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# REGIONAL ANAESTHESIA OF THE HIND-LIMBS IN GOATS USING LIGNOCAINE HYDROCHLORIDE

By

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**THESIS**

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### DECLARATION

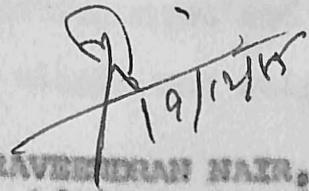
I hereby declare that this thesis entitled "REGIONAL ANAESTHESIA OF THE HIND-LIMBS IN GOATS USING LIDOCAINE HYDROCHLORIDE" is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship, or other similar title, of any other University or Society.

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PRAHLAD SAKPOTA

**CERTIFICATE**

Certified that this thesis, entitled "REGIONAL ANAESTHESIA OF THE HIND-LIMBS IN GOATS USING LIGNOCAINE HYDROCHLORIDE" is a record of research work done independently by Sri. Prahlad Sapkota 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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DEDICATED TO  
MY LATE BROTHER  
DHANANJAYA SAPKOTA

## TABLE OF CONTENTS

		<u>PAGE</u>
INTRODUCTION	..	1
REVIEW OF LITERATURE	..	3
MATERIALS AND METHODS		8
RESULTS	..	12
DISCUSSION	..	22
SUMMARY	..	26
TABLES	..	13, 15, 17 and 19
REFERENCES	..	28

## LIST OF TABLES

### Table No.

- 1      Onset, duration and recovery from anaesthesia with the administration of 2% solution of Lignocaine hydrochloride IV at the rate of 4.0 to 5.0 mg per kg body-weight  
Page 13
- 2      Onset, duration and recovery from anaesthesia with the administration of 2% solution of Lignocaine hydrochloride IV at the rate of 5.0 to 6.0 mg per kg body-weight  
Page 15
- 3      Onset, duration and recovery from anaesthesia with the administration of 2% solution of Lignocaine hydrochloride IV at the rate of 6.0 to 7.0 mg per kg body-weight  
Page 17
- 4      Onset, duration and recovery from anaesthesia with the administration of 2% solution of Lignocaine hydrochloride IV at the rate of 7.0 to 9.0 mg per kg body-weight.  
Page 19



## LIST OF ILLUSTRATIONS

### Fig. 12.

- 1 Limb with the tourniquet in position: before the administration of anesthetic
- 2 Limb after administration of the anesthetic: shows dropping of the hoof and flexion of the fetlock joint
- 3 Animal showing normal gait after the release of tourniquet
- 4 Site of surgical wound: healing wound
- 5 Sutured skin - experimental - Healed skin wound showing proliferating fibroblasts and collagen II and III x 200
- 6 Sutured skin - control - Healed skin wound showing proliferating fibroblasts and collagen II and III x 200

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# *Introduction*

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## INTRODUCTION

Modern surgery gained much of its sophistication owing to the recent advances made in the field of anaesthesiology. The efficacy and safety of the anaesthetic techniques have brought down the risk in surgery to a minimum. However, achieving general anaesthesia in ruminants is still a problem especially under field conditions. Hence, various regional anaesthetic techniques like paravertebral or epidural anaesthesia have been advocated in ruminants. However, the search for simple and better techniques of anaesthesia is continuing.

At the beginning of the 19th century, Bier (1908) reported the technique of intravenous regional anaesthesia in human beings and found it to be very simple and effective for the limbs. Kirrilov (1959) was the first to introduce this technique in the veterinary field. Since then the technique was studied in detail in a few species of domestic animals.

Intravenous regional anaesthesia is a technique developed for surgical interventions of extremities. The analgesia is produced by injecting a suitable local anaesthetic solution into a superficial vein, after applying a tourniquet proximal to the site of injection.

On perusal of the available literature, a detailed study on this technique in goats could not be seen. Goats play a vital role in the rural economy of our country. With the introduction of exotic breeds, goat husbandry is gaining importance. Surgical affections of the limbs in goats are much more common than the diseases affecting the rest of the body. Hence, a study for inducing anaesthesia of the limb in goats is fully justified.

The present study was undertaken with the object of ascertaining the suitability of intravenous regional anaesthesia of the hind-limbs in goats.

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*Review of Literature*

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## REVIEW OF LITERATURE

Doslions (1959) described intra-arterial and retro-grade intravenous injections into the lower limbs of horses, cattle and dogs. He mentioned the therapeutic applications of the technique in diseases affecting the lower limbs of these animals.

Kirrilov (1959) used 10% procaine solution with 400,000 units of penicillin at a dose of 10 to 20 ml for intravenous regional anaesthesia (IVRA) in horses, cattle and sheep.

