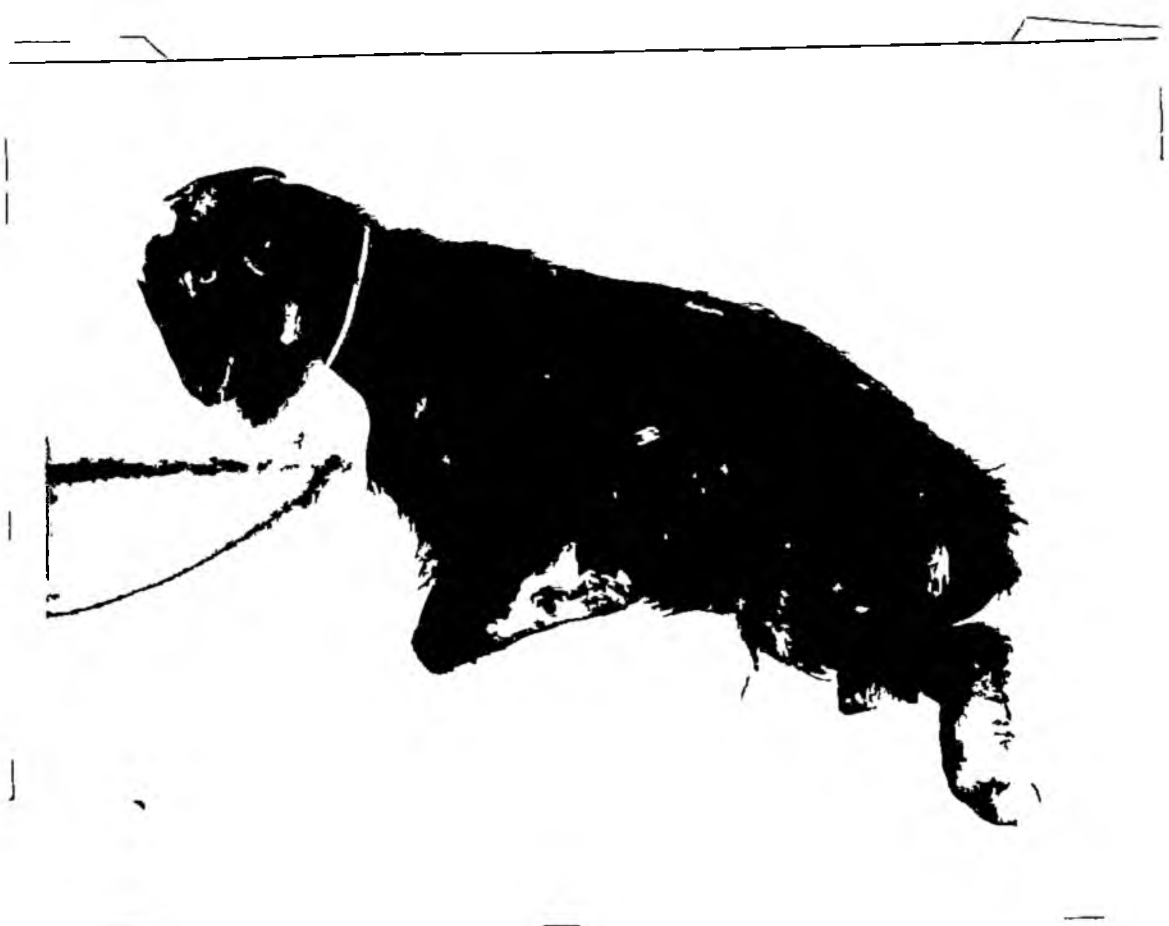


Fig. 6.

Fig. 7.