Harris et al. (1965) made a comparative study of three local anaesthetic agents in human beings and concluded that 1.5 mg/kg body weight of lidocaine hydrochloride was ideal for inducing safe and effective IVRA when injected after a 20 min period of ischaemia by an arterial tourniquet.

Knapp and Weinberg (1967) studied the pattern of distribution of the drug following IVRA in adult monkeys using lidocaine tagged with carbon<sup>14</sup>. They observed that the release of tourniquet was an important factor influencing the entry of the anaesthetic into systemic circulation.

Hall (1971) using this technique, operated on the digits of 20 greyhounds. He applied a pneumatic tourniquet above the carpus or hock. After partial exsanguination, a sphygmomanometer cuff was applied to maintain tourniquet

Tyagi et al. (1973) used procaine hydrochloride solution at a concentration ranging from two to five per cent in buffalo-calves and adopted pre-tourniquet ischaemia and saline-wash methods. They found that both low and high concentrations of anaesthetic agent produced similar degree of analgesia and muscle relaxation and concluded that the concentration of the solution was not a significant factor in producing the anaesthetic effect. Induction of ischaemia prior to injection of anaesthetic agent and saline-wash were found to be equally effective for the early onset and recovery from anaesthesia.

Manohar and Ramakumar (1974) opined a positive correlation between the induction period and extent of pre-injection ischaemia. The minimum time advocated for the release of tourniquet after injection was 30 min.

Prentice et al. (1974) anaesthetised both fore and hind-limbs in bovine, using the technique of IVRA and assessed the safety of anaesthetic agent by estimating the serum enzymes and plasma concentration of lignocaine. They opined that this technique was superior to other methods of local anaesthesia in surgery of the bovine foot.

Stipancevic and Fessel (1974) found that in IVRA, the onset of anaesthesia at the extremity was within four to five min and the time for waning away of anaesthesia was two min after the release of tourniquet.

Rumar et al. (1975) adopted this technique, in surgery of gangrene of tail in bovine, with encouraging results.

Estill (1977) conducted trials on IVRA of the distal end of the limbs in cattle and concluded that the technique was simple and safe and could be used to alleviate pain in painful conditions and for diagnostic procedures.

Singh and Mathew (1977) evaluated regional anaesthesia in the fore and hind-limbs of mules using two per cent lignocaine hydrochloride. They found that the regular use of this technique in mules led to complications like cardiac arrhythmia, respiratory distress and convulsions.

Boyan and Weaver (1978) measured lidocaine concentration in plasma/blood after IVRA and concluded that lidocaine toxicity in clinical practice would be negligible.

Murian and Nigen (1978) conducted IVRA in mares using 20 to 25 ml of two per cent novocain and suggested the use of pre-anaesthetic medication to avoid tourniquet discomfort.

Fohlings (1979) in his studies on IVRA for surgical operations in the fore-limb in cattle suggested IV injection of anaesthetic in the dorsal digital vein and reported that the method was effective and simple for surgical manipulation of the claw.

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ischaemia on local and systemic acid base status and blood gases in cattle. They reported that significant variations were not observed in the parameters in systemic circulation till the tourniquet was released. But there was a fall in pH in the samples from the limb along with a fall in  $PO_2$  and oxygen saturation. Systemic arterial and venous pH increased significantly following the release of tourniquet after 30 and 45 min respectively with an increase in  $HCO_3^-$ . Limb venous pH increased with significant fall in  $PO_2$  and a non-significant increase in  $HCO_3^-$  after release of tourniquet. Limb venous  $PO_2$  and oxygen saturation increased significantly but oxygen exchange and utilization was poor upto 150 min after release of tourniquet. They concluded that tourniquet ischaemia of 30 min and above was not safe.

Dull et al. (1984) in their experiments for inducing anaesthesia of the hind-limbs in camel, evaluated this technique and found it to be suitable for clinical use in field conditions.

On perusal of the available literature, it could be seen that a detailed study of this technique in goats has not been reported.

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## *Materials and Methods*

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## MATERIALS AND METHODS

Eighteen apparently healthy bucks, weighing 15 to 25 kg, were selected for the experiment. A total number of 27 experiments were conducted in these animals in four groups, viz.:

- Gr. I - 6 experiments with Lignocaine<sup>®</sup> hydrochloride administered at the rate of 4.0 to 5.0 mg/kg body-weight.
- Gr. II - 7 experiments with Lignocaine hydrochloride administered at the rate of 5.0 to 6.0 mg/kg body-weight.
- Gr. III - 7 experiments with Lignocaine hydrochloride administered at the rate of 6.0 to 7.0 mg/kg body-weight.
- Gr. IV - 7 experiments with Lignocaine hydrochloride administered at the rate of 7.0 to 9.0 mg/kg body-weight.

Nine animals were randomly selected, four amongst these four groups, for studying the effect of intravenous regional anaesthesia (IVRA) on wound healing.

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\*Lignocaine 2%; Cocaine(1%) 2%,  
S.C. Pharmaceuticals, Baroda.

In all the animals, the anaesthetic was administered IV, through the external saphenous vein. The site of injection was just above the hock joint on the lateral aspect of the limb. Two per cent Lignocaine hydrochloride was used as the anaesthetic.

**Technique:-**

The animals were controlled in lateral recumbency. A rubber tourniquet was applied tightly around the limb above the stifle joint (Fig.1). After 10 min, exsanguination was carried out directly from the vein by introducing an 18 gauge needle attached to a syringe. The volume of blood removed ranged from three to eight ml. After keeping the needle in situ, the syringe was carefully detached and two per cent Lignocaine hydrochloride at the rate of four to nine mg per kg body-weight was injected through the same needle, adjusting the dose to the volume of solution administered. The needle was then withdrawn and the area around the site of injection was gently massaged. The animal was allowed to stand up immediately after the injection and was observed for signs of anaesthesia. Anaesthetic effect was studied by assessing response to pain (loss of skin sensation) by pin-pricking in the pastern and metatarsal regions and by pinching in the interdigital space. The time taken for muscle relaxation, onset and duration of anaesthesia distal

Fig. No.1: Limb with the tourniquet in position:  
before the administration of anaesthetic

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Fig. No. 1

to the site of tourniquet was recorded. The duration of anaesthesia was calculated from the time of complete onset of anaesthesia till the return of reflexes after the release of tourniquet. The tourniquet was kept in situ for a period ranging from 15 min to 40 min and released afterwards. The area around the application of tourniquet was massaged. After the release of tourniquet, the time for return of reflexes and the time for bearing weight on the limbs were recorded, in each of the experiments. The animals were kept under observation for 10 days after the experiment.

The effect of anaesthesia on wound healing was studied in nine animals randomly selected from the four groups. The right hind-limb was subjected to IVRA while the left limb was kept as control.

A skin incision three cm long was made on the right hind-limb, when the limb was fully under anaesthesia. Another surgical wound of the same size was made on the left limb (control). The skin incisions on both the limbs were sutured using nylon with simple interrupted sutures. A Tr. benzoin seal was applied over the suture line. The animals were kept under observation for 10 days. On the 10th post-operative day, tissue from the site of incision was collected from each of the limbs and preserved in separate containers for histological examination.



The tissue was fixed in Bouin's fluid and processed by routine procedures for paraffin embedding. Tissue sections, 25 microns thick were prepared and stained with hematoxylin and eosin stain (Sheehan and Hargrett, 1950). Microscopic examination of the specimens was done to evaluate wound healing.

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## *Results*

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## RESULTS

### Group I

The observations on the experiments conducted are presented in table 1.

The average body-weight of the animals in this group was  $21.17 \pm 3.54$  kg. The average volume of blood removed from the saphenous vein was  $3.93 \pm 0.85$  ml. Lidocaine hydrochloride was administered at the rate of 4.0 to 5.0 mg/kg body-weight, the average being  $4.07 \pm 0.19$  mg/kg. The average volume of anesthetic administered was  $5.17 \pm 0.03$  ml. The tourniquet was released  $24.03 \pm 3.01$  min after the administration of the anesthetic.

Onset of anesthesia was apparent by  $2.50 \pm 0.06$  min. The average duration of anesthesia was  $15.0 \pm 7.77$  min including a short duration of  $2.07 \pm 1.31$  min observed after the release of tourniquet.

The muscles at the region below the tourniquet were relaxed. There was drooping of the back and flexion of the forelimb (Fig.2). When the animal was made to walk there was dragging of the limb.