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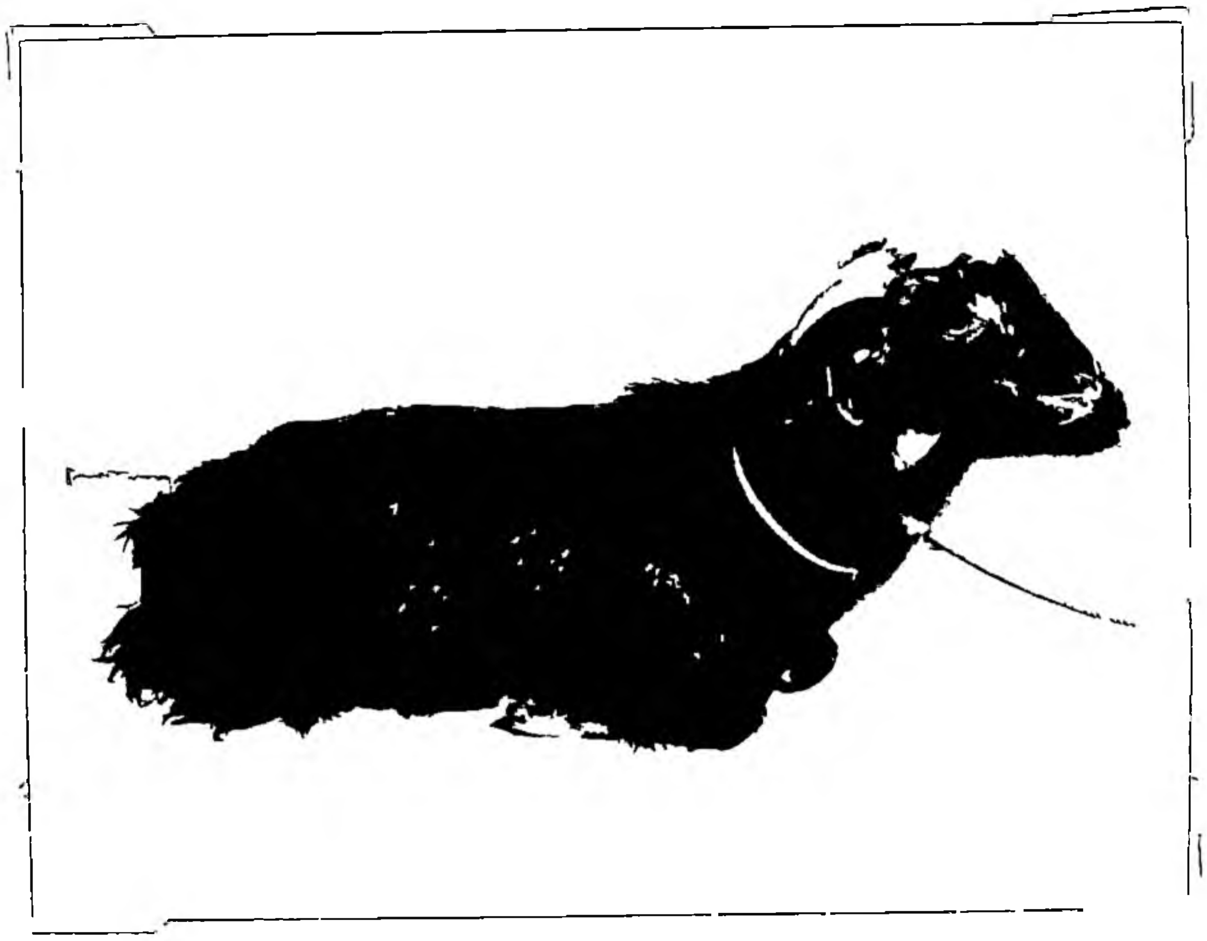