The animals could walk apparently normal by  $6.17 \pm 4.54$  min (Fig.3). In experiment No.4, after the administration of the anesthetic, the animal became restless, was lying down and getting up frequently with throwing of

Table 1

Onset, duration and recovery from anaesthesia with the administration of 2% solution of Lignocaine hydrochloride IV at the rate of 4.0 mg to 5.0 mg per kg body-weight

Serial No.	Body weight (kg)	Quantity of blood ensanguinated (ml)	Dose of anaesthetic (mg/kg)	Volume of anaesthetic injected (ml)	Onset of anaesthesia (min)	Tourniquet release time (min)	Return of reflexes (min)	Duration of anaesthesia (min)	Return of normal gait (min)	Other observations
1	17.0	4.0	4.70	4.0	4.0	14.0	5.0	15.0	7.0	
*2	19.0	3.0	4.70	4.50	2.0	15.0	2.0	15.0	15.0	Shivering of the body, muscular twitching with accelerated respiration
3	25.0	4.0	4.80	6.0	3.0	30.0	2.0	29.0	4.0	
4	24.0	4.0	5.0	6.0	2.0	30.0	2.0	30.0	4.0	Discomfort after administration of anaesthetic
5	18.0	3.0	5.0	4.50	2.0	30.0	3.0	31.0	4.0	
6	24.0	3.0	5.0	6.0	2.0	30.0	2.0	30.0	3.0	
Mean	21.17 ± 3.54	3.50 ± 0.55	4.87 ± 0.15	5.17 ± 0.93	2.50 ± 0.84	24.83 ± 8.01	2.67 ± 1.21	25.0 ± 7.77	6.17 ± 4.54	

\*Denotes animals in which the effect of IVMA on wound healing was studied

Fig. No.2: Limb after administration of the anaesthetic shows dropping of the hock and flexion of the fetlock joint.

Fig. No.3: Animal showing normal gait after the release of tourniquet.



Fig. No. 2



Fig. No. 3

head against the floor violently. The animal was frequently bleating and licking the area around the tourniquet. The limbs were fully extended when the animal was recumbent. The symptoms disappeared gradually when the tourniquet was released. In experiment No. 2, the animal exhibited shivering, muscular twitching and accelerated respiration after the tourniquet was released. Spontaneous recovery was noticed by 15 min.

Anaesthetic effects were first apparent at the interdigital space and subsequently extended upwards to the pastern, tarsal region and upto the level of the tourniquet. The waning away of anaesthetic effect was in the reverse order.

### Group II

The observations on the experiments conducted are presented in table 2.

The animals of this group had an average body-weight of  $17.0 \pm 1.91$  kg. The average volume of blood removed from the vein was  $3.63 \pm 0.79$  ml. Lidocaine hydrochloride was administered at the rate of 5.0 to 6.0 mg/kg body-weight, the average being  $5.63 \pm 0.27$  mg/kg. The average volume of anaesthetic injectate was  $4.78 \pm 0.57$  ml. The tourniquet was released  $24.96 \pm 3.93$  min after administration of the anaesthetic.

Table 2

Onset, duration and recovery from anaesthesia with the administration of 2% solution of Lignocaine hydrochloride IV at the rate of 5.0 mg to 6.0 mg per kg body-weight

Serial No.	Body weight (kg)	Quantity of blood exsanguinated (ml)	Dose of anaesthetic (mg/kg)	Volume of anaesthetic injected (ml)	Onset of anaesthesia (min)	Tourniquet release time (min)	Return of reflexes (min)	Duration of anaesthesia (min)	Return of normal gait (min)	Other observations
*1	17.0	3.0	5.30	4.50	2.0	25.0	2.0	25.0	4.0	
*2	17.0	3.0	5.30	4.50	1.0	22.0	1.0	22.0	3.0	
*3	16.0	3.0	5.60	4.50	1.0	20.0	3.0	22.0	5.0	One suture line infected
4	16.0	3.0	5.60	4.50	2.0	30.0	3.0	31.0	7.0	
*5	21.0	4.0	5.70	6.00	2.0	22.0	1.0	21.0	3.0	
6	17.0	5.0	5.90	5.0	3.0	25.0	2.0	24.0	4.0	Discomfort after administration of anaesthetic
7	15.0	3.0	6.00	4.50	3.0	30.0	2.0	20.0	4.0	
Mean	17.0 $\pm 1.91$	3.43 $\pm 0.79$	5.63 $\pm 0.27$	4.78 $\pm 0.57$	2.0 $\pm 0.82$	24.86 $\pm 3.93$	2.0 $\pm 0.82$	24.86 $\pm 3.80$	4.28 $\pm 1.38$	

\*Denotes animals in which the effect of IVRA on wound healing was studied



Onset of anaesthesia was apparent by  $2.0 \pm 0.82$  min. The average duration of anaesthesia was  $24.86 \pm 3.80$  min including  $2.0 \pm 0.82$  min after the release of tourniquet.

Relaxation of muscles, dropping of hock, flexion of fetlock and dragging of limbs were noticed, during anaesthesia.

The animals could walk apparently normal by  $4.28 \pm 1.33$  min. Restlessness, frequent lying down and getting up and licking the area around tourniquet were noticed in experiment No.6, of this group. The symptoms disappeared gradually after the release of tourniquet.

Anaesthetic effects were first noticed at the interdigital space and subsequently extended upwards gradually. The effects of anaesthetic waned away from the stifle downwards.

### Group III

The observations on the experiments conducted are presented in table 3.

The average body-weight of the animals in this group was  $18.50 \pm 4.52$  kg. The average volume of blood removed was  $4.78 \pm 1.68$  ml. Lignocaine hydrochloride at the rate of 6.0 to 7.0 mg/kg body-weight was administered, the average being  $6.50 \pm 0.26$  mg/kg. The average volume of

Table 3

Onset, duration and recovery from anaesthesia with the administration of 2% solution of Ligocaine hydrochloride IV at the rate of 6.0 mg to 7.0 mg per kg body-weight.

Serial No.	Body weight (kg)	Quantity of blood anaesthetized (ml)	Dose of anaesthetic (mg/kg)	Volume of anaesthetic injected (ml)	Onset of anaesthesia (min)	Termination of anaesthesia (min)	Return of reflexes (min)	Duration of anaesthesia (min)	Return of normal gait (min)	Other observations
1	16.3	5.0	6.25	5.0	2.0	23.0	3.0	21.0	5.0	
2	16.0	2.5	6.25	5.0	4.0	30.0	3.0	29.0	5.0	
3	25.0	6.0	6.60	6.0	5.0	15.0	7.0	17.0	10.0	
4	25.0	4.0	6.60	6.0	3.0	33.0	3.0	30.0	4.0	Discomfort after administration of anaesthetic
5	15.0	5.0	6.60	5.0	2.0	15.0	3.0	16.0	5.0	
6	15.0	5.0	6.60	5.0	3.0	16.0	3.0	15.0	5.0	
*7	17.50	4.0	7.00	6.0	1.0	21.0	2.0	22.0	4.0	
Mean	19.50 ±4.52	4.70 ±1.68	6.50 ±0.26	6.0 ±1.61	2.95 ±1.34	21.0 ±6.50	3.25 ±1.75	21.63 ±5.00	5.33 ±2.07	

\*Denotes animal in which the effect of IVN on wound healing was studied

anaesthetic administered was  $6.0 \pm 1.41$  ml. Tourniquet was released  $21.0 \pm 6.59$  min after administration of the anaesthetic.

Onset of anaesthesia was apparent by  $2.86 \pm 1.34$  min. The average duration of anaesthesia was  $21.43 \pm 6.08$  min. The anaesthetic effect was present for  $3.26 \pm 1.70$  min after the release of tourniquet which was also included in the total duration of anaesthesia.

Relaxation of muscles below the tourniquet was marked with the drooping of the neck and flexion of fetlock. Dragging of the affected limb was noticed during progression.

The animals could walk without discomfort by  $9.43 \pm 2.07$  min. In experiment No. 6, the animal exhibited signs like restlessness, frequent lying down and getting up and licking of the region around the tourniquet, after administration of anaesthetic. The signs disappeared gradually after the release of tourniquet.

Anaesthesia was found to develop from the interdigital space and extended upwards to the level of the tourniquet. The waning away of anaesthesia was in the reverse order.

#### Group IV

The observations on the experiments conducted are presented in table 4.

Table 4

Onset, duration and recovery from anaesthesia with the administration of 2M solution of lignocaine hydrochloride IV at the rate of 7.0 mg to 9.0 mg per kg body-weight

Ser- ial No.	Body weight (kg)	Quantity of blood anaes- thetic adminis- tered (ml)	Rate of anaes- thetic (mg/kg)	Volume of anaes- thetic injected (ml)	Onset of anaes- thesia (min)	Time of re- covery (min)	Re- turn of res- piratory rate (min)	Re- turn of pres- sure (min)	Other obser- vations
1	17.0	4.0	7.05	6.0	2.0	30.0	2.0	30.0	3.0
2	17.0	3.0	7.35	6.0	5.0	30.0	1.0	26.0	4.0
3	16.0	4.0	7.50	6.0	2.0	40.0	2.0	40.0	3.0
4	15.0	3.0	8.0	6.0	3.0	31.0	1.0	29.0	2.0
5	15.0	4.0	8.0	6.0	1.0	25.0	2.0	26.0	5.0
6	18.0	3.0	8.30	7.30	1.0	31.0	1.0	34.0	1.0
7	15.0	3.50	9.30	7.0	1.0	30.0	3.0	30.0	6.0
Mean	16.14	3.70	7.88	6.35	2.43	31.43	1.72	30.71	3.86
	21.21	2.77	8.79	6.68	2.40	21.61	2.75	24.92	21.21

\*Denotes animals in which the effect of 2M on wound healing was studied

The average body-weight of the animals of this group was  $16.14 \pm 1.21$  kg. The average volume of blood removed from the vein was  $3.73 \pm 0.77$  ml. Lidocaine hydrochloride was administered at the rate of 7.0 to 9.0 mg/kg body-weight, the average being  $7.83 \pm 0.73$  mg/kg. The average volume of anesthetic administered was  $6.36 \pm 0.63$  ml. Tourniquet was released  $31.43 \pm 4.01$  min after administration of the anesthetic.