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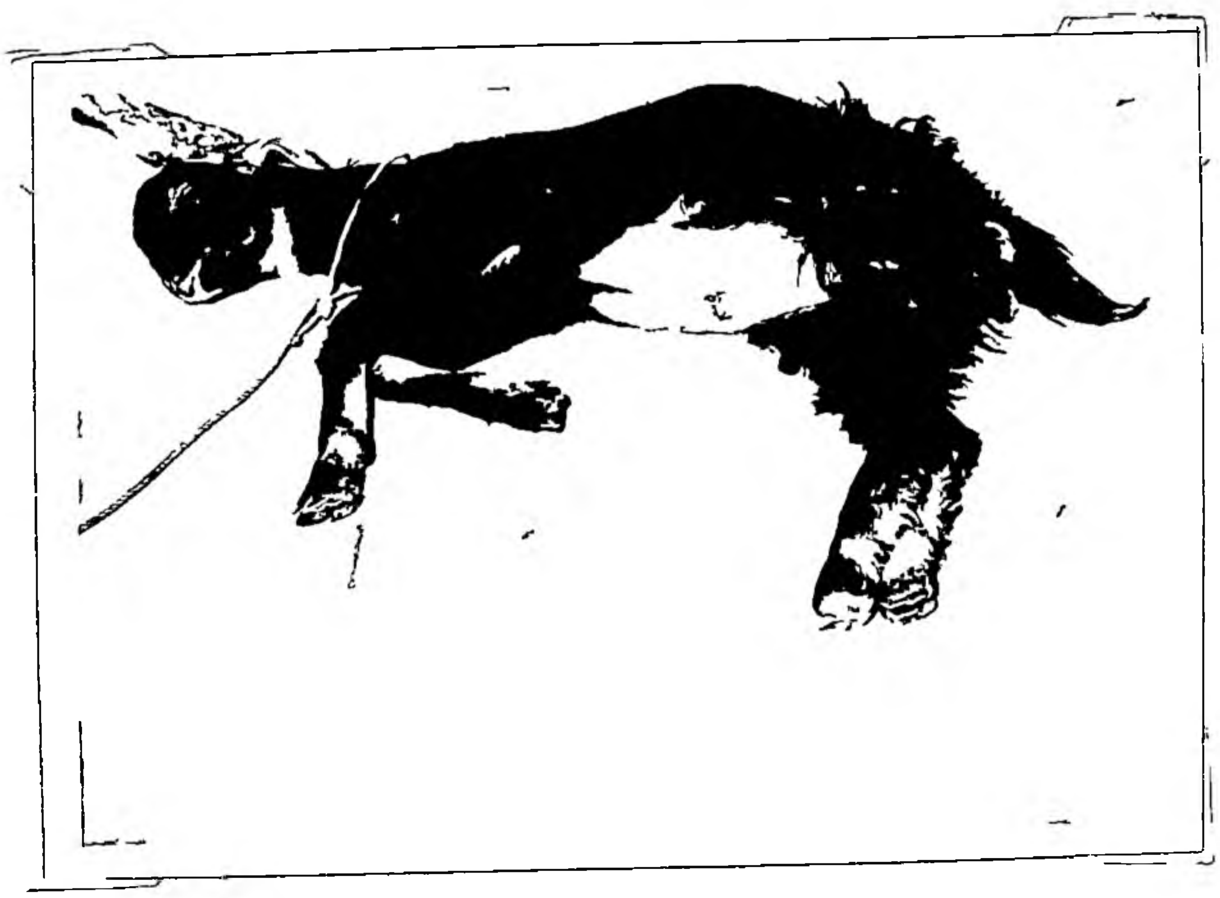

Fig. 10.

STUDIES ON EPIDURAL ANAESTHESIA IN GOATS

By

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ABSTRACT OF A THESIS

submitted in partial fulfilment
of the requirement for the degree

MASTER OF VETERINARY SCIENCE

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ABSTRACT

The present study was undertaken with the object of finding out the effects of epidural administration of varying doses of lidocaine hydrochloride two per cent solution with and without the addition of hyaluronidase in goats.

Epidural injection was given at the lumbosacral site using the Brooks' epidural needle directed perpendicularly downwards.

Thirty-six apparently healthy Alpine-Malabari crossbred bucks aged six to fifteen months and weighing seven to twenty-two kilograms were used for the study. The animals were divided into two groups viz., Group I and Group II, each consisting of 18 animals. In Group I, lidocaine hydrochloride at the rate of 4 mg, 8 mg and 16 mg/kg body-weight was administered as two per cent solution in three subgroups each consisting of six animals. Similarly in Group II, lidocaine hydrochloride was administered as two per cent solution along with hyaluronidase (150 I.U./100 ml of lidocaine hydrochloride solution) in three Subgroups each consisting of six animals.

The observations are tabulated and presented in the table given below

Average time of onset, duration and the extent of analgesia following epidural administration of lidocaine hydrochloride two per cent solution with and without the addition of hyaluronidase in goats.