Onset of anesthesia was apparent by  $2.43 \pm 1.40$  min. Anesthetic effect was present for  $30.71 \pm 4.92$  min which included a waning time of  $1.71 \pm 0.73$  min after the release of tourniquet.

The relaxation of muscles in the region below the tourniquet was accompanied by drooping of neck and flexion of fetlock. Animals dragged the limbs while walking.

The animals could walk apparently normal  $3.06 \pm 1.21$  min after the release of tourniquet.

The anesthetic effects were apparent first at the interdigital space and subsequently extended to the pastern and tarsal joint till the entire limb below the level of tourniquet. The waning away of anesthetic effect was in the reverse order.

### Wound healing

In the experimental and control groups the wound healing

was uneventful (Fig.4). The sutures were removed on the tenth day. One of the animals in control groups (No.II/3) developed stitch abscess.

Histopathological studies of the tissue collected revealed that there were dense bands of collagen in the dermis with scattered plump fibroblasts extending into the superficial dermis. Fibro-collagenous tissue was seen along with organised capillaries (Fig.5). Scattered infiltration of lymphocytes, macrophages and a few neutrophils were seen in some of the specimens. Granulation was complete in all the specimens. The epithelium showed slight acanthosis. No significant difference was found in the formation of granulation tissue between the control (Fig.6) and experimental groups. In one experimental animal (No.II/3) there was a focus of suppuration in the epidermis, but the healing was not affected by the focus of suppuration.



Fig. No.4: Site of surgical wound: Healing wound



Fig. No. 4



**Fig. No.5: Sutured skin - experimental - Healed skin wound showing proliferating fibroblasts and collagen H and E x 200**

**Fig. No.6: Sutured skin - control - Healed skin wound showing proliferating fibroblasts and collagen H and E x 200**

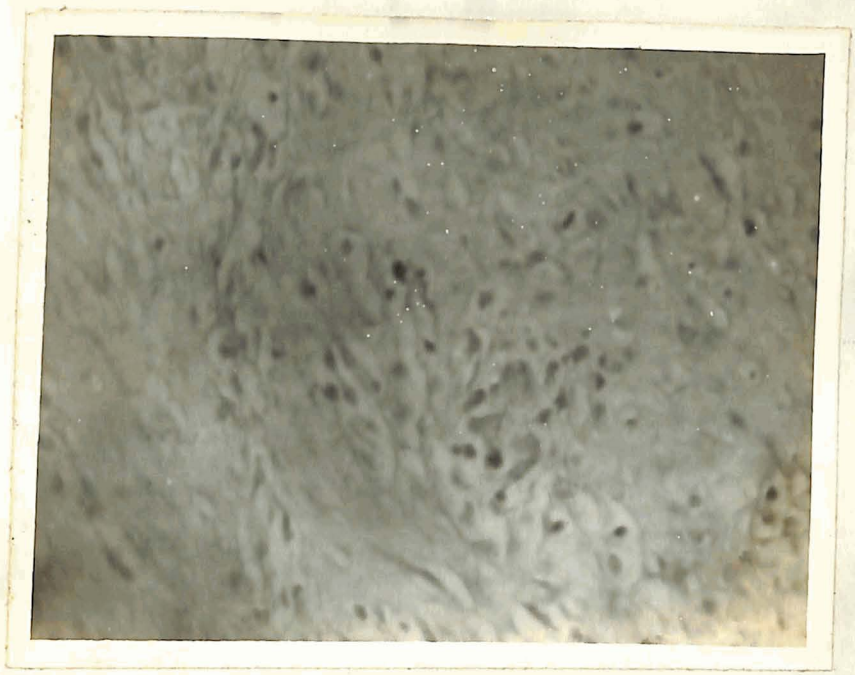


Fig. NO.5



Fig. NO.6

*Discussion*

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## DISCUSSION

Four doses of anaesthetic were tried in the present study viz.,  $4.87 \pm 0.15$ ;  $5.63 \pm 0.27$ ;  $6.50 \pm 0.26$  and  $7.88 \pm 0.79$  mg/kg body-weight of lignocaine hydrochloride.

The anaesthetic effects commenced from the distal end of the limb and gradually extended upto the level of the tourniquet. This is in agreement to the observations of Manohar *et al.* (1971).

Relaxation of muscles below the level of tourniquet was accompanied by dropping of hock and flexion of joints below the hock. The present findings are similar to the observations made in cattle (Weaver, 1972 and Arnbjerg and Sonnichsen, 1973), in buffalo-calves (Manohar *et al.*, 1971 and Tyagi *et al.*, 1973) and in horses (Arnbjerg and Sonnichsen, 1973).

Manohar *et al.* (1971) and Tyagi *et al.* (1973) reported that the induction time of anaesthesia varied from 15 to 20 min when exsanguination and pre-injection tourniquet ischaemia was not adopted. In the present study, pre-injection tourniquet ischaemia of 10 min duration was followed uniformly. The quantity of blood removed prior to administration of anaesthetic in the four groups was  $3.50 \pm 0.55$ ;  $3.43 \pm 0.79$ ;  $4.78 \pm 1.68$  and  $3.78 \pm 0.77$  ml. The onset of anaesthesia in these groups was noticed by

2.50  $\pm$  0.84; 2.0  $\pm$  0.82; 2.86  $\pm$  1.34 and 2.43  $\pm$  1.40 min. Harris *et al.* (1965) found that pre-injection ischaemia of 20 min duration by an arterial tourniquet could reduce the dose of anaesthetic. Tyagi *et al.* (1973) also reported quick onset of anaesthesia when pre-injection ischaemia of 15 min and venous exsanguination were done before administration of anaesthetic. The quantity of blood removed by these workers was not recorded.

Tyagi *et al.* (1973) employed three different concentrations of anaesthetic viz., 2%, 4% and 5% of procaine hydrochloride keeping the volume of anaesthetic constant, and had not observed any difference in the time of onset of anaesthesia. Harris *et al.* (1965) tried two dose levels viz., 1.50 mg/kg and 3.0 mg/kg of lidocaine in human beings and Arnbjerg and Sennichsen (1973) used 0.50 mg to 1.0 mg/kg of lidocaine in large animals and found that the higher concentration of the drug did not influence the onset of anaesthesia. In the present study, the increasing doses of anaesthetic had not brought about remarkable variation in the time for the onset of anaesthesia in any of the four groups.

In the present study, the tourniquet was released by 24.83  $\pm$  8.01; 24.86  $\pm$  3.93; 21.0  $\pm$  6.58 and 31.43  $\pm$  6.61 min and the duration of anaesthesia was 25.0  $\pm$  7.77; 24.86  $\pm$  3.80; 21.43  $\pm$  6.08 and 30.71  $\pm$  4.92 min respectively in the four

experimental groups. Anaesthesia persisted so long as the tourniquet was retained and for a few minutes after its release. Manohar *et al.* (1971), Weaver (1972) and Tyagi *et al.* (1973) found that the duration of anaesthesia was dependent on the tourniquet releasing time and not by the concentration of anaesthetic.

The time taken for complete waning away of anaesthesia after release of tourniquet in the present study, was  $2.67 \pm 1.31$ ;  $2.0 \pm 0.82$ ;  $3.28 \pm 1.70$  and  $1.71 \pm 0.75$  min respectively in Groups I, II, III and IV. Manohar *et al.* (1971) reported  $4.83 \pm 0.51$  min for return of reflexes whereas Singh and Mathew (1977) found it to be 1.0 to 2.0 min for waning away of anaesthesia after the release of tourniquet.

It has been reported that the concentration of anaesthetic that enters the systemic circulation depended on the time of release of tourniquet (Knapp and Weinberg, 1967). Tyagi *et al.* (1973) suggested the release of tourniquet after 30 min to avoid systemic reaction. In the present study, no untoward reactions were observed except in one experiment where the tourniquet was released by 15 min. Symptoms like shivering, muscular twitching and accelerated respiration were noticed in that animal.

Symptoms of discomfort such as frequent lying down and getting up, bleating and licking the area around the

tourniquet were observed in experiments number I/4, II/4 and III/4. The symptoms disappeared gradually after the release of tourniquet. Hanohar *et al.* (1971) and Syagi *et al.* (1973) reported similar signs in buffalo-calves when the tourniquet was loose. In the present study also, accidental entry of anaesthetic into the circulation might have caused such symptoms.