Group	Dose per kg body-weight	Time of onset (in min.): Flaccidity of tail	Time of onset: Relaxation of anal sphincter	Time of onset: Relaxation of abdominal muscles	Time of onset: Recumbency	Time of onset: Relaxation of hind-limbs	Duration (in min.): Relaxation of abdominal muscles	Duration: Relaxation of hind-limbs	Duration: Relaxation of anal sphincter	Duration: Flaccidity of tail	Duration: Recumbency	Extent of analgesia up to the level of:
I	4mg	3.50±0.43	4.00±0.65	8.83±1.45	11.33±1.87	11.83±1.35	21.17±7.51	21.50±7.60	43.00±9.18	44.17±8.65	47.67±11.73	second lumbar vertebra
	8mg	1.67±0.33	1.67±0.33	4.67±0.42	4.83±0.70	5.83±0.54	38.50±6.57	41.17±6.1d	61.67±6.44	62.17±6.27	64.67±8.30	11th thorac vertebra
	16mg	0.03±0.21	0.33±0.21	0.83±0.54	0.50±0.34	0.83±0.54	61.33±9.59	70.83±9.31	73.67±9.32	80.50±12.16	83.00±12.42	Ears
II	4mg	1.33±0.21	1.50±0.22	6.83±1.45	6.33±1.43	7.67±1.40	16.33±4.01	25.33±9.31	41.67±4.41	43.67±6.75	37.50±5.43	second lumbar vertebra
	8mg	1.00±0	1.00±0	2.17±0.60	2.67±0.62	2.67±0.80	23.50±2.74	33.50±7.37	47.50±8.03	48.17±7.92	48.83±9.24	10th thoracic verteb.
	16mg	0.17±0.17	0.17±0.17	0.33±0.21	0.17±0.17	0.33±0.21	47.50±8.98	52.83±10.88	56.83±10.32	60.00±10.42	58.00±10.52	Horns

In Group I lidocaine hydrochloride two per cent solution and in Group II lidocaine hydrochloride with hyaluronidase (150 I.U./100 ml of lidocaine hydrochloride solution) were used.

Significant positive correlation was noticed between the depth of insertion of the epidural needle and body-weight of the animals.

When the dose of lidocaine hydrochloride was increased, there was proportionate decrease in the time of onset and increase in the duration of anaesthesia. In the same dose level when hyaluronidase was added there was further reduction in the time of onset, but the duration of anaesthesia was decreased.

On statistical analysis of the data, no significant difference could be seen between

1) the time of onset of flaccidity of tail and relaxation of anal sphincter

2) the duration of flaccidity of tail and relaxation of anal sphincter and

3) the time taken for assuming sternal recumbency and complete relaxation of the muscles of hind-limbs.

At a dose of 4 mg/kg body-weight in both the groups, the extent of analgesia was found to be the same, irrespective of addition of hyaluronidase. At higher doses (8 mg and 16 mg/kg body-weight), the extent of analgesia was found to be more. But when hyaluronidase was added, the extent of analgesia was still further increased.

'Dog sitting posture' was observed during the onset of anaesthesia only at a dose of 4 mg/kg body-weight.

The animals got up only when flaccidity of tail and relaxation of anal sphincter disappeared.

At the dose of 4 mg and 8 mg/kg body-weight there were no untoward reactions. But at the dose of 16 mg/kg body-weight lacrimation, salivation, protrusion of tongue, locked jaw, stiffness of head and neck, pedalling movements with the fore-limbs, opisthotonos and dyspnoea were observed in some of the animals during the onset of anaesthesia. Recovery phase was uneventful in all the animals, at all the dose levels.

Transient unilateral or bilateral hind-leg lameness, dullness and anorexia were noticed in some of the animals as a post-anaesthetic complication.

Epidural injection of lidocaine hydrochloride, two per cent solution at the rate of 4 mg/kg body-weight is recommended for surgical operations of the hind-quarters and inguinal region, while 8mg/kg body-weight is recommended for operations on the flank region. Hyaluronidase may be added for getting quicker onset and greater extent of analgesia.