In the present study, nine animals selected at random, were subjected to the effects of IVRA on wound healing. Healing of the wounds was satisfactory in both the experimental and control groups. Formation of granulation tissue in both the groups was complete. Focus of suppuration was seen in the epidemia only in one of the specimens. Pruniceo *et al.* (1976) suggested the possibility of retardation of wound healing as a complication with IVRA though the serum enzyme levels did not indicate tissue damage when tourniquet was kept in situ for 75 min. From the results of the present study, it could be observed that the anaesthetic technique had not influenced the healing of wounds.

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## Summary

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## SUMMARY

Effects of intravenous regional anaesthesia of the hind-limbs in goats was studied using 2% Lignocaine hydrochloride (Coelicain<sup>(R)</sup>) solution. Eighteen bucks divided in four groups were used for the present study. Pre-injection tourniquet ischaemia of 10 min duration followed by exsanguination was done before IV administration of the anaesthetic. Four doses of the anaesthetic viz., 4-5 mg, 5-6 mg, 6-7 mg and 7-9 mg/kg body-weight were tried. Response to pinpricks and pinching the interdigital space were done to assess the anaesthetic effect. The time taken for onset and duration of anaesthesia were recorded. The anaesthetic effects developed first from the distal end of the limbs and extended gradually upwards to the level of tourniquet. Relaxation of muscles below the level of tourniquet was accompanied by dropping of hock and flexion of fetlock joint.

The onset of anaesthesia was noticed by  $2.50 \pm 0.84$ ;  $2.0 \pm 0.82$ ;  $2.96 \pm 1.34$  and  $2.43 \pm 1.40$  min and the duration of anaesthesia was  $25.0 \pm 7.77$ ;  $24.86 \pm 3.80$ ;  $21.43 \pm 6.00$  and  $30.71 \pm 4.92$  min.

Anaesthesia persisted in the limbs as long as the tourniquet was retained. The release of tourniquet was followed by return of reflexes and the anaesthetic effect

persisted for  $2.67 \pm 1.21$ ;  $2.0 \pm 0.83$ ;  $3.28 \pm 1.70$  and  $1.71 \pm 0.75$  min after release of tourniquet.

In nine animals where the effect of IVRA on wound healing was studied, the wounds healed uneventfully. Histological examination revealed that there was no difference in healing process between control and experimental groups.

Unusual reactions like shivering, muscular twitching and accelerated respiration were seen in one experiment when the tourniquet was released by 15 min. Four experimental animals exhibited signs of discomfort seen after the administration of anaesthetic and the signs disappeared when the tourniquet was released.

From the present study it could be seen that:

1. The onset of anaesthesia was quick with a pre-injection ischaemic of 10 min and subsequent exsanguination before IV administration of local anaesthetic.
2. Duration of anaesthesia depended on the time upto which the tourniquet was retained and for a few minutes after the release of tourniquet.
3. Healing of wounds were not influenced by the anaesthetic technique.

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# REGIONAL ANAESTHESIA OF THE HIND-LIMBS IN GOATS USING LIGNOCAINE HYDROCHLORIDE

By

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## **ABSTRACT OF A THESIS**

submitted in partial fulfilment of  
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## ABSTRACT

A study on intravenous regional anaesthesia (IVRA) of the hind-limb was conducted in 18 bucks, weighing 15 to 25 kg body-weight (in four groups).

Lignocaine hydrochloride 2% solution was used as the anaesthetic. Four dose levels viz., 4-5 mg; 5-6 mg; 6-7 mg and 7-9 mg/kg body-weight were employed. A tourniquet was applied around the limb above the stifle joint. After a 10 min period of pre-injection tourniquet ischaemia, the anaesthetic was administered through saphenous vein following exsanguination. Anaesthetic effect was ascertained by pin-pricking and pinching the interdigital space. In nine animals the effect of IVRA on wound healing was studied.

The onset and duration of anaesthesia and the time for wearing away of anaesthesia were also recorded. Onset of anaesthesia was noticed in  $2.90 \pm 0.04$ ;  $3.0 \pm 0.02$ ;  $2.06 \pm 1.16$  and  $2.48 \pm 1.00$  min. Duration of anaesthesia in the four groups was  $25.9 \pm 7.77$ ;  $24.06 \pm 3.80$ ;  $21.43 \pm 6.08$  and  $30.71 \pm 4.92$  min respectively including a short duration after the release of tourniquet. The complete disappearance of anaesthetic effect was noticed by  $8.17 \pm 4.56$ ;  $4.28 \pm 1.36$ ;  $9.03 \pm 3.07$  and  $3.06 \pm 1.21$  min after the release of tourniquet.



The anaesthetic effects were first apparent at the phalangeal region and progressed gradually upwards to the level of tourniquet and waned away in the reverse order.

The healing of wound was uneventful and the histological study revealed that there was no variation in the healing process between the experimental and control groups.

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